~~Draft~~Final Environmental Impact Statement

Volume ~~I~~HIV of ~~I~~HIV - Appendices

PROPOSED OLOWALU TOWN MASTER PLAN

(TMK Nos. (2)4-8-003:84, 98 through 118, and 124)

Prepared for:

Olowalu Town, LLC and
Olowalu Ekolu, LLC

~~February 2012~~October 2015

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by Munekiyo Hiraga

MUNEKIYO HIRAGA

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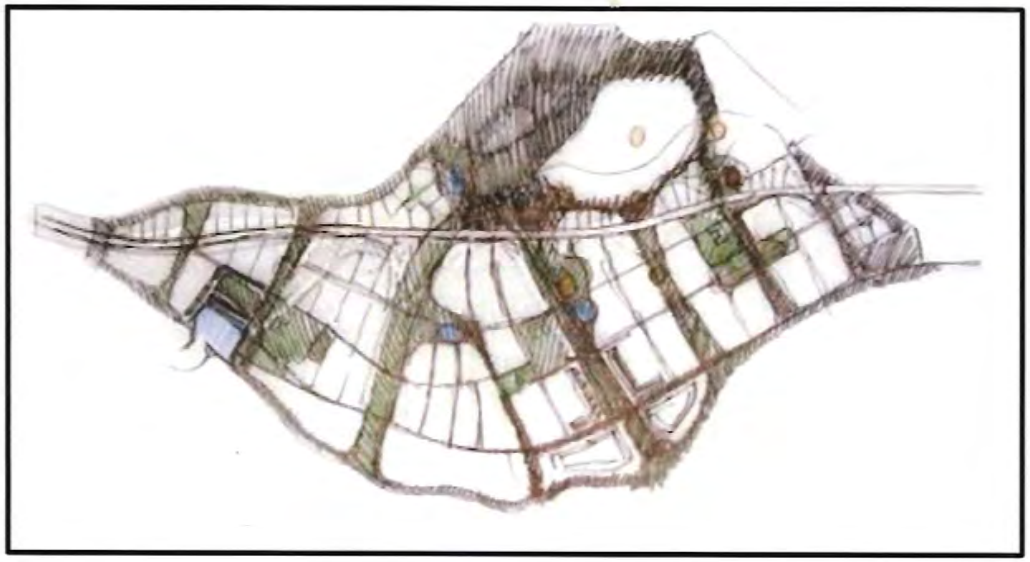
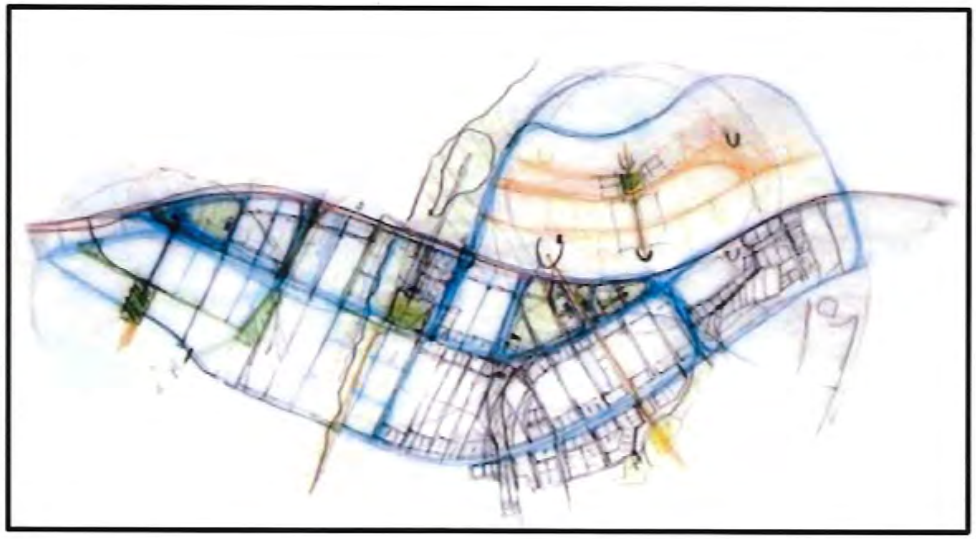
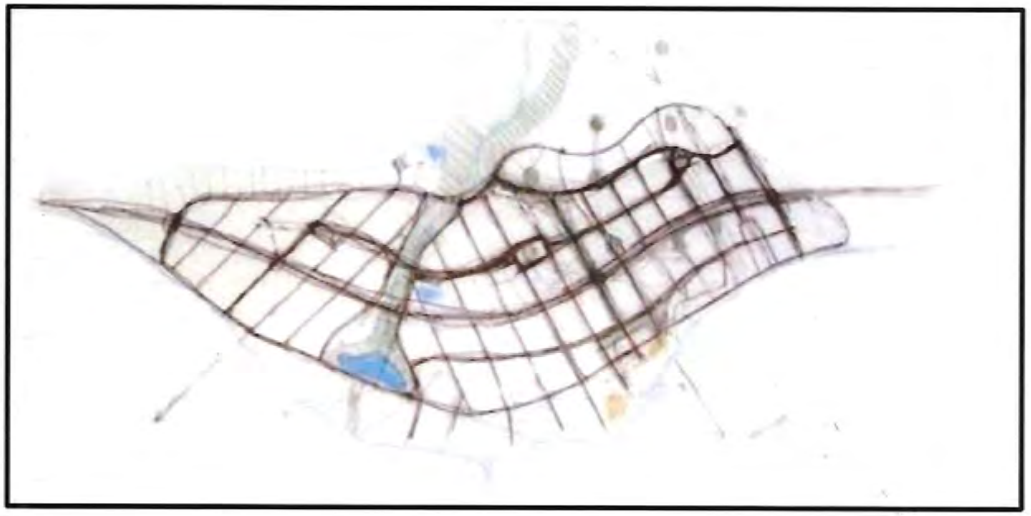
APPENDIX A.

Olowalu Talk Story Alternative Designs

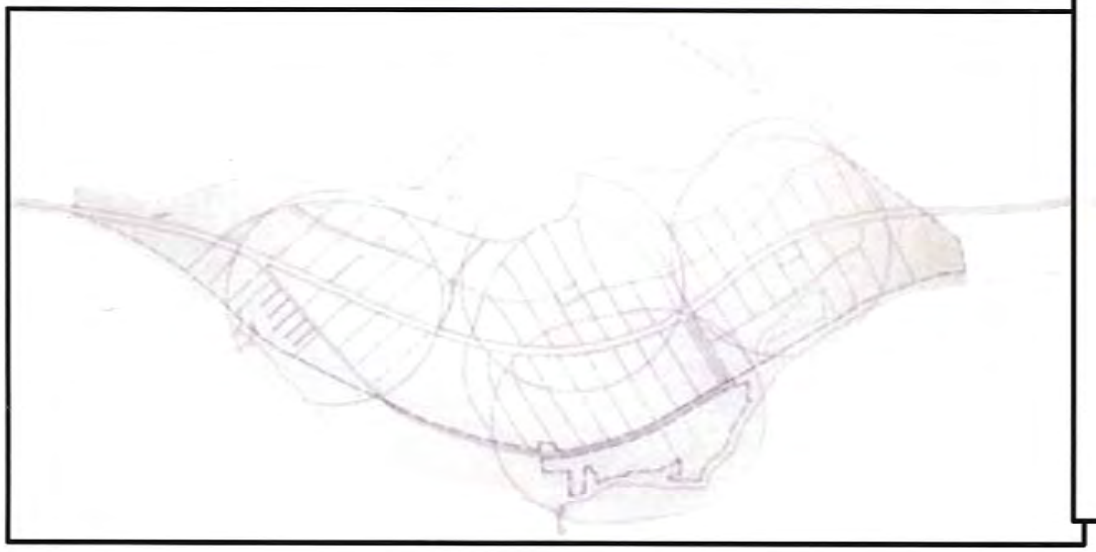
Alternative Design Analysis

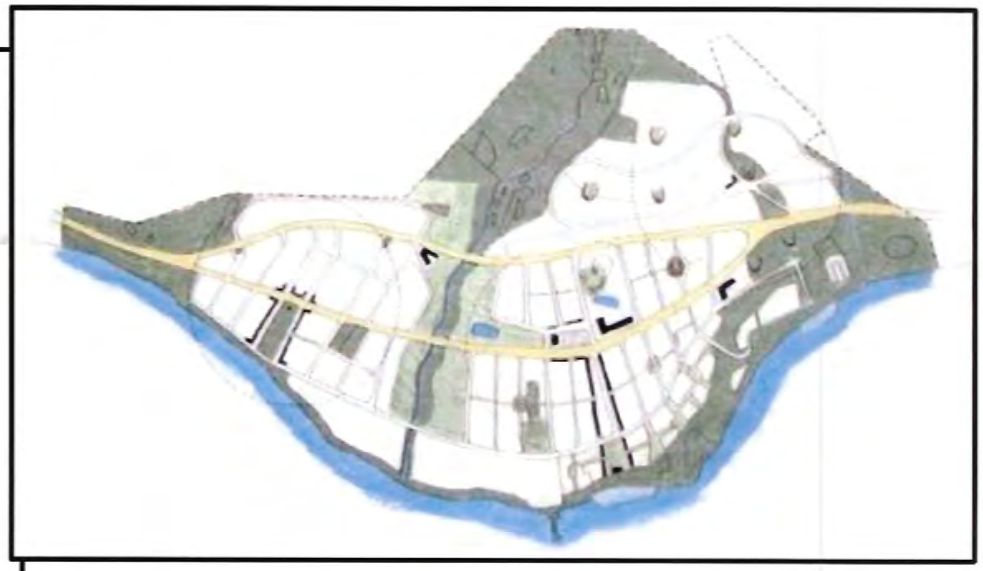


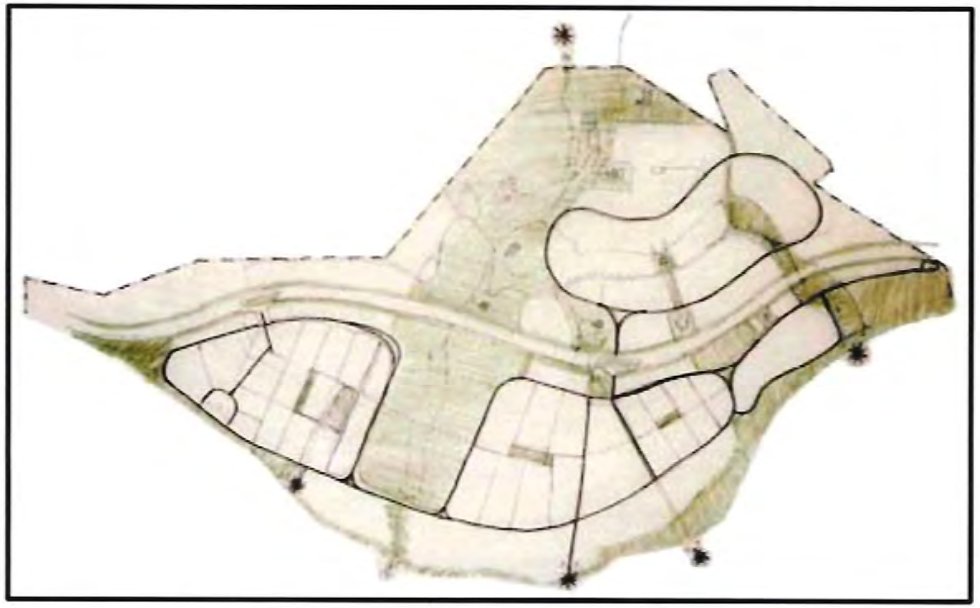




Alternative Design Analysis







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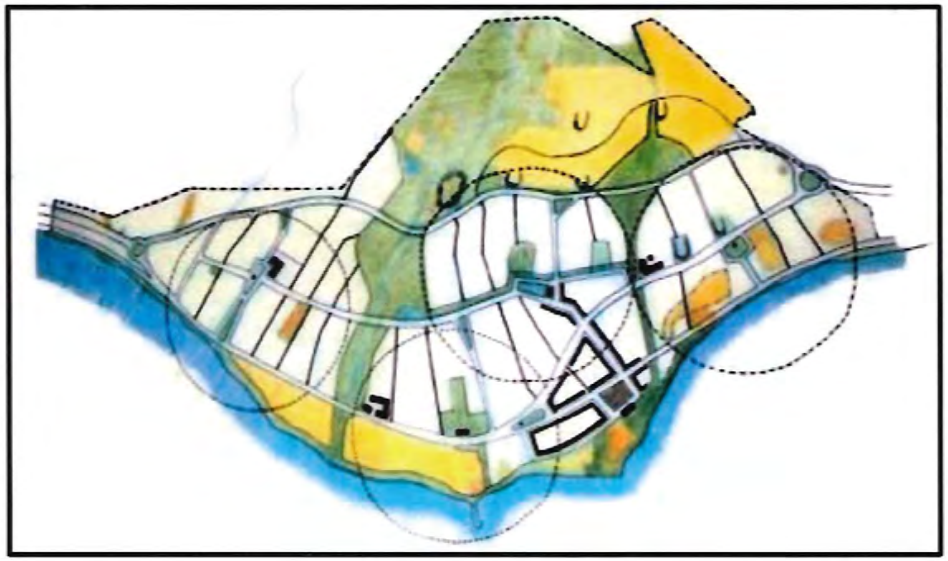

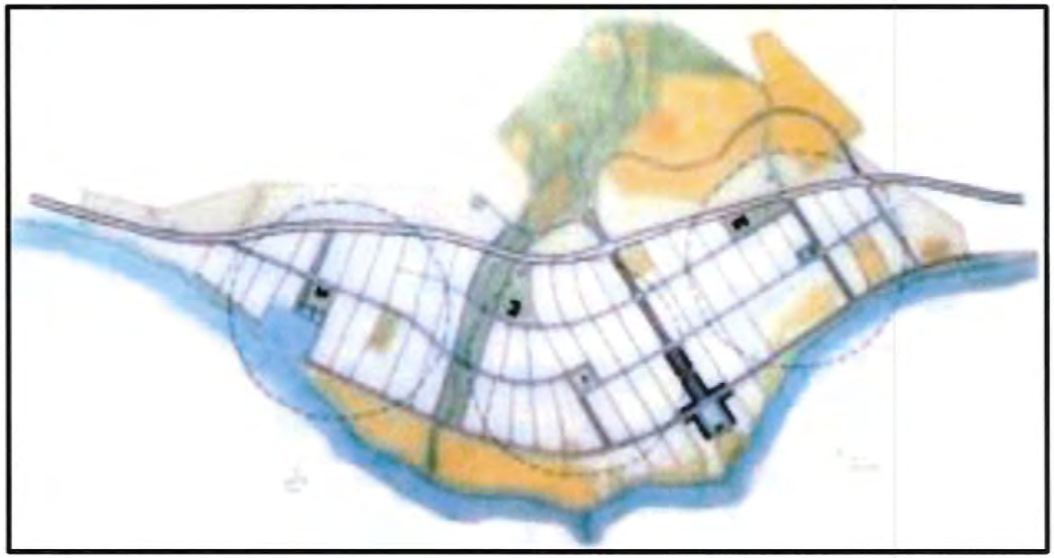

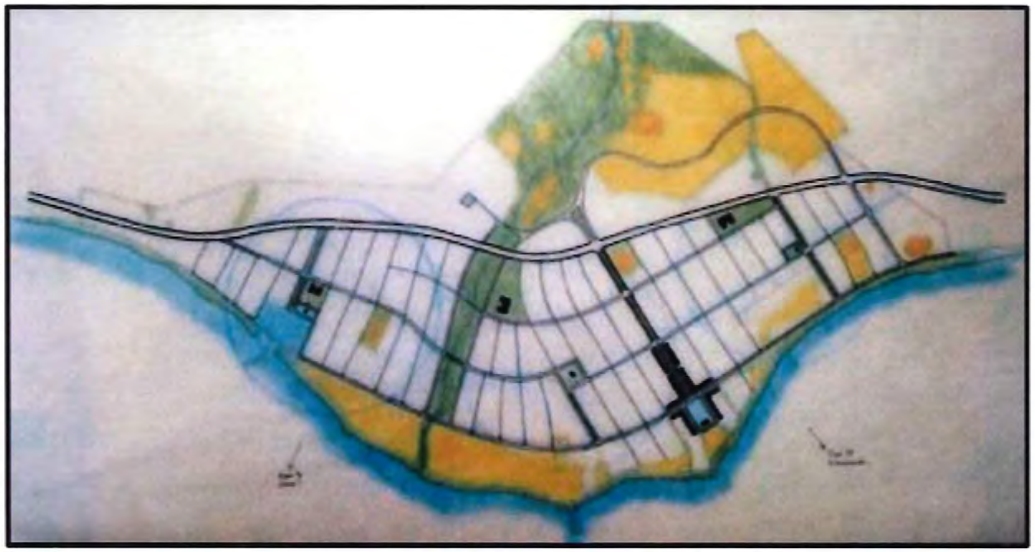

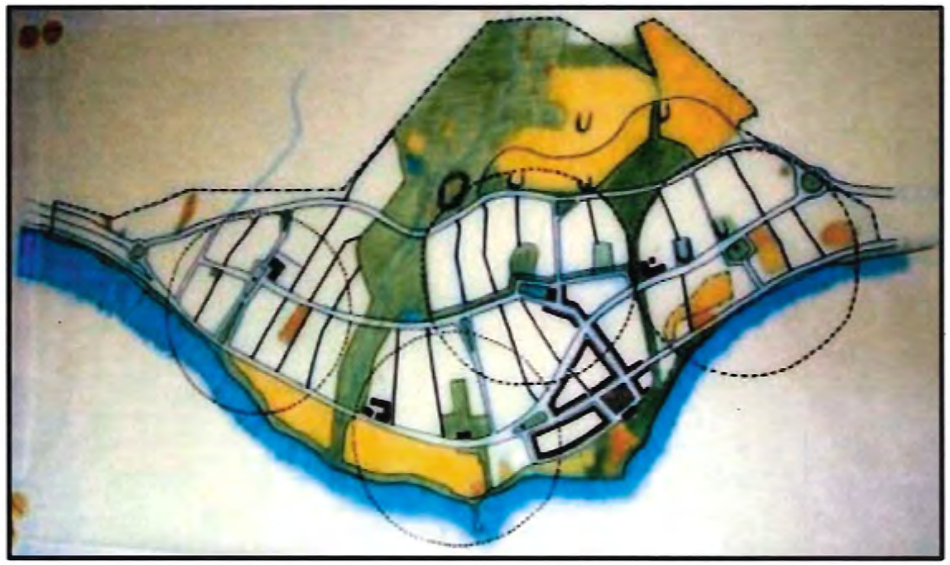

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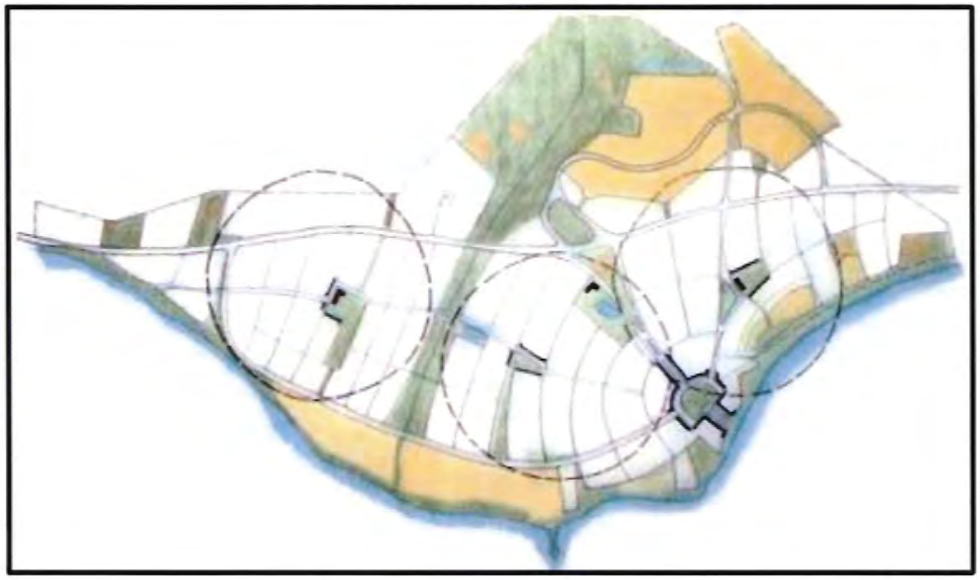

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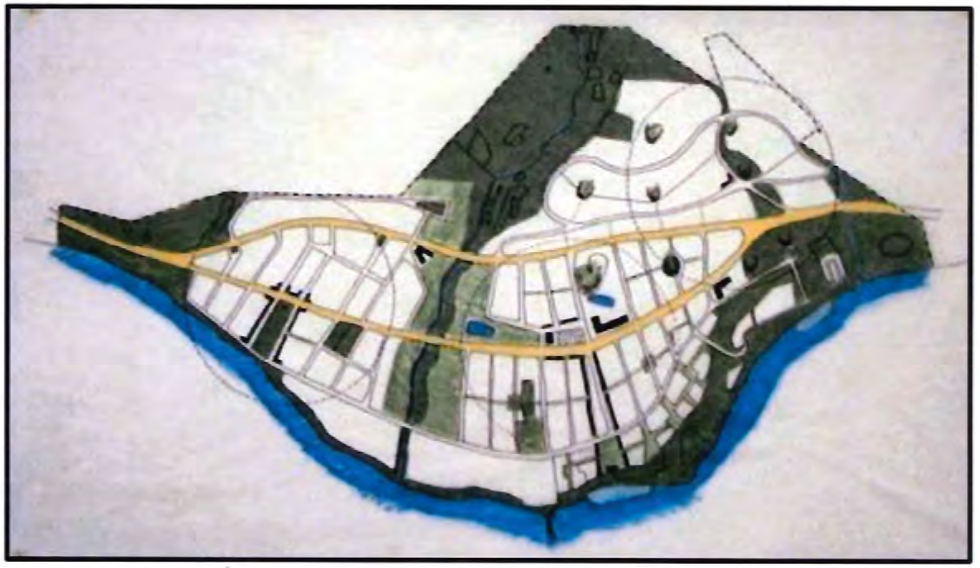

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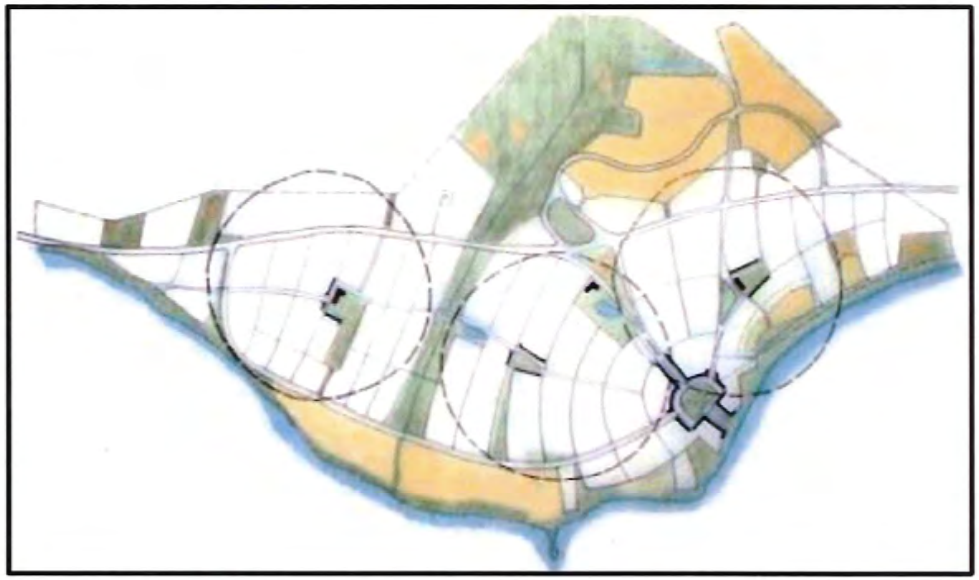
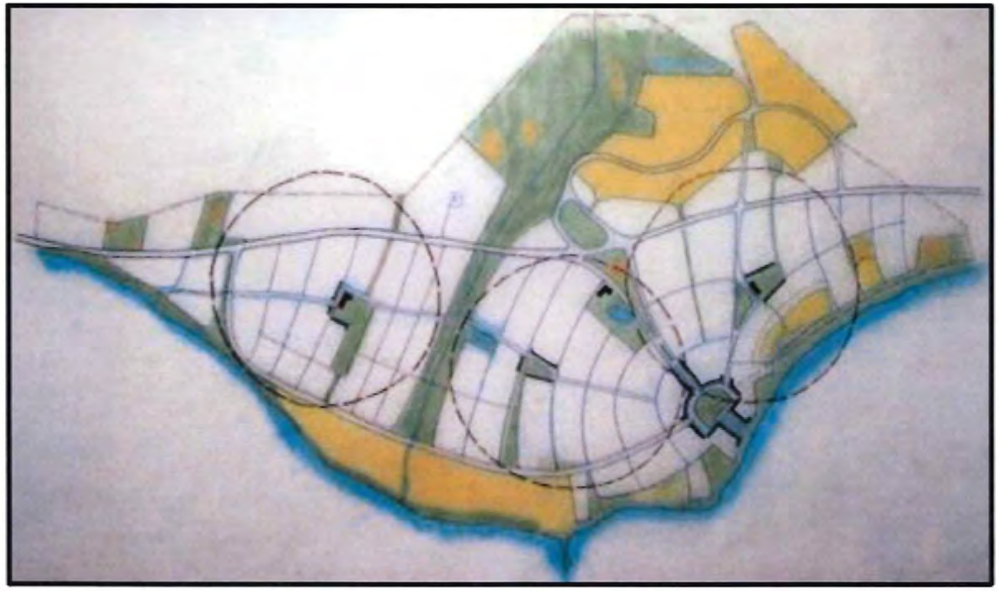
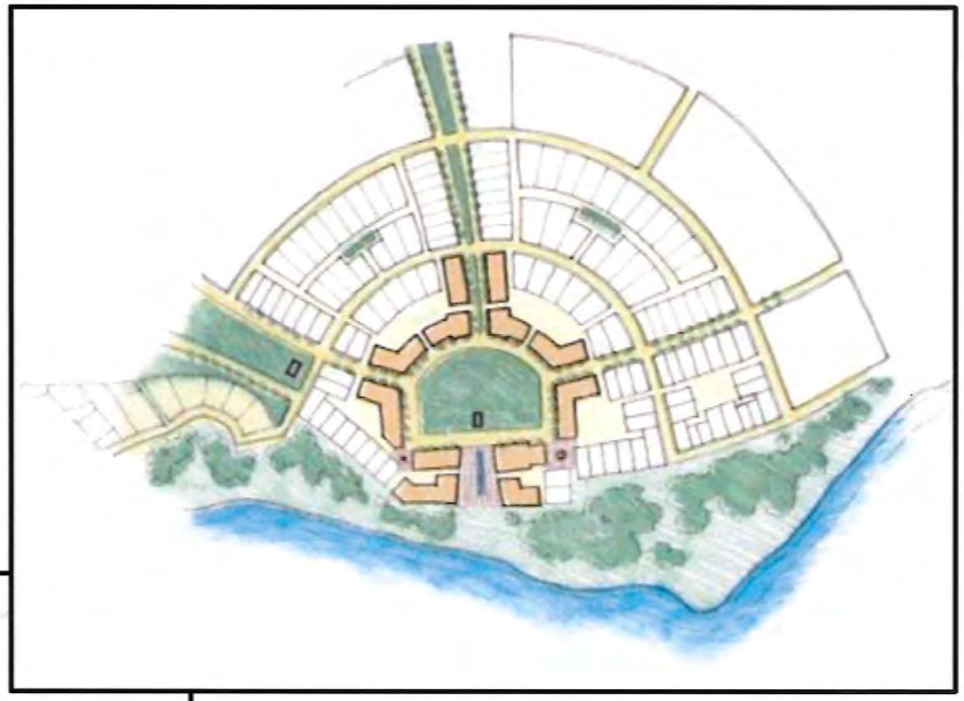




Alternative Design Analysis

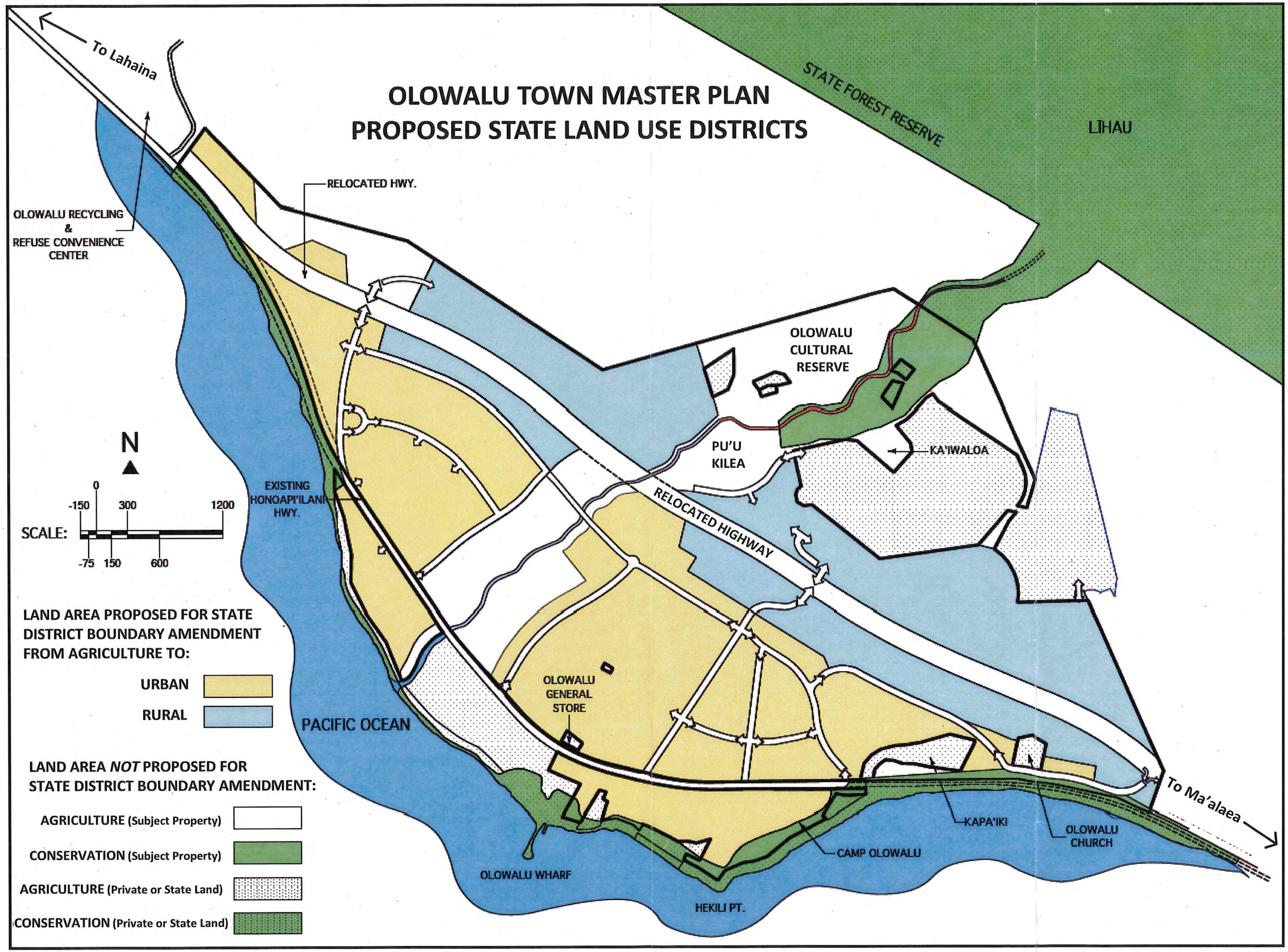
Alternative Design Analysis



APPENDIX A-1.

Conceptual Master Plans Alternative 1 and Alternative 2

Alternative 1


OLOWALU TOWN MASTER PLAN
PROPOSED STATE LAND USE DISTRICTS
To Lahaina
STATE FOREST RESERVE
LIHAU
RELOCATED HWY.
OLOWALU RECYCLING & REFUSE CONVENIENCE CENTER
OLOWALU CULTURAL RESERVE
PU'U KILEA
KA'IWALOA
EXISTING HONOAPI'ILANI HWY.
RELOCATED HIGHWAY
N
0
-150
300
1200
SCALE:
-75
150
600
LAND AREA PROPOSED FOR STATE DISTRICT BOUNDARY AMENDMENT FROM AGRICULTURE TO:
URBAN
RURAL
OLOWALU GENERAL STORE
PACIFIC OCEAN
LAND AREA NOT PROPOSED FOR STATE DISTRICT BOUNDARY AMENDMENT:
AGRICULTURE (Subject Property)
CONSERVATION (Subject Property)
AGRICULTURE (Private or State Land)
CONSERVATION (Private or State Land)
To Ma'alaea
KAPA'IKI
OLOWALU CHURCH
CAMP OLOWALU
OLOWALU WHARF
HEKILI PT.

OLOWALU TOWN MASTER PLAN

To Lahaina

Existing County Solid Waste Transfer Center

Proposed Wastewater Treatment Facility

Existing Honoapi'ilani Highway

Existing 150 ft. Shoreline Setback

Segment of Existing Hwy. to be Removed

N

SCALE: -150 0 300 1200 / -75 150 600

STATE FOREST RESERVE

LĪHAU

Relocated Highway /Transit Corridor

Olowalu Cultural Reserve

Pu'ukilea

Ka'iwaloa

Olowalu Stream

Existing Honoapi'ilani Hwy.

PACIFIC OCEAN

Ka'apiki

To Ma'alaea

Olowalu Church

Camp Olowalu

Olowalu General Store

Olowalu Wharf

Hekili Point

Segment of Existing Hwy. to be Removed

Existing Honoapi'ilani Highway

KEY

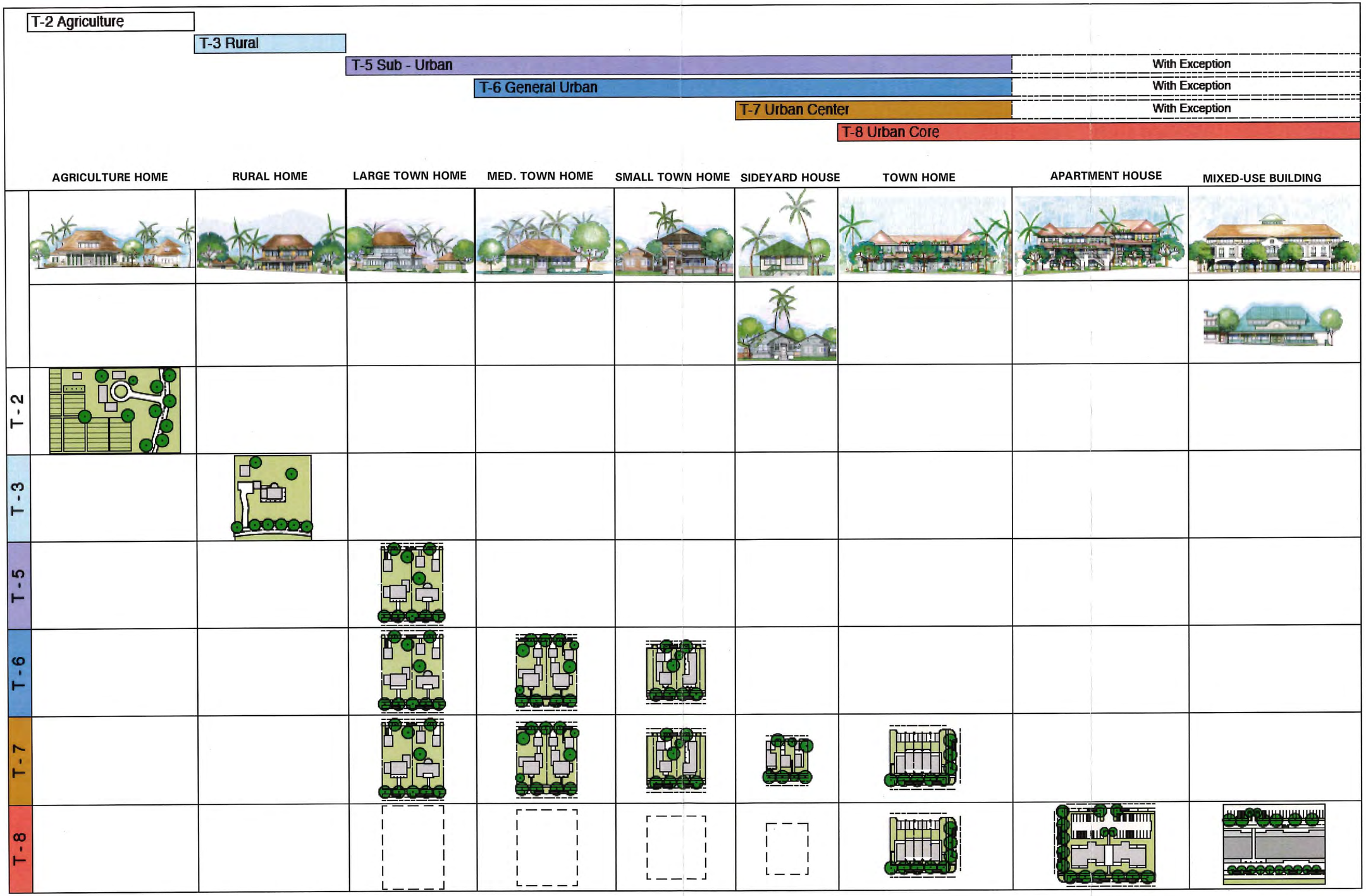
URBAN TRANSECTS

- EDGE OF URBAN AREA
- TOWN CENTER - T8
- TOWN CENTER RESIDENCES -T7
- SMALL TOWN LOTS - T6
- LARGE TOWN LOTS - T5
- PARKS - T4
- PUBLIC AMENITIES - T4A

RURAL & AG. TRANSECTS

- RURAL - T3
- RURAL PARKS - T3A
- AGRICULTURE - T2
- AGRICULTURE PARKS - T2A
- CONSERVATION - T1
- CULTURAL RESERVE
- AGR. (PRIVATE & STATE)
- CONSERVATION (Private & State))

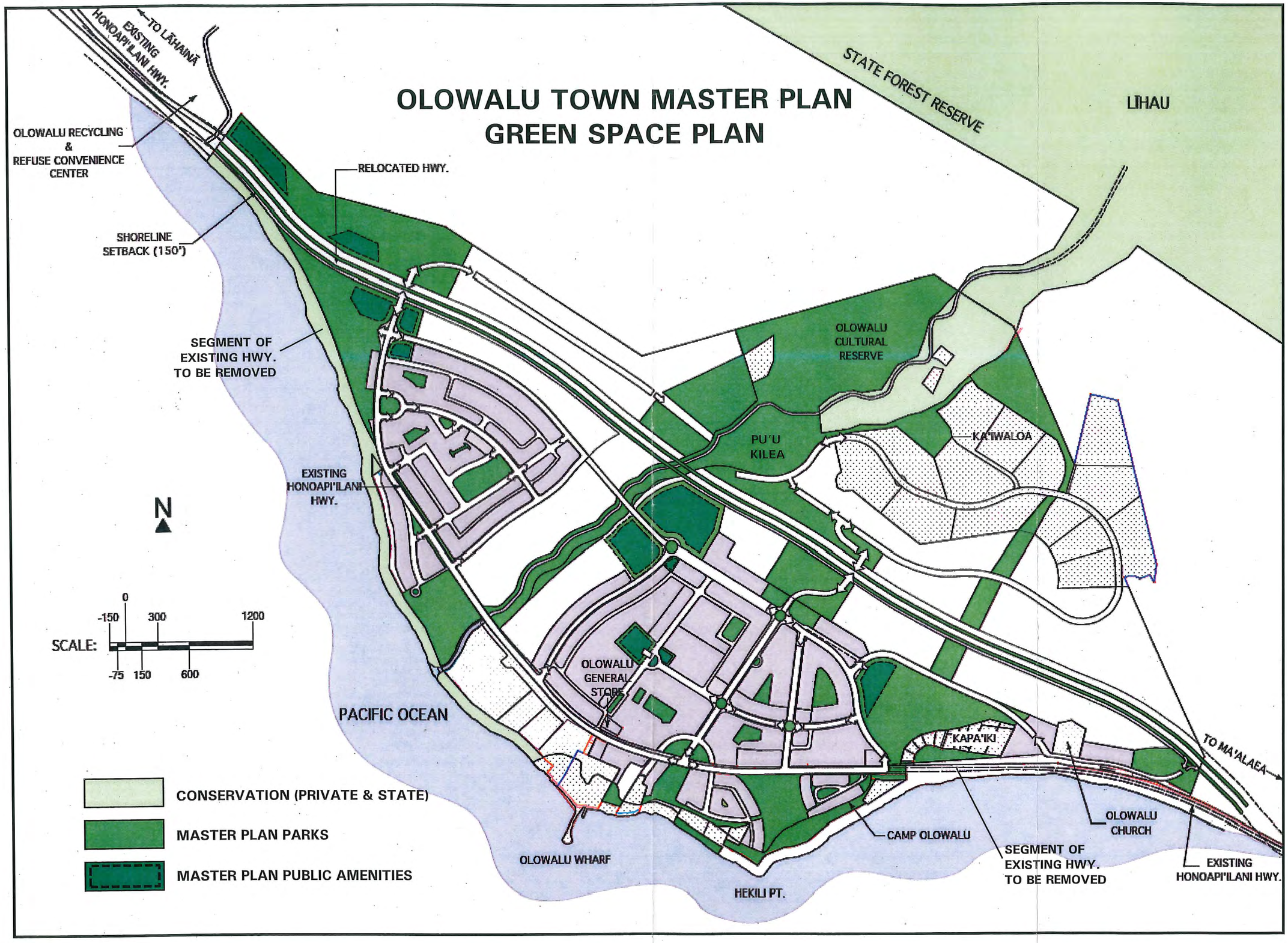
NOTE: CONCEPTUAL MASTER ONLY, SUBJECT TO CHANGE



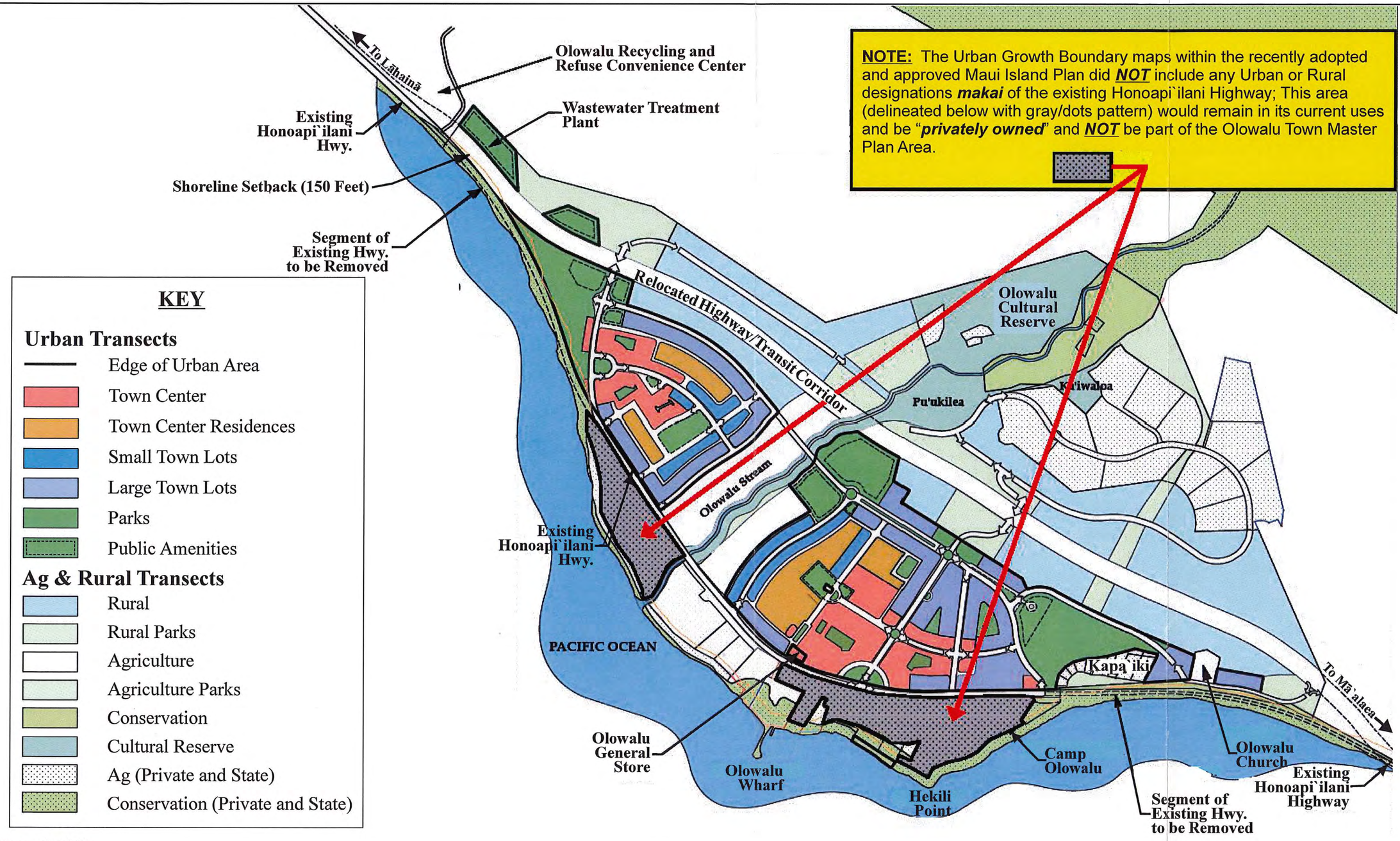
NOTES:

- THE ABOVE PLAN IS CONCEPTUAL ONLY AND IS SUBJECT TO CHANGE DURING LAND USE ENTITLEMENT PROCESS.
- T4 (PARKS) & T4A (PUBLIC AMENITIES) ARE NOT SHOWN AS THEY DO NOT CONTAIN RESDENTIAL STRUCTURES.

OLOWALU TOWN MASTER PLAN
GREEN SPACE PLAN



Alternative 2



Source: Artel, Inc.

Proposed Olowalu Town Master Plan

Alternative 2 Conceptual Plan

NOT TO SCALE

Prepared for: Olowalu Town, LLC and Olowalu Ekolu, LLC

MUNEKIYO HIRAGA

OlowaluTown/MasterPl/Final EIS/Alt2 ConceptualPlan

APPENDIX A-~~1~~2.

LEED 2009 For Neighborhood Development

LEED 2009 FOR NEIGHBORHOOD DEVELOPMENT

For Public Use and Display
LEED 2009 for Neighborhood Development Rating System
Created by the Congress for the New Urbanism, Natural Resources Defense Council, and the U.S. Green Building Council
(Updated November 2011)

LEED-ND

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The built environment has a profound impact on our natural environment, economy, health, and productivity. Through its Leadership in Environmental and Energy Design (LEED®) certification programs, the U.S. Green Building Council (USGBC) is transforming the built environment. The green building movement offers an unprecedented opportunity to respond to the most important challenges of our time, including global climate change, dependence on nonsustainable and expensive sources of energy, and threats to human health. The work of innovative building planning professionals is a fundamental driving force in the green development movement. Such leadership is a critical component to achieving USGBC's mission of a sustainable built environment for all within a generation.

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USGBC's greatest strength is the diversity of our membership. USGBC is a balanced, consensus-based nonprofit with more than 20,000 member companies and organizations representing the entire building industry. Since its inception in 1993, USGBC has played a vital role in providing a leadership forum and a unique, integrating force for the building industry. USGBC's programs have three distinguishing characteristics:

Committee-based

The heart of this effective coalition is our committee structure, in which volunteer members design strategies that are implemented by staff and expert consultants. Our committees provide a forum for members to resolve differences, build alliances, and forge cooperative solutions for influencing change in all sectors of the building industry.

Member-driven

Membership is open and balanced and provides a comprehensive platform for carrying out important programs and activities. We target the issues identified by our members as the highest priority. We conduct an annual review of achievements that allows us to set policy, revise strategies, and devise work plans based on members' needs.

Consensus-focused

We work together to promote green buildings and neighborhoods, and in doing so, we help foster greater economic vitality and environmental health at lower costs. We work to bridge ideological gaps between industry segments and develop balanced policies that benefit the entire industry.

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(800) 795-1747 Office
(202) 828-5110 Fax
www.usgbc.org

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The Congress for the New Urbanism and the Natural Resources Defense Council collaborated with the U.S. Green Building Council in creating the LEED for Neighborhood Development Rating System. USGBC's consensus-focused approach to rating system development was furthered by these organizations' expertise in New Urbanism and smart growth strategies.

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ACKNOWLEDGMENTS

The LEED 2009 for Neighborhood Development Rating System has been made possible only through the efforts of many dedicated volunteers, staff members from USGBC and the two partner organizations, consultants, and others in the USGBC community. The rating system development work was managed and implemented by USGBC staff and the LEED for Neighborhood Development Core Committee and included review and input by many Technical Advisory Group (TAG) members with oversight by the LEED Steering Committee. We extend our deepest gratitude to all of our LEED committee members who participated in the development of this rating system, and especially the LEED for Neighborhood Development Core Committee, for their tireless volunteer efforts and support of USGBC's mission:

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Heather Holdridge	Lake Flato Architects
Jason King	Greenworks, PC
Michael Lane	Lighting Design Lab
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Karen Poff	Austin Energy
Shabbir Rawalpindiwala	Kohler Co.

Neil Rosen	North Shore LIJ Health System
Robert Rubin	McKim and Creed
Stephanie Tanner	U.S. Environmental Protection Agency
Bill Wall	Clivus New England, Inc.
Daniel Yeh	University of South Florida

LEED for Neighborhood Development Core Committee

The LEED 2009 for Neighborhood Development Rating System is the work of members of the LEED for Neighborhood Development Core Committee, both those who have worked on this version and those who helped create previous versions. In addition, staff would like to thank Criterion Planners, Urban Advantage, and AECOM for the graphics.

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Elizabeth Schilling	Smart Growth Leadership Institute
Laura Watchman	Watchman Consulting
Sandy Wiggins	Conscilience, LLC

LEED 2009 FOR NEIGHBORHOOD DEVELOPMENT PROJECT CHECKLIST

Smart Location and Linkage — 27 possible points

☑	Prerequisite 1	Smart Location	Required
☑	Prerequisite 2	Imperiled Species and Ecological Communities	Required
☑	Prerequisite 3	Wetland and Water Body Conservation	Required
☑	Prerequisite 4	Agricultural Land Conservation	Required
☑	Prerequisite 5	Floodplain Avoidance	Required
☐	Credit 1	Preferred Locations	10
☐	Credit 2	Brownfield Redevelopment	2
☐	Credit 3	Locations with Reduced Automobile Dependence	7
☐	Credit 4	Bicycle Network and Storage	1
☐	Credit 5	Housing and Jobs Proximity	3
☐	Credit 6	Steep Slope Protection	1
☐	Credit 7	Site Design for Habitat or Wetland and Water Body Conservation	1
☐	Credit 8	Restoration of Habitat or Wetlands and Water Bodies	1
☐	Credit 9	Long-Term Conservation Management of Habitat or Wetlands and Water Bodies	1

Neighborhood Pattern and Design — 44 possible points

☑	Prerequisite 1	Walkable Streets	Required
☑	Prerequisite 2	Compact Development	Required
☑	Prerequisite 3	Connected and Open Community	Required
☐	Credit 1	Walkable Streets	12
☐	Credit 2	Compact Development	6
☐	Credit 3	Mixed-Use Neighborhood Centers	4
☐	Credit 4	Mixed-Income Diverse Communities	7
☐	Credit 5	Reduced Parking Footprint	1
☐	Credit 6	Street Network	2
☐	Credit 7	Transit Facilities	1
☐	Credit 8	Transportation Demand Management	2
☐	Credit 9	Access to Civic and Public Spaces	1
☐	Credit 10	Access to Recreation Facilities	1
☐	Credit 11	Visitability and Universal Design	1
☐	Credit 12	Community Outreach and Involvement	2
☐	Credit 13	Local Food Production	1
☐	Credit 14	Tree-Lined and Shaded Streets	2
☐	Credit 15	Neighborhood Schools	1

Green Infrastructure and Buildings — 29 possible points

☑	Prerequisite 1	Certified Green Building	Required
☑	Prerequisite 2	Minimum Building Energy Efficiency	Required
☑	Prerequisite 3	Minimum Building Water Efficiency	Required
☑	Prerequisite 4	Construction Activity Pollution Prevention	Required

☐ Credit 1	Certified Green Buildings	5
☐ Credit 2	Building Energy Efficiency	2
☐ Credit 3	Building Water Efficiency	1
☐ Credit 4	Water-Efficient Landscaping	1
☐ Credit 5	Existing Building Reuse	1
☐ Credit 6	Historic Resource Preservation and Adaptive Use	1
☐ Credit 7	Minimized Site Disturbance in Design and Construction	1
☐ Credit 8	Stormwater Management	4
☐ Credit 9	Heat Island Reduction	1
☐ Credit 10	Solar Orientation	1
☐ Credit 11	On-Site Renewable Energy Sources	3
☐ Credit 12	District Heating and Cooling	2
☐ Credit 13	Infrastructure Energy Efficiency	1
☐ Credit 14	Wastewater Management	2
☐ Credit 15	Recycled Content in Infrastructure	1
☐ Credit 16	Solid Waste Management Infrastructure	1
☐ Credit 17	Light Pollution Reduction	1

Innovation and Design Process — **6 possible points**

☐ Credit 1	Innovation and Exemplary Performance	1–5
☐ Credit 2	LEED® Accredited Professional	1

Regional Priority Credit — **4 possible points**

☐ Credit 1	Regional Priority	1–4

LEED 2009 for Neighborhood Development Certification Levels

100 base points plus 6 possible Innovation and Design Process and 4 possible Regional Priority Credit points

Certified	40–49 points
Silver	50–59 points
Gold	60–79 points
Platinum	80 points and above

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INTRODUCTION

I. THE CASE FOR GREEN NEIGHBORHOOD DEVELOPMENTS

As the U.S. population continues to expand rapidly, consumption of land grows exponentially—currently, three times the rate of population growth. At this breathtaking pace, two-thirds of the development on the ground in 2050 will be built between now and then.[1] The way we grow—especially how and where we grow—will have a profound effect on our planet and on us.

Land use and neighborhood design patterns create a particular physical reality and compel behaviors that have a significant effect on the environmental performance of a given place. Segregated land uses accessed by high-speed roadways that necessitate the use of cars have been the predominant development pattern over the past 50 years. In the United States, transportation accounts for roughly one-third of greenhouse gas emissions, a large portion of which can be attributed to personal automobile use.[2] Burning fossil fuels for transportation increases air pollution and related respiratory diseases. Automobile-oriented neighborhoods tend to be hostile to pedestrians and unsupportive of traditional mixed-use neighborhood centers. Sprawling development patterns fragment habitat, endanger sensitive land and water bodies, destroy precious farmland, and increase the burden on municipal infrastructure.

In contrast, by placing residences and jobs proximate to each other, thoughtful neighborhood planning and development can limit automobile trips and the associated greenhouse gas emissions. Mixed-use development and walkable streets encourage walking, bicycling, and public transportation for daily errands and commuting. Environmentally responsible buildings and infrastructure are an important component of any green neighborhood, further reducing greenhouse gas emissions by decreasing energy consumption. Green buildings and infrastructure also lessen negative consequences for water resources, air quality, and natural resource consumption.

Green neighborhood developments are beneficial to the community and the individual as well as the environment. The character of a neighborhood, including its streets, homes, workplaces, shops, and public spaces, significantly affects the quality of life. Green neighborhood developments enable a wide variety of residents to be part of the community by including housing of varying types and price ranges. Green developments respect historical resources and the existing community fabric; they preserve open space and encourage access to parks. Green buildings, community gardens, and streets and public spaces that encourage physical activity are beneficial for public health. Combine the substantial environmental and social benefits and the case for green neighborhoods makes itself.

II. LEED® RATING SYSTEMS

Background on LEED®

Following the formation of the U.S. Green Building Council (USGBC) in 1993, the organization's members quickly realized that the sustainable building industry needed a system to define and measure "green buildings." USGBC began to research existing green building metrics and rating systems. Less than a year after formation, the members acted on the initial findings by establishing a committee to focus solely on this topic. The composition of the committee was diverse; it included architects, real estate agents, a building owner, a lawyer, an environmentalist, and

1 Reid Ewing, Keith Bartholomew, Steve Winkelman, Jerry Walters, and Don Chen, *Growing Cooler: The Evidence on Urban Development and Climate Change* (Washington, D.C.: Urban Land Institute, 2008).
2 "Greenhouse Gases, Climate Change, and Energy" (Energy Information Administration, May 2008).

industry representatives. This cross section of people and professions added a richness and depth both to the process and to the ultimate product, the Leadership in Energy and Environmental Design (LEED) certification system.

The first LEED Pilot Project Program, also referred to as LEED Version 1.0, was launched at the USGBC Membership Summit in August 1998. After extensive modifications, LEED Green Building Rating System Version 2.0 was released in March 2000, with LEED Version 2.1 following in 2002 and LEED Version 2.2 following in 2005.

As LEED has evolved and matured, the program has undertaken new initiatives. In addition to a rating system specifically devoted to building operational and maintenance issues (LEED for Existing Buildings: Operations & Maintenance), LEED addresses the different project development and delivery processes that exist in the U.S. building design and construction market, through rating systems for specific building typologies, sectors, and project scopes: LEED for Core & Shell, LEED for New Construction, LEED for Schools, LEED for Retail, LEED for Healthcare, LEED for Homes, and LEED for Commercial Interiors. LEED for Neighborhood Development is the latest LEED certification system to be released.

The green building and neighborhood development field is growing and changing daily. New technologies and products are being introduced into the marketplace, and innovative designs and practices are proving their effectiveness. The LEED rating systems and reference guides will evolve as well. Project teams must comply with the version of the rating system that is current at the time of their registration. USGBC will highlight new developments on its website on a continual basis, at www.usgbc.org.

Background on LEED for Neighborhood Development

The U.S. Green Building Council (USGBC), the Congress for the New Urbanism (CNU), and the Natural Resources Defense Council (NRDC)—organizations that represent leading design professionals, progressive builders and developers, and the environmental community—have come together to develop a rating system for neighborhood planning and development based on the combined principles of smart growth, New Urbanism, and green infrastructure and building. The goal of this partnership is to establish a national leadership standard for assessing and rewarding environmentally superior green neighborhood development practices within the framework of the LEED® Green Building Rating System™.

Unlike other LEED rating systems, which focus primarily on green building practices and offer only a few credits for site selection and design, LEED for Neighborhood Development places emphasis on the site selection, design, and construction elements that bring buildings and infrastructure together into a neighborhood and relate the neighborhood to its landscape as well as its local and regional context. The work of the LEED-ND core committee, made up of representatives from all three partner organizations, has been guided by sources such as the Smart Growth Network's ten principles of smart growth, the charter of the Congress for the New Urbanism, and other LEED rating systems. LEED for Neighborhood Development creates a label, as well as guidelines for both decision making and development, to provide an incentive for better location, design, and construction of new residential, commercial, and mixed-use developments.

Whereas the other LEED rating systems have five environmental categories, LEED for Neighborhood Development has three: Smart Location and Linkage, Neighborhood Pattern and Design, and Green Infrastructure and Buildings. An additional category, Innovation and Design Process, addresses sustainable design and construction issues and measures not covered under the three categories. Regional bonus credits are another feature of LEED-ND. These credits acknowledge the importance of local conditions in determining best environmental design and construction practices as well as social and health practices.

The LEED 2009 minimum program requirements define the minimum characteristics that a project must possess to be eligible for certification under LEED 2009. These requirements do not apply to LEED for Neighborhood Development projects.

LEED Credit Weightings

In LEED 2009, the allocation of points among credits is based on the potential environmental impacts and human benefits of each credit with respect to a set of impact categories. The impacts are defined as the environmental or human effect of the design, construction, operation, and maintenance of the building, such as greenhouse gas emissions, fossil fuel use, toxins and carcinogens, air and water pollutants, and indoor environmental conditions. In the LEED for Neighborhood Development Rating System, social and public health benefits were added to the impact categories, and the impact categories were then applied at the neighborhood scale. A combination of approaches, including energy modeling, life-cycle assessment, and transportation analysis, is used to quantify each type of impact. The resulting allocation of points among credits is called credit weighting.

LEED 2009 uses the U.S. Environmental Protection Agency's TRACI[3] environmental impact categories as the basis for weighting each credit. TRACI was developed to assist with impact evaluation for life-cycle assessment, industrial ecology, process design, and pollution prevention. LEED 2009 also takes into consideration the weightings developed by the National Institute of Standards and Technology (NIST); these compare impact categories with one another and assign a relative weight to each. Together, the two approaches provide a solid foundation for determining the point value of each credit in LEED 2009.

The LEED 2009 credit weightings process is based on the following parameters, which maintain consistency and usability across rating systems:

- All LEED credits are worth a minimum of 1 point.
- All LEED credits are positive, whole numbers; there are no fractions or negative values.
- All LEED credits receive a single, static weight in each rating system; there are no individualized scorecards based on project location.
- All LEED rating systems have 100 base points; Innovation and Design Process and Regional Priority credits provide opportunities for up to 10 bonus points.

Given the above criteria, the LEED 2009 credit weightings process involves three steps for LEED for Neighborhood Development:

1. A reference neighborhood is used to estimate the environmental impacts in 15 categories associated with a typical neighborhood development pursuing LEED certification.
2. The relative importance of neighborhood impacts in each category is set to reflect values based on the NIST weightings.[4]
3. Data that quantify neighborhood impacts on environmental and human health are used to assign points to individual credits.

Each credit is allocated points based on the relative importance of the neighborhood-related impacts that it addresses. The result is a weighted average that combines neighborhood impacts and the relative value of the impact categories. Credits that most directly address the most important impacts are given the greatest weight, subject to the system design parameters described above. Credit weights also reflect a decision by LEED to recognize the market implications of point allocation.

The details of the weightings process vary slightly among individual rating systems. For example, LEED for Neighborhood Development includes credits related to infill development but LEED for New Construction does not. This results in a difference in the portion of the environmental footprint addressed by each rating system and the relative allocation of points.

3 Tools for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) (U.S. Environmental Protection Agency, Office of Research and Development, http://www.epa.gov/nrmrl/std/sab/traci/).
4 Relative impact category weights based on an exercise undertaken by NIST (National Institute of Standards and Technology) for the BEES program, http://www.bfrl.nist.gov/oae/software/bees/.

The weightings process for each rating system is fully documented in a weightings workbook. The credit weightings process will be reevaluated over time to incorporate changes in values ascribed to different neighborhood impacts and neighborhood types, based on both market reality and evolving knowledge related to buildings and neighborhood design. A complete explanation of the LEED credit weightings system is available on the USGBC website, at www.usgbc.org.

III. OVERVIEW AND PROCESS

The LEED 2009 for Neighborhood Development Rating System is a set of performance standards for certifying the planning and development of neighborhoods. The intent is to promote healthful, durable, affordable, and environmentally sound practices in building design and construction.

Prerequisites and credits in the rating system address five topics:

- Smart Location and Linkage (SLL)
- Neighborhood Pattern and Design (NPD)
- Green Infrastructure and Buildings (GIB)
- Innovation and Design Process (IDP)
- Regional Priority Credit (RPC)

When to Use LEED for Neighborhood Development

The LEED for Neighborhood Development Rating System responds to land use and environmental considerations in the United States. It is designed to certify exemplary development projects that perform well in terms of smart growth, urbanism, and green building. Projects may constitute whole neighborhoods, portions of neighborhoods, or multiple neighborhoods. There is no minimum or maximum size for a LEED-ND project, but the core committee's research has determined that a reasonable minimum size is at least two habitable buildings and that the maximum area that can appropriately be considered a neighborhood is 320 acres, or half a square mile. A project larger than 320 acres is eligible but may find documenting certain credits difficult and may want to consider dividing the area into separate LEED-ND projects, each smaller than 320 acres. Although projects may contain only a single use, typically a mix of uses will provide the most amenities to residents and workers and enable people to drive less and safely walk or bike more. Small infill projects that are single use but complement existing neighboring uses, such as a new affordable-housing infill development in a neighborhood that is already well served by retail and commercial uses, are also good candidates for certification.

This rating system is designed primarily for the planning and development of new green neighborhoods, whether infill sites or new developments proximate to diverse uses or adjacent to connected and previously developed land. Many infill projects or projects near transit will be in urban areas, which helps direct growth into places with existing infrastructure and amenities. LEED-ND also promotes the redevelopment of aging brownfield sites into revitalized neighborhoods by rewarding connections beyond the site, walkable streets within the site, and the integration of any historic buildings and structures that will give the new neighborhood development a unique sense of place.

Existing neighborhoods can also use the rating system, and its application in this context could be especially beneficial in urban areas and historic districts. It is, however, important to point out that the owner or owners applying for certification should already own, have title to, or have significant control over a majority of the land within the project boundary and the plan for new construction or major renovation for the majority of the project's square footage. The new construction could take place on vacant land within the boundary, and the major renovations could involve existing buildings, recent or historic, within the project. In addition to guiding infill development opportunities, LEED-ND has additional relevance for existing neighborhoods, as a tool to set

performance levels for a group of owners wanting to retrofit their homes, offices, or shops, and finally for shaping new green infrastructure, such as sidewalks, alleys, and public spaces. Many prerequisites or credits have a specific compliance path for existing buildings; this is highlighted in the rating system, and more detail is provided in the reference guide.

LEED-ND also can be used in suburban locations. There are tremendous opportunities to retrofit the suburbs, whether this involves reviving old shopping centers and their surrounding parking lots or adding new units and vibrant walkable town centers to existing subdivisions. Increasingly, many suburbs are well served by transit and thus should be considered good candidates for creating mixed-use, walkable developments with the potential to decrease residents' and workers' dependence on personal automobiles.

LEED for Neighborhood Development was not designed as a rating system for existing campuses, such as colleges, universities, and military bases. Many campuses have circulation patterns and building forms and placement that differ from the strategies outlined in LEED-ND. As a result, the rating system may not be appropriate for such facilities, but it could be applied in certain situations. For example, LEED-ND could be used for a civilian-style development on or adjacent to a military base, especially now that there is increased interest in developing mixed-use main streets as a focal point for new residential development in military bases. In addition, with many installations facing closure under the Base Realignment and Closure Act, LEED-ND could be used to guide the redevelopment of a base as it finds a new use. For colleges and universities, the program best lends itself to campuses that are expanding or undergoing major redevelopment. Increasingly, many universities are creating mixed-use development projects, often with local partners, to serve as catalytic projects in their communities, and LEED-ND could be a good framework and certification tool. Some universities are looking to their own campus lands for new development opportunities, particularly for housing that is affordable to faculty and staff but also walkable to campus and other amenities, and LEED-ND may be appropriate.

LEED for Neighborhood Development is not meant to be a national standard that replaces zoning codes or comprehensive plans, nor has it been designed to certify sector plans or other policy tools. Local development patterns and performance levels vary greatly across the country because land regulation is largely controlled by local governments. One city may be a leader in stormwater management, and another an innovator in traffic calming, but neither may be advanced in all areas covered by LEED-ND. The rating system should therefore not be considered a one-size-fits-all policy tool. Instead, LEED-ND is a voluntary leadership standard, and local governments should consider promoting its use by the development community or public-private partnerships. In addition, LEED-ND can be used to analyze whether existing development regulations, such as zoning codes, development standards, landscape requirements, building codes, or comprehensive plans are "friendly" to sustainable developments. By comparing a locality's development practices with the rating system, public officials and the planning department can better identify code barriers that make it onerous, costly, or even impossible to undertake some aspects of sustainable development. Finally, public sector projects (e.g., those sponsored by housing authorities, redevelopment agencies, or specialized development authorities) are eligible to use the rating system. Please visit the LEED for Neighborhood web page at www.usgbc.org for LEED-ND policy guidance for state and local governments.

"Neighborhood Development," Defined

Based on research on the origins of neighborhood design and current best practices for locating and designing new development, the LEED for Neighborhood Development core committee has developed a rating system for smart, healthy, and green neighborhood development. Although LEED-ND does not strictly define what constitutes a neighborhood, the prerequisites and credits are written to encourage a type of development that recalls the siting and design of traditional neighborhoods and promotes best practices in new neighborhood development today.

Since ancient times, cities around the world have been spatially divided into districts or neighborhoods. Excavations of some of the earliest cities reveal evidence of social neighborhoods. Urban scholar Lewis Mumford noted that "neighborhoods, in some primitive, inchoate fashion exist wherever human beings congregate, in permanent family dwellings; and many of the functions of the city tend to be distributed naturally—that is, without any theoretical preoccupation or political direction—into neighborhoods."[5] In basic terms, a neighborhood is an area of dwellings, employment, retail, and civic places and their immediate environment that residents and/or employees identify with in terms of social and economic attitudes, lifestyles, and institutions.

A neighborhood can be considered the planning unit of a town. The charter of the Congress for the New Urbanism characterizes this unit as "compact, pedestrian-friendly, and mixed-use."[6] By itself the neighborhood is a village, but combined with other neighborhoods it becomes a town or a city. Similarly, several neighborhoods with their centers at transit stops can constitute a transit corridor. The neighborhood, as laid out in LEED-ND, is in contrast to sprawl development patterns, which create podlike clusters that are disconnected from surrounding areas. Existing and new traditional neighborhoods provide an alternative to development patterns that characterize sprawl, such as the single-zoned, automobile-dominated land uses that have been predominant in suburban areas since the 1950s. Instead, traditional neighborhoods meet all those same needs—for housing, employment, shopping, civic functions, and more—but in formats that are compact, complete, and connected, and ultimately more sustainable and diverse.[7] The metrics of a neighborhood vary in density, population, mix of uses, and dwelling types and by regional customs, economies, climates, and site conditions. In general, they include size, identifiable centers and edges, connectedness with the surroundings, walkable streets, and sites for civic uses and social interaction.

Size is a defining feature of a neighborhood and is typically based on a comfortable distance for walking from the center of the neighborhood to its edge; that suggests an area of 40 to 160 acres. In the 1929 Regional Plan of New York and Environs, urban planner Clarence Perry outlined a neighborhood center surrounded by civic uses, parks, residential uses, a school, and retail at the edge, all within one-quarter mile—about a 5-minute walk. This amounts to an area or pedestrian "shed" of 125 acres, or if the land area is a square, 160 acres. Although Perry's diagram does not address many of the sustainable features of LEED-ND, such as access to multimodal transportation options, location of infrastructure, and building form, it serves as a reference point for the mix of uses and walkable scale of neighborhood development encouraged in the rating system. Most people will walk approximately one-quarter mile (1,320 feet) to run daily errands; beyond that, many will take a bicycle or car. Additional research shows that people will walk as far as a half-mile (2,640 feet) to reach heavy rail transit systems or more specialized shops or civic uses.[8] Since half a square mile contains 320 acres, the core committee has decided that this size should serve as guidance for the upper limit of a LEED-ND project.

5 Lewis Mumford, "The Neighbourhood and the Neighbourhood Unit," *Town Planning Review* 24 (1954): 256-270, p. 258.
6 Charter of the Congress for the New Urbanism, www.cnu.org/charter, 1996.
7 Ibid
8 H. Dittmar and G. Ohland, eds., *The New Transit Town: Best Practices in Transit-Oriented Development* (Washington, D.C.: Island Press, 2004), p. 120.

Figure 1. Clarence Perry's Neighborhood Unit, 1929. Source: Regional Plan Association

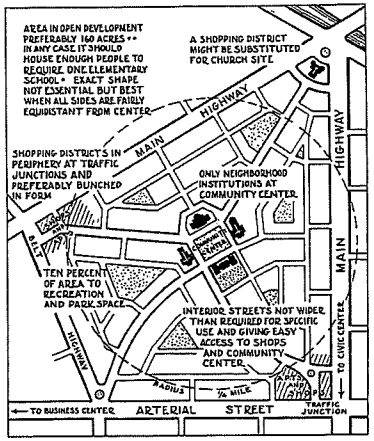
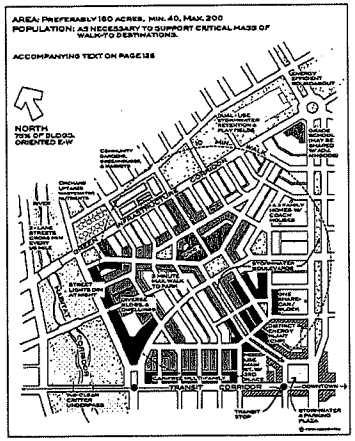


Figure 2. A "sustainable" update of Perry's neighborhood unit. Source: Douglas Farr, *Sustainable Urbanism*

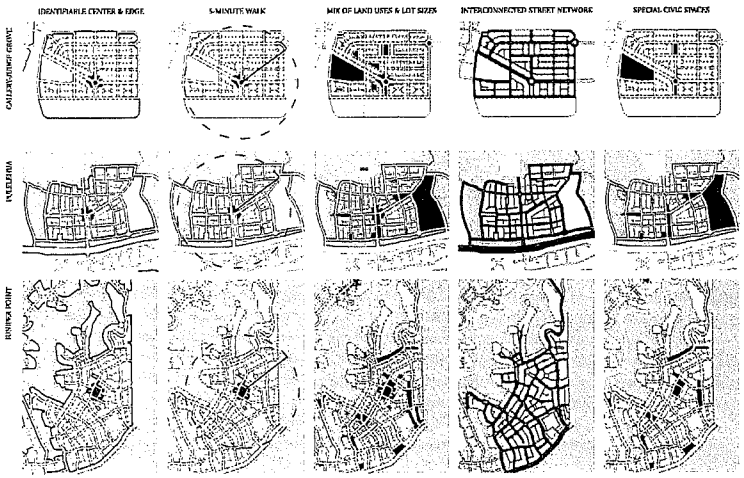


A neighborhood should have places where the public feels welcome and encouraged to congregate, recognizable as the heart of the community. A proper center has at least one outdoor public space for this purpose, designed with pedestrians in mind; this is the most well-defined outdoor "room" in the neighborhood. The best centers are within walking distance of the primarily residential areas, and typically some gradient in density is discernible from center to edge. The "center" need not be in the geographic center of the neighborhood; it can be along the edge, on an arterial or transit line. It is important for a neighborhood to have boundaries as well as a defined center, and this characteristic is often achieved through identifiable edges, either man-made or natural, such as adjacent farmland, parks, greenways, schools, major rights-of-way, or other uses.

When a neighborhood has a robust network of internal streets and good connections to surrounding communities, pedestrians, bicyclists, and drivers can move more efficiently and more safely. Multiple intersections and short blocks also give pedestrians a more interesting environment. The maximum average block perimeter to achieve an integrated network is 1,500 feet, with a maximum uninterrupted block face of ideally no more than 450 feet; intersecting streets are placed at intervals of 500 to 600 feet, and no greater than 800 feet apart along any single stretch.

The morphology of a sustainable neighborhood—the design of its blocks, streets, and buildings—can serve as the foundation of a walkable environment. Walkable streets have many features, and those elements deemed most important by the core committee are encouraged by the LEED-ND Rating System. These features, such as human-scaled buildings and street widths, wide sidewalks, buildings that are pulled up to the sidewalk to create a continuous street wall, retail storefronts and other uses, and interesting street furniture and trees, are meant to create a safe, inviting, and well-used public realm with visual interest. To keep loading docks, garage openings, and utilities away from sidewalks, neighborhoods with walkable streets often feature alleys.

Figure 3. Examples of neighborhood morphology. Source: Douglas Farr, *Sustainable Urbanism*



A mix of uses is often integral to the vitality of a neighborhood; the mix can include not only residential and commercial but also a variety of retail establishments, services, community facilities, and other kinds of "diverse uses," whether available within the neighborhood or adjacent. Urban theorist Ray Oldenburg would classify diverse uses as "Third Places"—small neighborhood grocers, coffee shops, pubs, or post offices that allow residents and workers to mingle and have social interactions. A mix of active and diverse retail uses on a walkable street can create a place that is alive day and night, and not closed down at 6 p.m.

Existing neighborhoods have the added benefit of historic buildings and events with cultural significance. Jane Jacobs argued that every neighborhood needed a mixture of newer and older buildings to allow for a variety of uses, income levels, and even ideas within the neighborhood.[9] New neighborhoods can bring some of the architectural diversity found in existing neighborhoods by including a mix of uses and housing types, each of which might need a different building type and design, thus generating visual interest. Finally, placing important civic buildings, such as churches, libraries, schools, or local government buildings at the termination of a street can create civic pride and also an interesting vista for pedestrians. With a focus on civic buildings and gathering places and the pedestrian experience in general, it is no surprise that walkable neighborhoods are often defined by the social interaction among people living and working near one another.

In conclusion, LEED for Neighborhood Development emphasizes the creation of compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities. In addition to neighborhood morphology, pedestrian scale, and mix of uses, the rating system also emphasizes the location of the neighborhood and the performance of the infrastructure and buildings within it. The sustainable benefits of a neighborhood increase when it offers proximity to transit and when residents and workers can safely travel by foot or bicycle to jobs, amenities,

9 Jane Jacobs, *The Death and Life of Great American Cities* (New York: Random House, 1961), p. 187.

and services. This can create a neighborhood with a high quality of life and healthy inhabitants. Likewise, green buildings can reduce energy and water use, and green infrastructure, such as landscaping and best practices to reduce stormwater runoff, can protect natural resources. Together, well-located and well-designed green neighborhood developments will play an integral role in reducing greenhouse gas emissions and improving quality of life.

Certification

To earn LEED certification, the applicant project must satisfy all the prerequisites and qualify for a minimum number of points to attain the project ratings listed below. Having satisfied the basic prerequisites of the program, applicant projects are then rated according to their degree of compliance within the rating system.

LEED for Neighborhood Development certifications are awarded according to the following scale:

Certified	40–49 points
Silver	50–59 points
Gold	60–79 points
Platinum	80 points and above

Stages of Certification

LEED for Neighborhood Development involves projects that may have significantly longer construction periods than single buildings, and as a result the standard LEED certification process has been modified. To provide developers of certifiable projects with conditional approval at an early stage, LEED 2009 for Neighborhood Development certification is divided into a three-stage process. A land-use entitlement, referred to below, is the existing or granted right to use property for specific types and quantities of residential and nonresidential land uses.

Stage 1. Conditional Approval of a LEED-ND Plan. This stage is optional for projects at any point before the entitlement process begins, or when no more than 50% of a project's total new and/or renovated building square footage has land-use entitlements to use property for the specific types and quantities of residential and nonresidential land uses proposed, either by right or through a local government regulatory change process. Projects with more than 50% of new and/or renovated square footage already entitled must complete the local entitlement process for 100% of new and/or renovated square footage and apply under Stage 2. If conditional approval of the plan is achieved, a letter will be issued stating that if the project is built as proposed, it will be eligible to achieve LEED for Neighborhood Development certification. The purpose of this letter is to help the developer build a case for entitlement among land-use planning authorities, as well as attract financing and occupant commitments.

Stage 2. Pre-Certified LEED-ND Plan. This stage is available after 100% of the project's total new and/or renovated building square footage has been fully entitled by public authorities with jurisdiction over the project. The project can also be under construction or partially completed, but no more than 75% of the total square footage can be constructed; projects that are more than 75% constructed must finish and use Stage 3. Any changes to the conditionally approved plan that could affect prerequisite or credit achievement must be communicated as part of this submission. If precertification of the plan is achieved, a certificate will be issued stating that the plan is a Pre-Certified LEED for Neighborhood Development Plan and it will be listed as such on the USGBC website.

Stage 3. LEED-ND Certified Neighborhood Development. This final step takes place when the project can submit documentation for all prerequisites and attempted credits, and when certificates of occupancy for buildings and acceptance of infrastructure have been issued by public authorities with jurisdiction over the project. Any changes to the Pre-Certified LEED-ND Plan that could affect prerequisite or credit achievement must be communicated as part of this submission. If certification of the completed neighborhood development is achieved, a plaque or similar award for public display at the project site will be isssued and it will be listed as certified on the USGBC website.

Since the location of a project cannot be changed, whereas its design and technologies can, a review is offered to determine a project's compliance with the Smart Location and Linkage (SLL) prerequisites and inform the team whether the location qualifies. If it does, a project team can proceed; if it doesn't, the team can end its participation in the program before investing more time. This optional review of the SLL prerequisites is available to projects in advance of a Stage 1, Stage 2, or Stage 3 application.

IV. EXEMPLARY PERFORMANCE

Exemplary performance strategies result in performance that greatly exceeds the performance level or expands the scope required by an existing credit. To earn an exemplary performance point, teams must meet the performance level defined by the next step in the threshold progression. For a credit with more than one compliance path, an Innovation and Design Process point can be earned by satisfying more than one compliance path if their benefits are additive.

The credits for which exemplary performance points are available are listed in the LEED Reference Guide for Green Neighborhood Development, 2009 Edition.

V. REGIONAL PRIORITY

To provide incentive to address geographically specific environmental issues, USGBC regional councils and chapters, the Congress for the New Urbanism chapters, and representatives of Smart Growth America's State and Local Caucus have identified 6 credits per rating system that are of particular importance to specific areas. Each Regional Priority credit is worth an additional 1 point, and a total of 4 additional points may be earned by achieving Regional Priority credits, with 1 point earned per credit. If the project achieves more than 4 Regional Priority credits, the team can choose the credits for which these points will apply. The USGBC website contains a searchable database of Regional Priority credits.

SMART LOCATION AND LINKAGE

SLL Prerequisite 1: Smart Location

Required

Intent

To encourage development within and near *existing* communities and public transit infrastructure. To encourage improvement and redevelopment of existing cities, suburbs, and towns while limiting the expansion of the *development footprint* in the region to appropriate circumstances. To reduce vehicle trips and *vehicle miles traveled* (VMT). To reduce the incidence of obesity, heart disease, and hypertension by encouraging daily physical activity associated with walking and bicycling.

Requirements

FOR ALL PROJECTS

Either (a) locate the *project* on a site served by existing *water and wastewater infrastructure* or (b) locate the project within a legally adopted, publicly owned, planned water and wastewater service area, and provide new water and wastewater infrastructure for the project.

AND

OPTION 1. Infill Sites

Locate the project on an *infill site*.

OR

OPTION 2. Adjacent Sites with Connectivity

Locate the project on an *adjacent site* (i.e., a site that is adjacent to *previously developed* land; see Definitions) where the *connectivity* of the site and adjacent land is at least 90 intersections/square mile as measured within a 1/2-mile distance of a continuous segment of the *project boundary*, equal to or greater than 25% of the project boundary, that is adjacent to previous development. Existing external and internal intersections may be counted if they were not constructed or funded by the project *developer* within the past ten years. Locate and/or design the project such that a through-*street* and/or nonmotorized right-of-way intersects the project boundary at least every 600 feet on average, and at least every 800 feet, connecting it with an existing street and/or right of way outside the project; nonmotorized rights-of-way may count for no more than 20% of the total. The exemptions listed in NPD Prerequisite 3, Connected and Open Community, do not apply to this option.

Figure 1. Adjacent and connected project site based on minimum 25% of perimeter adjacent to previously developed parcels and at least 90 eligible intersections per square mile within 1/2 mile of boundary segment adjacent to previous development

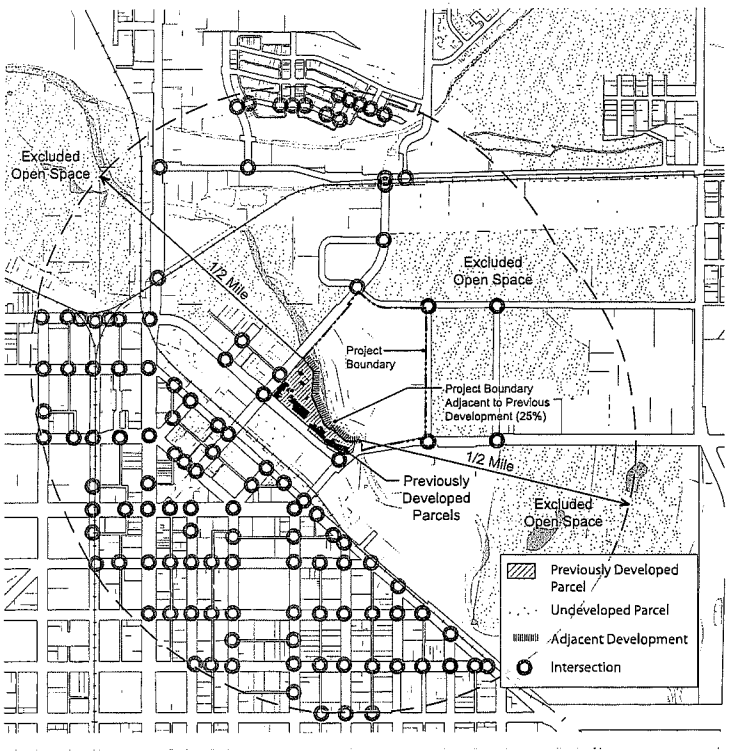
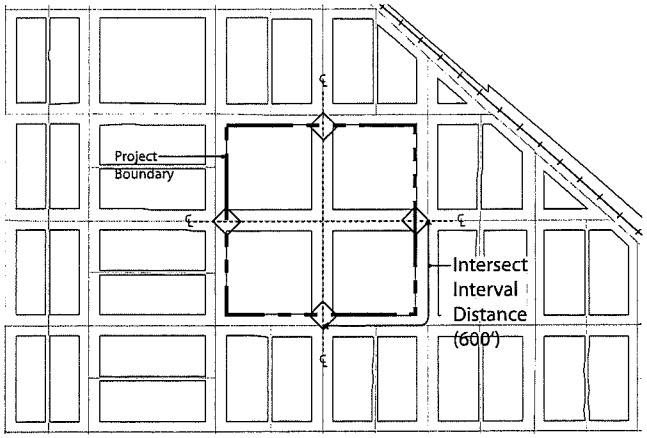


Figure 2. Project site with through-street right-of-way intersecting project boundary at least every 600 feet on average



OR

OPTION 3. Transit Corridor or Route with Adequate Transit Service

Locate the project on a site with existing and/or planned transit service such that at least 50% of *dwelling units* and nonresidential building entrances (inclusive of existing buildings) are within a 1/4 mile *walk distance* of bus and/or streetcar stops, or within a 1/2 mile walk distance of *bus rapid transit* stops, light or heavy rail stations, and/or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in Table 1 (both weekday and weekend trip minimums must be met).

Weekend trips must include service on both Saturday and Sunday. Commuter rail must serve more than one *metropolitan statistical area* (MSA) and/or the area surrounding the core of an MSA.

Table 1. Minimum daily transit service

	Weekday trips	Weekend trips
Projects with multiple transit types (bus, streetcar, rail, or ferry)	60	40
Projects with commuter rail or ferry service only	24	6

If transit service is planned but not yet operational, the project must demonstrate one of the following:

a. The relevant transit agency has a signed full funding grant agreement with the Federal Transit Administration that includes a revenue operations date for the start of transit service. The revenue operations date must be no later than the occupancy date of 50% of the project's total building square footage.

b. For bus, streetcar, bus rapid transit, or ferry service, the transit agency must certify that it has an approved budget that includes specifically allocated funds sufficient to provide the planned service at the levels listed above and that service at these levels will commence no later than occupancy of 50% of the project's total building square footage.

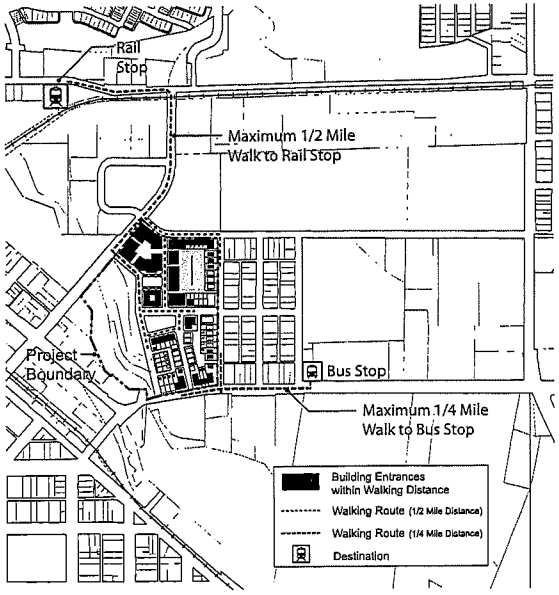
c. For rail service other than streetcars, the transit agency must certify that preliminary engineering for a rail line has commenced. In addition, the service must meet either of these two requirements:

- A state legislature or local subdivision of the state has authorized the transit agency to expend funds to establish rail transit service that will commence no later than occupancy of 50% of the project's total building square footage.

OR

- A municipality has dedicated funding or reimbursement commitments from future tax revenue for the development of stations, platforms, or other rail transit infrastructure that will service the project no later than occupancy of 50% of the project's total building square footage.

Figure 3. Walking routes on pedestrian network showing distances from dwellings and nonresidential uses to transit stops



OR

OPTION 4. Sites with Nearby Neighborhood Assets

Include a residential component equaling at least 30% of the project's total building square footage (exclusive of portions of parking structures devoted exclusively to parking), and locate the project near existing neighborhood shops, uses, and facilities ("diverse uses"; see Appendix) such that the project boundary is within 1/4-mile walk distance of at least five diverse uses, or such that the project's geographic center is within 1/2-mile walk distance of at least seven diverse uses. In either case the qualifying uses must include at least one food retail establishment and at least one use from each of two other categories, with the following limitations:

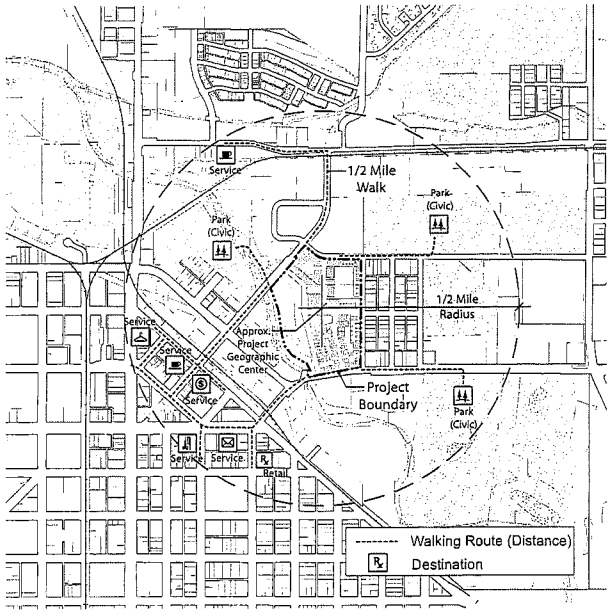
a. A single establishment may not be counted in two categories (e.g., a place of worship may be counted only once even if it also contains a daycare facility, and a retail store may be counted only once even if it sells products in several categories).

b. Establishments in a mixed-use building may each count if they are distinctly operated enterprises with

separate exterior entrances, but no more than half of the minimum number of diverse uses can be situated in a single building or under a common roof.

c. Only two establishments in a single category may be counted (e.g., if five restaurants are within the required distance, only two may be counted).

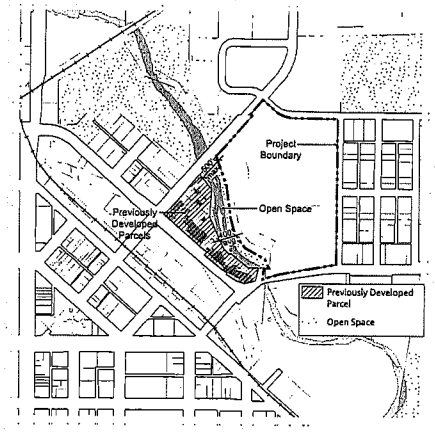
Figure 4. Walking routes on pedestrian network showing distances from dwellings and nonresidential uses to diverse use destinations



Key Definitions

adjacent site a site having at least 25% of its boundary bordering parcels that are each at least 75% *previously developed*. A *street* or other right-of-way does not constitute previously developed land; instead, it is the status of the property on the other side of the street or right-of-way that matters. Any fraction of the boundary that borders waterfront other than a stream is excluded from the calculation. A site is still considered adjacent if the 25% adjacent portion of its boundary is separated from previously developed parcels by undeveloped, permanently protected land averaging no more than 400 feet in width and no more than 500 feet in any one place. The undeveloped land must be permanently preserved as natural area, riparian corridor, *park*, greenway, agricultural land, or designated *cultural landscape*. Permanent pedestrian paths connecting the project through the protected parcels to the bordering site may be counted to meet the requirement of SLL Prerequisite 1, Option 2 (that the *project* be connected to the adjacent parcel by a through-street or nonmotorized right-of-way every 600 feet on average, provided the path or paths traverse the undeveloped land at no more than a 10% grade for walking by persons of all ages and physical abilities).

Adjacent project site based on minimum 25% of perimeter adjacent to previously developed parcels, including allowance for permanently protected land between project boundary and previously developed parcels



connectivity the number of publicly accessible *street* intersections per square mile, including intersections of streets with dedicated *alleys* and transit rights-of-way, and intersections of streets with nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to *culs-de-sac* are also not counted. The calculation of square mileage excludes *water bodies*, *parks* larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed*, and that in aggregate are at least 75% previously developed.

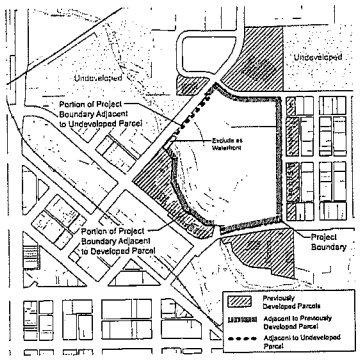
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

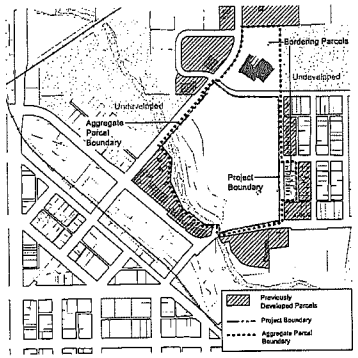
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

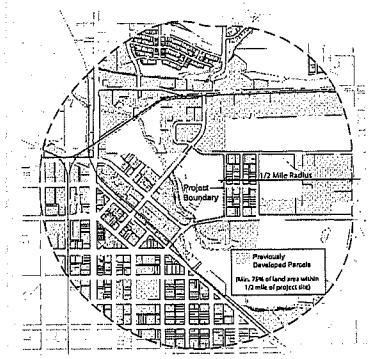
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



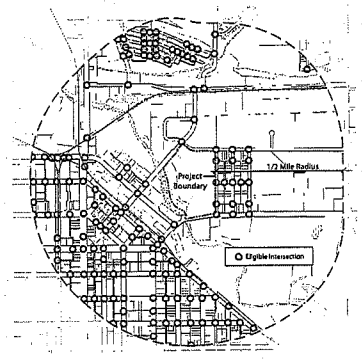
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed



(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

SLL Prerequisite 2: Imperiled Species and Ecological Communities Conservation

Required

Intent

To conserve imperiled species and ecological communities.

Requirements

FOR ALL PROJECTS

Consult with the state Natural Heritage Program and state fish and wildlife agencies to determine whether species listed as threatened or endangered under the federal Endangered Species Act, the state's endangered species act, or species or ecological communities classified by NatureServe as GH (possibly extinct), G1 (critically imperiled), or G2 (imperiled) have been or are likely to be found on the *project* site because of the presence of suitable habitat and nearby occurrences. If the consultations are inconclusive and site conditions indicate that imperiled species or ecological communities could be present, using a qualified biologist, perform biological surveys using accepted methodologies during appropriate seasons to determine whether such species or communities occur or are likely to occur on the site.

OPTION 1. Sites without Affected Species or Ecological Community

The prerequisite is satisfied if the consultation and any necessary biological surveys determine that no such imperiled species or ecological communities have been found or have a high likelihood of occurring.

OR

OPTION 2. Sites with Affected Species or Ecological Community: Habitat Conservation Plan

Comply with an approved habitat conservation plan under the Endangered Species Act for each identified species or ecological community.

OR

OPTION 3. Sites with Affected Species or Ecological Community: Habitat Conservation Plan Equivalent

Work with a qualified biologist, a nongovernmental conservation organization, or the appropriate state, regional, or local agency to create and implement a conservation plan that includes the following actions:

a. Identify and map the extent of the habitat and the appropriate buffer, not less than 100 feet, according to best available scientific information.

b. To the maximum extent practicable, protect the identified habitat and buffer in perpetuity by donating or selling the land or a conservation easement on the land to an accredited land trust or relevant public agency.

c. If on-site protection can be accomplished, analyze threats from development and develop a monitoring and management plan that eliminates or significantly reduces the threats.

d. If any portion of the identified habitat and buffer cannot be protected in perpetuity, quantify the effects by acres or number of plants and/or animals affected, and protect from development in perpetuity habitat of similar or better quality, on-site or off-site, by donating or selling a conservation easement on it to an accredited land trust or relevant public agency. The donation or easement must cover an amount of land equal to or larger than the area that cannot be protected.

SLL Prerequisite 3: Wetland and Water Body Conservation

Required

Intent

To preserve water quality, natural hydrology, habitat, and biodiversity through conservation of *wetlands* and *water bodies*.

Requirements

Limit development effects on wetlands, water bodies, and surrounding buffer land according to the requirements below.

OPTION 1. Sites with No Wetlands, Water Bodies, Land within 50 Feet of Wetlands, or Land within 100 Feet of Water Bodies

Locate the *project* on a site that includes no wetlands, no water bodies, no land within 50 feet of wetlands, and no land within 100 feet of water bodies.

OR

OPTION 2. Sites with Wetlands, Water Bodies, Land within 50 Feet of Wetlands, or Land within 100 Feet of Water Bodies

a. Locate the project such that *preproject* wetlands, water bodies, land within 50 feet of wetlands, and land within 100 feet of water bodies is not affected by new development, unless the development is minor improvements or is on *previously developed* land.

OR

b. Earn at least 1 point under GIB Credit 8, Stormwater Management, and limit any impacts beyond minor improvements to less than the percentage of buffer land listed in Table 1.

Table 1. Maximum allowable area of impacts within buffer zone, by density

Residential density (DU/acre)*	Nonresidential density (FAR)*	Percentage of buffer land** where impacts beyond minor improvements are allowed
> 25	> 1.75	≤ 20%
> 18 and ≤ 25	> 1.25 to ≤ 1.75	≤ 15%
> 10 and ≤ 18	> .75 to ≤ 1.25	≤ 10%
≤ 10	≤ .75	≤ 5%

DU = dwelling unit; FAR = floor-area ratio.

* For this option, a mixed-use project may use either its residential or its nonresidential *density* to determine the percentage of allowable impacts, regardless of which is higher.

** For this option, buffer width may vary as long as the total buffer area is equal to the area within 50 feet of wetlands and/or within 100 feet of water bodies, minus excluded features (see below). The minimum buffer width, however, is 25 feet for wetlands and 50 feet for water bodies, measured from the edge. In the minimum buffer, only minor improvements and/or improvements that result in no ecological impairment of the wetland or water body, as determined by a qualified biologist, are allowed.

AND

FOR ALL PROJECTS

Comply with all local, state, and federal regulations pertaining to wetland and water body conservation.

The following features are not considered wetlands, water bodies, or buffer land that must be protected for the purposes of this prerequisite:

a. Previously developed land.

b. Man-made water bodies (such as industrial mining pits, concrete-lined canals, or stormwater retention ponds) that lack natural edges and floors or native ecological communities in the water and along the edge.

c. Man-made linear wetlands that result from the interruption of natural drainages by *existing* rights-of-way.

d. Wetlands that were man-made incidentally and have been rated "poor" for all measured wetland functions. Wetland quality assessment must be performed by a qualified biologist using a method that is accepted by state or regional permitting agencies.

Minor improvements within the buffer may be undertaken to enhance appreciation for the wetland or water body, provided such facilities are open to public access. Only the following improvements are permitted:

a. Bicycle and pedestrian pathways no more than 12 feet wide, of which no more than 8 feet may be impervious.

b. Activities to maintain or restore native natural communities and/or natural hydrology.

c. One single-story structure not exceeding 500 square feet per 300 linear feet of buffer, on average.

d. Grade changes necessary to ensure public access.

e. Clearings, limited to one per 300 linear feet of buffer on average, not exceeding 500 square feet each, for tables, benches, and access for nonmotorized recreational watercraft. Off-street parking is not considered a minor improvement.

f. Removal of hazardous trees; up to 75% of dead trees; trees less than 6 inches diameter at breast height; trees under 40% condition rating; and up to 20% of trees more than 6 inches diameter at breast height with a condition rating of 40% or higher. The condition rating must be based on an assessment by an arborist certified by the International Society of Arboriculture (ISA) using ISA standard measures.

g. *Brownfield* remediation activities.

Direct impacts to wetlands and water bodies are prohibited, except for minimal-impact structures, such as an elevated boardwalk, that allow access to the water for educational and recreational purposes. Structures that protrude into wetlands or water bodies may be replaced, provided the replacement structure has the same or smaller footprint and a similar height.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

SLL Prerequisite 4: Agricultural Land Conservation

Required

Intent

To preserve irreplaceable agricultural resources by protecting prime and unique soils on farmland and forestland from development.

Requirements

FOR ALL PROJECTS

Locate the *project* on a site that is not within a state or locally designated agricultural preservation district, unless any changes made to the site conform to the requirements for development within the district (as used in this requirement, district does not equate to land-use zoning).

AND

OPTION 1. Protected Soils Not Impacted

Locate the project *development footprint* such that it does not disturb *prime soils*, *unique soils*, or soils of state significance as identified in a state Natural Resources Conservation Service soil survey.

OR

OPTION 2. Infill Sites

Locate the project on an *infill site*.

OR

OPTION 3. Sites Served by Transit

Comply with SLL Prerequisite 1, Option 3, Transit Corridor or Route with Adequate Transit Service.

OR

OPTION 4. Development Rights Receiving Area

Locate the project within a designated receiving area for development rights under a publicly administered farmland protection program that provides for the transfer of development rights from lands designated for conservation to lands designated for development.

OR

OPTION 5. Sites with Impacted Soils

If development footprint affects land with prime soils, unique soils, or soils of state significance, as identified in a state Natural Resources Conservation Service soil survey, mitigate the loss through the purchase of easements providing permanent protection from development on land with comparable soils in accordance with the ratios based on densities per acre of *buildable land* as listed in Tables 1 and 2.

Table 1. Mitigation ratios for projects in metropolitan or micropolitan statistical areas, pop. 250,000 or more

Residential density (DU per acre of buildable land available for residential use)	Nonresidential density (FAR of buildable land available for nonresidential use)	Mitigation ratio (acres of easement : acres of project on prime, unique, or significant soil)
> 7 and ≤ 8.5	> 0.50 and ≤ 0.67	2 to 1
> 8.5 and ≤ 10	> 0.67 and ≤ 0.75	1.5 to 1
> 10 and ≤ 11.5	> 0.75 and ≤ 0.87	1 to 1
> 11.5 and ≤ 13	> 0.87 and ≤ 1.0	.5 to 1
> 13	> 1.0	No mitigation

Table 2. Mitigation ratios for projects in metropolitan or micropolitan statistical areas, pop. less than 250,000

Residential density (DU/acre of buildable land available for residential use)	Nonresidential density (FAR of buildable land available for nonresidential use)	Mitigation ratio (acres of easement : acres of project on prime, unique, or significant soil)
> 7 and ≤ 8	> 0.50 and ≤ 0.58	2 to 1
> 8 and ≤ 9	> 0.58 and ≤ 0.67	1 to 1
> 9 and ≤ 10	> 0.67 and ≤ 0.75	0.5 to 1
> 10	> 0.75	No mitigation

DU = dwelling unit; FAR = floor-area ratio.

All off-site mitigation must be located within 100 miles of the project.

Up to 15% of the impacted soils area may be exempted from the *density* requirements if it is permanently dedicated for community gardens, and may also count toward the mitigation requirement for the remainder of the site. Portions of parking structures devoted exclusively to parking must be excluded from the numerator when calculating the *floor-area ratio* (FAR).

The mitigation ratio for a mixed-use project is calculated as follows:

1. Determine the total square footage of all residential and nonresidential uses.
2. Calculate the percentage residential and percentage nonresidential of the total square footage.
3. Determine the density of the residential and nonresidential components as measured in *dwelling units* per acre and FAR, respectively.
4. Referring to Tables 1 and 2, find the appropriate mitigation ratios for the residential and nonresidential components.
5. If the mitigation ratios are different, multiply the mitigation ratio of the residential component by its percentage of the total square footage, and multiply the mitigation ratio of the nonresidential component by its percentage.
6. Add the two numbers produced by Step 5. The result is the mitigation ratio.

Key Definitions

buildable land the portion of the site where construction can occur, including land voluntarily set aside and not constructed upon. When used in *density* calculations, buildable land excludes public rights-of-way and land excluded from development by codified law or LEED for Neighborhood Development prerequisites. An *applicant* may exclude additional land not exceeding 15% of the buildable land base defined above, provided the following conditions are present:

a. The land is protected from residential and nonresidential construction by easement, deed restriction, or other enforceable legal instrument.

AND

b. Either 25% or more of the boundary of each contiguous parcel proposed for exclusion borders a *water body* or areas outside the *project boundary* that are protected by codified law; or ownership of, or management authority over, the exclusion area is transferred to a public entity.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed*, and that in aggregate are at least 75% previously developed.

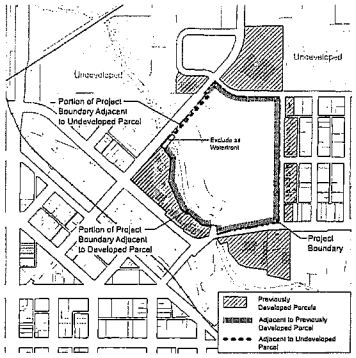
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

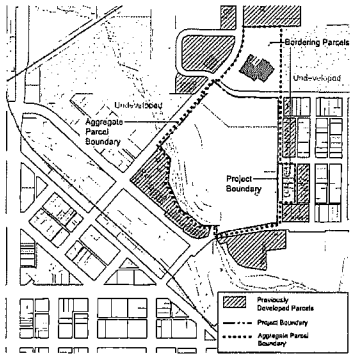
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

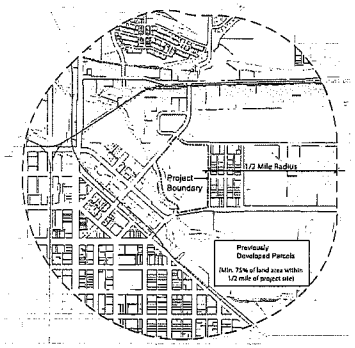
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



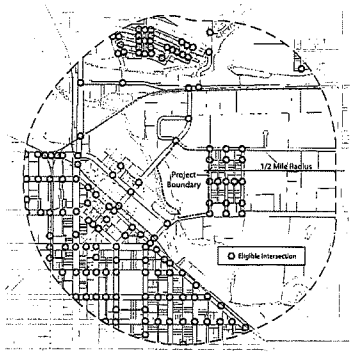
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed



(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



SLL Prerequisite 5: Floodplain Avoidance

Required

Intent

To protect life and property, promote open space and habitat conservation, and enhance water quality and natural hydrological systems.

Requirement

OPTION 1. Sites without Floodplains

Locate on a site that does not contain any land within a 100-year high- or moderate-risk floodplain as defined and mapped by the Federal Emergency Management Agency (FEMA) or a state or local floodplain management agency, whichever is more recent.

OR

OPTION 2. Infill or Previously Developed Sites with Floodplains

Locate the *project* on an *infill site* or a *previously developed site* or in a nonconveyance area of river or coastal floodplain without storm surge potential where compensatory storage is used in accordance with a FEMA-approved mitigation plan. Comply with the National Flood Insurance Program (NFIP) requirements for developing any portions of the site that lie within a 100-year high-or moderate-risk floodplain, as defined in Option 1. If the project includes construction of any critical facility, such as a hospital, water and sewage treatment facility, emergency center, or fire or police station, the critical facility must be designed and built so as to be protected and operable during a 500-year event, as defined by FEMA.

OR

OPTION 3. All Other Sites with Floodplains

If any part of the site is located within a 100-year high- or moderate-risk floodplain, as defined above, develop only on portions of the site that are not in the floodplain, or that have been previously developed, or that are in a nonconveyance area of river or coastal floodplain without storm surge potential where compensatory storage is used in accordance with a FEMA-approved mitigation plan. Previously developed portions in the floodplain must be developed according to NFIP requirements. If development includes construction of any critical facility, as described above, the critical facility must be designed and built so as to be protected and operable during a 500-year event, as defined by FEMA.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed*, and that in aggregate are at least 75% previously developed.

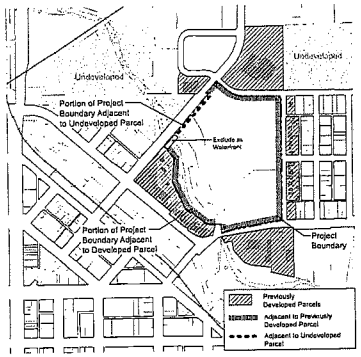
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

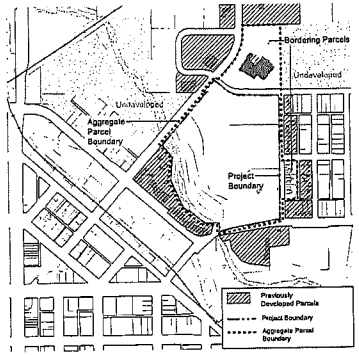
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

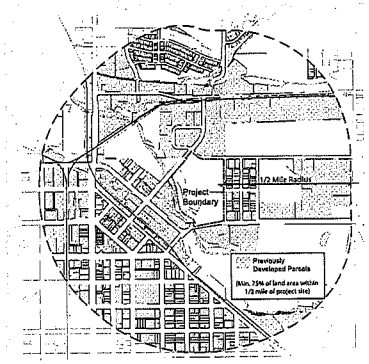
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



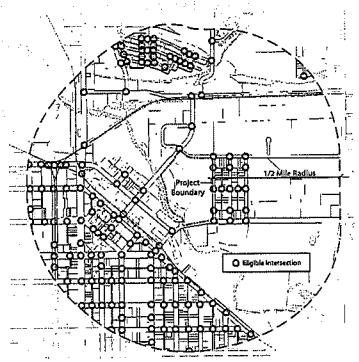
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed



(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



SLL Credit 1: Preferred Locations

1–10 points

Intent

To encourage development within *existing* cities, suburbs, and towns to reduce adverse environmental and public health effects associated with sprawl. To reduce development pressure beyond the limits of existing development. To conserve natural and financial resources required for construction and maintenance of infrastructure.

Requirements

Achieve any combination of requirements in the following three options:

OPTION 1. Location Type

Locate the *project* in one of the following locations:

a. A *previously developed site* that is not an *adjacent site* or *infill site* (1 point).

b. An adjacent site that is also a previously developed site (2 points).

c. An infill site that is not a previously developed site (3 points).

d. An infill site that is also a previously developed site (5 points).

AND/OR

OPTION 2. Connectivity

Locate the project in an area that has existing *connectivity* within 1/2 mile of the *project boundary*, as listed to Table 1.

Table 1. Points for connectivity within 1/2 mile of project

Intersections per square mile	Points
≥ 200 and < 250	1
≥ 250 and < 300	2
≥ 300 and < 350	3
≥ 350 and < 400	4
≥ 400	5

Intersections within the site may be counted if the intersections were not constructed or funded by the *developer* within the past ten years.

AND/OR

OPTION 3. Designated High-Priority Locations

Achieve the following (3 points):

- Earn at least 2 points under NPD Credit 4, Mixed-Income Diverse Communities, Option 2, Affordable Housing.

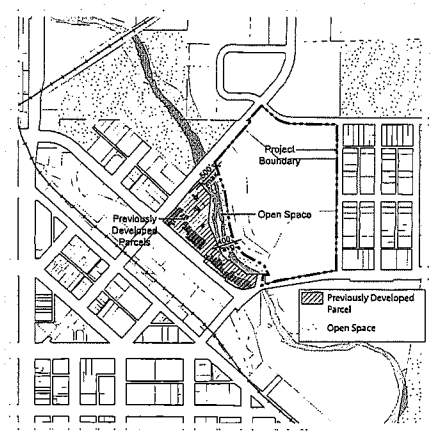
- In addition, locate the project in one of the following high-priority redevelopment areas: EPA National Priorities List, Federal Empowerment Zone, Federal Enterprise Community, Federal Renewal Community, Department of Justice Weed and Seed Strategy Community, Department of the Treasury Community Development Financial Institutions Fund Qualified Low-Income Community (a subset of the New Markets Tax Credit Program), or the U.S. Department of Housing and Urban Development's Qualified Census Tract (QCT) or Difficult Development Area (DDA).

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

adjacent site a site having at least 25% of its boundary bordering parcels that are each at least 75% *previously developed*. A *street* or other right-of-way does not constitute previously developed land; instead, it is the status of the property on the other side of the street or right-of-way that matters. Any fraction of the boundary that borders waterfront other than a stream is excluded from the calculation. A site is still considered adjacent if the 25% adjacent portion of its boundary is separated from previously developed parcels by undeveloped, permanently protected land averaging no more than 400 feet in width and no more than 500 feet in any one place. The undeveloped land must be permanently preserved as natural area, riparian corridor, *park*, greenway, agricultural land, or designated *cultural landscape*. Permanent pedestrian paths connecting the project through the protected parcels to the bordering site may be counted to meet the requirement of SLL Prerequisite 1, Option 2 (that the *project* be connected to the adjacent parcel by a through-street or nonmotorized right-of-way every 600 feet on average, provided the path or paths traverse the undeveloped land at no more than a 10% grade for walking by persons of all ages and physical abilities).

Adjacent project site based on minimum 25% of perimeter adjacent to previously developed parcels, including allowance for permanently protected land between project boundary and previously developed parcels



connectivity the number of publicly accessible *street* intersections per square mile, including intersections of streets with dedicated *alleys* and transit rights-of-way, and intersections of streets with nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to *culs-de-sac* are also not counted. The calculation of square mileage excludes *water bodies, parks* larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed,* and that in aggregate are at least 75% previously developed.

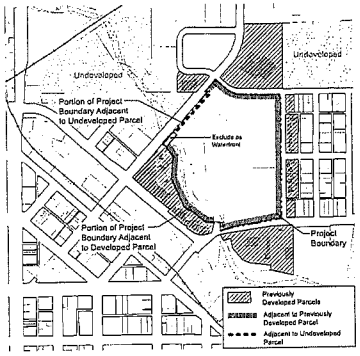
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

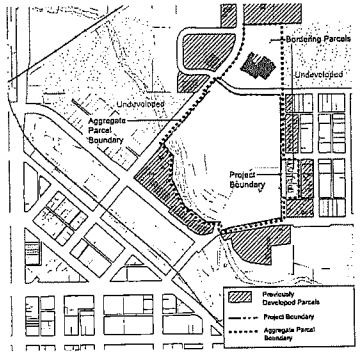
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

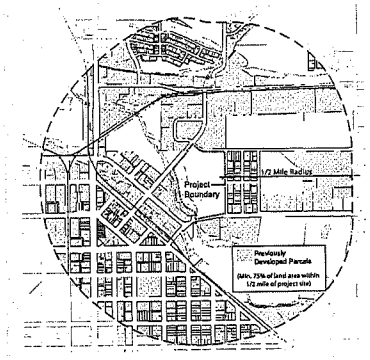
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



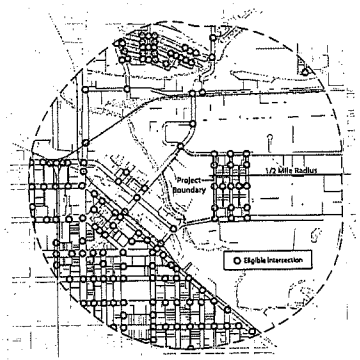
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed



(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



SLL Credit 2: Brownfields Redevelopment

1–2 points

Intent

To encourage the reuse of land by developing sites that are complicated by environmental contamination, thereby reducing pressure on undeveloped land.

Requirements

OPTION 1. Brownfield Sites (1 point)

Locate the *project* on a site, part or all of which is documented as contaminated (by means of an ASTM E1903-97 Phase II Environmental Site Assessment or a local Voluntary Cleanup Program), or on a site defined as a *brownfield* by a local, state, or federal government agency; and remediate site contamination such that the controlling public authority approves the protective measures and/or cleanup as effective, safe, and appropriate for the future use of the site.

OR

OPTION 2. High-Priority Redevelopment Areas (2 points)

Achieve the requirements in Option 1;

AND

Locate the project in one of the following high-priority redevelopment areas: EPA National Priorities List, Federal Empowerment Zone, Federal Enterprise Community, Federal Renewal Community, Department of Justice Weed and Seed Strategy Community, Department of the Treasury Community Development Financial Institutions Fund Qualified Low-Income Community (a subset of the New Markets Tax Credit Program), or the U.S. Department of Housing and Urban Development's Qualified Census Tract (QCT) or Difficult Development Area (DDA).

SLL Credit 3: Locations with Reduced Automobile Dependence

1–7 points

Intent

To encourage development in locations shown to have multimodal transportation choices or otherwise reduced motor vehicle use, thereby reducing greenhouse gas emissions, air pollution, and other adverse environmental and public health effects associated with motor vehicle use.

Requirements

OPTION 1. Transit-Served Location

Locate the *project* on a site with *existing* transit service such that at least 50% of *dwelling units* and nonresidential building entrances (inclusive of existing buildings) are within a 1/4-mile *walk distance* of bus or streetcar stops, or within a 1/2-mile walk distance of *bus rapid transit* stops, light or heavy rail stations, or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in Tables 1 and 2. Both weekday and weekend trip minimums must be met to earn points at a particular threshold.

Projects larger than 125 acres can meet the requirements by locating on a site with existing transit service such that at least 40% of dwelling units and nonresidential building entrances (inclusive of existing buildings) are within a 1/4-mile walk distance of bus or streetcar stops, or within a 1/2-mile walk distance of bus rapid transit stops, lightor heavy rail stations, or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in Tables 1 and 2 (both weekday and weekend trip minimums must be met to earn points at a particular threshold), as long as the 40% complies with NPD Prerequisite 2 and any portion of the project beyond the 1/4-mile and/or 1/2-mile walk distances meets SLL Prerequisite 1, Option 3-compliant planned transit service.

Projects greater than 500 acres can meet the requirements by locating on a site with existing transit service such that at least 30% of dwelling units and nonresidential building entrances (inclusive of existing buildings) are within a 1/4-mile walk distance of bus or streetcar stops, or within a 1/2-mile walk distance of bus rapid transit stops, light or heavy rail stations, or ferry terminals, and the transit service at those stops in aggregate meets the minimums listed in Tables 1 and 2 (both weekday and weekend trip minimums must be met to earn points at a particular threshold), as long as the 30% complies with NPD Prerequisite 2 and any portion of the project beyond the 1/4-mile and/or 1/2-mile walk distances meets SLL Prerequisite 1, Option 3-compliant planned transit service.

For all projects, weekend daily trips must include service on both Saturday and Sunday. Commuter rail must serve more than one *metropolitan statistical area* (MSA) and/or the area surrounding the core of an MSA.

Table 1. Minimum daily transit service for projects with multiple transit types (bus, streetcar, rail, or ferry)

Weekday trips	Weekend trips	Points
60	40	1
76	50	2
100	65	3
132	85	4
180	130	5
246	150	6
320	200	7

Table 2. Minimum daily transit service for projects with commuter rail or ferry service only

Weekday trips	Weekend trips	Points
24	6	1
40	8	2
60	12	3

Projects served by two or more transit routes such that no one route provides more than 60% of the prescribed levels may earn 1 bonus point, up to the maximum 7 points.

Projects where existing transit service is temporarily rerouted outside the required distances for less than 2 years may meet the requirements if the local transit agency has committed to restoring the compliant routes with service at or above the prior level.

OR

OPTION 2. Metropolitan Planning Organization Location with Low VMT

Locate the project within a region served by a metropolitan planning organization (MPO) and within a transportation analysis zone (TAZ) where either a) the current annual home-based vehicle miles traveled (VMT) per capita (if TAZ is 100% residential) or b) the annual non-home-based VMT per employee (if TAZ is 100% non-residential) does not exceed 90% of the average of the equivalent metropolitan region value. The research must be derived from household or employment transportation surveys conducted by the MPO within ten years of the date of submission for LEED for Neighborhood Development certification. Additional credit may be awarded for increasing levels of performance, as indicated in Table 3. Mixed-use TAZs must use whichever TAZ VMT is greater, either residential per capita or non-residential per employee.

Table 3. Points for low-VMT location

Percentage of average regional VMT per capita	Points
81–90%	1
71–80%	2
61–70%	3
51–60%	4
41–50%	5
31–40%	6
30 or less	7

VMT = vehicle miles traveled.

Points earned under Options 1 and 2 may not be combined.

SLL Credit 4: Bicycle Network and Storage

1 point

Intent

To promote bicycling and transportation efficiency, including reduced *vehicle miles traveled* (VMT). To support public health by encouraging utilitarian and recreational physical activity.

Requirements

BICYCLE NETWORK

Design and/or locate the *project* to meet at least one of the three requirements below:

a. An *existing bicycle network* of at least 5 continuous miles in length is within 1/4-mile bicycling distance of the *project boundary*.

b. If the project is 100% residential, an existing bicycle network begins within 1/4-mile bicycling distance of the project boundary and connects to a *school* or *employment center* within 3 miles' bicycling distance.

c. An existing bicycle network within 1/4-mile bicycling distance of the project boundary connects to at least ten diverse uses (see Appendix) within 3 miles' bicycling distance from the project boundary.

AND

BICYCLE STORAGE

Provide bicycle parking and storage capacity to new buildings as follows:

a. **Multiunit residential.** Provide at least one secure, enclosed bicycle storage space per occupant for 30% of the *planned occupancy* but no fewer than one per unit. Provide secure visitor bicycle racks on-site, with at least one bicycle space per ten *dwelling units* but no fewer than four spaces per project site.

b. **Retail.** Provide at least one secure, enclosed bicycle storage space per new retail worker for 10% of retail worker planned occupancy. Provide visitor or customer bicycle racks on-site, with at least one bicycle space per 5,000 square feet of retail space, but no fewer than one bicycle space per business or four bicycle spaces per project site, whichever is greater. Provide at least one on-site shower with changing facility for any development with 100 or more new workers and at least one additional on-site shower with changing facility for every 150 new workers thereafter.

c. **Nonresidential other than retail.** Provide at least one secure, enclosed bicycle storage space per new occupant for 10% of planned occupancy. Provide visitor bicycle racks on-site with at least one bicycle space per 10,000 square feet of new commercial nonretail space but not fewer than four bicycle spaces per building. Provide at least one on-site shower with changing facility for any development with 100 or more new workers and at least one additional on-site shower with changing facility for every 150 new workers thereafter.

Secure, enclosed bicycle storage areas must be locked and easily accessible to residents and/or workers. Provide informational signage on using the storage facilities.

Visitors' and customers' bicycle racks must be clearly visible from a main entry, located within 100 feet of the door, served with night lighting, and protected from damage from nearby vehicles. If the building has multiple main entries, bicycle racks must be proportionally dispersed within 100 feet of each.

Shower and changing facility requirements may be met by providing the equivalent of free access to on-site health club shower facilities, if the health club can be accessed without going outside. Provide informational signage on using the shower facilities.

SLL Credit 5: Housing and Jobs Proximity

1–3 points

Intent

To encourage balanced communities with a diversity of uses and employment opportunities.

Requirements

OPTION 1. Project with Affordable Residential Component (3 points)

Include a residential component equaling at least 30% of the *project*'s total building square footage (exclusive of parking structures), and locate and/or design the project such that the geographic center (or boundary if the project exceeds 500 acres) is within 1/2-mile *walk distance* of *existing* full-time-equivalent jobs whose number is equal to or greater than the number of *dwelling units* in the project; and satisfy the requirements necessary to earn at least one point under NPD Credit 4, Mixed-Income Diverse Communities, Option 2, Affordable Housing.

OR

OPTION 2. Project With Residential Component (2 points)

Include a residential component equaling at least 30% of the project's total building square footage (exclusive of parking structures), and locate and/or design the project such that the geographic center (or boundary if the project exceeds 500 acres) is within 1/2-mile walk distance of existing full-time-equivalent jobs whose number is equal to or greater than the number of dwelling units in the project.

OR

OPTION 3. Infill Project with Nonresidential Component (1 point)

Include a nonresidential component equaling at least 30% of the project's total building square footage (exclusive of parking structures), and locate on an *infill site* whose geographic center (or boundary if the project exceeds 500 acres) is within 1/2-mile walk distance of an existing rail transit, ferry, or tram stop and within 1/2-mile walk distance of existing dwelling units whose number is equal to or greater than 50% of the number of new full-time-equivalent jobs created as part of the project.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed*, and that in aggregate are at least 75% previously developed.

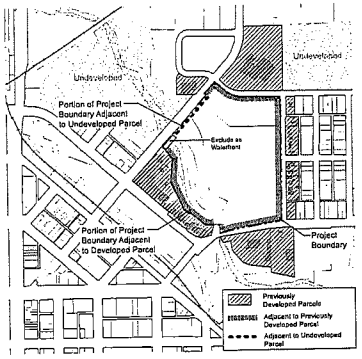
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

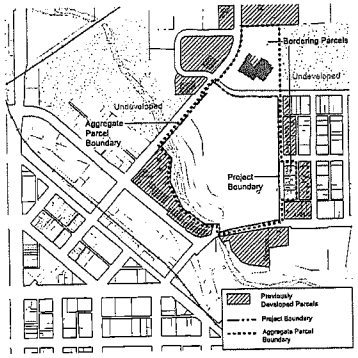
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

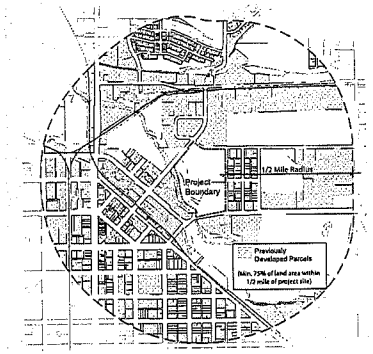
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



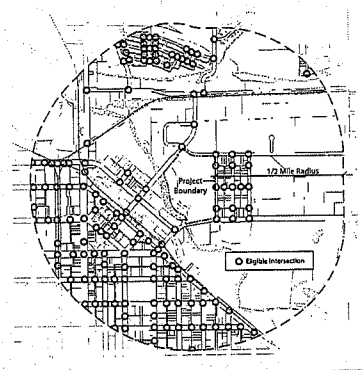
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed



(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



SLL Credit 6: Steep Slope Protection

1 point

Intent

To minimize erosion to protect habitat and reduce stress on natural water systems by preserving steep slopes in a natural, vegetated state.

Requirements

FOR ALL PROJECTS

All options apply to *existing* natural or constructed slopes. Portions of *project* sites with slopes up to 20 feet in elevation, measured from toe (a distinct break between a 40% slope and lesser slopes) to top, that are more than 30 feet in any direction from another slope greater than 15% are exempt from the requirements, although more restrictive local regulations may apply.

OPTION 1. No Disturbance of Slopes Over 15%

Locate on a site that has no existing slopes greater than 15%, or avoid disturbing portions of the site that have existing slopes greater than 15%.

OR

OPTION 2. Previously Developed Sites with Slopes Over 15%

On portions of *previously developed sites* with existing slopes greater than 15%, restore the slope area with *native plants* or noninvasive *adapted plants* according to Table 1.

Table 1. Required restoration area of slope

Slope	Restoration
> 40%	100%
26% to 40%	60%
< 15% to 25%	40%

In addition, develop *covenants, conditions, and restrictions* (CC&R); development agreements; or other binding documents that will protect the specified steep slope areas in perpetuity. Comply with the requirements of Option 3 on any slope over 15% that has not been previously developed.

OR

OPTION 3. Sites Other than Previously Developed Sites with Slopes Over 15%

On sites that are not previously developed sites, protect existing slopes over 15% as follows:

a. Do not disturb slopes greater than 40% and do not disturb portions of the project site within 50 feet horizontally of the top of the slope and 75 feet horizontally from the toe of the slope.

b. Limit development to no more than 40% of slopes between 25% and 40% and to no more than 60% of slopes between 15% and 25%.

c. Locate development such that the percentage of the *development footprint* that is on existing slopes less than 15% is greater than the percentage of *buildable land* that has existing slopes less than 15%.

d. Develop CC&R, development agreements, or other binding documents that will protect steep slopes in perpetuity.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

buildable land the portion of the site where construction can occur, including land voluntarily set aside and not constructed upon. When used in *density* calculations, buildable land excludes public rights-of-way and land excluded from development by codified law or LEED for Neighborhood Development prerequisites. An *applicant* may exclude additional land not exceeding 15% of the buildable land base defined above, provided the following conditions are present:

a. The land is protected from residential and nonresidential construction by easement, deed restriction, or other enforceable legal instrument.

AND

b. Either 25% or more of the boundary of each contiguous parcel proposed for exclusion borders a *water body* or areas outside the *project boundary* that are protected by codified law; or ownership of, or management authority over, the exclusion area is transferred to a public entity.

SLL Credit 7: Site Design for Habitat or Wetland and Water Body Conservation

1 point

Intent

To conserve *native plants*, wildlife habitat, *wetlands*, and *water bodies*.

Requirements

OPTION 1. Sites without Significant Habitat or Wetlands and Water Bodies

Locate the *project* on a site that does not have significant habitat, as defined in Option 2 of this credit, or land within 100 feet of such habitat, and fulfill the requirements of Options 1 or 2(a) under SLL Prerequisite 3, Wetland and Water Body Conservation.

OR

OPTION 2. Sites with Significant Habitat

Work with both the state's Natural Heritage Program and the state fish and wildlife agency to delineate identified significant habitat on the site. Do not disturb significant habitat or portions of the site within an appropriate buffer around the habitat. The geographic extent of the habitat and buffer must be identified by a qualified biologist, a nongovernmental conservation organization, or the appropriate state or regional agency. Protect significant habitat and its identified buffers from development in perpetuity by donating or selling the land, or a conservation easement on the land, to an accredited land trust or relevant public agency (a deed covenant is not sufficient to meet this requirement). Identify and commit to ongoing management activities, along with parties responsible for management and funding available, so that habitat is maintained in *preproject* condition or better for a minimum of three years after the project is built out. The requirement for identifying ongoing management activities may also be met by earning SLL Credit 9, Long-Term Conservation Management of Wetlands and Water Bodies.

Significant habitat for this credit includes the following:

a. Habitat for species that are listed or are candidates for listing under state or federal endangered species acts, habitat for species of special concern in the state, and/or habitat for those species and/or ecological communities classified as GH, G1, G2, G3, and/or S1 and S2 species by NatureServe.

b. Locally or regionally significant habitat of any size, or patches of predominantly native vegetation at least 150 acres (even if some of the 150 acres lies outside the *project boundary*).

c. Habitat flagged for conservation under a regional or state conservation or green infrastructure plan.

OR

OPTION 3. Sites with Wetlands and Water Bodies

Design the project to conserve 100% of all water bodies, wetlands, land within 100 feet of water bodies, and land within 50 feet of wetlands on the site. Using a qualified biologist, conduct an assessment, or compile *existing* assessments, showing the extent to which those water bodies and/or wetlands perform the following functions: (1) water quality maintenance, (2) wildlife habitat protection, and (3) hydrologic function maintenance, including flood protection. Assign appropriate buffers (not less than 100 feet for water bodies and 50 feet for wetlands) based on the functions provided, contiguous soils and slopes, and contiguous land uses. Do not disturb wetlands, water bodies, and their buffers, and protect them from development in perpetuity by donating or selling the land, or a conservation easement on the land, to an accredited land trust or relevant public agency (a deed covenant is not sufficient to meet this requirement). Identify and commit to ongoing management activities, along with parties responsible for management and funding available, so that habitat is maintained in preproject condition or better for a minimum of three years after the project is built out. The requirement for identifying ongoing management activities may also be met by earning SLL Credit 9, Long-Term Conservation Management of Wetlands and Water Bodies. The project does not meet the requirements if it has negative effects on habitat for species identified in Option 2(a).

FOR ALL PROJECTS

The following features are not considered wetlands, water bodies, or buffer land that must be protected:

a. *Previously developed* land.

b. Man-made water bodies (such as industrial mining pits, concrete-lined canals, or stormwater retention ponds) that lack natural edges and floors or native ecological communities in the water and along the edge

c. Man-made linear wetlands that result from the interruption of natural drainages by existing rights-of-way.

d. Wetlands that were created incidentally by human activity and have been rated "poor" for all measured wetland functions. Wetland quality assessment must be performed by a qualified biologist using a method that is accepted by state or regional permitting agencies.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

SLL Credit 8: Restoration of Habitat or Wetlands and Water Bodies

1 point

Intent

To restore *native plants*, wildlife habitat, *wetlands*, and *water bodies* that have been harmed by previous human activities.

Requirements

Using only native plants, restore *predevelopment* native ecological communities, water bodies, or wetlands on the *project* site in an area equal to or greater than 10% of the *development footprint*. Work with a qualified biologist to ensure that restored areas will have the native species assemblages, hydrology, and other habitat characteristics that likely occurred in predevelopment conditions. Protect such areas from development in perpetuity by donating or selling the land, or a conservation easement on the land, to an accredited land trust or relevant public agency (a deed covenant is not sufficient to meet this requirement). Identify and commit to ongoing management activities, along with parties responsible for management and funding available, so that restored areas are maintained for a minimum of three years after the project is built out or the restoration is completed, whichever is later. The requirement for identifying ongoing management activities may also be met by earning SLL Credit 9, Long-Term Conservation Management of Wetlands and Water Bodies. The project does not meet the requirements if it has negative effects on habitat for species identified in Option 2(a) of SLL Credit 7, Site Design for Habitat or Wetland and Water Body Conservation.

SLL Credit 9: Long-Term Conservation Management of Habitat or Wetlands and Water Bodies

1 point

Intent

To conserve *native plants*, wildlife habitat, *wetlands*, and *water bodies*.

Requirements

Create and commit to implementing a long-term (at least ten-year) management plan for new or *existing* on-site native habitats, water bodies, and/or wetlands and their buffers, and create a guaranteed funding source for management. Involve a qualified biologist or a professional from a natural resources agency or natural resources consulting firm in writing the management plan and conducting or evaluating the ongoing management. The plan must include biological objectives consistent with habitat and/or water resource conservation, and it must identify (1) procedures, including personnel to carry them out, for maintaining the conservation areas; (2) estimated implementation costs and funding sources; and (3) threats that the *project* poses for habitat and/or water resources within conservation areas (e.g., introduction of exotic species, intrusion of residents in habitat areas) and measures to substantially reduce those threats. The project does not meet the requirements if it has negative effects on habitat for species identified in Option 2(a) of SLL Credit 7, Site Design for Habitat or Wetland and Water Body Conservation.

NEIGHBORHOOD PATTERN AND DESIGN

NPD Prerequisite 1: Walkable Streets

Required

Intent

To promote transportation efficiency, including reduced *vehicle miles traveled* (VMT). To promote walking by providing safe, appealing, and comfortable *street* environments that support public health by reducing pedestrian injuries and encouraging daily physical activity.

Requirements

Design and build the *project* to achieve all of the following:

a. For 90% of new building frontage, a principal *functional entry* on the front façade faces a public space, such as a street, square, *park*, *paseo*, or *plaza*, but not a parking lot, and is connected to sidewalks or equivalent provisions for walking. The square, park, or plaza must be at least 50 feet wide at a point perpendicular to each entry.

b. At least 15% of *existing* and new street frontage within and bordering the project has a minimum building-height-to-street-width ratio of 1:3 (i.e., a minimum of 1 foot of building height for every 3 feet of street width).

- Nonmotorized rights-of-way may be counted toward the 15% requirement, but 100% of such spaces must have a minimum building-height-to-street-width ratio of 1:1.
- Projects with bordering street frontage must meet only their proportional share of the height-to-width ratio (i.e., only on the project side of the street).
- Street frontage is measured in linear feet.
- Building height is measured to eaves or the top of the roof for a flat-roof structure, and street width is measured façade to façade. For building frontages with multiple heights, use the weighted average height of all frontage segments based on each segment's height weighted by the segment's share of total building width.
- *Alleys* and driveways are excluded.

c. Continuous sidewalks or equivalent all-weather provisions for walking are provided along both sides of 90% of streets or frontage within the project, including the project side of streets bordering the project. New sidewalks, whether adjacent to streets or not, must be at least 8 feet wide on retail or mixed-use blocks and at least 4 feet wide on all other blocks. Equivalent provisions for walking include *woonerfs* and all-weather-surface footpaths. Alleys, driveways, and reconstructed existing sidewalks are excluded from these calculations.

d. No more than 20% of the street frontages within the project are faced directly by garage and service bay openings.

Projects in a designated *historic district* subject to review by a local historic preservation entity are exempt from (b), (c), and (d) if approval for compliance is not granted by the review body. Projects in historic districts listed in or eligible for listing in a state register or the National Register of Historic Places that are subject to review by a state historic preservation office or the National Park Service are exempt from (b), (c), and (d) if approval for compliance is not granted. If the public space is a square, park, or plaza, it must be at least 50 feet deep, measured at a point perpendicular to each entry.

NPD Prerequisite 2: Compact Development

Required

Intent

To conserve land. To promote livability, walkability, and transportation efficiency, including reduced *vehicle miles traveled* (VMT). To leverage and support transit investments. To reduce public health risks by encouraging daily physical activity associated with walking and bicycling.

Requirements

OPTION 1. Projects in Transit Corridors

For *projects* with *existing* and/or planned transit service (i.e., service with the funding commitments specified in SLL Prerequisite 1, Smart Location) that meets or exceeds the 2-point threshold in SLL Credit 3, Locations with Reduced Automobile Dependence, Option 1, build at the following densities, based on the *walk distances* to the transit service specified in SLL Credit 3:

a. For residential components located within the walk distances: 12 or more *dwelling units* per acre of buildable land available for residential uses.

b. For residential components falling outside the walk distances: 7 or more dwelling units per acre of buildable land available for residential uses.

c. For nonresidential components located within the walk distances: 0.80 *floor-area ratio* (FAR) or greater of buildable land available for nonresidential uses.

d. or nonresidential components falling outside the walk distances: 0.50 FAR or greater of buildable land available for nonresidential uses.

If the project location is served by a transit agency that has specified guidelines for minimum service densities that are greater than the densities required by this prerequisite, the project must achieve those service densities instead.

OR

OPTION 2. All Other Projects

Build any residential components of the project at a *density* of 7 dwelling units per acre of *buildable land* available for residential uses.

AND

Build any nonresidential components of the project at a density of 0.50 FAR or greater of buildable land available for nonresidential uses.

FOR ALL PROJECTS

Density calculations include all planned and existing buildings within the *project boundary*, excluding those portions of parking structures devoted exclusively to parking.

The specified density must be achieved within five years of the date that the first building of any type is occupied.

If one component of the project, residential or nonresidential, meets the minimum density requirement but the other component does not, include only the qualifying density. Use that component's dwelling units or nonresidential floor area in the numerator and the total buildable land area in the denominator. If the resulting density meets the minimum requirement, the prerequisite is achieved.

NPD Prerequisite 3: Connected and Open Community

Required

Intent

To promote *projects* that have high levels of internal *connectivity* and are well connected to the community at large. To encourage development within *existing* communities that promote transportation efficiency through multimodal transportation. To improve public health by encouraging daily physical activity.

Requirements

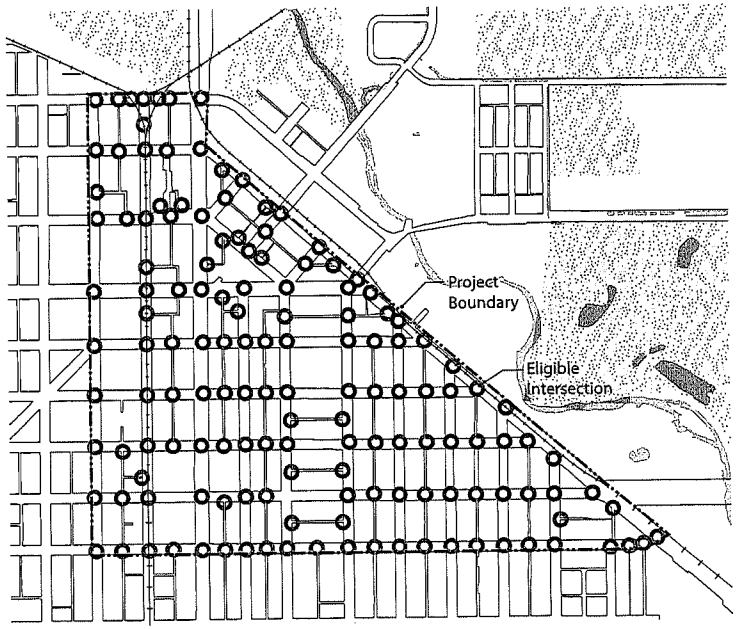
OPTION 1. Projects with Internal Streets

Design and build the project such that its internal connectivity is at least 140 intersections per square mile. All *streets* and sidewalks that are counted toward the connectivity requirement must be available for general public use and not gated. Gated areas are not considered available for public use, with the exception of education and health care campuses and military bases where gates are used for security purposes.

AND

Design and build the project with at least one through-street and/or nonmotorized right-of-way intersecting or terminating at the *project boundary* at least every 800 feet, or at existing abutting street intervals and intersections, whichever is the shorter distance. Nonmotorized rights-of-way may count for no more than 20% of the total. This does not apply to portions of the boundary where connections cannot be made because of physical obstacles, such as prior platting of property, construction of existing buildings or other barriers, slopes over 15%, *wetlands* and *water bodies*, railroad and utility rights-of-way, existing limited-access motor vehicle rights-of-way, and parks and dedicated open space.

Figure 1. Project site design with 140 eligible intersections per square mile on streets that are not gated

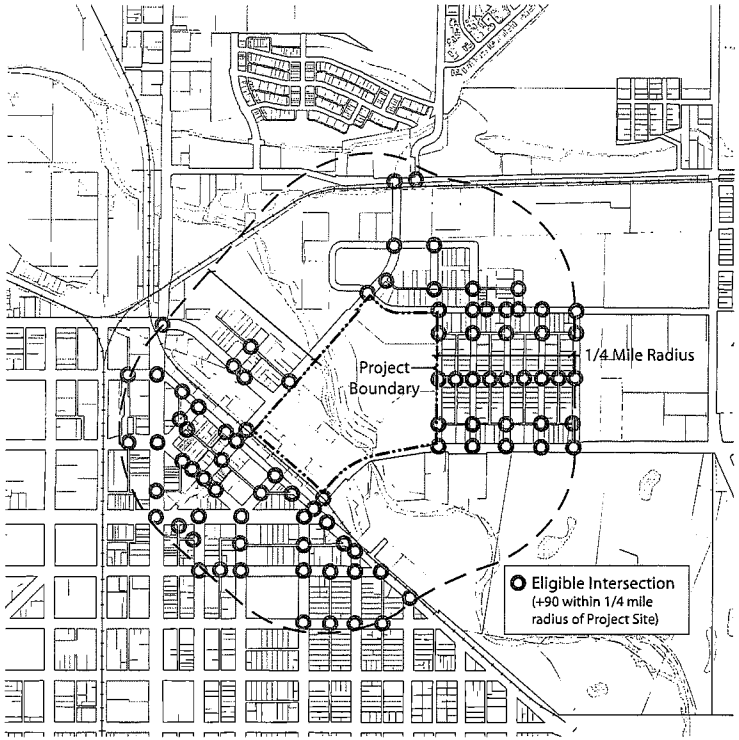


OR

OPTION 2. Projects without Internal Streets

Locate the project such that the connectivity of the existing streets within 1/4 mile of the project boundary is at least 90 intersections per square mile. All streets and sidewalks that are counted toward the connectivity requirement must be available for general public use and not gated. Gated areas are not considered available for public use, with the exception of education and health care campuses and military bases where gates are used for security purposes.

Figure 2. Project site with at least 90 eligible intersections per square mile within 1/4 mile of project boundary



Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

connectivity the number of publicly accessible *street* intersections per square mile, including intersections of streets with dedicated *alleys* and transit rights-of-way, and intersections of streets with nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to *culs-de-sac* are also not counted. The calculation of square mileage excludes *water bodies*, *parks* larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

NPD Credit 1: Walkable Streets

1–12 points

Intent

To promote transportation efficiency, including reduced *vehicle miles traveled* (VMT). To promote walking by providing safe, appealing, and comfortable *street* environments that support public health by reducing pedestrian injuries and encouraging daily physical activity.

Requirements

A *project* may earn a maximum of 12 points according to the schedule in Table 1:

Table 1. Points for walkable street features

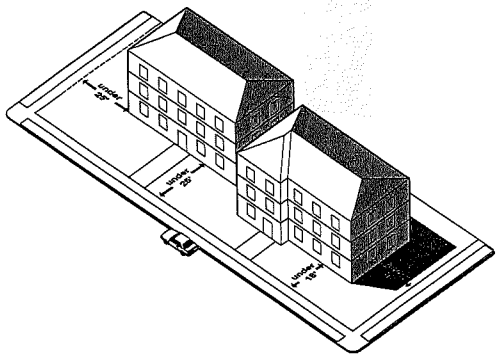
Items achieved	Points
2–3	1
4–5	2
6–7	3
8–9	4
10	7
11	8
12	9
13	10
14	11
15–16	12

Façades and Entries

a. At least 80% of the total linear feet of street-facing building façades in the project is no more than 25 feet from the property line.

b. At least 50% of the total linear feet of street-facing building façades in the project is no more than 18 feet from the property line.

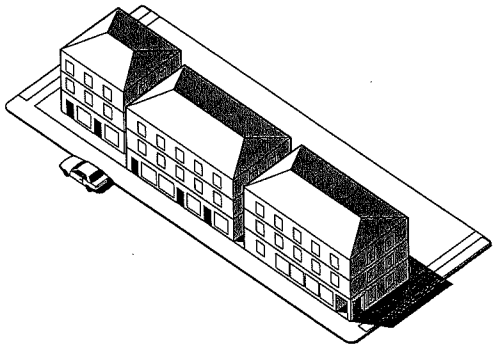
Figure 1. Minimal street-facing building façade setbacks



c. At least 50% of the total linear feet of mixed-use and nonresidential street-facing building façades in the project is within 1 foot of a sidewalk or equivalent provision for walking.

d. *Functional entries* to the building occur at an average of 75 feet or less along nonresidential or mixed-use buildings or *blocks*.

Figure 2. Functional building entries at minimum average distances along blocks



e. Functional entries to the building occur at an average of 30 feet or less along nonresidential or mixed-use buildings or blocks (items d and e are cumulative).

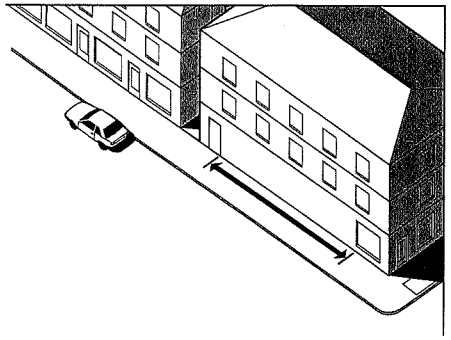
Ground-Level Use and Parking

f. All ground-level retail, service, and trade uses that face a public space have clear glass on at least 60% of their façades between 3 and 8 feet above grade.

Figure 3. Ground-level retail and service uses with minimum amounts of clear glass façades

g. If a façade extends along a sidewalk, no more than 40% of its length or 50 feet, whichever is less, is blank (without doors or windows).

Figure 4. Limits on length of blank walls along sidewalks

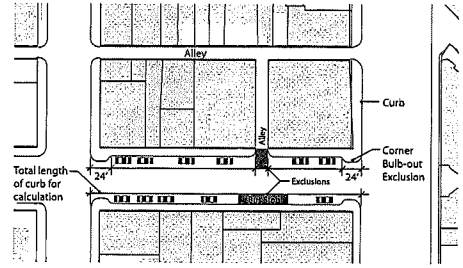


h. Any ground-level retail, service, or trade windows must be kept visible (unshuttered) at night; this must be stipulated in *covenants, conditions, and restrictions* (CC&R) or other binding documents.

i. On-street parking is provided on a minimum of 70% of both sides of all new and *existing* streets, including the project side of bordering streets. The percentage of on-street parking is calculated by dividing the length of

street designated for parking by the total length of the curb along each street, including curb cuts, driveways, and intersection radii. Space within the parking lane that is occupied by corner bulb-outs (within 24 feet of an intersection), transit stops, and motorcycle or bicycle parking may be counted as designated for parking in this calculation. *Woonerfs* are not considered streets for this subsection.

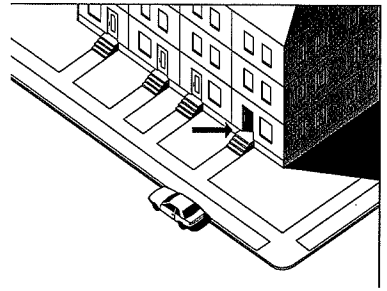
Figure 5. On-street parking requirements



j. Continuous sidewalks or equivalent provisions for walking are available along both sides of all streets within the project, including the project side of streets bordering the project. New sidewalks, whether adjacent to streets or not, must be at least 10 feet wide on retail or mixed-use blocks and at least 5 feet wide on all other blocks. Equivalent provisions for walking include woonerfs and all-weather-surface footpaths at least 5 feet wide. Note that these requirements specify wider sidewalks than required by NPD Prerequisite 1, Walkable Streets.

k. If the project has ground-floor *dwelling units*, the principal floor of at least 50% of those units must have an elevated finished floor no less than 24 inches above the sidewalk grade. Below-grade basement spaces and/or *accessory dwelling units* are exempt from this requirement.

Figure 6. Minimal above-grade entrance requirements



l. In nonresidential or mixed-use projects, 50% or more of the total number of office buildings include ground-floor retail along 60% of the length of the street-level façade; 100% of mixed-use buildings include ground-floor retail, live-work spaces, and/or ground-floor dwelling units along at least 60% of the street-level façade; and all businesses and/or other community services on the ground floor are accessible directly from sidewalks along a public space, such as a street, square, paseo, or plaza, but not a parking lot.

m. At least 40% of all street frontage within the project has a minimum building-height-to-street-width ratio of 1:3 (i.e., a minimum of 1 foot of building height for every 3 feet of street width).

- Nonmotorized rights-of-way may be counted toward the 40% requirement, but 100% of such spaces must have a minimum 1:1 ratio of building height to street width.
- Projects with bordering street frontage must meet only their proportional share of the height-to-width ratio (i.e., only on the project side of the street).
- Street frontage is measured in linear feet.
- Building height is measured to eaves or the top of the roof for a flat-roof structure, and street width is measured façade to façade. For building frontages with multiple heights, use the weighted average height of all frontage segments based on each segment's height weighted by the segment's share of total building width.
- *Alleys* and driveways are excluded.

Design Speeds for Safe Pedestrian and Bicycle Travel

n. 75% of residential-only streets within the project are designed for a target speed of no more than 20 mph (existing streets may be exempted from calculations).

o. 70% of nonresidential and/or mixed-use streets within the project are designed for a target speed of no more than 25 mph. A multiway boulevard, with travel lanes separated from access lanes by medians, may apply this requirement to its outer access lanes only (through-lanes are exempt), provided pedestrian crosswalks are installed across the boulevard at intervals no greater than 800 feet (existing streets may be exempted from calculations).

Sidewalk Intrusions

p. At-grade crossings with driveways account for no more than 10% of the length of sidewalks within the project.

NPD Credit 2: Compact Development

1–6 points

Intent

To encourage development in *existing* areas to conserve land and protect farmland and wildlife habitat. To promote livability, walkability, and transportation efficiency, including reduced *vehicle miles traveled* (VMT). To improve public health encouraging daily physical activity associated with alternative modes of transportation and compact development.

Requirements

Design and build the *project* such that residential and nonresidential components achieve the *densities* per acre of *buildable land* listed in Table 1 (excluding those portions of parking structures devoted to parking).

Table 1. Points for density per acre of buildable land

Residential density (DU/acre)	Nonresidential density (FAR)	Points
> 10 and ≤ 13	> 0.75 and ≤ 1.0	1
> 13 and ≤ 18	> 1.0 and ≤ 1.25	2
> 18 and ≤ 25	> 1.25 and ≤ 1.75	3
> 25 and ≤ 38	> 1.75 and ≤ 2.25	4
> 38 and ≤ 63	> 2.25 and ≤ 3.0	5
> 63	> 3.0	6

DU = dwelling unit; FAR = floor-area ratio.

The specified densities must be achieved within five years of the date that the first building of any type is occupied.

The scoring of a mixed-use project is calculated with a weighted average, according to the following steps.

1. Determine the total square footage of all residential and nonresidential uses.
2. Calculate the percentage residential and percentage nonresidential of the total square footage.
3. Determine the density of each component as measured in *dwelling units* per acre and *floor-area ratio*, respectively.
4. Referring to Table 1, find the appropriate points for the densities of the residential and nonresidential components.
5. If the points are different, multiply the point value of the residential component by its percentage of the total square footage and multiply the point value of the nonresidential component by its percentage.
6. Add the two scores.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

buildable land the portion of the site where construction can occur, including land voluntarily set aside and not constructed upon. When used in *density* calculations, buildable land excludes public rights-of-way and land excluded from development by codified law or LEED for Neighborhood Development prerequisites. An *applicant* may exclude additional land not exceeding 15% of the buildable land base defined above, provided the following conditions are present:

a. The land is protected from residential and nonresidential construction by easement, deed restriction, or other enforceable legal instrument.

AND

b. Either 25% or more of the boundary of each contiguous parcel proposed for exclusion borders a *water body* or areas outside the *project boundary* that are protected by codified law; or ownership of, or management authority over, the exclusion area is transferred to a public entity.

NPD Credit 3: Mixed-Use Neighborhood Centers

1–4 points

Intent

To cluster diverse land uses in accessible neighborhood and regional centers to encourage daily walking, biking, and transit use, reduce *vehicle miles traveled* (VMT) and automobile dependence, and support car-free living.

Requirements

FOR ALL PROJECTS

Locate and/or design the *project* such that 50% of its *dwelling units* are within a 1/4-mile *walk distance* of the number of diverse uses (see Appendix) in Table 1, including at least one use from each of the four categories. For projects with no dwellings, 50% of dwelling units within 1/4 mile of the *project boundary* must be within a 1/4-mile walk distance of the number of diverse uses specified in Table 1, including at least one food retail store and at least one establishment from each of two other categories. Establishments may be inside or outside the project and may be *existing* or *planned diverse uses*.

The specified number of diverse uses must be in place by the time of occupancy according to the percentages indicated in Table 1 (exclusive of portions of parking structures devoted to parking):

Table 1. Points for diverse uses within 1/4-mile walk distance, by time of occupancy

Diverse uses	Percentage occupancy of total square footage	Points
4–6	20%	1
7–10	30%	2
11–18	40%	3
≥ 19	50%	4

Per neighborhood center, the following restrictions apply:

a. A single establishment may not be counted in two categories or as two types of diverse use (e.g., a place of worship may be counted only once even if it also contains a daycare facility, and a retail store may be counted only once even if it sells products in several categories).

b. Establishments in a mixed-use building may each count if they are distinctly operated enterprises with separate exterior entrances, but no more than half of the minimum number of diverse uses can be situated in a single building or under a common roof.

c. Only two establishments of a single type may be counted (e.g., if five restaurants are within the required distance, only two may be counted).

FOR PROJECTS 40 ACRES OR GREATER

Cluster diverse uses into neighborhood centers as follows:

Table 2. Points for clustering of diverse uses

Diverse uses	Minimum uses per neighborhood center	Points
4–6	3	1
7–10	5	2
11–18	7	3
≥ 19	9	4

Within each neighborhood center, the principal entries of the establishments must be within a 300-foot walk distance from a single common point that represents the center of the cluster (1 or 2 points) or within a 400-foot walk distance (3 or 4 points).

Also, projects with multiple centers must determine points earned based on the number of uses in the centers weighted by the percentage of total dwelling units within a 1/4-mile walk distance from each center's common point.

AND

FOR PROJECTS WITH REGIONAL-SERVING RETAIL OF 150,000 OR MORE SQUARE FEET

Projects with retail uses totaling 150,000 or more square feet, if they have at least one retail establishment totaling 75,000 or more square feet, must also earn a minimum of 1 point under SLL Credit 3, Reduced Automobile Dependence, Option 1, Transit-Served Location (planned transit service can be counted), and for every additional 50,000 square feet of retail above 150,000 square feet, must earn 1 additional point under SLL Credit 3.

If transit service is planned but not yet operational, the project must demonstrate one of the following:

a. The relevant transit agency has a signed full funding grant agreement with the Federal Transit Administration that includes a revenue operations date for the start of transit service. The revenue operations date must be no later than the occupancy date of 50% of the project's total building square footage.

b. For bus, streetcar, *bus rapid transit*, or ferry service, the transit agency must certify that it has an approved budget that includes specifically allocated funds sufficient to provide the planned service at the levels listed above and that service at these levels will commence no later than occupancy of 50% of the project's total building square footage.

c. For rail service other than streetcars, the transit agency must certify that preliminary engineering for a rail line has commenced. In addition, the service must meet either of these two requirements:

- A state legislature or local subdivision of the state has authorized the transit agency to expend funds to establish rail transit service that will commence no later than occupancy of 50% of the project's total building square footage.

OR

- A municipality has dedicated funding or reimbursement commitments from future tax revenue for the development of stations, platforms, or other rail transit infrastructure that will service the project no later than occupancy of 50% of the project's total building square footage.

NPD Credit 4: Mixed-Income Diverse Communities

1–7 points

Intent

To promote socially equitable and engaging communities by enabling residents from a wide range of economic levels, household sizes, and age groups to live in a community.

Requirements

Meet the requirements of one or more options below.

OPTION 1. Diversity of Housing Types

Include a sufficient variety of housing sizes and types in the *project* such that the total variety of planned and *existing* housing within the project achieves a Simpson Diversity Index score greater than 0.5, using the housing categories below. Projects of less than 125 acres may calculate the Simpson Diversity Index for the area within 1/4 mile of the project's geographic center. The Simpson Diversity Index calculates the probability that any two randomly selected *dwelling units* in a project will be of a different type.

$$\text{Score} = 1 - \sum (n/N)^2$$

where n = the total number of dwelling units in a single category, and N = the total number of dwelling units in all categories.

Table 1. Points for housing diversity

Simpson Diversity Index score	Points
> 0.5 to < 0.6	1
≥ 0.6 to < 0.7	2
≥ 0.7	3

Housing categories are defined according to the dwelling unit's net square footage, exclusive of any garage, as listed in Table 2.

Table 2. Housing categories

Type	Square feet
Detached residential, large	> 1,250
Detached residential, small	≤ 1,250
Duplex or townhouse, large	> 1,250
Duplex or townhouse, small	≤ 1,250
Dwelling unit in multiunit building with no elevator, large	> 1,250
Dwelling unit in multiunit building with no elevator, medium	> 750 to ≤ 1,250
Dwelling unit in multiunit building with no elevator, small	≤ 750
Dwelling unit in multiunit building with elevator, 4 stories or fewer, large	> 1,250
Dwelling unit in multiunit building with elevator, 4 stories or fewer, medium	> 750 to ≤ 1,250
Dwelling unit in multiunit building with elevator, 4 stories or fewer, small	≤ 750
Dwelling unit in multiunit building with elevator, 5 to 8 stories, large	> 1,250
Dwelling unit in multiunit building with elevator, 5 to 8 stories, medium	> 750 to ≤ 1,250
Dwelling unit in multiunit building with elevator, 5 to 8 stories, small	≤ 750
Dwelling unit in multiunit building with elevator, 9 stories or more, large	> 1,250
Dwelling unit in multiunit building with elevator, 9 stories or more, medium	> 750 to ≤ 1,250
Dwelling unit in multiunit building with elevator, 9 stories or more, small	≤ 750
Live-work space, large	> 1,250
Live-work space, small	≤ 1,250
Accessory dwelling unit, large	> 1,250
Accessory dwelling unit, small	≤ 1,250

For the purposes of this credit, townhouse and live-work units may have individual ground-level entrances and/or be within a multiunit or mixed-use building. Double counting is prohibited; each dwelling may be classified in only one category. The number of stories in a building is inclusive of the ground floor regardless of its use.

AND/OR

OPTION 2. Affordable Housing

Include a proportion of new rental and/or for-sale dwelling units priced for households earning below the *area median income* (AMI). Rental units must be maintained at affordable levels for a minimum of 15 years. Existing dwelling units are exempt from requirement calculations. A maximum of 3 points may be earned by meeting any combination of thresholds in Table 3.

Table 3. Points for affordable housing

Rental dwelling units				For-sale dwelling units			
Priced up to 60% AMI		Priced up to 80% AMI		Priced up to 100% AMI		Priced up to 120% AMI	
Percentage of total rental units	Points	Percentage of total rental units	Points	Percentage of total for-sale units	Points	Percentage of total for-sale units	Points
5	1	10	1	5	1	8	1
10	2	15	2	10	2	12	2
15	3	25	3	15	3	--	--

AMI = area median income.

AND/OR

OPTION 3. Mixed-Income Diverse Communities

A project may earn 1 additional point by earning at least 2 points in Option 1 and at least 2 points in Option 2 (at least one of which must be for providing housing at or below 100% AMI).

NPD Credit 5: Reduced Parking Footprint

1 point

Intent

To design parking to increase the pedestrian orientation of *projects* and minimize the adverse environmental effects of parking facilities. To reduce public health risks by encouraging daily physical activity associated with walking and bicycling.

Requirements

For new nonresidential buildings and *multiunit residential* buildings, either do not build new off-street parking lots, or locate all new off-street surface parking lots at the side or rear of buildings, leaving building frontages facing streets free of surface parking lots.

AND

Use no more than 20% of the total *development footprint* area for all new off-street surface parking facilities, with no individual surface parking lot larger than 2 acres. For the purposes of this credit, surface parking facilities include ground-level garages unless they are under *habitable building* space. Underground or multistory parking facilities can be used to provide additional capacity, and on-street parking spaces are exempt from this limitation.

AND

Provide bicycle parking and storage capacity to new buildings as follows:

a. **Multiunit residential.** Provide at least one secure, enclosed bicycle storage space per occupant for 30% of the *planned occupancy* but no fewer than one per unit. Provide secure visitor bicycle racks on-site, with at least one bicycle space per ten *dwelling units* but no fewer than four spaces per project site.

b. **Retail.** Provide at least one secure, enclosed bicycle storage space per new retail worker for 10% of retail worker planned occupancy. Provide visitor or customer bicycle racks on-site, with at least one bicycle space per 5,000 square feet of retail space, but no fewer than one bicycle space per business or four bicycle spaces per project site, whichever is greater. Provide at least one on-site shower with changing facility for any development with 100 or more new workers and at least one additional on-site shower with changing facility for every 150 new workers thereafter.

c. **Nonresidential other than retail.** Provide at least one secure, enclosed bicycle storage space per new occupant for 10% of planned occupancy. Provide visitor bicycle racks on-site with at least one bicycle space per 10,000 square feet of new commercial nonretail space but not fewer than four bicycle spaces per building. Provide at least one on-site shower with changing facility for any development with 100 or more new workers and at least one additional on-site shower with changing facility for every 150 new workers thereafter.

Secure, enclosed bicycle storage areas must be locked and easily accessible to residents and/or workers. Provide informational signage on using the storage facilities.

Visitors' and customers' bicycle racks must be clearly visible from a main entry, located within 100 feet of the door, served with night lighting, and protected from damage from nearby vehicles. If the building has multiple main entries, bicycle racks must be proportionally dispersed within 100 feet of each.

Shower and changing facility requirements may be met by providing the equivalent of free access to on-site health club shower facilities, if the health club can be accessed without going outside. Provide informational signage on using the shower facilities.

AND

Provide carpool and/or shared-use vehicle parking spaces equivalent to 10% of the total automobile parking for each nonresidential and mixed-use building on the site. Signage indicating such parking spots must be provided, and the parking spots must be within 200 feet of entrances to the buildings served.

NPD Credit 6: Street Network

1–2 points

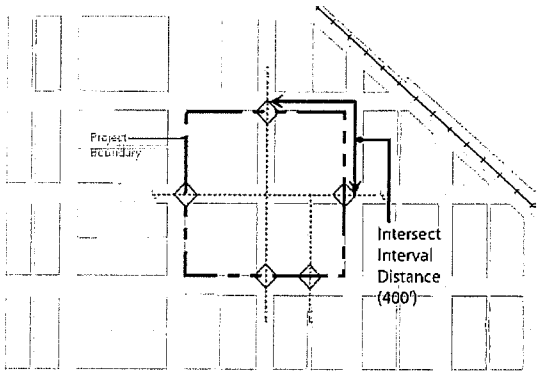
Intent

To promote *projects* that have high levels of internal connectivity and are well connected to the community at large. To encourage development within *existing* communities, thereby conserving land and promoting multimodal transportation. To improve public health by encouraging daily physical activity and reducing the negative effects of motor vehicle emissions.

Requirements

Design and/or locate the project such that a through-street and/or nonmotorized right-of-way intersects or terminates at the *project boundary* at least every 400 feet or at existing abutting street intervals and intersections, whichever is the shorter distance. Include a pedestrian or bicycle through-connection in at least 90% of any new *culs-de-sac*. This does not apply to portions of the boundary where connections cannot be made because of physical obstacles, such as prior platting of property, construction of existing buildings or other barriers, slopes over 15%, *wetlands* and *water bodies*, railroad and utility rights-of-way, existing limited-access motor vehicle rights-of-way, and parks and dedicated open space.

Figure 1. Project site with right-of-way intersects on project boundary at least every 400 feet



AND

Locate and/or design the project such that its internal *connectivity* and/or the connectivity within a 1/4-mile distance of the project boundary falls within one of the ranges listed in Table 1.

Table 1. Points for connectivity

Street intersections per square mile	Points
> 300 and ≤ 400	1
> 400	2

All streets and sidewalks that are counted toward the connectivity requirement must be available for general public use and not gated. Gated areas are not considered available for public use, with the exception of education and health care campuses, and military bases where gates are used for security purposes.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

connectivity the number of publicly accessible *street* intersections per square mile, including intersections of streets with dedicated *alleys* and transit rights-of-way, and intersections of streets with nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to *culs-de-sac* are also not counted. The calculation of square mileage excludes *water bodies, parks* larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

NPD Credit 7: Transit Facilities

1 point

Intent

To encourage transit use and reduce driving by providing safe, convenient, and comfortable transit waiting areas and safe and secure bicycle storage facilities for transit users.

Requirements

Work with the transit agency or agencies serving the *project* to identify transit stop locations within and/or bordering the *project boundary* where transit agency-approved shelters and any other agency-required improvements, including bicycle racks, will be installed no later than construction of 50% of total project square footage. At those locations, install approved shelters and any required improvements, or provide funding to the transit agency for their installation. Shelters must be covered, be at least partially enclosed to buffer wind and rain, and have seating and illumination. Any required bicycle racks must have a two-point support system for locking the frame and wheels and be securely affixed to the ground or a building.

AND

Work with the transit agency or agencies serving the project to identify locations within and bordering the project boundary where the agency determines that transit stops will be warranted within two years of project completion, either because of increased ridership on *existing* service resulting from the project or because of planned future transit. At those locations, reserve space for transit shelters and any required improvements, including bicycle racks. In lieu of or in addition to new stops, this requirement can be satisfied with a commitment from the transit agency to provide increased service to the transit stops that will have been installed at the time of 50% *build-out*.

AND

Work with the transit agency or agencies serving the project to provide kiosks, bulletin boards, and/or signs that display transit schedules and route information at each public transit stop within and bordering the project.

NPD Credit 8: Transportation Demand Management

1–2 points

Intent

To reduce energy consumption, pollution from motor vehicles, and adverse public health effects by encouraging multimodal travel.

Requirements

FOR ALL PROJECTS

Earn one point for every two options achieved below, for a maximum of two points. For the purposes of this credit, *existing* buildings and their occupants are exempt from the requirements.

OPTION 1. TDM Program

Create and implement a comprehensive transportation demand management (TDM) program for the *project* that reduces weekday peak-period motor vehicle trips by at least 20% compared with a baseline case, and fund the program for a minimum of three years following *build-out* of the project. The TDM program must be prepared by a qualified transportation professional. Any trip reduction effects of Options 2, 3, 4, or 5 may not be included in calculating the 20% threshold.

OR

OPTION 2. Transit Passes

Provide transit passes valid for at least one year, subsidized to be half of regular price or cheaper, to each occupant locating within the project during the first three years of project occupancy (or longer). Publicize the availability of subsidized transit passes are available to project occupants;

OR

OPTION 3. Developer-Sponsored Transit

Provide year-round, *developer*-sponsored private transit service (with vans, shuttles, buses) from at least one central point in the project to other major transit facilities, and/or other destinations such as a retail or *employment center*, with service no less frequent than 45 daily weekday trips and 30 daily weekend trips. The service must begin by the time the project total square footage is 20% occupied and must be guaranteed for at least three years beyond project build-out. Twenty percent occupancy is defined as residents living in 20% of the *dwelling units* and/or employees working in 20% of the total nonresidential square footage.

Provide transit stop shelters and bicycle racks adequate to meet projected demand but no less than one shelter and one bicycle rack at each transit stop. Shelters must be covered, be at least partially enclosed to buffer wind and rain, and have seating and illumination. Bicycle racks must have a two-point support system for locking the frame and wheels and must be securely affixed to the ground or a building.

OR

OPTION 4. Vehicle Sharing

Locate the project such that 50% of the dwelling units and nonresidential building entrances are within a 1/4 mile *walk distance* of at least one vehicle in a vehicle-sharing program. For each vehicle, dedicate one parking space accessible to vehicle-sharing members. Through signage and other means, publicize to project occupants the availability and benefits of the vehicle-sharing program. If the project has more than 100 dwelling units and/or employees and has a minimum transit service of 60 daily weekday trips and 40 daily weekend trips, at least one additional vehicle and parking space for every 100 dwelling units and/or employees must be available. If the project has more than 100 dwelling units and/or employees but does not have transit service at the frequencies specified above, at least one additional vehicle and parking space for every 200 dwelling units and/or employees must be available. Where new vehicle locations are created, a vehicle sharing program must begin by the time the project total square footage is 20% occupied; commit to providing vehicles to the locations for at least two years. Twenty percent occupancy is defined as residents living in 20% of the project dwelling units and/or employees working in 20% of the total nonresidential square footage of the project.

OR

OPTION 5. Unbundling of Parking

For 90% of *multiunit residential* units and/or nonresidential square footage, the associated parking spaces are sold or rented separately from the dwelling units and/or nonresidential square footage.

NPD Credit 9: Access to Civic and Public Space

1 point

Intent

To improve physical and mental health and social capital by providing a variety of open spaces close to work and home to facilitate social networking, civic engagement, physical activity, and time spent outdoors.

Requirements

Locate and/or design the *project* such that a civic or passive-use space, such as a square, *park*, or *plaza*, at least 1/6 acre in area lies within a 1/4-mile *walk distance* of 90% of planned and *existing dwelling units* and nonresidential building entrances. Spaces less than 1 acre must have a proportion no narrower than 1 unit of width to 4 units of length.

AND

For projects larger than 7 acres, locate and/or design the project such that the median size of civic or passive-use spaces within and/or contiguous to the project is at least 1/2 acre.

NPD Credit 10: Access to Recreation Facilities

1 point

Intent

To improve physical and mental health and social capital by providing a variety of recreational facilities close to work and home to facilitate physical activity and social networking.

Requirements

Locate and/or design the *project* so that a publicly accessible outdoor recreation facility at least 1 acre in area, or a publicly accessible indoor recreational facility of at least 25,000 square feet, lies within a 1/2-mile *walk distance* of 90% of new and *existing dwelling units* and nonresidential building entrances. Outdoor recreation facilities must consist of physical improvements and may include "tot lots," swimming pools, and sports fields, such as baseball diamonds.

NPD Credit 11: Visitability and Universal Design

1 point

Intent

To enable the widest spectrum of people, regardless of age or ability, to more easily participate in community life by increasing the proportion of areas usable by people of diverse abilities.

Requirements

OPTION 1. Projects with Dwelling Units

For each new *project dwelling unit* of the following residential building types, design to the applicable requirements specified:

Single dwelling unit buildings. Design a minimum of 20% of the dwelling units (and not less than one) in accordance with ICC/ANSI A117.1, Type C, Visitable Unit, each of which has an open-space plan for primary functions (an area for cooking, eating, and social gathering), as well as a sleeping area and a full bathroom.

Multiunit building with two or three dwelling units. Design a minimum of 20% of the dwelling units (and not less than one) in accordance with ICC/ANSI A117.1, Type C, Visitable Unit, each of which has a kitchen, dining area, living area, full bathroom, and bedroom on the accessible level. If a project has both attached and detached single dwelling unit buildings, the requirements apply to each type separately. Similarly, if a project has both 2- and 3- dwelling unit buildings, the requirements apply to each type.

Multiunit buildings with four or more dwelling units. This category includes mixed-use buildings with dwelling units. Design a minimum of 20% of the dwelling units (and not less than one) to incorporate the universal design requirements stated below, or comply with Option 2. Choose at least one of the following three strategies for universal design:

a. Throughout the home, include at least five of the following universal design features to facilitate universal function, access, and user ability:
   - Easy-to-grip lever door handles.
   - Easy-to-grip cabinet and drawer loop handles.
   - Easy-to-grip locking mechanisms on doors and windows.
   - Easy-to-grip single-lever faucet handles.
   - Easy-touch rocker or hands-free switches.
   - Motion-detector lighting at entrance, in hallways and stairwells, and in closets, and motion-detector light switches in garages, utility spaces, and basements.
   - Large, high-contrast print for controls, signals, and the house or unit numbers.
   - A built-in shelf, bench, or table with knee space below, located outside the entry door with weather protection overhead, such as porch or stoop with roof, awning, or other overhead covering.
   - A minimum 32-inch clear door opening width for all doorways.

- Tread at the entrance, on stairs, and other areas where slipping is common, with color contrast difference between stair treads and risers.
- Interior floor surfaces (e.g., low-pile carpets, hard-surface flooring) that provide easy passage for a wheelchair or walker, with color contrast between floor surfaces and trim. No carpet is permitted in a kitchen, bathroom, or other wet areas of the dwelling unit.

OR

b. On the main floor of the home (or on another floor, if an elevator or stair lift is provided), provide a kitchen with hard-surface flooring, plumbing with single-lever controls, a 5-foot turning radius, and at least four of the following universal design features to facilitate universal function, access, and user-ability:

- Variable-height (28- to 42-inch) or adjustable work surfaces, such as countertops, sinks, and/or cooktops.
- Clear knee space under sink and cooktops (this requirement can be met by installing removable base cabinets or fold-back or self-storing doors), cooktops and ranges with front or side-mounted controls, and wall-mounted ovens at a height to accommodate a seated adult.
- A toe kick area at the base of lower cabinets with a minimum height of 9 inches, and full-extension drawers and shelves in at least half (by volume) of the cabinets.
- Contrasting color treatment between countertops, front edges, and floor.
- Adjustable-height shelves in wall cabinets.
- Glare-free task lighting to illuminate work areas without too much reflectivity.

OR

c. On the main floor of the building (or on another floor, if an elevator or stair lift is provided), include all of the following:

In at least one accessible bedroom,

- Size the room to accommodate a twin bed with a 5-foot turning radius around the bed.
- Install a clothes closet with a 32-inch clear opening with adjustable-height closet rods and shelves.

In at least one full bathroom on the same floor as the bedroom,

- Provide adequate maneuvering space with a 30-by-48-inch clear floor space at each fixture.
- Center the toilet 18 inches from any side wall, cabinet, or tub, and allow a 3-foot clear space in front.
- Install broad blocking in walls around toilet, tub, and/or shower for future placement and relocation of grab bars
- Provide knee space under the lavatory (this requirement may be met by installing removable base cabinets or fold-back or self-storing doors).
- Install a long mirror whose bottom is no more than 36 inches above the finished floor and whose top is at least 72 inches high.

In addition, all bathrooms must have hard-surface flooring, all plumbing fixtures must have single-lever controls, and tubs or showers must have hand-held shower heads.

OR

OPTION 2. Projects with Noncompliant Public Rights-of-Way or Accessible Travel Routes

For projects with only nonresidential components, or residential components that are not within the scope of Option 1, but have public rights-of-way or other publicly accessible travel routes within the project that are not in compliance with Americans with Disabilities Act (for private sector and local and state government facilities) or the Architectural Barriers Act (for federally funded facilities), design, construct, and/or retrofit 100% of the rights-of-way and/or travel routes in accordance with the ADA-ABA Accessibility Guidelines, as applicable.

NPD Credit 12: Community Outreach and Involvement

1–2 points

Intent

To encourage responsiveness to community needs by involving the people who live or work in the community in *project* design and planning and in decisions about how it should be improved or how it should change over time.

Requirements

OPTION 1. Community Outreach (1 point)

Meet with adjacent property owners, residents, business owners, and workers; local planning and community development officials; and any current residents or workers at the project site to solicit and document their input on the proposed project prior to commencing a design.

AND

Work directly with community associations and/or the local government to advertise an open community meeting, other than an official public hearing, to generate comments on project design from the beginning.

AND

Host an open community meeting, other than an official public hearing, to solicit and document public input on the proposed project at the beginning of project design.

AND

Modify the project's conceptual design as a direct result of community input, or if modifications are not made, explain why community input did not generate design modifications.

AND

Establish ongoing means for communication between the *developer* and the community throughout the design and construction phases and, in cases where the developer maintains any control during the postconstruction phase.

OR

OPTION 2. Charrette (2 points)

Comply with Option 1 and conduct a design charrette or interactive workshop of at least two days and open to the public that includes, at a minimum, participation by a representative group of nearby property owners, residents, business owners, and workers in the preparation of conceptual project plans and drawings.

OR

OPTION 3. Local Endorsement Pursuant to Evaluation Program (2 points)

Comply with Option 1 and obtain an endorsement from an ongoing local or regional nongovernmental program that systematically reviews and endorses smart growth development projects under a rating and/or jury system.

NPD Credit 13: Local Food Production

1 point

Intent

To promote community-based food production, improve nutrition through increased access to fresh produce, support preservation of small farms producing a wide variety of crops, reduce the negative environmental effects of large-scale industrialized agriculture, and support local economic development that increases the economic value and production of farmlands and community gardens.

Requirements

FOR ALL PROJECTS

Establish *covenants, conditions, and restrictions* (CC&R) or other forms of deed restrictions which state that the growing of produce is not prohibited in *project* areas, including greenhouses, any portion of residential front, rear, or side yards; or balconies, patios, or rooftops. Greenhouses but not gardens may be prohibited in front yards that face the *street*.

AND

OPTION 1. Neighborhood Farms and Gardens

Dedicate permanent and viable growing space and/or related facilities (such as greenhouses) within the project according to the square footage areas specified in Table 1 (exclusive of *existing* dwellings). Provide solar access, fencing, watering systems, garden bed enhancements (such as raised beds), secure storage space for tools, and pedestrian access for these spaces. Ensure that the spaces are owned and managed by an entity that includes occupants of the project in its decision making, such as a community group, homeowners' association, or public body.

Table 1. Minimum garden space, by project density

Project density (DU/acre)	Growing space (sf/DU)
> 7 and ≤14	200
> 14 and ≤ 22	100
> 22 and ≤ 28	80
> 28 and ≤ 35	70
> 35	60

DU = dwelling unit; sf = square feet.

Established community gardens outside the *project boundary* but within a 1/2 mile *walk distance* of the project's geographic center can satisfy this option if the garden otherwise meets all of the option requirements.

OR

OPTION 2. Community-Supported Agriculture

Purchase shares in a *community-supported agriculture* (CSA) program located within 150 miles of the project site for at least 80% of *dwelling units* within the project (exclusive of existing dwelling units) for two years, beginning with each dwelling unit's occupancy until the 80% threshold is reached. Shares must be delivered to a point within 1/2 mile of the project's geographic center on a regular schedule not less than twice per month at least four months of the year.

OR

OPTION 3. Proximity To Farmers' Market

Locate the project's geographic center within a 1/2-mile walk distance of an existing or planned farmers' market that is open or will operate at least once weekly for at least five months annually. Farmers' market vendors may sell only items grown within 150 miles of the project site. A planned farmers' market must have firm commitments from farmers and vendors that the market will meet all the above requirements and be in full operation by the time of 50% occupancy of the project's total square footage.

NPD Credit 14: Tree-Lined and Shaded Streets

1–2 points

Intent

To encourage walking, bicycling, and transit use and discourage excessive motoring speeds. To reduce urban heat island effects, improve air quality, increase evapotranspiration, and reduce cooling loads in buildings.

Requirements

OPTION 1. Tree-Lined Streets (1 point)

Design and build the *project* to provide street trees on both sides of at least 60% of new and *existing streets* within the project and on the project side of bordering streets, between the vehicle travel way and walkway, at intervals averaging no more than 40 feet (excluding driveways and utility vaults).

AND/OR

OPTION 2. Shaded Streets (1 point)

Trees or other structures provide shade over at least 40% of the length of sidewalks on streets within or contiguous to the project. Trees must provide shade within ten years of landscape installation. Use the estimated crown diameter (the width of the shade if the sun is directly above the tree) to calculate the shaded area.

AND

FOR ALL PROJECTS INVOLVING STREET TREE PLANTINGS

Obtain a registered landscape architect's determination that planting details are appropriate to growing healthy trees, taking into account tree species, root medium, and width and soil volume of planter strips or wells, and that the selected tree species are not considered *invasive* in the project context according to USDA or the state agricultural extension service.

NPD Credit 15: Neighborhood Schools

1 point

Intent

To promote community interaction and engagement by integrating *schools* into the neighborhood. To support students' health by encouraging walking and bicycling to school.

Requirements

Include in the *project* a residential component that constitutes at least 30% of the project's total building square footage, and locate or design the project such that at least 50% of the *dwelling units* are within a 1/2-mile *walk distance* of an *existing* or new elementary or middle school building entrance or within a 1-mile walk distance of an existing or new high school building entrance. For any new school, the school district or equivalent organization must commit in a legally binding warrant that the school will be open by the time of occupancy of 50% of the project dwelling units.

Streets within and/or bordering the *project boundary* that lead from dwelling units to the school site must have a complete network of sidewalks on both sides and either bicycle lanes or traffic control and/or calming measures. If the school is planned as part of the project, it must be designed such that pedestrians and cyclists can easily reach building entrances without crossing bus zones, parking entrances, and student drop-off areas.

AND

New school campuses must not exceed the following:

- High schools, 15 acres.
- Middle schools, 10 acres.
- Elementary schools, 5 acres.

Schools combining grade levels from more than one category may use the grade level with the higher allowable acreage.

Facilities on the school site for which there is a formal joint-use agreement with another entity, such as athletic facilities, playgrounds, and multipurpose spaces in buildings, may be deducted from the total site area of the school.

GREEN INFRASTRUCTURE AND BUILDINGS

GIB Prerequisite 1: Certified Green Building

Required

Intent

To encourage the design, construction, and retrofit of buildings that utilize green building practices.

Requirements

Design, construct, or retrofit one whole building within the *project* to be certified through LEED for New Construction, LEED for Existing Buildings: Operations & Maintenance, LEED for Homes, LEED for Schools, LEED for Retail: New Construction, or LEED for Core and Shell (with at least 75% of the floor area certified under LEED for Commercial Interiors or LEED for Retail: Commercial Interiors), or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have either been accredited by an IAF accreditation body to, or could demonstrate compliance to, ISO 17021 or ISO/IEC Guide 65, and, when subsequently available, ISO/IEC 17065.

GIB Prerequisite 2: Minimum Building Energy Efficiency

Required

Intent

To encourage the design and construction of energy-efficient buildings that reduce air, water, and land pollution and adverse environmental effects from energy production and consumption.

Requirements

The following requirement applies to 90% of the building floor area (rounded up to the next whole building) of all nonresidential buildings, mixed-use buildings, and *multiunit residential* buildings four stories or more constructed as part of the *project* or undergoing major renovations as part of the project.

New buildings must demonstrate an average 10% improvement over ANSI/ASHRAE/IESNA Standard 90.1–2007 (with errata but without addenda). Buildings undergoing major renovations must demonstrate an average 5% improvement over ANSI/ASHRAE/IESNA Standard 90.1–2007.

Projects must document building energy efficiency using one or a combination of the following:

a. Produce a LEED-compliant energy model following the methodology outlined in the LEED rating system appropriate to each building's scope, including demonstration by a whole building project computer simulation using the building performance rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1–2007. Appendix G requires that the energy analysis done for the building performance rating method include all energy costs associated with the building project. Projects in California may use Title 24–2005, Part 6, in place of ANSI/ASHRAE/IESNA Standard 90.1–2007.

b. Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide listed below, appropriate to each building's scope. Comply with all applicable criteria as established in the guide for the climate zone in which the project is located.

- ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004 (office occupancy buildings less than 20,000 square feet).
- ASHRAE Advanced Energy Design Guide for Small Retail Buildings 2006 (retail occupancy buildings less than 20,000 square feet).
- ASHRAE Advanced Energy Design Guide for Small Warehouses and Self-Storage Buildings 2008 (warehouse or self-storage occupancy less than 50,000 square feet).
- ASHRAE Advanced Energy Design Guide for K–12 School Buildings (K–12 school occupancy less than 200,000 square feet).

c. For buildings less than 100,000 square feet, comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute, as follows:

- Comply with Section 1, Design Process Strategies, and Section 2, Core Performance Requirements, of the Core Performance Guide.
- Health care, warehouse and laboratory projects are ineligible for this path.

If method (a) is used for all of the floor area evaluated in this prerequisite, the total percentage improvement is calculated as a sum of energy costs for each building compared with a baseline. If any combination of methods (a), (b), and (c) is used, the total percentage improvement is calculated as a weighted average based on building floor area. In determining the weighted average, buildings pursuing (a) will be credited at the percentage value determined by the energy model. Buildings pursuing (b) or (c) will be credited at 12% better than ANSI/ASHRAE/IESNA Standard 90.1–2007 for new buildings and 8% better for *existing* building renovations.

AND

For new *single-family residential* buildings and new multiunit residential buildings three stories or fewer, 90% of the buildings must meet ENERGY STAR or equivalent criteria. Projects may demonstrate compliance with ENERGY STAR criteria through the prescriptive requirements of a Builder Option Package, the *Home Energy Rating System (HERS)* index, or a combination of the two.

Project teams wishing to use ASHRAE-approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.

GIB Prerequisite 3: Minimum Building Water Efficiency

Required

Intent

To reduce effects on natural water resources and reduce burdens on community water supply and wastewater systems.

Requirements

For nonresidential buildings, mixed-use buildings, and multifamily residential buildings four stories or more:

Indoor water usage in new buildings and buildings undergoing major renovations as part of the *project* must be an average 20% less than in baseline buildings. The baseline usage is based on the requirements of the Energy Policy Act of 1992 and subsequent rulings by the Department of Energy, the requirements of the Energy Policy Act of 2005, and the fixture performance standards in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code as to fixture performance. Calculations are based on estimated occupant usage and include only the following fixtures and fixture fittings (as applicable to the project scope): water closets (toilets), urinals, lavatory faucets, showers, kitchen sink faucets, and prerinse spray valves.

The water efficiency threshold is calculated as a weighted average of water usage for the buildings constructed as part of the project based on their conditioned square footage. Projects may also follow the LEED for Multiple Buildings and On-Campus Building Application Guide alternative calculation methodology to show compliance with this prerequisite.

Table 1. National efficiency baselines

Commercial fixtures, fittings, or appliances	Baseline water usage
Commercial toilet	1.6 gpf[1] Except blow-out fixtures, 3.5 gpf
Commercial urinal	1.0 gpf
Commercial lavatory (restroom) faucet	2.2 gpm at 60 psi, private applications only (hotel-motel guest rooms, hospital patient rooms) 0.5 gpm at 60 psi[2] all others except private applications 0.25 gallons per cycle for metering faucets
Commercial prerinse spray valve (for food service applications)	Flow rate ≤ 1.6 gpm (no pressure specified; no performance requirement)

[1] EPAct 1992 standard for toilets applies to both commercial and residential models.
[2] In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code.

Residential Fixtures, Fittings, and Appliances	Baseline water usage
Residential toilet	1.6 gpf[3]
Residential lavatory (bathroom) faucet	2.2 gpm at 60 psi
Residential kitchen faucet	
Residential showerhead	2.5 gpm at 80 psi per shower stall4

gpf = gallons per flush; psi = pounds per square inch.
Source: Adapted from information developed and summarized by the U.S. EPA Office of Water.
[3] EPAct 1992 standard for toilets applies to both commercial and residential models.
[4] Residential shower compartment (stall) in dwelling units: The total allowable flow rate from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas, and jets, shall be limited to the allowable showerhead flow rate as specified above (2.5-gpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 sq.in. For each increment of 2,500 sq.in. of floor area thereafter or part thereof, an additional showerhead with total allowable flow rate from all flowing devices equal to or less than the allowable flow rate as specified above shall be allowed. Exception: Showers that emit recirculated non-potable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

The following fixtures, fittings, and appliances are outside the scope of the water use reduction calculation:

a. Commercial steam cookers.

b. Commercial dishwashers.

c. Automatic commercial ice makers.

d. Commercial (family-sized) clothes washers.

e. Residential clothes washers.

f. Standard and compact residential dishwashers.

AND

For new *single-family residential* buildings and new *multiunit residential* buildings three stories or fewer, 90% of buildings must use a combination of fixtures that would earn 3 points under LEED for Homes 2008 WE Credit 3, Indoor Water Use.

GIB Prerequisite 4: Construction Activity Pollution Prevention

Required

Intent

To reduce pollution from construction activities by controlling soil erosion, waterway sedimentation, and airborne dust generation.

Requirements

Create and implement an erosion and sedimentation control plan for all new construction activities associated with the *project*. The plan must incorporate practices such as phasing, seeding, grading, mulching, filter socks, stabilized site entrances, preservation of *existing* vegetation, and other best management practices (BMPs) to control erosion and sedimentation in runoff from the entire project site during construction. The plan must list the BMPs employed and describe how they accomplish the following objectives:

a. Prevent loss of soil during construction by stormwater runoff and/or wind erosion, including but not limited to stockpiling of topsoil for reuse.

b. Prevent sedimentation of any affected stormwater conveyance systems or receiving streams.

c. Prevent polluting the air with dust and particulate matter.

The erosion and sedimentation control plan must describe how the project team will do the following:

a. Preserve vegetation and mark clearing limits.

b. Establish and delineate construction access.

c. Control flow rates.

d. Install sediment controls.

e. Stabilize soils.

f. Protect slopes.

g. Protect drain inlets.

h. Stabilize channels and outlets.

i. Control pollutants.

j. Control dewatering.

k. Maintain the BMPs.

l. Manage the erosion and sedimentation control plan.

The BMPs must be selected from the Washington State Department of Ecology's *Stormwater Management Manual for Western Washington, Volume II, Construction Stormwater Pollution Prevention* (2005 edition), or a locally approved equivalent, whichever is more stringent, and must comply with all federal, state, and local erosion and sedimentation control regulations.

GIB Credit 1: Certified Green Buildings

1–5 points

Intent

To encourage the design, construction, and retrofit of buildings that utilize green building practices.

Requirements

OPTION 1. Projects with 10 or Fewer Habitable Buildings

Design, construct, or retrofit one building as part of the *project*, beyond the prerequisite, to be certified under one of the following LEED green building rating systems: LEED for New Construction, LEED for Existing Buildings, LEED for Homes, LEED for Schools, LEED for Retail: New Construction, or LEED for Core & Shell (with at least 75% of the floor area certified under LEED for Commercial Interiors or LEED for Retail: Commercial Interiors) or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have either been accredited by an IAF accreditation body to, or could demonstrate compliance to, ISO 17021 or ISO/IEC Guide 65, and, when subsequently available, ISO/IEC 17065.

OR

OPTION 2. Projects of All Sizes

Design, construct, or retrofit a percentage of the total project building square footage, beyond the prerequisite requirement, to be certified under one of the LEED green building rating systems listed above or through a green building rating system requiring review by independent, impartial, third-party certifying bodies that have either been accredited by an IAF accreditation body to, or could demonstrate compliance to, ISO 17021 or ISO/IEC Guide 65, and, when subsequently available, ISO/IEC 17065.

Table 1. Points for green building certification

Percentage of square footage certified	Points
≥ 10% and < 20%	1
≥ 20% and < 30%	2
≥ 30% and < 40%	3
≥ 40% and < 50%	4
≥ 50%	5

AND

FOR ALL PROJECTS

Detached *accessory dwelling units* must be counted as separate buildings. Accessory dwellings attached to a main building are not counted separately.

GIB Credit 2: Building Energy Efficiency

2 points

Intent

To encourage the design and construction of energy-efficient buildings that reduce air, water, and land pollution and adverse environmental effects from energy production and consumption.

Requirements

The following requirement applies to 90% of the building floor area (rounded up to the next whole building) of all nonresidential buildings, mixed-use buildings, and *multiunit residential* buildings four stories or more constructed as part of the *project* or undergoing major renovations as part of the project.

New buildings must demonstrate an average 18% (1 point) or 26% (2 points) improvement over ANSI/ASHRAE/IESNA Standard 90.1–2007 (with errata but without addenda). Buildings undergoing major renovations as part of the project must demonstrate an average 14% (1 point) or 22% (2 points) improvement over ANSI/ASHRAE/IESNA Standard 90.1–2007.

Projects must document building energy efficiency using one or a combination of the following:

a. Produce a LEED-compliant energy model following the methodology outlined in the LEED rating system appropriate to each building's scope, including demonstration by a whole building project computer simulation using the building performance rating method in Appendix G of ANSI/ASHRAE/IESNA Standard 90.1–2007. Appendix G requires that the energy analysis done for the building performance rating method include all energy costs associated with the building project. Projects in California may use Title 24–2005, Part 6, in place of ANSI/ASHRAE/IESNA Standard 90.1–2007.

b. Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide listed below, appropriate to each building's scope. Comply with all applicable criteria as established in the guide for the climate zone in which the project is located.

- ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004 (office occupancy buildings less than 20,000 square feet).
- ASHRAE Advanced Energy Design Guide for Small Retail Buildings 2006 (retail occupancy buildings less than 20,000 square feet).
- ASHRAE Advanced Energy Design Guide for Small Warehouses and Self-Storage Buildings 2008 (warehouse or self-storage occupancy less than 50,000 square feet).
- ASHRAE Advanced Energy Design Guide for K–12 School Buildings (K–12 school occupancy less than 200,000 square feet).

c. For buildings less than 100,000 square feet, comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute, as follows:

- Comply with Section 1, Design Process Strategies, and Section 2, Core Performance Requirements, of the Core Performance Guide.
- Health care, warehouse and laboratory projects are ineligible for this path.

If method (a) is used for all of the floor area evaluated in this prerequisite, the total percentage improvement is calculated as a sum of energy costs for each building compared with a baseline. If any combination of methods (a), (b), and (c) is used, the total percentage improvement is calculated as a weighted average based on building floor area. In determining the weighted average, buildings pursuing (a) will be credited at the percentage value determined by the energy model. Buildings pursuing (b) or (c) will be credited at 12% better than ANSI/ASHRAE/IESNA Standard 90.1–2007 for new buildings and 8% better for *existing* building renovations.

AND

For new *single-family residential* buildings and new multiunit residential buildings three stories or fewer, 90% of the buildings must achieve a *Home Energy Rating System* (*HERS*) index score of at least 75.

Project teams wishing to use ASHRAE-approved addenda for the purposes of this credit may do so at their discretion. Addenda must be applied consistently across all LEED credits.

GIB Credit 3: Building Water Efficiency

1 point

Intent

To reduce effects on natural water resources and reduce burdens on community water supply and wastewater systems.

Requirements

For nonresidential buildings, mixed-use buildings, and multifamily residential buildings four stories or more:

Indoor water usage in new buildings and buildings undergoing major renovations as part of the *project* must be an average 40% less than in baseline buildings. The baseline usage is based on the requirements of the Energy Policy Act of 1992 and subsequent rulings by the Department of Energy, the requirements of the Energy Policy Act of 2005, and the fixture performance standards in the 2006 editions of the Uniform Plumbing Code or International Plumbing Code as to fixture performance. Calculations are based on estimated occupant usage and include only the following fixtures and fixture fittings (as applicable to the project scope): water closets (toilets), urinals, lavatory faucets, showers, kitchen sink faucets, and prerinse spray valves.

The water efficiency threshold is calculated as a weighted average of water usage for the buildings constructed as part of the project based on their conditioned square footage. Projects may also follow the LEED for Multiple Buildings and On-Campus Building Application Guide alternative calculation methodology to show compliance with this credit.

Table 1. National efficiency baselines

Commercial fixtures, fittings, or appliances	Baseline water usage
Commercial toilet	1.6 gpf[1] Except blow-out fixtures, 3.5 gpf
Commercial urinal	1.0 gpf
Commercial lavatory (restroom) faucet	2.2 gpm at 60 psi, private applications only (hotel-motel guest rooms, hospital patient rooms) 0.5 gpm at 60 psi[2] all others except private applications 0.25 gallons per cycle for metering faucets
Commercial prerinse spray valve (for food service applications)	Flow rate ≤ 1.6 gpm (no pressure specified; no performance requirement)

[1] EPAct 1992 standard for toilets applies to both commercial and residential models.
[2] In addition to EPAct requirements, the American Society of Mechanical Engineers standard for public lavatory faucets is 0.5 gpm at 60 psi (ASME A112.18.1-2005). This maximum has been incorporated into the national Uniform Plumbing Code and the International Plumbing Code.

Residential Fixtures, Fittings, and Appliances	Baseline water usage
Residential toilet	1.6 gpf[3]
Residential lavatory (bathroom) faucet	2.2 gpm at 60 psi
Residential kitchen faucet	
Residential showerhead	2.5 gpm at 80 psi per shower stall4

gpf = gallons per flush; psi = pounds per square inch.
Source: Adapted from information developed and summarized by the U.S. EPA Office of Water.
[3] EPAct 1992 standard for toilets applies to both commercial and residential models.
[4] Residential shower compartment (stall) in dwelling units: The total allowable flow rate from all flowing showerheads at any given time, including rain systems, waterfalls, bodysprays, bodyspas, and jets, shall be limited to the allowable showerhead flow rate as specified above (2.5-gpm) per shower compartment, where the floor area of the shower compartment is less than 2,500 sq.in. For each increment of 2,500 sq.in. of floor area thereafter or part thereof, an additional showerhead with total allowable flow rate from all flowing devices equal to or less than the allowable flow rate as specified above shall be allowed. Exception: Showers that emit recirculated non-potable water originating from within the shower compartment while operating are allowed to exceed the maximum as long as the total potable water flow does not exceed the flow rate as specified above.

The following fixtures, fittings, and appliances are outside the scope of the water use reduction calculation:

a. Commercial steam cookers.

b. Commercial dishwashers.

c. Automatic commercial ice makers.

d. Commercial (family-sized) clothes washers.

e. Residential clothes washers.

f. Standard and compact residential dishwashers.

AND

For new *single-family residential* buildings and new *multiunit residential* buildings three stories or fewer, 90% of buildings must use a combination of fixtures that would earn 5 points under LEED for Homes 2008 WE Credit 3, Indoor Water Use.

GIB Credit 4: Water-Efficient Landscaping

1 point

Intent

To limit or eliminate the use of *potable water* and other natural surface or subsurface water resources on *project* sites, for landscape irrigation.

Requirements

Reduce water consumption for outdoor landscape irrigation by 50% from a calculated midsummer baseline case. Reductions may be attributed to any combination of the following strategies, among others:

a. Plant species, plant density, and microclimate factor.

b. Irrigation efficiency.

c. Use of captured rainwater.

d. Use of recycled wastewater.

e. Use of water treated and conveyed by a public agency specifically for nonpotable uses.

f. Use of other nonpotable water sources, such as stormwater, air-conditioning condensate, and foundation drain water.

Projects with no new or *existing* landscape irrigation requirements automatically meet the credit requirements.

Groundwater seepage that is pumped away from the immediate vicinity of buildings slabs and foundations can be used for landscape irrigation and meet the intent of this credit. However, it must be demonstrated that doing so does not affect site stormwater management systems.

GIB Credit 5: Existing Building Reuse

1 point

Intent

To extend the life cycle of *existing* building stock to conserve resources, reduce waste, and reduce adverse environmental effects of new buildings related to materials manufacturing and transport.

Requirements

Reuse the existing *habitable building* stock, achieving the greater of the following two benchmarks (based on surface area):

a. 50% of one existing building structure (including structural floor and roof decking) and envelope (including exterior skin and framing but excluding window assemblies and nonstructural roofing material).

b. 20% of the total existing building stock (including structure and envelope, as defined above).

Hazardous materials that are remediated as a part of the *project* scope must be excluded from the calculations.

AND

FOR ALL PROJECTS

Do not demolish any *historic buildings*, or portions thereof, or alter any *cultural landscapes* as part of the project.

An exception is granted only if such action has been approved by an appropriate review body. For buildings listed locally, approval must be granted by the local historic preservation review board, or equivalent. For buildings listed in a state register or in the National Register of Historic Places, approval must appear in a programmatic agreement with the State Historic Preservation Office.

GIB Credit 6: Historic Resource Preservation and Adaptive Use

1 point

Intent

To encourage the preservation and adaptive use of *historic buildings* and *cultural landscapes* that represent significant embodied energy and cultural value, in a manner that preserves historic materials and character-defining features.

Requirements

To achieve this credit, at least one historic building or cultural landscape must be present on the *project* site.

Do not demolish any historic buildings, or portions thereof, or alter any cultural landscapes as part of the project.

An exception is granted only if such action has been approved by an appropriate review body. For buildings or landscapes listed locally, approval must be granted by the local historic preservation review board, or equivalent. For buildings or landscapes listed in a state register or in the National Register of Historic Places, approval must appear in a programmatic agreement with the State Historic Preservation Office.

If any historic building in the project site is to be rehabilitated, rehabilitate in accordance with local review or federal standards for rehabilitation, whichever is more restrictive, using one of the following approaches:

a. Obtain approval, in the form of a "certificate of appropriateness," from a locally appointed historic preservation commission or architectural review board for any exterior alterations or additions.

b. If federal funds are used for the project, obtain confirmation from a state historic preservation office or the National Park Service that the rehabilitation satisfies the Secretary of the Interior's Standards for Rehabilitation.

c. If a building or site is listed in or determined eligible for the National Register of Historic Places but is not subject to federal or local review board review, include on the project team a preservation professional who meets the federal qualifications for historic architect and attests to conformance to the Secretary of the Interior's Standards for the Treatment of Historic Properties.

GIB Credit 7: Minimized Site Disturbance in Design and Construction

1 point

Intent

To preserve *existing* noninvasive trees, *native plants*, and pervious surfaces.

Requirements

OPTION 1. Development Footprint on Previously Developed Land

Locate 100% of the *development footprint* on areas that are *previously developed* and for which 100% of the *construction impact zone* is previously developed.

OR

OPTION 2. Undeveloped Portion of Project Left Undisturbed

Depending on the *density* of the *project*, do not develop or disturb a portion of the land that has not been previously developed on the site, exclusive of any land preserved by codified law or a prerequisite of LEED for Neighborhood Development; or exempt areas designated as nonbuildable in land-use comprehensive plans and stipulate in *covenants, conditions, and restrictions* (CC&R) or other binding documents that the undisturbed area will be protected from development in perpetuity. Densities and minimum percentages are as follows (mixed-use projects must use the lowest applicable density or calculate a weighted average per the methodology in NPD Credit 2, Compact Development):

Table 1. Minimum undeveloped area, by project density

Residential density (DU/acre)	Nonresidential density (FAR)	Minimum area left undisturbed
< 15	< .50	20%
15 – 21	.50 – 1.0	15%
> 21	> 1.0	10%

DU = dwelling unit; FAR = floor-area ratio.

For portions of the site that are not previously developed, identify construction impact zones that limit disturbance to a minimum of 40 feet beyond the building perimeter; 10 feet beyond surface walkways, patios, surface parking and utilities less than 12 inches in diameter; 15 feet beyond *street* curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater retention facilities, and playing fields) that require additional staging areas to limit compaction in the constructed zone.

AND

FOR ALL PROJECTS

Survey the site to identify the following:

a. Trees in good or excellent condition, as determined by an arborist certified by the International Society of Arboriculture (ISA).

b. Any heritage or champion trees of special importance to the community because of their age, size, type, historical association, or horticultural value, as defined by a government forester.

c. All trees larger than 6 inches in diameter at breast height (dbh, 4 feet 6 inches above ground).

d. Any *invasive* tree species present on the site, and whether those trees threaten the health of other trees to be preserved on the site, as determined by an ISA-certified arborist.

Preserve the following trees that are also identified as in good or excellent condition:

a. All heritage or champion trees and trees whose dbh exceeds 50% of the state champion dbh for the species.

b. A minimum of 75% of all noninvasive trees (including the above) larger than 18 inches dbh.

c. A minimum of 25% of all noninvasive trees (including the above) larger than 12 inches dbh if deciduous, and 6 inches dbh if coniferous.

Tree condition ratings must be based on assessment by an ISA-certified arborist using ISA-approved assessment measures.

Develop a plan, in consultation with and approved by an ISA-certified arborist, for the health of the trees, including fertilization and pruning, and for their protection during construction. The plan must include protective fencing located 1 foot for each 1-inch caliper from the trunk or at the tree drip line, whichever is larger, and specify that if trenching or other disturbance is necessary within the protected zone, this work must be done by hand. If disturbance includes a permanent excavation of 3 feet or deeper, the excavation must start from a point not closer than 15 feet from the tree's drip line. If an ISA-certified arborist has determined that any trees to be preserved are threatened by invasive vegetarion, develop a plan to reduce the invasive vegetation to the maximum extent possible. Stipulate in CC&R or other binding documents that the undisturbed area of the preserved trees will be protected from development in perpetuity.

Key Definitions

For the meanings of other terms used in the requirements, refer to the Glossary.

previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

GIB Credit 8: Stormwater Management

1–4 points

Intent

To reduce pollution and hydrologic instability from stormwater, reduce flooding, promote aquifer recharge, and improve water quality by emulating natural hydrologic conditions.

Requirements

Implement a comprehensive stormwater management plan for the *project* that retains on-site, through infiltration, evapotranspiration, and/or reuse, the rainfall volumes listed in Table 1. Rainfall volume is based on the project's *development footprint*, any other areas that have been graded so as to be effectively impervious, and any pollution-generating pervious surfaces, such as landscaping, that will receive treatments of fertilizers or pesticides.

The percentile rainfall event (Table 1) is the total rainfall on a given day in the record that is greater than or equal to X percent of all rainfall events over a 20- to 40+-year period. For example, a 95th percentile event in a particular region might be 1.5 inches, which would then be the volume to retain. To determine the volume to be retained, projects may use NOAA's published national rainfall data, run an approved stormwater model, or independently gather local rain gauge data and rank rainfall events. One hundred percent of the water volume from rainfall events up to the X percentile event must not be discharged to surface waters unless the harvested and reused runoff is authorized for discharge or allowed to be discharged into sanitary treatment systems.

Table 1. Points for retaining stormwater on-site

Percentile rainfall event (determines total volume from development footprint to be retained)	Points
80th percentile	1
85th percentile	2
90th percentile	3
95th percentile	4

Projects that earn at least 2 points under this credit may earn 1 additional point by meeting one of the following site characteristics:

a. The project is located on a *previously developed site* (1 point).

b. The project is located on a site that meets the definition of *brownfield* in SLL Credit 2, Brownfields Redevelopment (1 point).

c. The project is designed to be transit ready by achieving the following (1 point):

- At least 2 points under NPD Credit 1, Walkable Streets.
- At least 2 points under NPD Credit 2, Compact Development.
- At least 2 points under NPD Credit 3, Mixed-Use Neighborhood Centers.

Select BMPs from the *Washington State Department of Ecology's Stormwater management Manual for Western Washington, Volume V, Run off Treatment* (2005 *edition*), or locally approved equivalent, whichever is more stringent. If

the BMPs are comparable in stringency, choose BMPs that are most appropriate to the project site and region. BMPs must also comply with all federal, state, and local regulations.

For stormwater reuse systems not on a combined stormwater and sewer system, the total water reused for indoor use must not exceed 90% of the average annual rainfall.

Stormwater BMPs (except cisterns) must be designed to drain down within 72 hours.

GIB Credit 9: Heat Island Reduction

1 point

Intent

To reduce heat islands to minimize effects on the microclimate and human and wildlife habitat.

Requirements

OPTION 1. Nonroof Measures

Use any combination of the following strategies for 50% of the nonroof site hardscape (including roads, sidewalks, courtyards, parking lots, parking structures, and driveways):

a. Provide shade from open structures, such as those supporting solar photovoltaic panels, canopied walkways, and vine pergolas, all with a solar reflectance index (SRI) of at least 29.

b. Use paving materials with an SRI of at least 29.

c. Install an open-grid pavement system that is at least 50% pervious.

d. Provide shade from tree canopy (within ten years of landscape installation).

OR

OPTION 2. High-Reflectance and Vegetated Roofs

Use roofing materials that have an SRI equal to or greater than the values in Table 1 for a minimum of 75% of the roof area of all new buildings within the *project*; or install a vegetated ("green") roof for at least 50% of the roof area of all new buildings within the project. Combinations of SRI compliant and vegetated roofs can be used provided they satisfy the equation in Option 3.

Table 1. Minimum solar reflectance index value, by roof slope

Roof slope	SRI
Low (≤ 2:12)	78
Steep (> 2:12)	29

OR

OPTION 3. Mixed Nonroof and Roof Measures

Use any of the strategies listed under Options 1 and 2 that in combination meet the following criterion:

$$\frac{\text{Area of Nonroof Measures}}{0.5} + \frac{\text{Area of SRI Roof}}{0.75} + \frac{\text{Area of Vegetated Roof}}{0.5} \geq \text{Total Site Hardscape Area} + \text{Total Roof Area}$$

GIB Credit 10: Solar Orientation

1 point

Intent

To encourage energy efficiency by creating optimum conditions for the use of passive and active solar strategies.

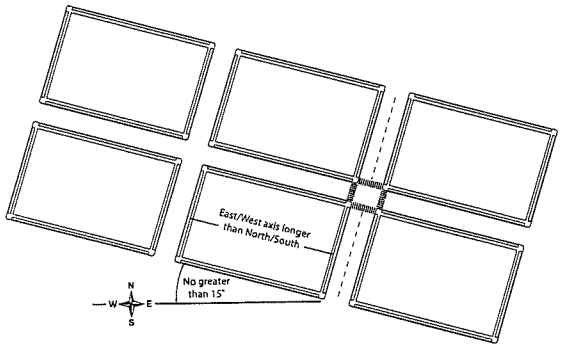
Requirements

OPTION 1. Block Orientation (For Projects Earning at Least 2 Points Under NPD Credit 2, Compact Development)

Locate the *project* on *existing blocks* or design and orient the project such that 75% or more of the blocks have one axis within plus or minus 15 degrees of geographical east-west, and the east-west lengths of those blocks are at least as long as the north-south lengths of the blocks.

Earn at least 2 points under NPD Credit 2, Compact Development.

Figure 1. Solar-oriented blocks with east-west lengths equal to or greater than north-south lengths, and east-west axis within 15 degrees of geographic east-west

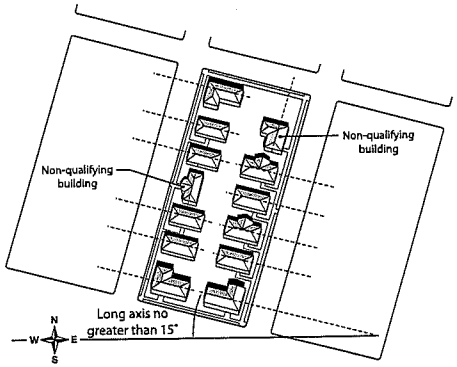


OR

OPTION 2. Building Orientation (Available For All Projects)

Design and orient 75% or more of the project's total building square footage (excluding existing buildings) such that one axis of each qualifying building is at least 1.5 times longer than the other, and the longer axis is within 15 degrees of geographical east-west. The length-to-width ratio applies only to walls enclosing conditioned spaces; walls enclosing unconditioned spaces, such as garages, arcades, or porches, cannot contribute to credit achievement. The surface area of equator-facing vertical surfaces and slopes of roofs of buildings counting toward credit achievement must not be more than 25% shaded at the time of initial occupancy, measured at noon on the winter solstice.

Figure 2. Solar-oriented buildings with longer axis (at least 1.5 times length of other axis) within 15 degrees of geographic east-west



GIB Credit 11: On-Site Renewable Energy Sources

1–3 points

Intent

To encourage on-site renewable energy production to reduce the adverse environmental and economic effects associated with fossil fuel energy production and use.

Requirements

Incorporate on-site nonpolluting renewable energy generation, such as solar, wind, geothermal, small-scale or micro hydroelectric, and/or biomass, with production capacity of at least 5% of the *project's* annual electrical and thermal energy cost (exclusive of *existing* buildings), as points are awarded as listed in Table 1.

Table 1. Points for on-site renewable energy generation

Percentage of annual electrical and thermal energy cost	Points
5%	1
12.5%	2
20%	3

GIB Credit 12: District Heating and Cooling

2 points

Intent

To encourage the development of energy-efficient neighborhoods by employing district heating and cooling strategies that reduce energy use and adverse energy-related environmental effects.

Requirements

Incorporate a district heating and/or cooling system for space conditioning and/or water heating of new buildings (at least two buildings total) such that at least 80% of the *project's* annual heating and/or cooling consumption is provided by the district plant. *Single-family residential* buildings and *existing* buildings of any type may be excluded from the calculation.

Each system component that is addressed by ANSI/ASHRAE/IESNA Standard 90.1–2007 must have an overall efficiency performance at least 10% better than that specified by the standard's prescriptive requirements. Additionally, annual district pumping energy consumption that exceeds 2.5% of the annual thermal energy output of the heating and cooling plant (with 1 kWh of electricity equal to 3,413 Btus) must be offset by increases in the component's efficiency beyond the specified 10% improvement. Combined heat and power (CHP) district systems can achieve this credit by demonstrating equivalent performance.

GIB Credit 13: Infrastructure Energy Efficiency

1 point

Intent
To reduce adverse environmental effects from energy used for operating public infrastructure.

Requirements
Design, purchase, or work with the municipality to install all new infrastructure, including but not limited to traffic lights, *street* lights, and water and wastewater pumps, to achieve a 15% annual energy reduction below an estimated baseline energy use for this infrastructure. The baseline is calculated with the assumed use of lowest first-cost infrastructure items.

GIB Credit 14: Wastewater Management

1–2 points

Intent
To reduce pollution from wastewater and encourage water reuse.

Requirements
Design and construct the *project* to retain on-site at least 25% of the average annual wastewater generated by the project (exclusive of *existing* buildings), and reuse that wastewater to replace *potable water*. An additional point may be awarded for retaining and reusing 50%. Provide on-site treatment to a quality required by state and local regulations for the proposed reuse. The percentage of wastewater diverted and reused is calculated by determining the total wastewater flow using the design case after the GIB Prerequisite 3 calculations, and determining how much of that volume is reused on-site.

Table 1. Points for reusing wastewater

Percentage of wastewater reused	Points
25%	1
50%	2

GIB Credit 15: Recycled Content in Infrastructure

1 point

Intent

To use recycled and reclaimed materials to reduce the adverse environmental effects of extracting and processing virgin materials.

Requirements

Use materials for new infrastructure such that the sum of *postconsumer* recycled content, in-place reclaimed materials, and one-half of the *preconsumer* recycled content constitutes at least 50% of the total mass of infrastructure materials.

Count materials in all of the following infrastructure items as applicable to the *project*:

a. Roadways, parking lots, sidewalks, unit paving, and curbs.

b. Water retention tanks and vaults.

c. Base and subbase materials for the above.

d. Stormwater, sanitary sewer, steam energy distribution, and water piping.

Recycled content is defined in accordance with ISO/IEC 14021, Environmental labels and declaration, Self-declared environmental claims (Type II environmental labeling).

GIB Credit 16: Solid Waste Management Infrastructure

1 point

Intent

To reduce the volume of waste deposited in landfills. To promote the proper disposal of hazardous wastes.

Requirements

Meet at least four of the following five requirements and publicize their availability and benefits:

a. Include as part of the *project* at least one recycling or reuse station, available to all project occupants, dedicated to the separation, collection, and storage of materials for recycling; or locate the project in a local government jurisdiction that provides recycling services. The recyclable materials must include, at a minimum, paper, corrugated cardboard, glass, plastics and metals.

b. Include as part of the project at least one drop-off point, available to all project occupants, for potentially hazardous office or household wastes; or locate the project in a local government jurisdiction that provides collection services. Examples of potentially hazardous wastes include paints, solvents, oil, and batteries. If a plan for postcollection disposal or use does not exist, establish one.

c. Include as part of the project at least one compost station or location, available to all project occupants, dedicated to the collection and composting of food and yard wastes; or locate the project in a local government jurisdiction that provides composting services. If a plan for postcollection use does not exist, establish one.

d. On every mixed-use or nonresidential *block* or at least every 800 feet, whichever is shorter, include recycling containers adjacent to other receptacles or recycling containers integrated into the design of the receptacle.

e. Recycle and/or salvage at least 50% of nonhazardous construction and demolition debris. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and specifies whether the materials will be stored on-site or commingled. Excavated soil and land-clearing debris do not contribute to this credit. Calculations can be done by weight or volume but must be consistent throughout.

GIB Credit 17: Light Pollution Reduction

1 point

Intent

To minimize light trespass from *project* sites, reduce sky-glow to increase night sky access, improve nighttime visibility through glare reduction, and reduce adverse effects on wildlife environments.

Requirements

"Shared areas" of a project are spaces and facilities dedicated to common use (publicly or privately owned).

In residential areas, at least 50% of the external luminaires must have fixture-integrated lighting controls that use motion sensors to reduce light levels by at least 50% when no activity has been detected for 15 minutes.

AND

In all shared areas, install automatic controls that turn off exterior lighting when sufficient daylight is available and when the lighting is not required during nighttime hours; these lights must meet the total exterior lighting power allowance requirements in Table 3.

AND

Document which lighting zone or zones (Table 1) describe the project, and for all shared areas, follow the requirements in Table 2. If two or more different zones border the project, use the most stringent uplight requirements, and use light trespass requirements for the adjacent zone. Roadway lighting that is part of the project must meet the requirements for the appropriate zone.

For illuminance generated from a single luminaire placed at the intersection of a private vehicular driveway and public roadway accessing the site, project teams may use the centerline of the public roadway as the site boundary for a length of two times the driveway width centered at the centerline of the driveway when complying with the trespass requirements.

Compliance with the light trespass requirements may alternatively be met by using only luminaires that comply with Table 4 ratings for backlight and glare.

AND

Stipulate *covenants, conditions, and restrictions* (CC&R) or other binding documents to require continued adherence to the requirements.

Table 1. Lighting zones

Zone	Definition
LZ0	Undeveloped areas within national parks, state parks, forest land and rural areas and sites immediately adjacent to areas officially recognized as ecologically sensitive by the local zoning authority.
LZ1	Developed areas within national parks, state parks, forest land and rural areas.
LZ2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use, and residential mixed-use areas.
LZ3	All other areas not included in LZ0, LZ1, LZ2, or LZ4 (including commercial-industrial and high-density residential).
LZ4	High-activity commercial districts in major metropolitan areas (as designated by local jurisdiction, such as local zoning authority).

Table 2. Allowable light trespass and uplight, by lighting zone

Lighting zone	Maximum horizontal and vertical illuminance (fc) at site boundary	Maximum horizontal and vertical illuminance (fc) at specified distance beyond site boundary	Maximum percentage of fixture lumens emitted above 90° or higher from nadir (straight down)
LZ0	0	0 at 0 ft.	0%
LZ1	0.01	.01 at 0 ft.	0%
LZ2*	0.10	.02 at 10 ft.	1%
LZ3*	0.20	.05 at 15 ft.	2%
LZ4*	0.60	.05 at 15 ft.	5%

fc = footcandle.
* In LZ2, LZ3, and LZ4, for project boundaries that abut public rights-of-way, light trespass requirements may be met relative to the curb line instead of the project boundary.

Table 3. Allowable lighting power densities, by lighting zone

	Lighting zone				
	LZ0	LZ1	LZ2	LZ3	LZ4
All exterior improved areas (except those listed below)	0.04 W/sf	0.04 W/sf	0.06 W/sf	0.10 W/sf	0.13 W/sf
Walkways	0.7 W/lf	0.7 W/lf	0.7 W/lf	0.8 W/lf	1.0 W/lf
Landscaping	No allowance	0.04 W/sf	0.05 W/sf	0.05 W/sf	0.05 W/sf
Entrance door (per linear foot of doorway)	20W	20W	20W	30W	30W
Entry canopy	0.25 W/sf	0.25 W/sf	0.25 W/sf	0.40 W/sf	0.40 W/sf
Illuminated building façade	No allowance	No allowance	2.5W/lf	3.75W/lf	5.0W/lf

sf = square feet; lf = linear feet.
Note: The total exterior lighting power density allowance for all shared exterior applications is the sum of the specified allowances for individual illuminated areas. The following lighting is exempted when its controls meet the above requirements and are independent of the controls for nonexempt lighting:

a. Specialized signal, directional, and marker lighting associated with transportation.
b. Advertising and directional signage.
c. Lighting integral to equipment or instrumentation and installed by its manufacturer.
d. Lighting for theatrical purposes, including performance, stage, film, and video.
e. Lighting for athletic playing fields.
f. Temporary lighting (installed for no more than 30 days and then removed for at least 30 days).
g. Lighting for industrial production, material handling, transportation sites, and associated storage areas.
h. Theme elements in theme or amusement parks.
i. Lighting to highlight features of public monuments and registered *historic buildings* or landmark structures.

Alternative method for meeting light trespass requirements in Table 2

A luminaire may be used if it is rated as follows according to the lighting zone of the site. If the luminaire is installed in other than the intended manner, the rating must account for the actual photometric geometry. An exception applies if at least 98% of a luminaire's emitted lumens are intercepted by man-made structures within the project. In either case, luminaires equipped with adjustable mounting devices permitting alteration of luminaire aiming in the field are not permitted.

Table 4. Allowable backlight and glare, by lighting zone

	Lighting zone				
Backlight luminaire rating	LZ0	LZ1	LZ2	LZ3	LZ4
> 2 mounting heights from property line	B0	B1	B2	B3	B4
1 to 2 mounting heights from property line and properly oriented*	B0	B1	B2	B3	B3
0.5 to 1 mounting height to property line and properly oriented*	B0	B0	B1	B2	B2
< 0.5 mounting height to property line adjacent to street and properly oriented*	B0	B0	B1	B2	B2
< 0.5 mounting height to property line and properly oriented*	B0	B0	B0	B1	B2
Glare luminaire rating	G0	G1	G2	G3	G4

* The luminaire must be mounted with backlight toward the property line.
Note: Backlight and glare ratings are defined based on specific lumen limits for IESNA TM-15-07 solid angles, Addendum A.

INNOVATION AND DESIGN PROCESS

IDP Credit 1: Innovation and Exemplary Performance

1–5 points

Intent

To encourage exemplary performance above the requirements set by the LEED for Neighborhood Development Rating System and/or innovative performance in green building, smart growth, or new urbanist categories not specifically addressed by the LEED for Neighborhood Development Rating System.

Requirements

In writing, identify the intent of the proposed innovation credit, the proposed requirement for compliance, the proposed submittals to demonstrate compliance, and the design approach and strategies that might be used to meet the requirements.

One point is awarded for each IDP Credit 1 earned, up to a total of 5. No more than 3 exemplary performance credits will be awarded in the Innovation and Design Process category.

IDP Credit 2: LEED Accredited Professional

1 point

Intent
To support the integrated planning and design required for a LEED for Neighborhood Development *project* and to streamline the application and certification process.

Requirements
At least one principal member of the project team must be a LEED Accredited Professional.

OR
At least one principal member of the project design team must be a professional who is credentialed in smart growth as determined by the Natural Resources Defense Council in consultation with Smart Growth America.

OR
At least one principal member of the project design team must be a professional who is credentialed in new urbanism as determined by the Congress for the New Urbanism.

Note: A separate LEED Accredited Professional exam track for professionals wanting to specialize in the LEED for Neighborhood Development Rating System will be available in early 2010; this IDP credit can be achieved if a principal member of the project design team is accredited as a result of passing the exam.

REGIONAL PRIORITY CREDIT

RPC Credit 1: Regional Priority

1–4 points

Intent
To encourage strategies that address geographically specific environmental, social equity, and public health priorities.

Requirements
Earn up to four of the six Regional Priority credits. These credits have been identified by subject matter experts representing the U.S. Green Building Council (regional councils and chapters), the Congress for the New Urbanism (chapters and membership in regions without chapters), and Smart Growth America (members of Smart Growth America's State and Local Caucus or their designees) as having additional regional importance for the project's location. A database of Regional Priority credits and their geographic applicability will be available on the USGBC website, www.usgbc.org.

One point is awarded for each Regional Priority credit earned, up to a maximum of 4. Non-U.S. projects are not eligible for Regional Priority credits.

APPENDIX. DIVERSE USES

Food Retail

Supermarket
Other food store with produce

Community-Serving Retail

Clothing store or department store selling clothes
Convenience store
Farmer's market
Hardware store
Pharmacy
Other retail

Services

Bank
Gym, health club, exercise studio
Hair care
Laundry, dry cleaner
Restaurant, café, diner (excluding establishments with only drive-throughs)

Civic and Community Facilities

Adult or senior care (licensed)
Child care (licensed)
Community or recreation center
Cultural arts facility (museum, performing arts)
Educational facility (including K–12 school, university, adult education center, vocational school, community college)
Family entertainment venue (theater, sports)
Government office that serves public on-site
Place of worship
Medical clinic or office that treats patients
Police or fire station
Post office
Public library
Public park
Social services center

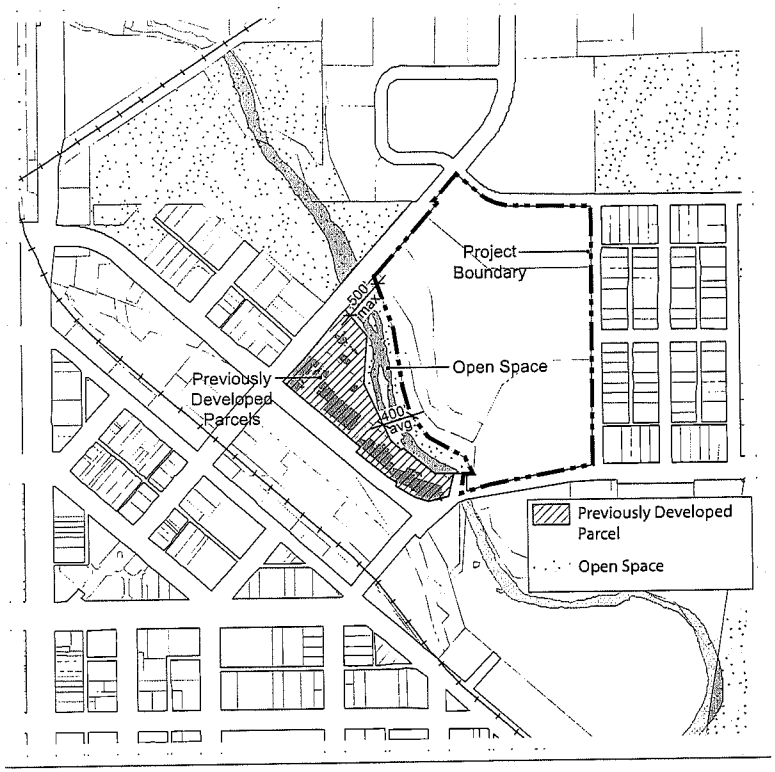
Adapted from Criterion Planners, INDEX neighborhood completeness indicator, 2005.

GLOSSARY

Key Definitions

adjacent site a site having at least 25% of its boundary bordering parcels that are each at least 75% *previously developed*. A *street* or other right-of-way does not constitute previously developed land; instead, it is the status of the property on the other side of the street or right-of-way that matters. Any fraction of the boundary that borders waterfront other than a stream is excluded from the calculation. A site is still considered adjacent if the 25% adjacent portion of its boundary is separated from previously developed parcels by undeveloped, permanently protected land averaging no more than 400 feet in width and no more than 500 feet in any one place. The undeveloped land must be permanently preserved as natural area, riparian corridor, *park*, greenway, agricultural land, or designated *cultural landscape*. Permanent pedestrian paths connecting the project through the protected parcels to the bordering site may be counted to meet the requirement of SLL Prerequisite 1, Option 2 (that the *project* be connected to the adjacent parcel by a through-street or nonmotorized right-of-way every 600 feet on average, provided the path or paths traverse the undeveloped land at no more than a 10% grade for walking by persons of all ages and physical abilities).

Adjacent project site based on minimum 25% of perimeter adjacent to previously developed parcels, including allowance for permanently protected land between project boundary and previously developed parcels



buildable land the portion of the site where construction can occur, including land voluntarily set aside and not constructed upon. When used in *density* calculations, buildable land excludes public rights-of-way and land excluded from development by codified law or LEED for Neighborhood Development prerequisites. An *applicant* may exclude additional land not exceeding 15% of the buildable land base defined above, provided the following conditions are present:

a. The land is protected from residential and nonresidential construction by easement, deed restriction, or other enforceable legal instrument.

AND

b. Either 25% or more of the boundary of each contiguous parcel proposed for exclusion borders a *water body* or areas outside the *project boundary* that are protected by codified law; or ownership of, or management authority over, the exclusion area is transferred to a public entity.

connectivity the number of publicly accessible *street* intersections per square mile, including intersections of streets with dedicated *alleys* and transit rights-of-way, and intersections of streets with nonmotorized rights-of-way. If one must both enter and exit an area through the same intersection, such an intersection and any intersections beyond that point are not counted; intersections leading only to *culs-de-sac* are also not counted. The calculation of square mileage excludes *water bodies, parks* larger than 1/2 acre, public facility campuses, airports, rail yards, slopes over 15%, and areas nonbuildable under codified law or the rating system. Street rights-of-way may not be excluded.

infill site a site that meets any of the following four conditions:

a. At least 75% of its boundary borders parcels that individually are at least 50% *previously developed*, and that in aggregate are at least 75% previously developed.

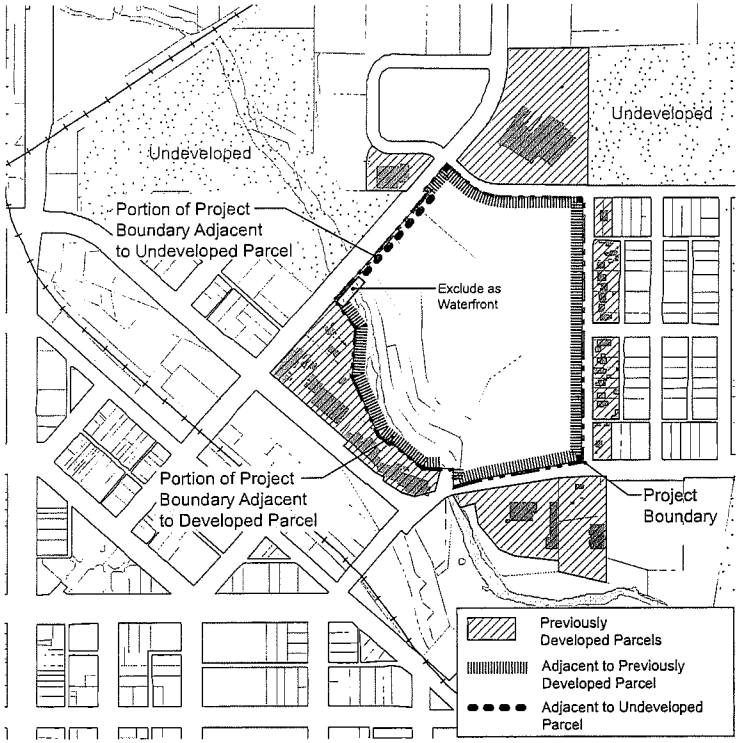
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

c. At least 75% of the land area, exclusive of rights-of-way, within a 1/2 mile distance from the *project boundary* is previously developed.

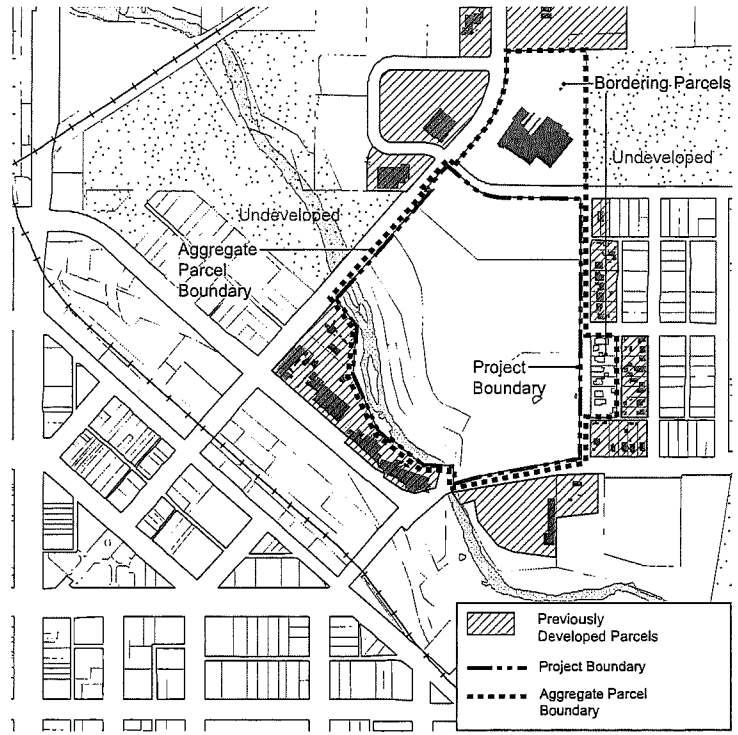
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

A *street* or other right-of-way does not constitute previously developed land; it is the status of property on the other side or right-of-way of the street that matters. For conditions (a) and (b) above, any fraction of the perimeter that borders waterfront other than a stream is excluded from the calculation.

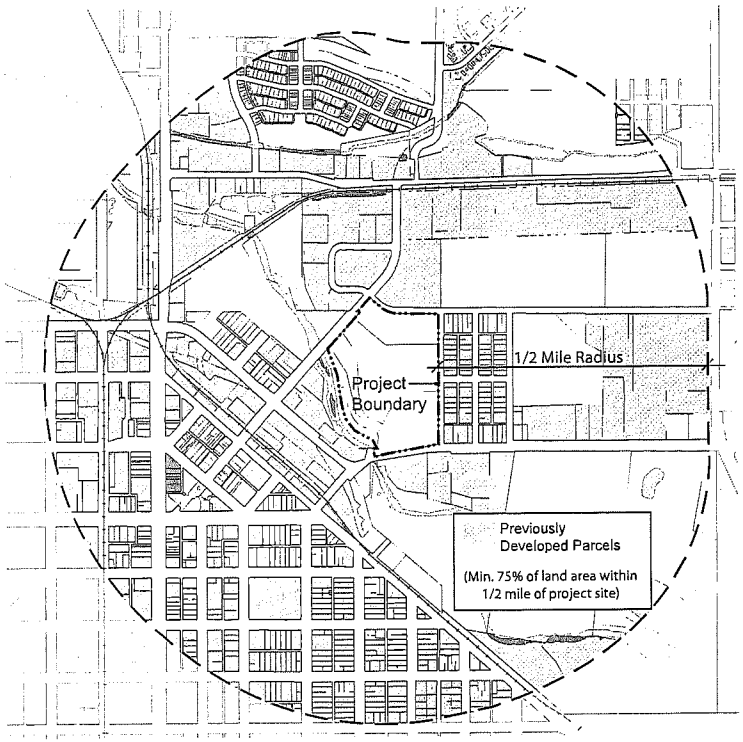
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



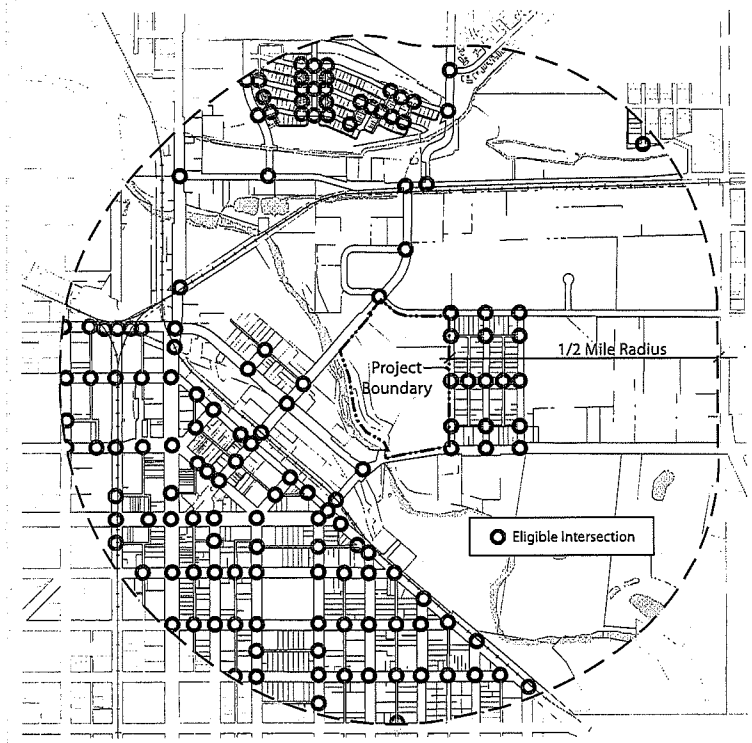
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(c). Infill project site based on minimum 75% of land area within 1/2 mile of project boundary being previously developed



(d). Infill project site based on minimum 140 intersections/sq.mi. within 1/2 mile of project boundary



previously developed altered by paving, construction, and/or land use that would typically have required regulatory permitting to have been initiated (alterations may exist now or in the past). Previously developed land includes a platted lot on which a building was constructed if the lot is no more than 1 acre; previous development on lots larger than 1 acre is defined as the *development footprint* and land alterations associated with the footprint. Land that is not previously developed and altered landscapes resulting from current or historical clearing or filling, agricultural or forestry use, or preserved natural area use are considered undeveloped land. The date of previous development permit issuance constitutes the date of previous development, but permit issuance in itself does not constitute previous development.

ADDITIONAL DEFINITIONS

accessory dwelling unit a subordinate *dwelling unit* that is attached to a principal building or contained in a separate structure on the same property as the principal unit.

adapted (or introduced) plant a species that reliably grows well in a given habitat with minimal attention from humans in the form of winter protection, pest protection, water irrigation, or fertilization once its root systems are established in the soil. Adapted plants are low maintenance but not invasive.

alley a publicly accessible right-of-way, generally located midblock, that can accommodate slow-speed motor vehicles, as well as bicycles and pedestrians. An alley provides access to the side or rear of abutting properties for loading, parking, and other service functions, minimizing the need for these functions to be located along streets. It may be publicly dedicated or privately owned and deeded in perpetuity for general public use.

applicant the entity that prepares the LEED-ND *project* submission and is responsible for project implementation. An applicant may be the *developer* or another cooperating entity.

area median income the median income of a county as determined by the U.S. Department of Housing and Urban Development.

bicycle network a continuous network consisting of any combination of physically designated in-*street* bicycle lanes at least 5 feet wide, off-street bicycle paths or trails at least 8 feet wide for a two-way path and at least 5 feet wide for a one-way path, and/or streets designed for a target speed of 25 miles per hour or slower.

block land bounded by the *project boundary*, transportation or utility rights-of-way that may be publicly dedicated or privately owned and deeded in perpetuity for general public use, waterfront, and/or comparable land division features.

brownfield real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or possible presence of a hazardous substance, pollutant, or contaminate.

build-out the time at which all *habitable buildings* on the *project* are complete and ready for occupancy.

bus rapid transit an enhanced bus system that operates on exclusive bus lanes or other transit rights-of-way; it is designed to combine the flexibility of buses with the efficiency of rail.

community-supported agriculture (CSA) a farm operation for which a community of individuals pledges support so that the farmland becomes, either legally or informally, the community's farm. The growers and consumers provide mutual support, sharing the risks and benefits of food production. Consumers receive portions of the farm's harvest throughout the growing season.

construction impact zone the *project's development footprint* plus the areas around the improvement where construction crews, equipment, and/or materials are staged and moved during construction.

covenants, conditions, and restrictions limitations that may be placed on a property and its use and are made a condition of holding title or lease.

cul-de-sac a *street* segment that terminates without intersecting another street segment.

cultural landscape an officially designated geographic area that includes both cultural and natural resources associated with a historic event, activity, or person or that exhibits other significant cultural or aesthetic values.

density the amount of building structures constructed on the *project site*, measured for residential buildings as *dwelling units* per acre of *buildable land* available for residential uses, and for non-residential buildings as the *floor-area ratio* of buildable land area available for nonresidential uses. In both cases, structured parking is excluded.

developer a public and/or private entity that controls a majority of the *project's buildable land* and is committed to making a majority of the investments required for the project implementation described in the LEED-ND submission.

development footprint the total land area of a *project* site covered by buildings, *streets*, parking areas, and other typically impermeable surfaces constructed as part of the project.

dwelling unit living quarters intended for long-term occupancy that provide facilities for cooking, sleeping, and sanitation. This does not include hotel rooms.

employment center a nonresidential area of at least 5 acres with a job density of at least 50 employees per net acre.

existing present on the date of submission of LEED-ND certification documents; similarly, an element or condition that exists is present on the date that LEED-ND certification documents are submitted.

floor-area ratio (FAR) the *density* of nonresidential land use, exclusive of parking, measured as the total nonresidential building floor area divided by the total *buildable land* area available for nonresidential structures. For example, on a site with 10,000 square feet of buildable land area, an FAR of 1.0 would be 10,000 square feet of building floor area. On the same site, an FAR of 1.5 would be 15,000 square feet of built floor area; an FAR of 2.0 would be 20,000 built square feet and an FAR of 0.5 would be 5,000 built square feet.

functional entry a building opening designed to be used by pedestrians and open during regular business hours. This does not include any door exclusively designated as an emergency exit, or a garage door not designed as a pedestrian entrance.

graywater untreated wastewater that has not come into contact with toilet waste. Graywater includes used water from bathtubs, showers, bathroom washbasins, and water from clothes washers and laundry tubs. It does not include wastewater from kitchen sinks or dishwashers, unless a graywater definition established by the authority having jurisdiction in the area has precedence.

habitable building a structure intended for living, working, or other types of occupancy. Habitable structures do not include stand-alone garages and utility structures such as pump stations.

heat island thermal gradient differences between developed and undeveloped areas.

historic building a building or structure listed or determined to be eligible as a historic structure or building or structure or as a contributing building or structure in a designated historic district, due to its historic, architectural, engineering, archeological, or cultural significance. The building or structure must be designated as historic by a local historic preservation review board or similar body, be listed in a state register of historic places, be listed in the National Register of Historic Places, or have been determined eligible for listing in the National Register.

historic district a group of buildings, structures, objects, and sites, of varying sizes, that have been designated as historically and architecturally significant and categorized as either contributing or noncontributing.

Home Energy Rating System (HERS) index a scoring system established by the Residential Energy Services Network (RESNET) in which a home built to the specifications of the HERS Reference Home (based on the 2006 International Energy Conservation Code) scores 100, and a net zero energy home scores 0. The lower a home's HERS Index, the more energy efficient it is.

invasive plant either an indigenous or nonindigenous species or strain that is characteristically adaptable, aggressive, has a high reproductive capacity, and tends to overrun the ecosystems it inhabits.

major renovations extensive alteration work in addition to work on the exterior shell of the building and/or primary structural components and/or the core and peripheral MEP and service systems and/or site work. Typically, the extent and nature of the work is such that the primary function space cannot be used for its intended purpose while the work is in progress and where a new certificate of occupancy is required before the work area can be reoccupied.

metropolitan (metro) and micropolitan (micro) statistical area a geographic entity defined by the U.S. Office of Management and Budget for use by federal statistical agencies in collecting, tabulating, and publishing federal statistics. A metro area contains a core urban area with a population of 50,000 or more, and a micro area contains an urban core with a population between 10,000 and 50,000. Each metro or micro area consists of one or more counties and includes the counties containing the core urban area, as well as any adjacent counties that have a high degree of social and economic integration (as measured by commuting to work) with the urban core. "Core-based statistical area" (CBSA) encompasses both metro and micro areas.

multiunit residential consisting of four or more residential units sharing a common entry.

native (or indigenous) plant a plant species that did or would have occurred on the site or within the subject county prior to the widespread land alterations that accompanied European settlement. Cultivars of native plants may be considered native plants.

park a publicly accessible area that is permanently maintained in a seminatural condition for human recreation and relaxation; it has soil, grass, water, flora, and/or recreation improvements.

paseo a publicly accessible pedestrian path, at least 4 feet wide and no more than 12 feet wide, that provides shortcuts between buildings and through the block, connecting *street* frontages to rear parking areas, midblock courtyards, *alleys*, or other streets. A paseo may be roofed for up to 50% of its length and may be privately owned or publicly dedicated.

planned diverse use a shop, service, or facility outside the *project boundary* that has received a building permit and is under construction at the time of the first certificate of occupancy is issued for any building in the LEED-ND *project*.

planned occupancy the highest estimate of building occupants based on planned use(s) and industry standards for square foot requirements per employee (see USDOE EIA CBECS survey for suggested default nonresidential occupancies). The minimum planned occupancy for *multiunit residential* buildings is 1 person for a studio unit, 1.5 persons for a one-bedroom unit, and 1.25 persons per bedroom for a two- bedroom or larger unit.

plaza a publicly accessible gathering space that is integrated into the street network and allows vehicular, bicycle, and/or pedestrian travel. A plaza is generally paved, is spatially defined by building fronts paralleling at least two-thirds of its perimeter, and may be privately owned or publicly dedicated.

postconsumer generated by households or commercial, industrial, or institutional facilities in their role as end-users of a product, which can no longer be used for its intended purpose.

potable water water that meets or exceeds EPA's drinking water quality standards and is approved for human consumption by the state or local authorities having jurisdiction; it may be supplied from wells or municipal water systems.

preconsumer diverted from the waste stream during the manufacturing process. It does not include the reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

predevelopment before any development occurred on the site. Predevelopment conditions describe the natural conditions of the site prior to any human alteration, such as development of roads or buildings.

previously developed site a site that, *preproject*, consisted of at least 75% *previously developed* land.

preproject before the LEED-ND *project* was initiated, but not necessarily before any development or disturbance took place. Preproject conditions describe the state of the project site on the date the *developer* acquired rights to a majority of its *buildable land* through purchase or option to purchase.

prime soil earth with chemical, hydrographic, and topological properties that make it especially suited to the production of crops, as defined by the U.S. Natural Resources Conservation Service.

project the land, water, and construction that constitutes the project application. A project *applicant* does not have to own or control all land or water within a *project boundary*, but all the area within the project boundary must comply with prerequisites and attempted credits.

project boundary the platted property line of the *project* defining land and water within it. Projects located on publicly owned campuses that do not have internal property lines must delineate a sphere-of-influence line to be used instead. *Project site* is equivalent to the land and water inside the project boundary. The project must not contain noncontiguous parcels, but parcels can be separated by public rights-of-way. Projects may also have enclaves of nonproject properties that are not subject to the rating system, but such enclaves cannot exceed 2% of the total project area and cannot be described as certified.

school a kindergarten, elementary, or secondary institution for the academic instruction of children.

single-family residential any residential unit other than *multiunit residential*, including single, duplex, triplex, row house, townhouse and semiattached residential building types.

street a dedicated right-of-way that can accommodate one or more modes of travel, excluding *alleys* and *paseos*. A street is suitable for primary entrances and provides access to the front and/or sides of buildings and lots. A street may be privately owned as long as it is deeded in perpetuity for general public use. A street must be an addressable thoroughfare (for mail purposes) under the standards of the applicable regulating authority.

square (also **green**) a publicly accessible open area for gatherings that is wholly or partially bounded by segments of the *street* network. A square can be landscaped or landscaped and paved, is spatially defined by building fronts paralleling at least 45% of its perimeter, and may be privately owned or publicly dedicated.

unique soil earth with chemical, hydrographic, and topological properties that make it especially suited to specific crops, as defined by the U.S. Natural Resources Conservation Service.

walk distance the distance that a pedestrian must travel between origins and destinations without obstruction, in a safe and comfortable environment on a continuous network of sidewalks, all-weather-surface footpaths, crosswalks, *woonerfs*, or equivalent pedestrian facilities.

water body the surface water of a stream (first-order and higher, including intermittent streams), arroyo, river, canal, lake, estuary, bay, or ocean, excluding irrigation ditches

water and wastewater infrastructure publicly owned water and wastewater infrastructure; this excludes septic and mound wastewater treatment systems.

wetland an area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas, but exclude irrigation ditches unless delineated as part of an adjacent wetland.

woonerf a *street*, also known as a home zone, shared zone, or living street, where pedestrians have priority over vehicles and the posted speed limit is no greater than 10 miles per hour. Physical elements within the roadway, such as shared surfaces, plantings, street furniture, parking, and play areas, slow traffic and invite pedestrians to use the entire right-of-way.

vehicle miles traveled (VMT) the number of miles driven by motorists in a specified time period, such as a day or a year, in absolute or per capita terms.

APPENDIX A-23.

SmartCode

SmartCode

Version 9.2

The Town Paper
Publisher

The term "code" derives from "caudex," which was simultaneously the trunk of a tree and set of laws. It is one of several terms clustering around the idea of power being resident in a sacred tree at the center of a traditional village. A code, then, is etymologically and functionally the trunk around which a settlement arranges itself.

Patrick Pinnell

INTRODUCTION

About the SmartCode

The SmartCode is a form-based code that incorporates Smart Growth and New Urbanism principles. It is a unified development ordinance, addressing development at all scales of design, from regional planning on down to the building signage. It is based on the rural-to-urban transect rather than separated-use zoning, thereby able to integrate a full range of environmental techniques. Because the SmartCode envisions intentional outcomes based on known patterns of urban design, it is a more succinct and efficient document than most conventional codes.

The model SmartCode is freeware, available in an editable format from the websites www.smartcodecentral.org and www.transect.org.

The SmartCode is a model ordinance. It is not persuasive and instructive like a guideline, nor is it intentionally general like a vision statement. It is meant to be law, precise and technical, administered by municipal planning departments and interpreted by elected representatives of local government. The SmartCode is designed to be calibrated to local circumstances, ideally with the participation of the local citizens.

This booklet, *SmartCode Version 9.2*, presents the entire 56-page base code in compact form. Another publication, a printed calibrator's Manual, the *SmartCode Version 9 and Manual*, offers a fully annotated SmartCode Version 9.2, and an extended appendix with sample plans, step-by-step procedures, illustrations, historical commentary, checklists, and resources. In addition, there are numerous supplementary Modules, as listed here in the Table of Contents. The Manual is useful for anyone who is considering calibrating and adopting the SmartCode for a project, city, or region. To date (early 2009), over 100 American municipalities and counties have calibrated the SmartCode, with 25 adoptions and many more in process. These numbers do not include scores of private developments.

The official text of the SmartCode appears in a **sans serif font like this**. The introductory commentary appears in a **serif font like this**. Green text indicates items that should be considered for calibration.

Codes and the SmartCode

Consider the most-loved towns of North America. They were either carefully planned, or they evolved as compact, mixed use places because of their geography and the limits of the transportation and economics of their time. However, over the past sixty years, places have evolved in a completely different pattern. They have spread loosely along highways and haphazardly across the countryside, enabled by the widespread ownership of automobiles, by cheap petroleum and cheap land, and by generalized wealth.

Such patterns are enabled by zoning codes that separate dwellings from workplaces, shops, and schools. These codes include design standards that favor the automobile over the pedestrian, and are unable to resist the homogenizing effects of globalization.

These practices have produced banal housing subdivisions, business parks, strip shopping, big box stores, enormous parking lots, and sadly gutted downtowns. They have caused the proliferation of drive-by eateries and billboards. They have made walking or cycling dangerous or unpleasant. They have made children, the elderly, and the poor utterly dependent on those who can drive, even for ordinary daily needs. They have caused the simultaneous destruction of both towns and open space -- the 20th century phenomenon known as sprawl.

The form of our built environment needs a 21st century correction. But in most places it is actually illegal to build in a traditional neighborhood pattern. The existing codes prevent it. In most places people do not have a choice between sprawl and traditional urbanism. Codes favor sprawl and isolated residential subdivisions. It is not a level playing field.

The SmartCode was created to deal with this problem at the point of decisive impact -- the intersection of law and design. It is a form-based code, meaning it envisions and encourages a certain physical outcome -- the form of the region, community, block, and/or building. Form-based codes are fundamentally different from conventional codes that are based primarily on use and statistics -- none of which envision or require any particular physical outcome.

The SmartCode is a tool that guides the form of the built environment in order to create and protect development patterns that are compact, walkable, and mixed use. These traditional neighborhood patterns tend to be stimulating, safe, and ecologically sustainable. The SmartCode requires a mix of uses within walking distance of dwellings, so residents aren't forced to drive everywhere. It supports a connected network to relieve traffic congestion. At the same time, it preserves open lands, as it operates at the scale of the region as well as the community.

INTRODUCTION

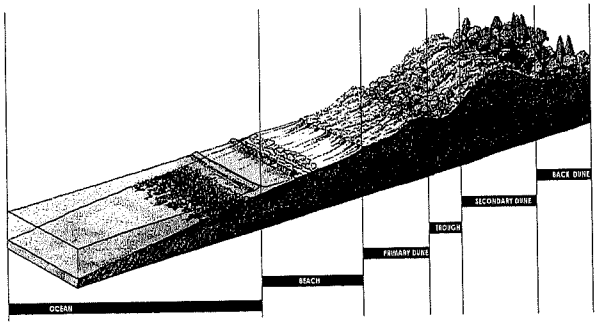
Transect-Based Planning

"A town is saved, not more by the righteous men in it than by the woods and swamps that surround it." -- Henry David Thoreau

The SmartCode is a transect-based code. A transect of nature, first conceived by Alexander Von Humboldt at the close of the 18th century, is a geographical cross-section of a region intended to reveal a sequence of environments. Originally, it was used to analyze natural ecologies, showing varying characteristics through different zones such as shores, wetlands, plains, and uplands. It helps study the many elements that contribute to habitats where certain plants and animals thrive in symbiotic relationship to the minerals and microclimate.

Human beings also thrive in different places. There are those who could never live in an urban center; there are those who would wither in a rural hamlet. Humans need a system that preserves and creates meaningful choices in their habitats. Near the close of the 20th century, New Urbanist designers recognized that sprawl was eradicating the pre-war American transect of the built environment. They began to analyze it and extract its genetic material for replication. In this way, they extended the natural transect to include the built environment, thus establishing the basis for the SmartCode.

The rural-to-urban Transect is divided into six Transect Zones for application on zoning maps. These six habitats vary by the level and intensity of their physical and social character, providing immersive contexts from rural to urban. SmartCode elements are coordinated by these T-zones at all scales of planning, from the region through the community scale down to the individual lot and building.



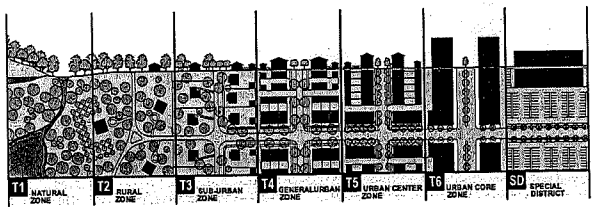
A Typical Natural Transect

One of the principles of Transect-based planning is that certain forms and elements belong in certain environments. For example, an apartment building belongs in a more urban setting, a ranch house in a more rural setting. Some types of thoroughfares are urban in character, and some are rural. A deep suburban setback destroys the spatial enclosure of an urban street; it is out of context. These distinctions and rules don't limit choices; they expand them. This is the antidote for the one-size-fits-all development of today.

The Transect is evident in two ways. Zones and communities (1) exist as characteristic places on the Transect and (2) they evolve along the Transect over time. As places, the six Transect Zones display identifiable characteristics, based on normative American urban patterns. They also increase in complexity, density and intensity over a period of years, until a "climax condition" is reached. This is a growth process analogous to succession in natural environments.

The best urbanism requires the sequential influence of many participants. A code allows buildings to be designed and built by many hands over years, or even generations. The single designer or committee leads to a lack of robustness, similar to vulnerable monocultures in nature. A parametric and successional code like the SmartCode allows experience to feed back and become integrated -- the fourth dimension of time. Once adopted, it stays in place, allowing urbanism to evolve and mature without losing its necessary foundation of order.

It also ensures that a community will not have to scrutinize all proposed projects, because the intentions of the citizens will have already been determined in the process that leads to the code. The SmartCode is a comprehensive framework for that process.



A Typical Rural-Urban Transect, with Transect Zones

Summary: What the SmartCode Does

- It utilizes a type of zoning category that ranges systematically from the wilderness to the urban core.
- It enables and qualifies Smart Growth community patterns that include Clustered Land Development (CLD), Traditional Neighborhood Development (TND™), Regional Center Development (RCD), and Transit-Oriented Development (TOD).
- It integrates the scale of planning concern from the regional through the community scale, on down to the individual lot and, if desired, its architectural elements.
- It integrates the design process across professional disciplines.
- It integrates methods of environmental protection, open space conservation and water quality control.
- It integrates subdivision, public works and Transfer of Development Rights (TDR) standards.
- It provides a set of zoning categories common to new communities and to the infill of existing urbanized areas.
- It is compatible with architectural, environmental, signage, lighting, hazard mitigation, and visitability standards.
- It establishes parity of process for existing and new urban areas.
- It integrates protocols for the preparation and processing of plans.
- It encourages the efficiency of administrative approvals when appropriate, rather than decision by public hearing.
- It encourages specific outcomes through incentives, rather than through prohibitions.
- It specifies standards parametrically (by range) in order to minimize the need for variances.
- It generally increases the range of the options over those allowed by conventional zoning codes.

Outline of the SmartCode

	ARTICLE 2 REGIONAL SCALE PLANS	ARTICLE 3 & ARTICLE 4 COMMUNITY SCALE PLANS		ARTICLE 5 BUILDING SCALE PLANS
	A. Regional Sector	B. Community Unit	C.Transect Zones	Standards
Open Lands	O1 Preserved Open Sector	None	T1 Natural Zone T2 Rural Zone	
	O2 Reserved Open Sector	None		
New Development	G1 Restricted Growth Sector	CLD Clustered Land Development	T2 Rural Zone T3 Sub-Urban Zone T4 General Urban Zone	
	G2 Controlled Growth Sector	CLD Clustered Land Development	T2 Rural Zone T3 Sub-Urban Zone T4 General Urban Zone	Building Disposition Building Configuration
		TND Traditional Neighborhood Development	T3 Sub-Urban Zone T4 General Urban Zone T5 Urban Center Zone	Building Function Density Calculations
	G3 Intended Growth Sector	TND Traditional Neighborhood Development	T3 Sub-Urban Zone T4 General Urban Zone T5 Urban Center Zone	Parking Standards
		RCD Regional Center Development	T4 General Urban Zone T5 Urban Center Zone T6 Urban Core Zone	Landscape Standards Signage Standards
Existing Development	G4 Infill Growth Sector	INFILL TND Traditional Neighborhood Development	T3 Sub-Urban Zone T4 General Urban Zone T5 Urban Center Zone	Supplementary Modules
		INFILL RCD Regional Center Development	T4 General Urban Zone T5 Urban Center Zone T6 Urban Core Zone	
Other			CB Civic Building CS Civic Space	
		SD Special Districts		

INTRODUCTION

The Structure of the SmartCode

Article 1 contains the general instructions pertaining to all other Articles.
Article 2 prescribes how Regional Plans designate the Open Sectors intended for open lands and the Growth Sectors intended for development and redevelopment. It also prescribes what Community Unit types belong in each Sector.
Article 3 prescribes the requirements for New Communities, including the Transect Zones that make up each type.
Article 4 prescribes the Infill requirements for areas already urbanized.
Article 5 prescribes lot and building standards within each Transect Zone.
Article 6 contains diagrams and tables supporting the other Articles.
Article 7 contains terms and definitions supporting the other Articles.

The SmartCode is a unified planning ordinance that applies to three scales of land use. The three patterns are in a nesting relationship.

A. **Regional Sectors** contain designated types of Communities (Article 2).
B. **Community Units** contain designated ratios of Transect Zones (Articles 3 and 4).
C. **Transect Zones** contain the building elements appropriate to them (Articles 5 and 6).

A. Regional Scale:
"Sector" is a neutral term for a geographic area. In the SmartCode, six Sectors establish the locations where certain patterns of development are allowed. This system addresses preservation and development at the Regional scale. The Sectors are assigned as follows:

- **O-1 Preserved Open Sector** and **O-2 Reserved Open Sector** for protection of open lands
- **G-1 Restricted Growth Sector, G-2 Controlled Growth Sector,** and **G-3 Intended Growth Sector** for New Communities
- **G-4 Infill Growth Sector** for managed growth of existing urbanized areas.

B. Community Scale:
The Regional Sectors each contain one or more of the three basic Community Unit types (CLD, TND, RCD).

- **CLD - Clustered Land Development** (Hamlet, settlement, cluster) permitted in Growth Sectors G1, G2
- **TND - Traditional Neighborhood Development** (Village, neighborhood) – permitted in Growth Sectors G2, G3, G4
- **RCD - Regional Center Development** (Regional Center, town center, downtown) – permitted in Growth Sectors G3, G4

C. Transect Zones:
The Transect, as a framework, identifies a range of habitats from the most natural to the most urban. Its continuum, when subdivided, lends itself to the creation of zoning categories. These categories include standards that encourage diversity similar to that of organically evolved settlements. The standards overlap (they are parametric), reflecting the successional ecotones of natural and human communities. The Transect thereby integrates environmental and zoning methodologies, enabling environmentalists to assess the design of social habitats and urbanists to support the viability of natural ones.

- **T-1 Natural Zone** consists of lands approximating or reverting to a wilderness condition, including lands unsuitable for settlement due to topography, hydrology or vegetation.
- **T-2 Rural Zone** consists of sparsely settled lands in open or cultivated state. These include woodland, agricultural land, grassland, and irrigable desert. Typical buildings are farmhouses, agricultural buildings, cabins, and villas.
- **T-3 Sub-Urban Zone** consists of low density residential areas, adjacent to higher zones that some mixed use. Home occupations and outbuildings are allowed. Planting is naturalistic and setbacks are relatively deep. Blocks may be large and the roads irregular to accommodate natural conditions.
- **T-4 General Urban Zone** consists of a mixed use but primarily residential urban fabric. It may have a wide range of building types: single, sideyard, and rowhouses. Setbacks and landscaping are variable. Streets with curbs and sidewalks define medium-sized blocks.
- **T-5 Urban Center Zone** consists of higher density mixed use building that accommodate retail, offices, rowhouses and apartments. It has a tight network of streets, with wide sidewalks, steady street tree planting and buildings set close to the sidewalks.
- **T-6 Urban Core Zone** consists of the highest density and height, with the greatest variety of uses, and civic buildings of regional importance. It may have larger blocks; streets have steady street tree planting and buildings set close to the wide sidewalks. Typically only large towns and cities have an Urban Core Zone.
- **Civic Zone** consists of Civic Buildings and/or Civic Spaces appropriate to thir Transect Zones.
- **Special Districts** consist of areas with buildings that by their Function, Disposition, or Configuration cannot, or should not, conform to one or more of the six normative Transect Zones.

Adjusting the Structure of the SmartCode

To create SmartCodes for different purposes, certain Articles may be discarded and the code reassembled.

- All codes will require the inclusion of **Article 1 General To All Plans, Article 6 Standards & Tables** and **Article 7 Definitions of Terms.**
- If a Regional Plan has already been prepared, or if the code will be used entirely for Infill situations, **Article 2 Regional Scale Plans** may be eliminated.
- If a Community Scale plan has already been prepared, or if there is no prospect of greenfield development, **Article 3 New Community Scale Plans** may be adjusted or eliminated. (Note: Article 4 depends on Article 3 for larger Infill parcels.)
- If an Infill Community Plan already has been prepared or if there is no prospect of Infill development, **Article 4 Infill Community Scale Plans** may be eliminated.
- If and when all plans have been prepared, **Article 5 Building Scale Plans** becomes the de facto code for builders and architects. This Article may be used by developers as the guidelines for their private property owners association.
- A calibrated SmartCode for a municipality should include some Thoroughfare standards and large-site provisions even if Article 3 and/or Article 4 are not used. Portions of Section 3.7 and Article 4 may be incorporated into Article 5 or a new Article created for **Thoroughfare Standards** or **Public Space Standards.**
- In **Article 6,** tables may be individually dropped or modified as necessary.
- In **Article 7,** definitions that do not apply should be deleted, and any necessary new ones added.
- **Modules** and their associated definitions may be added as needed.

Responsibilities for Implementation

The SmartCode requires the preparation of plans that allocate the Sectors, lay out the Communities, and show lot and building placement.

- **Article 2 - Regional Plans** shall be prepared by or on behalf of the Municipal Planning Department.
- **Article 3 - New Community Plans** shall be prepared on behalf of the land owner, the developer, or the Municipal Planning Department.
- **Article 4 - Infill Community Plans** shall be prepared by or on behalf of the Municipal Planning Department.
- **Article 5 - Building Scale Plans** shall be prepared on behalf of a builder or the property owner.
- The Planning Office may include a Development and Design Center (DDC). A DDC may be assigned to advise on the use of the SmartCode and to aid in the design of the Communities and buildings based on it.

Calibrating the SmartCode

- The model code in this booklet must be calibrated for local character and metrics. SmartCode calibration should be done in the context of a public charrette with the advice of urban designers, architects, landscape architects, planners, civil engineers and land use attorneys familiar with the SmartCode.
- For free electronic editable files and PDFs of the model SmartCode v9.0 and v9.2, Supplementary SmartCode Modules, case studies, workshop opportunities, and consultant services, please visit www.SmartCodeCentral.org and www.Transect.org.
- A fully illustrated and annotated 250-page calibrator's manual is available for purchase. To order *SmartCode Version 9 and Manual* contact New Urban News Publications at 607-275-3087 or mail@newurbannews.com, or visit www.newurbannews.com.

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  - VEHICLE MILES TRAVELED
  - WIND POWER
  - ZERO NET ENERGY BUILDINGS
- THOROUGHFARE ASSEMBLIES
- VISITABILITY

1.1 AUTHORITY

1.1.1 The action of the Municipality, State in the adoption of this Code is authorized under the Charter of the Municipality, Section X and Local and State Statutes, Section X.

1.1.2 This Code was adopted as one of the instruments of implementation of the public purposes and objectives of the adopted Municipal Comprehensive Plan. This Code is declared to be in accord with the Municipal Comprehensive Plan, as required by the Local Land Development Statutes.

1.1.3 This Code was adopted to promote the health, safety and general welfare of the _____ of _____, State and its citizens, including protection of the environment, conservation of land, energy and natural resources, reduction in vehicular traffic congestion, more efficient use of public funds, health benefits of a pedestrian environment, historic preservation, education and recreation, reduction in sprawl development, and improvement of the built environment.

1.1.4 This Code was adopted and may be amended by vote of the Planning Commission and Legislative Body.

1.2 APPLICABILITY

1.2.1 Provisions of this Code are activated by "shall" when required; "should" when recommended; and "may" when optional.

1.2.2 The provisions of this Code, when in conflict, shall take precedence over those of other codes, ordinances, regulations and standards except the Local Health and Safety Codes.

1.2.3 The existing _____ of _____, State Zoning Ordinances and the _____ of _____, State Subdivision Ordinances (the "Existing Local Codes") shall continue to be applicable to issues not covered by this Code except where the Existing Local Codes would be in conflict with Section 1.3 Intent.

1.2.4 Capitalized terms used throughout this Code may be defined in Article 7 Definitions of Terms. Article 7 contains regulatory language that is integral to this Code. Those terms not defined in Article 7 shall be accorded their commonly accepted meanings. In the event of conflicts between these definitions and those of the Existing Local Codes, those of this Code shall take precedence.

1.2.5 The metrics of Article 6 Standards and Tables are an integral part of this Code. However, the diagrams and illustrations that accompany them should be considered guidelines, with the exception of those on Table 15 Form-Based Code Graphics, which are also legally binding.

1.2.6 Where in conflict, numerical metrics shall take precedence over graphic metrics.

1.3 INTENT

The intent and purpose of this Code is to enable, encourage and qualify the implementation of the following policies:

1.3.1 THE REGION

a. That the region should retain its natural infrastructure and visual character derived from topography, woodlands, farmlands, riparian corridors and coastlines.
b. That growth strategies should encourage Infill and redevelopment in parity with New Communities.
c. That development contiguous to urban areas should be structured in the pattern of Infill TND or Infill RCD and be integrated with the existing urban pattern.

d. That development non-contiguous to urban areas should be organized in the pattern of CLD, TND, or RCD.
e. That Affordable Housing should be distributed throughout the region to match job opportunities and to avoid concentrations of poverty.
f. That transportation Corridors should be planned and reserved in coordination with land use.
g. That green corridors should be used to define and connect the urbanized areas.
h. That the region should include a framework of transit, pedestrian, and bicycle systems that provide alternatives to the automobile.

1.3.2 THE COMMUNITY

a. That neighborhoods and Regional Centers should be compact, pedestrian-oriented and Mixed Use.
b. That neighborhoods and Regional Centers should be the preferred pattern of development and that Districts specializing in a single use should be the exception.
c. That ordinary activities of daily living should occur within walking distance of most dwellings, allowing independence to those who do not drive.
d. That interconnected networks of Thoroughfares should be designed to disperse traffic and reduce the length of automobile trips.
e. That within neighborhoods, a range of housing types and price levels should be provided to accommodate diverse ages and incomes.
f. That appropriate building Densities and land uses should be provided within walking distance of transit stops.
g. That Civic, institutional, and Commercial activity should be embedded in downtowns, not isolated in remote single-use complexes.
h. That schools should be sized and located to enable children to walk or bicycle to them.
i. That a range of Open Space including Parks, Squares, and playgrounds should be distributed within neighborhoods and downtowns.

1.3.3 THE BLOCK AND THE BUILDING

a. That buildings and landscaping should contribute to the physical definition of Thoroughfares as Civic places.
b. That development should adequately accommodate automobiles while respecting the pedestrian and the spatial form of public areas.
c. That the design of streets and buildings should reinforce safe environments, but not at the expense of accessibility.
d. That architecture and landscape design should grow from local climate, topography, history, and building practice.
e. That buildings should provide their inhabitants with a clear sense of geography and climate through energy efficient methods.
f. That Civic Buildings and public gathering places should be provided as locations that reinforce community identity and support self-government.
g. That Civic Buildings should be distinctive and appropriate to a role more important than the other buildings that constitute the fabric of the city.
h. That the preservation and renewal of historic buildings should be facilitated, to affirm the continuity and evolution of society.
i. That the harmonious and orderly evolution of urban areas should be secured through form-based codes.

1.3.4 THE TRANSECT

a. That Communties should provide meaningful choices in living arrangements as manifested by distinct physical environments.

b. That the Transect Zone descriptions on Table 1 shall constitute the Intent of this Code with regard to the general character of each of these environments.

1.4 PROCESS

1.4.1 Municipality hereby creates a Consolidated Review Committee ("CRC") comprised of a member from each regulatory agency having jurisdiction over the permitting of a project, a representative of the Development and Design Center, and the town architect, to process administratively applications and plans for proposed projects.

1.4.2 The geographic locations of the Sectors and the standards for theTransect Zones shall be determined as set forth in Article 2, Article 3, Article 4, and Article 5 through a process of public consultation with approval by the Legislative Body. Once these determinations have been incorporated into this Code and its associated plans, then projects that require no Variances or Warrants, or only Warrants, shall be processed administratively without further recourse to public consultation.

1.4.3 An owner may appeal a decision of the CRC to the Board of Zoning Adjustment and may appeal a decision of the Board of Zoning Adjustment to the Legislative Body.

1.4.4 Should a violation of an approved Regulating Plan occur during construction, or should any construction, site work, or development be commenced without an approved Regulating Plan or Building Scale Plan, the Board of Zoning Adjustment has the right to require the owner to stop, remove, and/or mitigate the violation, or to secure a Variance to cover the violation.

1.5 WARRANTS AND VARIANCES

1.5.1 There shall be two types of deviation from the requirements of this Code: Warrants and Variances. Whether a deviation requires a Warrant or Variance shall be determined by the CRC.

1.5.2 A Warrant is a ruling that would permit a practice that is not consistent with a specific provision of this Code but is justified by the provisions of Section 1.3 Intent. The CRC shall have the authority to approve or disapprove administratively a request for a Warrant pursuant to regulations established by the CRC.

1.5.3 A Variance is any ruling on a deviation other than a Warrant. Variances shall be granted only in accordance with _____Statutes, _____, as amended.

1.5.4 The request for a Warrant or Variance shall not subject the entire application to public hearing, but only that portion necessary to rule on the specific issue requiring the relief.

1.5.5 The following standards and requirements shall not be available for Warrants or Variances:

a. The maximum dimensions of traffic lanes. (See Table 3a.)

b. The required provision of Rear Alleys and Rear Lanes.

c. The minimum Base Residential Densities. (See Table 14b.)

d. The permission to build Accessory Buildings.

e. The minimum requirements for parking. (See Table 10.)

1.6 SUCCESSION

1.6.1 Twenty years after the approval of a Regulating Plan, each Transect Zone, except the T1 Natural and T2 Rural Zones, shall be automatically rezoned to the successional (next higher) Transect Zone, unless denied in public hearing by the Legislative Body.

AVAILABLE MODULES FOR ARTICLE 1

AFFORDABLE HOUSING INCENTIVES
AFFORDABLE HOUSING POLICY
COMPREHENSIVE PLANNING
HAZARD MITIGATION STANDARDS
INCENTIVES

2.1 INSTRUCTIONS

2.1.1 This Article governs the preparation of Regional Scale Plans ("Regional Plans") that allocate Sectors. For lands within Municipality that have been mapped pursuant to this Article, Sections 2.5 et seq. prescribe the Community Unit types permitted in each Growth Sector. Articles 3 and 4 regulate the standards of those Community Unit types.

2.1.2 Regional Plans shall integrate the largest practical geographic area, overlapping property lines as necessary and municipal boundaries if possible.

2.1.3 Regional Sectors are defined in Article 2 and are comprised of Open Space and growth areas. Growth areas are intended for the development of Communy Units, defined in Article 3 and Article 4, which in turn are comprised of Transect Zones, defined by the elements appropriate to them in Article 5 and Article 6.

2.1.4 Regional Plans shall be prepared by the Planning Office and/or consultants under its supervision. The process shall involve citizen participation and the approval of the Legislative Body.

2.2 SEQUENCE OF SECTOR DETERMINATION

Determination of Sector designations shall be made in the following sequence:

2.2.1 The areas to be designated Preserved Open Sector (O-1) shall be mapped using the criteria listed in Section 2.3. The outline of this Sector is effectively the Rural Boundary Line, which is permanent.

2.2.2 The areas to be designated Reserved Open Sector (O-2) shall be mapped using the criteria listed under Section 2.4. The outline of this Sector is effectively the Urban Boundary Line which is to be adjusted by the ongoing permitting of New Community Plans or Infill Community Plans in accordance with this Code.

2.2.3 The areas to be designated Infill Growth Sectors (G-4) shall be mapped as described in Section 2.8. These areas may be redeveloped according to Article 4 of this Code.

2.2.4 All remaining areas shall be available for new development pursuant to New Community Plans submitted and approved in accordance with Article 3 of this Code. These areas shall be assigned to the Restricted Growth Sector, the Controlled Growth Sector, or the Intended Growth Sector using the criteria listed in this Article. Within these Sectors, the Community Unit types of CLD (Clustered Land Development), TND (Traditional Neighborhood Development), and RCD (Regional Center Development), shall be permitted to the extent set forth in Table 2.

2.2.5 Within the four Growth Sectors, development according to the Existing Local Codes remains as an option.

2.2.6 Those areas that cannot or should not conform to one of the Community Unit types shall be allocated to Special Districts. See Section 2.9.

2.2.7 A system for the gradual Transfer of Development Rights (TDR) shall be established and administered for the purpose of transferring development rights from the Reserved Open Sector (O-2) to the Growth Sectors as set forth in Section 2.4.3.

2.3 (O-1) PRESERVED OPEN SECTOR

2.3.1 The Preserved Open Sector shall consist of Open Space that is protected from development in perpetuity. The Preserved Open Sector includes areas under environmental protection by law or regulation, as well as land acquired for conservation through purchase, by easement, or by past Transfer of Development Rights.

2.3.2 The Preserved Open Sector shall consist of the aggregate of the following categories:
a. surface waterbodies
b. protected wetlands
c. protected habitat
d. riparian Corridors
e. purchased Open Space
f. conservation easements
g. transportation Corridors
h. areas residual to Clustered Land Development (CLD)

2.3.3 Development and construction within the Preserved Open Sector and the specifications required to do so shall be determined on an individual project basis by public hearing of the Legislative Body.

2.4 (O-2) RESERVED OPEN SECTOR

2.4.1 The Reserved Open Sector shall consist of Open Space that should be, but is not yet, protected from development.

2.4.2 The Reserved Open Sector shall consist of the aggregate of the following categories:
a. flood plain, including Special Flood Hazard Areas
b. steep slopes
c. Open Space to be acquired
d. Corridors to be acquired
e. buffers to be acquired
f. legacy woodland
g. legacy farmland
h. legacy viewsheds

2.4.3 The Reserved Open Sector is a Transfer of Development Rights (TDR) sending area, for the gradual sale of rights for development in the Controlled Growth Sector and the Intended Growth Sector. An owner who has purchased such development rights may exceed the allocated Densities of New Communities as set forth in Section 3.8 and Table 14b. Areas from where development rights have been transferred shall be designated Preserved Open Sector.The Planning Office shall maintain a record of such transfers, updating the regional map accordingly.

2.4.4 (For HAZARD MITIGATION STANDARDS)

2.5 (G-1) RESTRICTED GROWTH SECTOR

2.5.1 The Restricted Growth Sector shall be assigned to areas that have value as Open Space but nevertheless are subject to development, either because the zoning has already been granted or because there is no legally defensible reason, in the long term, to deny it.

2.5.2 Within the Restricted Growth Sector, Clustered Land Development (CLD) shall be permitted By Right.

2.6 (G-2) CONTROLLED GROWTH SECTOR

2.6.1 The Controlled Growth Sector shall be assigned to those locations that can support Mixed Use by virtue of proximity to an existing or planned Thoroughfare.

2.6.2 Within the Controlled Growth Sector, CLD and Traditional Neighborhood Development (TND) shall be permitted By Right.

2.6.3 Any TND on an existing or projected rail or Bus Rapid Transit (BRT) network may

be redesignated in whole or in part as TOD and permitted the higher Density represented by the Effective Parking allowance in Section 5.9.2d. The use of a TOD overlay requires approval by Variance.

2.7 (G-3) INTENDED GROWTH SECTOR

2.7.1 The Intended Growth Sector shall be assigned to those locations that can support substantial Mixed Use by virtue of proximity to an existing or planned regional Thoroughfare and/or transit.

2.7.2 Within the Intended Growth Sector, Communities in the pattern of Regional Center Developments (RCD), as well as TNDs, shall be permitted By Right, .

2.7.3 Any TND or RCD on an existing or projected rail or Bus Rapid Transit (BRT) network may be redesignated in whole or in part as TOD and permitted the higher Density represented by the Effective Parking allowance in Section 5.9.2d. The use of a TOD overlay requires approval by Variance.

2.8 (G-4) INFILL GROWTH SECTOR

2.8.1 The Infill Growth Sector shall be assigned to areas already developed, having the potential to be modified, confirmed or completed in the pattern of Infill TNDs or Infill RCDs.

2.9 (SD) SPECIAL DISTRICTS

2.9.1 Special District designations shall be assigned to areas that, by their intrinsic size, Function, or Configuration, cannot conform to the requirements of a CLD, a TND, or an RCD as set forth in Article 3.

2.9.2 Conditions of development for Special Districts shall be determined in public hearing of the Legislative Body and recorded on Table 16. Alternatively, the provisions of the Existing Local Codes shall remain applicable to Special Districts.

AVAILABLE MODULES FOR ARTICLE 2

COMPREHENSIVE PLANNING
HAZARD MITIGATION STANDARDS
PLACE TYPES TRANSLATION
RESIDENTIAL MARKETS
RETAIL MARKETS
RIPARIAN AND WETLAND BUFFERS
SUSTAINABLE URBANISM
- FOOD PRODUCTION
- SOLAR ENERGY
- TREE CANOPY COVER
- VEHICLE MILES TRAVELED
- WIND POWER

3.1 INSTRUCTIONS

3.1.1 Within the Growth Sectors as shown on the Regional Scale Plan ("Regional Plan"), the provisions of Article 3 and this Code in general shall be available By Right, upon request by the owner.

3.1.2 New Community Plans may be prepared in the absence of a Regional Plan or Comprehensive Plan by approval of the Legislative Body. New Community Plans may contain more than one Community Unit and/or more than one Community Unit type.

3.1.3 Once the CRC or Legislative Body approves a New Community Plan, the parcel shall become a Community Planning Area and shall be marked as such on the Zoning Map of Municipality. Within the Community Planning Area, this Code shall be the exclusive and mandatory zoning regulation, and its provisions shall be applied in their entirety.

3.1.4 New Community Plans submitted in accordance with the provisions of this Code, for the appropriate Sector of a Regional Plan and requiring no Variances, shall be approved administratively by the CRC.

3.1.5 New Community Plans may be prepared by an owner or by the Planning Office.

3.1.6 New Community Plans shall include a Regulating Plan consisting of one or more maps showing the following for each Community Unit in the plan area, in compliance with the standards described in this Article:
a. Transect Zones
b. Civic Zones
c. Thoroughfare network
d. Special Districts, if any
e. Special Requirements, if any
f. numbers of Warrants or Variances, if any.

3.1.7 New Community Plans shall include one set of preliminary site plans for each Transect Zone, as provided by Table 15 and Section 5.1.3a.

3.2 SEQUENCE OF COMMUNITY DESIGN

3.2.1 The site shall be structured using one or several Pedestrian Sheds, which should be located according to existing conditions, such as traffic intersections, adjacent developments, and natural features. The site or any Community Unit within it may be smaller or larger than its Pedestrian Shed.

3.2.2 The Pedestrian Sheds may be adjusted to include land falling between or outside them, but the extent of each shall not exceed the acreage limit specified in Section 3.3 for the applicable Community Unit type. An Adjusted Pedestrian Shed becomes the boundary of a Community Unit.

3.2.3 Areas of Transect Zones (Section 3.4) shall be allocated within the boundaries of each Community Unit as appropriate to its type. See Section 3.3 and Table 14a.

3.2.4 Civic Zones shall be assigned according to Section 3.5.

3.2.5 Special Districts, if any, shall be assigned according to Section 3.6.

3.2.6 The Thoroughfare network shall be laid out according to Section 3.7.

3.2.7 Density shall be calculated according to Section 3.8.

3.2.8 Remnants of the site outside the Adjusted Pedestrian Shed(s) shall be assigned to Transect Zones or Civic Space by Warrant or Special District by Variance.

3.3 COMMUNITY UNIT TYPES

3.3.1 **Clustered Land Development (CLD)**

a. A Clustered Land Development (CLD) shall be permitted within the G-1 Restricted Growth Sector and the G-2 Controlled Growth Sector.

b. A CLD shall be structured by one Standard Pedestrian Shed and shall consist of no fewer than 30 acres and no more than 80 acres.

c. A CLD shall include Transect Zones as allocated on Table 2 and Table 14a. A minimum of 50% of the Community Unit shall be permanently allocated to a T1 Natural Zone and/or T2 Rural Zone.

3.3.2 **Traditional Neighborhood Development (TND)**

a. A Traditional Neighborhood Development (TND) shall be permitted within the G-2 Controlled Growth Sector, the G-3 Intended Growth Sector, and the G-4 Infill Growth Sector.

b. A TND within the G-2 Controlled Growth Sector and the G-3 Intended Growth Sector shall be structured by one Standard or Linear Pedestrian Shed and shall be no fewer than 80 acres and no more than 160 acres. See Article 4 for Infill TND acreage requirements in the G-4 Infill Growth Sector.

c. A TND shall include Transect Zones as allocated on Table 2 and Table 14a.

d. Larger sites shall be designed and developed as multiple Communities, each subject to the individual Transect Zone requirements for its type as allocated on Table 2 and Table 14a. The simultaneous planning of adjacent parcels is encouraged.

e. In the T-4 General Urban Zone, a minimum Residential mix of three Building Disposition types (none less than 20%) shall be required, selected from Table 9.

3.3.3 **Regional Center Development (RCD)**

a. A Regional Center Development (RCD) shall be permitted within the G-3 Intended Growth Sector and the G-4 Infill Growth Sector.

b. An RCD within the G-3 Intended Growth Sector shall be structured by one Long Pedestrian Shed or Linear Pedestrian Shed and shall consist of no fewer than 80 acres and no more than 640 acres. See Article 4 for Infill RCD acreage requirements in the G-4 Infill Growth Sector

c. An RCD shall include Transect Zones as allocated on Table 2 and Table 14a.

d. For larger sites, an RCD may be adjoined without buffer by one or more TNDs, each subject to the individual Transect Zone requirements for TND as allocated on Table 2 and Table 14a. The simultaneous planning of adjacent parcels is encouraged.

3.3.4 **Transit Oriented Development (TOD)**

a. Any TND or RCD on an existing or projected rail or Bus Rapid Transit (BRT) network may be redesignated in whole or in part as TOD and permitted the higher Density represented by the Effective Parking allowance in Section 5.9.2d.

b. The use of a TOD overlay requires approval by Variance.

3.4 TRANSECT ZONES

3.4.1 Transect Zones shall be assigned and mapped on each New Community Plan according to the percentages allocated on Tables 2 and 14a.

3.4.2 A Transect Zone may include any of the elements indicated for its T-zone number throughout this Code, in accordance with Intent described in Table 1 and the metric standards summarized in Table 14.

3.5 CIVIC ZONES

3.5.1 **General**

a. Civic Zones dedicated for public use shall be required for each Community Unit and designated on the New Community Plan as Civic Space (CS) and Civic Building (CB).

b. Civic Space Zones are public sites permanently dedicated to Open Space.

c. Civic Building Zones are sites dedicated for buildings generally operated by not-for-profit organizations dedicated to culture, education, religion, government, transit and municipal parking, or for a use approved by the Legislative Body.

d. A Civic Zone may be permitted by Warrant if it does not occupy more than 20% of a Pedestrian Shed, otherwise it is subject to the creation of a Special District. See Section 3.6.

e. Parking for Civic Zones shall be determined by Warrant. Civic parking lots may remain unpaved if graded, compacted and landscaped.

3.5.2 **Civic Zones Specific to T1 & T2 Zones**

a. Civic Buildings and Civic Spaces within T1 Natural and T2 Rural Zones shall be permitted only by Variance.

3.5.3 **Civic Space (CS) Specific to T3-T6 Zones**

a. Each Pedestrian Shed shall assign at least 5% of its Urbanized area to Civic Space.

b. Civic Spaces shall be designed as generally described in Table 13, approved by Warrant, and distributed throughout Transect Zones as described in Table 14e.

c. Those portions of the T1 Natural Zone that occur within a development parcel shall be part of the Civic Space allocation and should conform to the Civic Space types specified in Table 13a or 13b.

d. Each Pedestrian Shed shall contain at least one Main Civic Space. The Main Civic Space shall be within 800 feet of the geographic center of each Pedestrian Shed, unless topographic conditions, pre-existing Thoroughfare alignments or other circumstances prevent such location. A Main Civic Space shall conform to one of the types specified in Table 13b, 13c, or 13d.

e. Within 800 feet of every Lot in Residential use, a Civic Space designed and equipped as a playground shall be provided. A playground shall conform to Table 13e.

f. Each Civic Space shall have a minimum of 50% of its perimeter enfronting a Thoroughfare, except for playgrounds.

g. Civic Spaces may be permitted within Special Districts by Warrant.

h. Parks may be permitted in Transect Zones T4, T5 and T6 by Warrant.

3.5.4 **Civic Buildings (CB) Specific to T3-T6 Zones**

a. The owner shall covenant to construct a Meeting Hall or a Third Place in proximity to the Main Civic Space of each Pedestrian Shed. Its corresponding Public Frontage shall be equipped with a shelter and bench for a transit stop.

b. One Civic Building Lot shall be reserved for an elementary school. Its area shall be one (1) acre for each increment of 100 dwelling units provided by the Community Plan, with a minimum of three (3) acres. The school site may be within any Transect Zone. Any playing fields should be outside the Pedestrian Shed.

c. One Civic Building Lot suitable for a childcare building shall be reserved within each Pedestrian Shed. The owner or a homeowners' association or other community council may organize, fund and construct an appropriate building as the need arises.

d. Civic Building sites shall not occupy more than 20% of the area of each Pedestrian Shed.
e. Civic Building sites should be located within or adjacent to a Civic Space, or at the axial termination of a significant Thoroughfare.
f. Civic Buildings shall not be subject to the standards of Article 5. The particulars of their design shall be determined by Warrant.
g. Civic Buildings may be permitted within Special Districts by Warrant.

3.6 SPECIAL DISTRICTS

3.6.1 Special District designations shall be assigned to areas that, by their intrinsic size, Function, or Configuration, cannot conform to the requirements of any Transect Zone or combination of zones. Conditions of development for Special Districts shall be determined in public hearing of the Legislative Body and recorded on Table 16.

3.7 THOROUGHFARE STANDARDS

3.7.1 GENERAL

a. Thoroughfares are intended for use by vehicular and pedestrian traffic and to provide access to Lots and Open Spaces.
b. Thoroughfares shall generally consist of vehicular lanes and Public Frontages.
c. Thoroughfares shall be designed in context with the urban form and desired design speed of the Transect Zones through which they pass. The Public Frontages of Thoroughfares that pass from one Transect Zone to another shall be adjusted accordingly or, alternatively, the Transect Zone may follow the alignment of the Thoroughfare to the depth of one Lot, retaining a single Public Frontage throughout its trajectory.
d. Within the most rural Zones (T1 and T2) pedestrian comfort shall be a secondary consideration of the Thoroughfare. Design conflict between vehicular and pedestrian generally shall be decided in favor of the vehicle. Within the more urban Transect Zones (T3 through T6) pedestrian comfort shall be a primary consideration of the Thoroughfare. Design conflict between vehicular and pedestrian movement generally shall be decided in favor of the pedestrian.
e. The Thoroughfare network shall be designed to define Blocks not exceeding the size prescribed in Table 14c. The perimeter shall be measured as the sum of Lot Frontage Lines. Block perimeter at the edge of the development parcel shall be subject to approval by Warrant.
f. All Thoroughfares shall terminate at other Thoroughfares, forming a network. Internal Thoroughfares shall connect wherever possible to those on adjacent sites. Cul-de-sacs shall be subject to approval by Warrant to accommodate specific site conditions only.
g. Each Lot shall Enfront a vehicular Thoroughfare, except that 20% of the Lots within each Transect Zone may Enfront a Passage.
h. Thoroughfares along a designated B-Grid may be exempted by Warrant from one or more of the specified Public Frontage or Private Frontage requirements. See Table 7.
i. Standards for Paths and Bicycle Trails shall be approved by Warrant.
j. The standards for Thoroughfares within Special Districts shall be determined by Variance.

3.7.2 VEHICULAR LANES

a. Thoroughfares may include vehicular lanes in a variety of widths for parked and for moving vehicles, including bicycles. The standards for vehicular lanes shall be as shown in Table 3A.
b. A bicycle network consisting of Bicycle Trails, Bicycle Routes and Bicycle Lanes should be provided throughout as defined in Article 7 Definitions of Terms and allocated as specified in Table 14d. Bicycle Routes should be marked with Sharrows. The community bicycle network shall be connected to existing or proposed regional networks wherever possible.

3.7.3 PUBLIC FRONTAGES

a. GENERAL TO ALL ZONES **T1, T2, T3, T4, T5, T6**
   i. The Public Frontage contributes to the character of the Transect Zone, and includes the types of Sidewalk, Curb, planter, bicycle facility, and street trees.
   ii. Public Frontages shall be designed as shown in Table 4A and Table 4B and allocated within Transect Zones as specified in Table 14d.
   iii. Within the Public Frontages, the prescribed types of Public Planting and Public Lighting shall be as shown in Table 4A, Table 4B, Table 5 and Table 6. The spacing may be adjusted by Warrant to accommodate specific site conditions.
b. SPECIFIC TO ZONES **T1, T2, T3**
   i. The Public Frontage shall include trees of various species, naturalistically clustered, as well as understory.
   ii. The introduced landscape shall consist primarily of native species requiring minimal irrigation, fertilization and maintenance. Lawn shall be permitted only by Warrant.
c. SPECIFIC TO ZONE **T4, T5, T6**
   i. The introduced landscape shall consist primarily of durable species tolerant of soil compaction.
d. SPECIFIC TO ZONE **T4**
   i. The Public Frontage shall include trees planted in a regularly-spaced Allee pattern of single or alternated species with shade canopies of a height that, at maturity, clears at least one Story.
e. SPECIFIC TO ZONES **T5, T6**
   i. The Public Frontage shall include trees planted in a regularly-spaced Allee pattern of single species with shade canopies of a height that, at maturity, clears at least one Story. At Retail Frontages, the spacing of the trees may be irregular, to avoid visually obscuring the shopfronts.
   ii. Streets with a Right-of-Way width of 40 feet or less shall be exempt from the tree requirement.

3.8 DENSITY CALCULATIONS

3.8.1 All areas of the New Community Plan site that are not part of the O-1 Preserved Sector shall be considered cumulatively the Net Site Area. The Net Site Area shall be allocated to the various Transect Zones according to the parameters specified in Table 14a.

3.8.2 Density shall be expressed in terms of housing units per acre as specified for the area of each Transect Zone by Table 14b. For purposes of Density calculation, the Transect Zones include the Thoroughfares but not land assigned to Civic Zones. Ten percent (10%) shall be in the Affordable Housing range.

3.8.3 The Base Density of the Community Unit may be increased by the Transfer of Development Rights (TDR) up to the amount specified for each Zone by Table 14b. Fifteen percent (15%) of the increase in housing units by TDR shall be in the Affordable Housing range.

3.8.4 Within the percentage range shown on Table 14b for Other Functions, the housing units specified on Table 14b shall be exchanged at the following rates:
a. For Lodging: 2 bedrooms for each unit of Net Site Area Density.
b. For Office or Retail: 1000 square feet for each unit of Net Site Area Density.
c. The number of units exchanged shall be subject to approval by Warrant.

3.8.5 The housing and other Functions for each Transect Zone shall be subject to further adjustment at the building scale as limited by Table 10, Table 11 and Section 5.9.

3.9 SPECIAL REQUIREMENTS

3.9.1 A New Community Plan may designate any of the following Special Requirements:

a. A differentiation of the Thoroughfares as A-Grid and B-Grid. Buildings along the A-Grid shall be held to the highest standard of this Code in support of pedestrian activity. Buildings along the B-Grid may be more readily considered for Warrants allowing automobile-oriented standards. The Frontages assigned to the B-Grid shall not exceed 30% of the total length of Frontages within a Pedestrian Shed.

b. Designations for Mandatory and/or Recommended Retail Frontage requiring or advising that a building provide a Shopfront at Sidewalk level along the entire length of its Private Frontage. The Shopfront shall be no less than 70% glazed in clear glass and shaded by an awning overlapping the Sidewalk as generally illustrated in Table 7 and specified in Article 5. The first floor shall be confined to Retail use through the depth of the second Layer. (Table 17d)

c. Designations for Mandatory and/or Recommended Gallery Frontage, requiring or advising that a building provide a permanent cover over the Sidewalk, either cantilevered or supported by columns. The Gallery Frontage designation may be combined with a Retail Frontage designation..

d. Designations for Mandatory and/or Recommended Arcade Frontage, requiring or advising that a building overlap the Sidewalk such that the first floor Facade is a colonnade. The Arcade Frontage designation may be combined with a Retail Frontage designation.

e. A designation for Coordinated Frontage, requiring that the Public Frontage (Table 4A) and Private Frontage (Table 7) be coordinated as a single, coherent landscape and paving design.

f. Designations for Mandatory and/or Recommended Terminated Vista locations, requiring or advising that the building be provided with architectural articulation of a type and character that responds visually to the location, as approved by the CRC.

g. A designation for Cross Block Passages, requiring that a minimum 8-foot-wide pedestrian access be reserved between buildings.

h. A designation for Buildings of Value, requiring that such buildings and structures may be altered or demolished only in accordance with Municipal Preservation Standards and Protocols.

AVAILABLE MODULES FOR ARTICLE 3

- AFFORDABLE HOUSING POLICY
- AGRICULTURAL URBANISM
- CYCLING STANDARDS
- GENERATIVE CODING
- HAZARD MITIGATION STANDARDS
- LIGHT IMPRINT MATRIX
- LIGHTING DESIGN
- NATURAL DRAINAGE STANDARDS
- PLACE TYPES TRANSLATION
- RESIDENTIAL MARKETS
- RETAIL MARKETS
- RIPARIAN AND WETLAND BUFFERS
- SUSTAINABLE URBANISM
  - BUILDING ORIENTATION
  - COMPOSTING & RECYCLING
  - FOOD PRODUCTION
  - PUBLIC DARKNESS
  - SHADING OF GLAZING
  - SOLAR ENERGY
  - STORMWATER MANAGEMENT
  - SURFACE TO VOLUME RATIO
  - TREE CANOPY COVER
  - VEHICLE MILES TRAVELED
  - WIND POWER
  - ZERO NET ENERGY BUILDINGS
- THOROUGHFARE ASSEMBLIES

4. 1 INSTRUCTIONS

4.1.1 Within the G-4 Infill Growth Sector of the Regional Plan (Article 2), or other areas designated as Infill, the Planning Office shall prepare, or have prepared on its behalf, Infill Regulating Plans to guide further development. Infill Regulating Plans shall be prepared in a process of public consultation subject to approval by the Legislative Body.

4.1.2 Infill Regulating Plans shall regulate, at minimum, an area the size of the Pedestrian Shed commensurate with its Community Unit type as listed in Section 4.2. The Planning Office shall determine a Community Unit type based on existing conditions and intended evolution in the plan area.

4.1.3 Infill Regulating Plans shall consist of one or more maps showing the following:

a. The outline(s) of the Pedestrian Shed(s) and the boundaries of the Community Unit(s)
b. Transect Zones and any Civic Zones within each Pedestrian Shed, assigned according to an analysis of existing conditions and future needs
c. a Thoroughfare network, existing or planned (Table 3A, Table 3B, Table 4A, Table 4B, and Table 4C)
d. any Special Districts (Section 4.5)
e. any Special Requirements (Section 4.7)
f. a record of any Warrants or Variances.

4.1.4 Within any area subject to an approved Infill Regulating Plan, this Code becomes the exclusive and mandatory regulation. Property owners within the plan area may submit Building Scale Plans under Article 5 in accordance with the provisions of this Code. Building Scale Plans requiring no Variances shall be approved administratively by the CRC.

4.1.5 The owner of a parcel, or abutting parcels, consisting of 10 acres or more of contiguous lots within an area subject to an Infill Regulating Plan may apply to prepare a Special Area Plan. In consultation with the Planning Office, a Special Area Plan may assign new Transect Zones, Civic Zones, Thoroughfares, Special Districts and/or Special Requirements as provided in this Code, with appropriate transitions to abutting areas. Special Area Plans may be approved by Warrant.

4.1.6 The owner of a parcel, or abutting parcels, consisting of 30 acres or more of contiguous lots, whether inside or outside an area already subject to an Infill Regulating Plan, may initiate the preparation of a New Community Plan. New Community Plans for the G-4 Sector, or other areas designated as Infill by the Planning Office, shall regulate, at minimum, an area the size of the Pedestrian Shed commensurate with its Community Unit type as listed in Section 4.2, even if it overlaps adjacent parcels. Both the site and plan area should connect and blend with surrounding urbanism.

4.2 COMMUNITY UNIT TYPES

4.2.1 Infill Regulating Plans shall encompass one or more of the following Community Unit types. The allocation percentages of Table 14a do not apply.

4.2.2 **Infill TND (Traditional Neighborhood Development)**

a. An Infill TND should be assigned to neighborhood areas that are predominantly residential with one or more Mixed Use Corridors or centers. An Infill TND shall be mapped as at least one complete Standard Pedestrian Shed, which may be adjusted as a Network Pedestrian Shed, oriented around one or more existing or planned Common Destinations.

b. The edges of an Infill TND should blend into adjacent neighborhoods and/or a downtown without buffers.

4.2.3 **Infill RCD (Regional Center Development)**

a. An Infill RCD should be assigned to downtown areas that include significant Office and Retail uses as well as government and other Civic institutions of regional importance. An Infill RCD shall be mapped as at least one complete Long or Linear Pedestrian Shed, which may be adjusted as a Network Pedestrian Shed, oriented around an important Mixed Use Corridor or center.
b. The edges of an Infill RCD should blend into adjacent neighborhoods without buffers.

4.2.4 **Infill TOD (Transit Oriented Development)**

a. Any Infill TND or Infill RCD on an existing or projected rail or Bus Rapid Transit (BRT) network may be redesignated in whole or in part as TOD and permitted the higher Density represented by the Effective Parking allowance in Section 5.9.2d.
b. The use of a TOD overlay shall be approved by Variance.

4.3 TRANSECT ZONES

4.3.1 Transect Zone standards for Infill Regulating Plans should be calibrated by means of a survey of exemplary existing and intended conditions, as identified in a process of public consultation and subject to the approval of the Legislative Body. Metrics shall be recorded on Table 14 and Table 15.

4.3.2 A Transect Zone shall include elements indicated by Article 3, Article 5, and Article 6.

4.4 CIVIC ZONES

4.4.1 **General**

a. Infill Plans should designate Civic Space Zones (CS) and Civic Building Zones (CB).
b. A Civic Zone may be permitted by Warrant if it does not occupy more than 20% of a Pedestrian Shed, otherwise it is subject to the creation of a Special District. See Section 4.5.
c. Parking provisions for Civic Zones shall be determined by Warrant.

4.4.2 **Civic Space Zones (CS)**

a. Civic Spaces shall be generally designed as described in Table 13, their type determined by the surrounding or adjacent Transect Zone in a process of public consultation subject to the approval of the Legislative Body.

4.4.3 **Civic Building Zones (CB)**

a. Civic Buildings shall be permitted by Variance in any Transect Zone or by Warrant on Civic Zones reserved in the Infill Regulating Plan.
b. Civic Buildings shall not be subject to the Requirements of Article 5. The particulars of their design shall be determined by Warrant.

4.5 SPECIAL DISTRICTS

4.5.1 Areas that, by their intrinsic size, Function, or Configuration, cannot conform to the requirements of any Transect Zone or combination of zones shall be designated as Special Districts by the Planning Office in the process of preparing an Infill Plan. Conditions of development for Special Districts shall be determined in public hearing of the Legislative Body and recorded on Table 16.

4.6 PRE-EXISTING CONDITIONS

4.6.1 Existing buildings and appurtenances that do not conform to the provisions of this Code may continue in the same use and form until a Substantial Modification occurs or is requested, at which time the Consolidated Review Committee (CRC) shall determine the provisions of this Section that shall apply.

4.6.2 Existing buildings that have at any time received a certificate of occupancy shall not require upgrade to the current Building Code and when renovated may meet the standards of the code under which they were originally permitted.

4.6.3 The modification of existing buildings is permitted By Right if such changes result in greater conformance with the specifications of this Code.

4.6.4 Where buildings exist on adjacent Lots, the CRC may require that a proposed building match one or the other of the adjacent Setbacks and heights rather than the provisions of this Code.

4.6.5 Any addition to or modification of a Building of Value that has been designated as such by the Local Preservation Organization or to a building actually or potentially eligible for inclusion on a state, local or national historic register, shall be subject to approval by the Local Preservation Organization.

4.6.6 The restoration or rehabilitation of an existing building shall not require the provision of (a) parking in addition to that existing or (b) on-site stormwater retention/detention in addition to that existing. Existing parking requirements that exceed those for this Code may be reduced as provided by Tables 10 and 11.

4.7 SPECIAL REQUIREMENTS

4.7.1 An Infill Community Plan may designate any of the following Special Requirements:

a. A differentiation of the Thoroughfares as A-Grid and B-Grid. Buildings along the A-Grid shall be held to the highest standard of this Code in support of pedestrian activity. Buildings along the B-Grid may be more readily considered for Warrants allowing automobile-oriented standards. The Frontages assigned to the B-Grid shall not exceed 30% of the total length of Frontages within a Pedestrian Shed.

b. Designations for Mandatory and/or Recommended Retail Frontage requiring or advising that a building provide a Shopfront at Sidewalk level along the entire length of its Private Frontage. The Shopfront shall be no less than 70% glazed in clear glass and shaded by an awning overlapping the Sidewalk as generally illustrated in Table 7 and specified in Article 5. The first floor shall be confined to Retail use through the depth of the second Layer. (Table 17d.)

c. Designations for Mandatory and/or Recommended Gallery Frontage, requiring or advising that a building provide a permanent cover over the Sidewalk, either cantilevered or supported by columns. The Gallery Frontage designation may be combined with a Retail Frontage designation.

d. Designations for Mandatory and/or Recommended Arcade Frontage, requiring or advising that a building overlap the Sidewalk such that the first floor Facade is a colonnade. The Arcade Frontage designation may be combined with a Retail Frontage designation.

e. A designation for Coordinated Frontage, requiring that the Public Frontage (Table 4A) and Private Frontage (Table 7) be coordinated as a single, coherent landscape and paving design.

f. Designations for Mandatory and/or Recommended Terminated Vista locations, requiring or advising that the building be provided with architectural articulation of a type and character that responds visually to the location, as approved by the CRC.

g. A designation for Cross Block Passages, requiring that a minimum 8-foot-wide pedestrian access be reserved between buildings.

h. A designation for Buildings of Value, requiring that such buildings and structures may be altered or demolished only in accordance with Municipal Preservation Standards and Protocols.

AVAILABLE MODULES FOR ARTICLE 4

AFFORDABLE HOUSING POLICY
AGRICULTURAL URBANISM
CYCLING STANDARDS
GENERATIVE CODING
HAZARD MITIGATION STANDARDS
LIGHT IMPRINT MATRIX
LIGHTING DESIGN
NATURAL DRAINAGE STANDARDS
PLACE TYPES TRANSLATION
RESIDENTIAL MARKETS
RETAIL MARKETS
RIPARIAN AND WETLAND BUFFERS
SUBURBAN RETROFIT
SUSTAINABLE URBANISM
- BUILDING ORIENTATION
- COMPOSTING & RECYCLING
- FOOD PRODUCTION
- PUBLIC DARKNESS
- SHADING OF GLAZING
- SOLAR ENERGY
- STORMWATER MANAGEMENT
- SURFACE TO VOLUME RATIO
- TREE CANOPY COVER
- VEHICLE MILES TRAVELED
- WIND POWER
- ZERO NET ENERGY BUILDINGS

THOROUGHFARE ASSEMBLIES

5.1 INSTRUCTIONS

5.1.1 Lots and buildings located within a New Community Plan or Infill Community Plan governed by this Code and previously approved by the Legislative Body shall be subject to the requirements of this Article.

5.1.2 Owners and developers may have the design plans required under this Article prepared on their behalf. Such plans require administrative approval by the CRC.

5.1.3 Building and site plans submitted under this Article shall show the following, in compliance with the standards described in this Article:

a. For preliminary site and building approval:
- Building Disposition
- Building Configuration
- Building Function
- Parking Location Standards

b. For final approval, in addition to the above:
- Landscape Standards
- Signage Standards
- Special Requirements, if any
- Hazard Mitigation Standards
- Natural Drainage Standards
- Architectural Standards
- Lighting Standards
- Sound Standards
- Visitability Standards

5.1.4 Special Districts that do not have provisions within this Code shall be governed by the standards of the pre-existing zoning.

5.2 PRE-EXISTING CONDITIONS

5.2.1 Existing buildings and appurtenances that do not conform to the provisions of this Code may continue in use as they are until a Substantial Modification is requested, at which time the CRC shall determine the provisions of this section that shall apply.

5.2.2 Existing buildings that have at any time received a certificate of occupancy shall not require upgrade to the current Building Code and when renovated may meet the standards of the code under which they were originally permitted.

5.2.3 The modification of existing buildings is permitted By Right if such changes result in greater conformance with the specifications of this Code.

5.2.4 Where buildings exist on adjacent Lots, the CRC may require that a proposed building match one or the other of the adjacent Setbacks and heights rather than the provisions of this Code.

5.2.5 Any addition to or modification of a Building of Value that has been designated as such by the Local Preservation Organization, or to a building actually or potentially eligible for inclusion on a state, local or national historic register, shall be subject to approval by the Local Preservation Organization.

5.2.6 The restoration or rehabilitation of an existing building shall not require the provision of (a) parking in addition to that existing nor (b) on-site stormwater retention/detention in addition to that existing. Existing parking requirements that exceed those for this Code may be reduced as provided by Table 10 and Table 11.

5.3 SPECIAL REQUIREMENTS

5.3.1 To the extent that a Regulating Plan for either a New Community Plan or an Infill Community Plan designates any of the following Special Requirements, standards shall be applied as follows:

a. Buildings along the A-Grid shall be held to the highest standard of this Code in support of pedestrian activity. Buildings along the B-Grid may be more readily considered for Warrants allowing automobile-oriented standards.

b. a Mandatory or Recommended Retail Frontage designation requires or advises that a building provide a Shopfront at Sidewalk level along the entire length of its Private Frontage. The Shopfront shall be no less than 70% glazed in clear glass and shaded by an awning overlapping the Sidewalk as generally illustrated in Table 7. The first floor shall be confined to Retail use through the depth of the second Layer. (Table 17d.)

c. a Mandatory or Recommended Gallery Frontage designation requires or advises that a building provide a permanent cover over the Sidewalk, either cantilevered or supported by columns (as generally illustrated in Table 7). A Gallery Frontage may be combined with a Retail Frontage.

d. a Mandatory or Recommended Arcade Frontage designation requires or advises that a building overlap the Sidewalk such that the first floor Facade is a colonnade (as generally illustrated in Table 7 and Table 8). The Arcade Frontage may be combined with a Retail Frontage.

e. a Coordinated Frontage designation requires that the Public Frontage (Table 4A) and Private Frontage (Table 7) be coordinated as a single, coherent landscape and paving design.

f. a Mandatory or Recommended Terminated Vista designation requires or advises that the building be provided with architectural articulation of a type and character that responds visually to its axial location, as approved by the CRC.

g. a Cross Block Passage designation requires that a minimum 8-foot-wide pedestrian access be reserved between buildings.

h. a Building of Value designation requires that the building or structure may be altered or demolished only in accordance with Municipal Preservation Standards and Protocols.

5.4 CIVIC ZONES

5.4.1 **General**

a. Civic Zones are designated on Community Plans as Civic Space (CS) or Civic Building (CB).

b. Parking provisions for Civic Zones shall be determined by Warrant.

5.4.2 **Civic Spaces (CS)**

a. Civic Spaces shall be generally designed as described in Table 13.

5.4.3 **Civic Buildings (CB)**

a. Civic Buildings shall not be subject to the requirements of this Article. The particulars of their design shall be determined by Warrant.

5.5 SPECIFIC TO T1 NATURAL ZONE

5.5.1 Buildings in the T1 Natural Zone are permitted only by Variance. Permission to build in T1 and the standards for Article 5 shall be determined concurrently as Variances, in public hearing of the Legislative Body.

5.6 BUILDING DISPOSITION

5.6.1 **Specific to zone T2**

a. Building Disposition shall be determined by Warrant.

5.6.2 **Specific to zones T3, T4, T5, T6**

a. Newly platted Lots shall be dimensioned according to Table 14f and Table 15.
b. Building Disposition types shall be as shown in Table 9 and Table 14i.
c. Buildings shall be disposed in relation to the boundaries of their Lots according to Table 14g, Table 14h, and Table 15.
d. One Principal Building at the Frontage, and one Outbuilding to the rear of the Principal Building, may be built on each Lot as shown in Table 17c.
e. Lot coverage by building shall not exceed that recorded in Table 14f and Table 15.
f. Facades shall be built parallel to a rectilinear Principal Frontage Line or to the tangent of a curved Principal Frontage Line, and along a minimum percentage of the Frontage width at the Setback, as specified as Frontage Buildout on Table 14g and Table 15.
g. Setbacks for Principal Buildings shall be as shown in Table 14g and Table 15. In the case of an Infill Lot, Setbacks shall match one of the existing adjacent Setbacks. Setbacks may otherwise be adjusted by Warrant.
h. Rear Setbacks for Outbuildings shall be a minimum of 12 feet measured from the centerline of the Rear Alley or Rear Lane easement. In the absence of Rear Alley or Rear Lane, the rear Setback shall be as shown in Table 14h and Table 15.
i. To accommodate slopes over ten percent, relief from front Setback requirements is available by Warrant.

5.6.3 **Specific to zone T6**

a. The Principal Entrance shall be on a Frontage Line.

5.7 BUILDING CONFIGURATION

5.7.1 **General to zones T2, T3, T4, T5, T6**

a. The Private Frontage of buildings shall conform to and be allocated in accordance with Table 7 and Table 14j.
b. Buildings on corner Lots shall have two Private Frontages as shown in Table 17. Prescriptions for the second and third Layers pertain only to the Principal Frontage. Prescriptions for the first Layer pertain to both Frontages.
c. All Facades shall be glazed with clear glass no less than 30% of the first Story.
d. Building heights, Stepbacks, and Extension Lines shall conform to Table 8 and Table 14j.
e. Stories may not exceed 14 feet in height from finished floor to finished ceiling, except for a first floor Commercial Function, which shall be a minimum of 11 feet with a maximum of 25 feet. A single floor level exceeding 14 feet, or 25 feet at ground level, shall be counted as two (2) stories. Mezzanines extending beyond 33% of the floor area shall be counted as an additional Story.
f. In a Parking Structure or garage, each above-ground level counts as a single Story regardless of its relationship to habitable Stories.
g. Height limits do not apply to Attics or raised basements, masts, belfries, clock towers, chimney flues, water tanks, or elevator bulkheads. Attics shall not exceed 14 feet in height.

5.7.2 **Specific to zones T2, T3, T4, T5**

a. The habitable area of an Accessory Unit within a Principal Building or an Outbuilding shall not exceed 440 square feet, excluding the parking area.

5.7.3 **Specific to zone T3**

a. No portion of the Private Frontage may Encroach the Sidewalk.
b. Open porches may Encroach the first Layer 50% of its depth. (Table 17d)
c. Balconies and bay windows may Encroach the first Layer 25% of its depth except that balconies on porch roofs may Encroach as does the porch.

5.7.4 **Specific to zone T4**

a. Balconies, open porches and bay windows may Encroach the first Layer 50% of its depth. (Table 17d)

5.7.5 **Specific to zones T5, T6**

a. Awnings, Arcades, and Galleries may Encroach the Sidewalk to within 2 feet of the Curb but must clear the Sidewalk vertically by at least 8 feet.
b. Maximum Encroachment heights (Extension Lines) for Arcades shall be as shown on Table 8.
c. Stoops, Lightwells, balconies, bay windows, and terraces may Encroach the first Layer 100% of its depth. (Table 17d)
d. Loading docks and service areas shall be permitted on Frontages only by Warrant.
e. In the absence of a building Facade along any part of a Frontage Line, a Streetscreen shall be built co-planar with the Facade.
f. Streetscreens should be between 3.5 and 8 feet in height. The Streetscreen may be replaced by a hedge or fence by Warrant. Streetscreens shall have openings no larger than necessary to allow automobile and pedestrian access.
g. A first level Residential or Lodging Function shall be raised a minimum of 2 feet from average Sidewalk grade.

5.8 BUILDING FUNCTION

5.8.1 **General to zones T2, T3, T4, T5, T6**

a. Buildings in each Transect Zone shall conform to the Functions on Table 10, Table 12 and Table 14l. Functions that do not conform shall require approval by Warrant or Variance as specified on Table 12.

5.8.2 **Specific to zones T2, T3**

a. Accessory Functions of Restricted Lodging or Restricted Office shall be permitted within an Accesory Building. See Table 10.

5.8.3 **Specific to zones T4, T5**

a. Accessory Functions of Limited Lodging or Limited Office shall be permitted within an Accesory Building. See Table 10.

5.8.4 **Specific to zones T5, T6**

a. First Story Commercial Functions shall be permitted.
b. Manufacturing Functions within the first Story may be permitted by Variance.

5.9 PARKING AND DENSITY CALCULATIONS

5.9.1 **Specific to zones T2, T3**

a. Buildable Density on a Lot shall be determined by the actual parking provided within the Lot as applied to the Functions permitted in Table 10 and Table 11.

5.9.2 **Specific to zones T4, T5, T6**

a. Buildable Density on a Lot shall be determined by the sum of the actual parking

calculated as that provided (1) within the Lot (2) along the parking lane corresponding to the Lot Frontage, and (3) by purchase or lease from a Civic Parking Reserve within the Pedestrian Shed, if available.

b. The actual parking may be adjusted upward according to the Shared Parking Factor of Table 11 to determine the Effective Parking. The Shared Parking Factor is available for any two Functions within any pair of adjacent Blocks.

c. Based on the Effective Parking available, the Density of the projected Function may be determined according to Table 10.

d. Within the overlay area of a Transit Oriented Development (TOD) the Effective Parking may be further adjusted upward by 30%.

e. The total Density within each Transect Zone shall not exceed that specified by an approved Regulating Plan based on Article 3 or Article 4.

f. Accessory Units do not count toward Density calculations.

g. Liner Buildings less than 30 feet deep and no more than two Stories shall be exempt from parking requirements.

5.10 PARKING LOCATION STANDARDS

5.10.1 **General to zones T2, T3, T4, T5, T6**

a. Parking shall be accessed by Rear Alleys or Rear Lanes, when such are available on the Regulating Plan.

b. Open parking areas shall be masked from the Frontage by a Building or Streetscreen.

c. For buildings on B-Grids, open parking areas may be allowed unmasked on the Frontage by Warrant, except for corner lots at intersections with the A-Grid.

5.10.2 **Specific to zones T2, T3**

a. Open parking areas shall be located at the second and third Lot Layers, except that Driveways, drop-offs and unpaved parking areas may be located at the first Lot Layer. (Table 17d)

b. Garages shall be located at the third Layer except that side- or rear-entry types may be allowed in the first or second Layer by Warrant.

5.10.3 **Specific to zones T3, T4**

a. Driveways at Frontages shall be no wider than 10 feet in the first Layer. (Table 3B.f)

5.10.4 **Specific to zone T4**

a. All parking areas and garages shall be located at the second or third Layer. (Table 17d)

5.10.5 **Specific to zones T5, T6**

a. All parking lots, garages, and Parking Structures shall be located at the second or third Layer. (Table 17d)

b. Vehicular entrances to parking lots, garages, and Parking Structures shall be no wider than 24 feet at the Frontage. (Table 3B.f)

c. Pedestrian exits from all parking lots, garages, and Parking Structures shall be directly to a Frontage Line (i.e., not directly into a building) except underground levels which may be exited by pedestrians directly into a building.

d. Parking Structures on the A-Grid shall have Liner Buildings lining the first and second Stories.

e. A minimum of one bicycle rack place shall be provided within the Public or Private Frontage for every ten vehicular parking spaces.

5.11 LANDSCAPE STANDARDS

5.11.1 **General to zones T2, T3, T4, T5, T6**

a. Impermeable surface shall be confined to the ratio of Lot coverage specified in Table 14f.

5.11.2 **Specific to zones T2, T3, T4**

a. The first Layer may not be paved, with the exception of Driveways as specified in Section 5.10.2 and Section 5.10.3. (Table 17d)

5.11.3 **Specific to zone T3**

a. A minimum of two trees shall be planted within the first Layer for each 30 feet of Frontage Line or portion thereof. (Table 17d)

b. Trees may be of single or multiple species as shown on Table 6.

c. Trees shall be naturalistically clustered.

d. Lawn shall be permitted by Warrant.

5.11.4 **Specific to zone T4**

a. A minimum of one tree shall be planted within the first Layer for each 30 feet of Frontage Line or portion thereof. (Table 17d)

b. Trees shall be a single species to match the species of Street Trees on the Public Frontage, or as shown on Table 6.

c. Lawn shall be permitted By Right.

5.11.5 **Specific to zones T5, T6**

a. Trees shall not be required in the first Layer.

b. The first Layer may be paved to match the pavement of the Public Frontage.

5.12 SIGNAGE STANDARDS

5.12.1 **General to zones T2, T3, T4, T5, T6**

a. There shall be no signage permitted additional to that specified in this section.

b. The address number, no more than 6 inches measured vertically, shall be attached to the building in proximity to the Principal Entrance or at a mailbox.

5.12.2 **Specific to zones T2, T3**

a. Signage shall not be illuminated.

5.12.3 **Specific to zones T4, T5, T6**

a. Signage shall be externally illuminated, except that signage within the Shopfront glazing may be neon lit.

5.12.4 **Specific to zones T2, T3, T4**

a. One blade sign for each business may be permanently installed perpendicular to the Facade within the first Layer. Such a sign shall not exceed a total of 4 square feet and shall clear 8 feet above the Sidewalk.

5.12.5 **Specific to zones T5, T6**

a. Blade signs, not to exceed 6 square ft. for each separate business entrance, may be attached to and should be perpendicular to the Facade, and shall clear 8 feet above the Sidewalk.

b. A single external permanent sign band may be applied to the Facade of each building, providing that such sign not exceed 3 feet in height by any length.

AVAILABLE MODULES FOR ARTICLE 5

- ARCHITECTURAL STANDARDS
- CYCLING STANDARDS
- GENERATIVE CODING
- HAZARD MITIGATION STANDARDS
- LIGHTING DESIGN
- NATURAL DRAINAGE STANDARDS
- NOISE LEVELS
- RESIDENTIAL MARKETS
- RETAIL MARKETS
- RIPARIAN AND WETLAND BUFFERS
- SUBURBAN RETROFIT
- SUSTAINABLE URBANISM
  - BUILDING ORIENTATION
  - COMPOSTING & RECYCLING
  - FOOD PRODUCTION
  - SHADING OF GLAZING
  - SOLAR ENERGY
  - STORMWATER MANAGEMENT
  - SURFACE TO VOLUME RATIO
  - WIND POWER
  - ZERO NET ENERGY BUILDINGS
- VISITABILITY STANDARDS

TABLE 1: Transect Zone Descriptions. This table provides descriptions of the character of each T-zone.

T1

T-1 NATURAL

T-1 Natural Zone consists of lands approximating or reverting to a wilderness condition, including lands unsuitable for settlement due to topography, hydrology or vegetation.

General Character:	Natural landscape with some agricultural use
Building Placement:	Not applicable
Frontage Types:	Not applicable
Typical Building Height:	Not applicable
Type of Civic Space:	Parks, Greenways

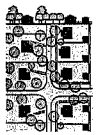
T2

T-2 RURAL

T-2 Rural Zone consists of sparsely settled lands in open or cultivated states. These include woodland, agricultural land, grassland, and irrigable desert. Typical buildings are farmhouses, agricultural buildings, cabins, and villas.

General Character:	Primarily agricultural with woodland & wetland and scattered buildings
Building Placement:	Variable Setbacks
Frontage Types:	Not applicable
Typical Building Height:	1- to 2-Story
Type of Civic Space:	Parks, Greenways

T3

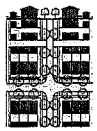


T-3 SUB-URBAN

T-3 Sub-Urban Zone consists of low density residential areas, adjacent to higher zones that some mixed use. Home occupations and outbuildings are allowed. Planting is naturalistic and setbacks are relatively deep. Blocks may be large and the roads irregular to accommodate natural conditions.

General Character:	Lawns, and landscaped yards surrounding detached single-family houses; pedestrians occasionally
Building Placement:	Large and variable front and side yard Setbacks
Frontage Types:	Porches, fences, naturalistic tree planting
Typical Building Height:	1- to 2-Story with some 3-Story
Type of Civic Space:	Parks, Greenways

T4

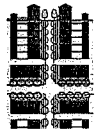


T-4 GENERAL URBAN

T-4 General Urban Zone consists of a mixed use but primarily residential urban fabric. It may have a wide range of building types: single, sideyard, and rowhouses. Setbacks and landscaping are variable. Streets with curbs and sidewalks define medium-sized blocks.

General Character:	Mix of Houses, Townhouses & small Apartment buildings, with scattered Commercial activity; balance between landscape and buildings; presence of pedestrians
Building Placement:	Shallow to medium front and side yard Setbacks
Frontage Types:	Porches, fences, Dooryards
Typical Building Height:	2- to 3-Story with a few taller Mixed Use buildings
Type of Civic Space:	Squares, Greens

T5

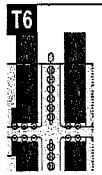


T-5 URBAN CENTER

T-5 Urban Center Zone consists of higher density mixed use building that accommodate etail, offices, rowhouses and apartments. It has a tight network of streets, with wide sidewalks, steady street tree planting and buildings set close to the sidewalks.

General Character:	Shops mixed with Townhouses, larger Apartment houses, Offices, workplace, and Civic buildings; predominantly attached buildings; trees within the public right-of-way; substantial pedestrian activit
Building Placement:	Shallow Setbacks or none; buildings oriented to street defining a street wall
Frontage Types:	Stoops, Shopfronts, Galleries
Typical Building Height:	3- to 5-Story with some variation
Type of Civic Space:	Parks, Plazas and Squares, median landscaping

T6

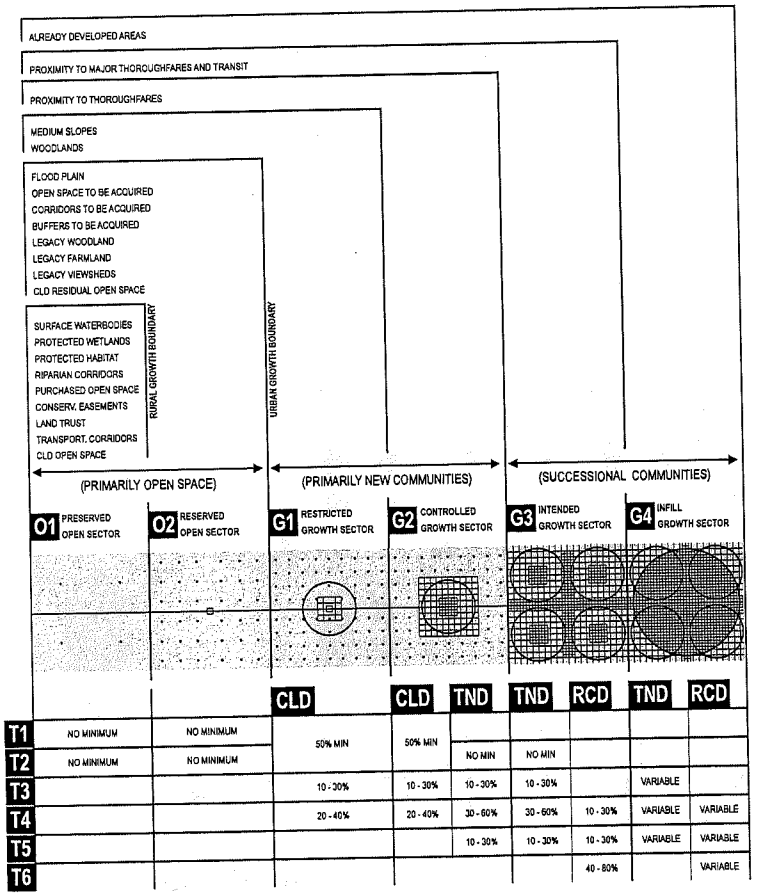


T-6 URBAN CORE

T-6 Urban Core Zone consists of the highest density and height, with the greatest variety of uses, and civic buildings of regional importance. It may have larger blocks; streets have steady street tree planting and buildings are set close to wide sidewalks. Typically only large towns and cities have an Urban Core Zone.

General Character:	Medium to high-Density Mixed Use buildings, entertainment, Civic and cultural uses. Attached buildings forming a continuous street wall; trees within the public right-of-way; highest pedestrian and transit activity
Building Placement:	Shallow Setbacks or none; buildings oriented to street, defining a street wall
Frontage Types:	Stoops, Dooryards, Forecourts, Shopfronts, Galleries, and Arcades
Typical Building Height:	4-plus Story with a few shorter buildings
Type of Civic Space:	Parks, Plazas and Squares; median landscaping

TABLE 2: Sector/Community Allocation. Table 2 defines the geography, including both natural and infrastructure elements, determining areas that are or are not suitable for development. Specific Community types of various intensities are allowable in specific Sectors. This table also allocates the proportions of Transect Zones within each Community Type.



			CLD	CLD	TND	TND	RCD	TND	RCD
T1	NO MINIMUM	NO MINIMUM	50% MIN	50% MIN					
T2	NO MINIMUM	NO MINIMUM			NO MIN	NO MIN			
T3			10 - 30%	10 - 30%	10 - 30%	10 - 30%		VARIABLE	
T4			20 - 40%	20 - 40%	30 - 60%	30 - 60%	10 - 30%	VARIABLE	VARIABLE
T5					10 - 30%	10 - 30%	10 - 30%	VARIABLE	VARIABLE
T6							40 - 80%		VARIABLE

TABLE 3A: Vehicular Lane Dimensions. This table assigns lane widths to Transect Zones. The Design ADT (Average Daily Traffic) is the determinant for each of these sections. The most typical assemblies are shown in Table 3B. Specific requirements for truck and transit bus routes and truck loading shall be decided by Warrant.

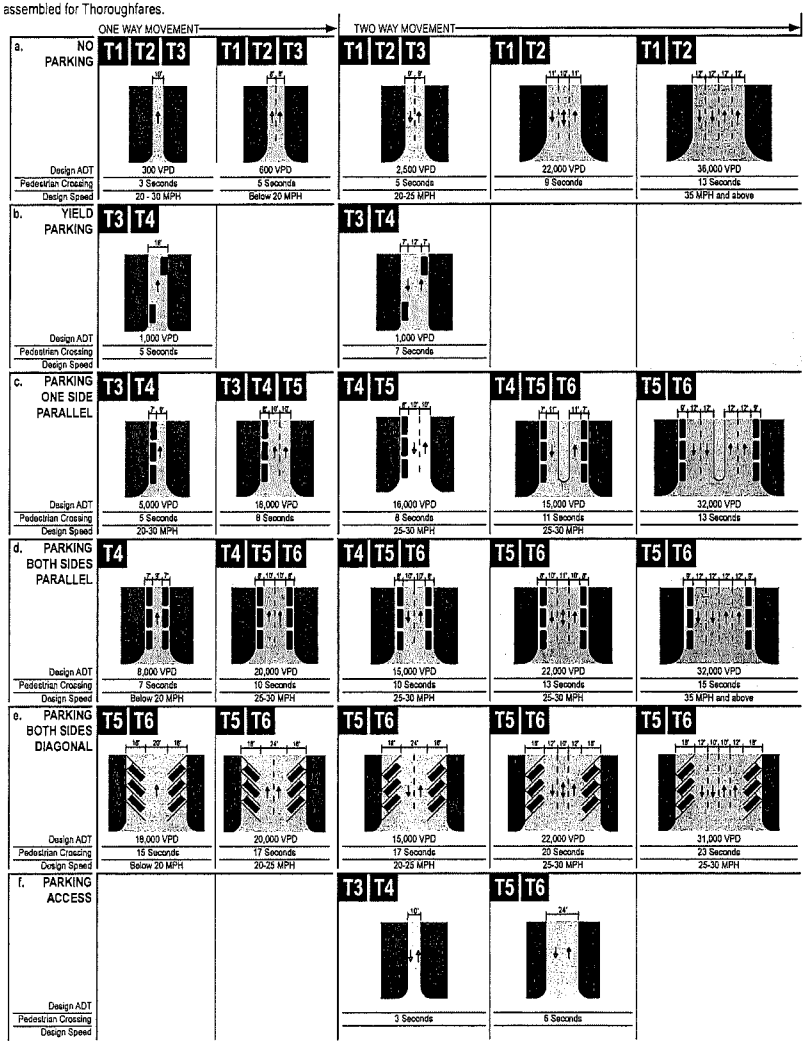
■ BY RIGHT
□ BY WARRANT

DESIGN SPEED	TRAVEL LANE WIDTH	T1	T2	T3	T4	T5	T6
Below 20 mph	8 feet	■	■	■	□		
20-25 mph	9 feet	■	■	■	■	□	□
25-35 mph	10 feet	■	■	■	■	■	■
25-35 mph	11 feet	■	■			■	■
Above 35 mph	12 feet	■	■			■	■

DESIGN SPEED	PARKING LANE WIDTH						
20-25 mph	(Angle) 18 feet					■	■
20-25 mph	(Parallel) 7 feet				■		
25-35 mph	(Parallel) 8 feet			■	■	■	■
Above 35 mph	(Parallel) 9 feet					■	■

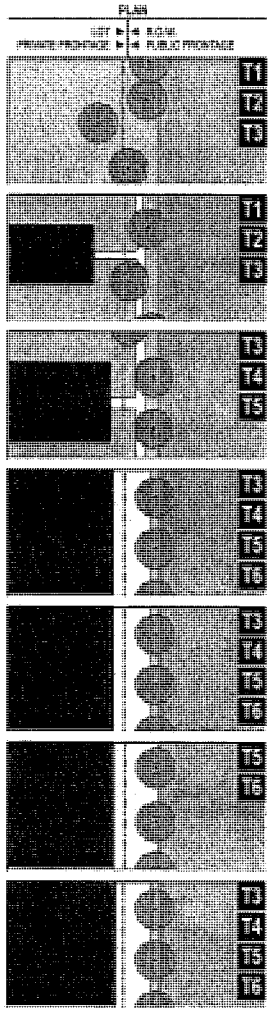
DESIGN SPEED	EFFECTIVE TURNING RADIUS (See Table 17b)						
Below 20 mph	5-10 feet			■	■	■	■
20-25 mph	10-15 feet	■	■	■	■	■	■
25-35 mph	15-20 feet	■	■	■	■	■	■
Above 35 mph	20-30 feet	■	■			□	□

TABLE 3B: Vehicular Lane/Parking Assemblies. The projected design speeds determine the dimensions of the vehicular lanes and Turning Radii assembled for Thoroughfares.



	ONE WAY MOVEMENT			TWO WAY MOVEMENT		
a. NO PARKING	T1 T2 T3	T1 T2 T3		T1 T2 T3	T1 T2	T1 T2
Design ADT	300 VPD	600 VPD		2,500 VPD	22,000 VPD	36,000 VPD
Pedestrian Crossing	3 Seconds	5 Seconds		5 Seconds	9 Seconds	13 Seconds
Design Speed	20 - 30 MPH	Below 20 MPH		20-25 MPH		35 MPH and above
b. YIELD PARKING	T3 T4			T3 T4		
Design ADT	1,000 VPD			1,000 VPD		
Pedestrian Crossing	5 Seconds			7 Seconds		
Design Speed						
c. PARKING ONE SIDE PARALLEL	T3 T4	T3 T4 T5		T4 T5	T4 T5 T6	T5 T6
Design ADT	5,000 VPD	16,000 VPD		16,000 VPD	15,000 VPD	32,000 VPD
Pedestrian Crossing	5 Seconds	8 Seconds		8 Seconds	11 Seconds	13 Seconds
Design Speed	20-30 MPH			25-30 MPH	25-30 MPH	
d. PARKING BOTH SIDES PARALLEL	T4	T4 T5 T6		T4 T5 T6	T5 T6	T5 T6
Design ADT	8,000 VPD	20,000 VPD		15,000 VPD	22,000 VPD	32,000 VPD
Pedestrian Crossing	7 Seconds	10 Seconds		10 Seconds	13 Seconds	15 Seconds
Design Speed	Below 20 MPH	25-30 MPH		25-30 MPH	25-30 MPH	35 MPH and above
e. PARKING BOTH SIDES DIAGONAL	T5 T6	T5 T6		T5 T6	T5 T6	T5 T6
Design ADT	18,000 VPD	20,000 VPD		15,000 VPD	22,000 VPD	31,000 VPD
Pedestrian Crossing	15 Seconds	17 Seconds		17 Seconds	20 Seconds	23 Seconds
Design Speed	Below 20 MPH	20-25 MPH		20-25 MPH	25-30 MPH	25-30 MPH
f. PARKING ACCESS				T3 T4	T5 T6	
Design ADT						
Pedestrian Crossing				3 Seconds	5 Seconds	
Design Speed						

TABLE 4A: Public Frontages - General. The Public Frontage is the area between the private Lot line and the edge of the vehicular lanes. Dimensions are given in Table 4B.



a. (HW) For Highway: This Frontage has open Swales drained by percolation, Bicycle Trails and no parking. The landscaping consists of the natural condition or multiple species arrayed in naturalistic clusters. Buildings are buffered by distance or berms.

b. (RD) For Road: This Frontage has open Swales drained by percolation and a walking Path or Bicycle Trail along one or both sides and Yield parking. The landscaping consists of multiple species arrayed in naturalistic clusters.

c. (ST) For Street: This Frontage has raised Curbs drained by inlets and Sidewalks separated from the vehicular lanes by individual or continuous Planters, with parking on one or both sides. The landscaping consists of street trees of a single or alternating species aligned in a regularly spaced Allee, with the exception that Streets with a right-of-way (R.O.W.) width of 40 feet or less are exempt from tree requirements.

d. (DR) For Drive: This Frontage has raised Curbs drained by inlets and a wide Sidewalk or paved Path along one side, related to a Greenway or waterfront. It is separated from the vehicular lanes by individual or continuous Planters. The landscaping consists of street trees of a single or alternating species aligned in a regularly spaced Allee.

e. (AV) For Avenue: This Frontage has raised Curbs drained by inlets and wide Sidewalks separated from the vehicular lanes by a narrow continuous Planter with parking on both sides. The landscaping consists of a single tree species aligned in a regularly spaced Allee.

f. (CS) (AV) For Commercial Street or Avenue: This Frontage has raised Curbs drained by inlets and very wide Sidewalks along both sides separated from the vehicular lanes by separate tree wells with grates and parking on both sides. The landscaping consists of a single tree species aligned with regular spacing where possible, but clears the storefront entrances.

g. (BV) For Boulevard: This Frontage has Slip Roads on both sides. It consists of raised Curbs drained by inlets and Sidewalks along both sides, separated from the vehicular lanes by Planters. The landscaping consists of double rows of a single tree species aligned in a regularly spaced Allee.

Table 4B: **Public Frontages - Specific.** This table assembles prescriptions and dimensions for the Public Frontage elements - Curbs, walkways and Planters – relative to specific Thoroughfare types within Transect Zones. Table 4B-a assembles all of the elements for the various street types. Locally appropriate planting species should be filled in to the calibrated Code.

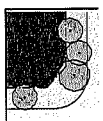
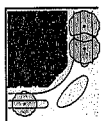
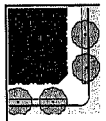
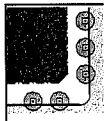
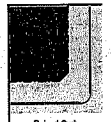
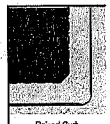
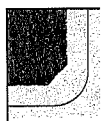
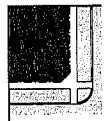
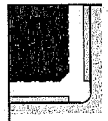
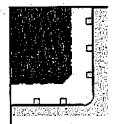
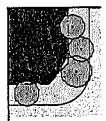
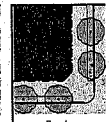
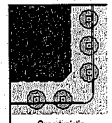
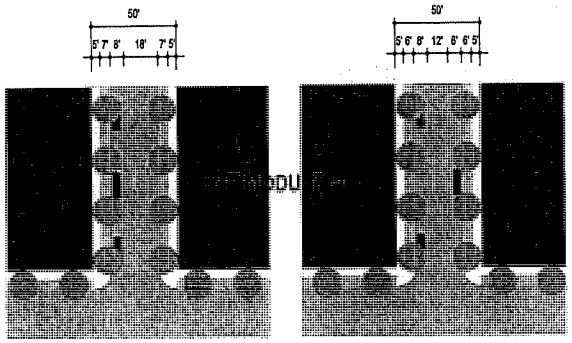
	RURAL			TRANSECT		URBAN
TRANSECT ZONE	T1 T2 T3	T1 T2 T3	T3 T4	T4 T5	T5 T6	T5 T6
Public Frontage Type	HW & RD	RD & ST	ST-DR-AV	ST-DR-AV-BV	CS-DR-AV-BV	CS-DR-AV-BV
a. Assembly: The principal variables are the type and dimension of Curbs, walkways, Planters and landscape.						
Total Width	16-24 feet	12-24 feet	12-18 feet	12-18 feet	18-24 feet	18-30 feet
b. Curb: The detailing of the edge of the vehicular pavement, incorporating drainage.						
Type	Open Swale	Open Swale	Raised Curb	Raised Curb	Raised Curb	Raised Curb
Radius	10-30 feet	10-30 feet	5-20 feet	5-20 feet	5-20 feet	5-20 feet
c. Walkway: The pavement dedicated exclusively to pedestrian activity.						
Type	Path Optional	Path	Sidewalk	Sidewalk	Sidewalk	Sidewalk
Width	n/a	4-8 feet	4-8 feet	4-8 feet	12-20 feet	12-30 feet
d. Planter: The layer which accommodates street trees and other landscape.						
Arrangement	Clustered	Clustered	Regular	Regular	Regular	Opportunistic
Species	Multiple	Multiple	Alternating	Single	Single	Single
Planter Type	Continuous Swale	Continuous Swale	Continuous Planter	Continuous Planter	Continuous Planter	Tree Well
Planter Width	8 feet-16 feet	8 feet-16 feet	8 feet-12 feet	8 feet-12 feet	4 feet-6 feet	4 feet-6 feet
e. Landscape: The recommended plant species. (See Table 6)						
f. Lighting: The recommended Public Lighting. (See Table 5)						

TABLE 4C: Thoroughfare Assemblies. These Thoroughfares are assembled from the elements that appear in Tables 3A and 3B and incorporate the Public Frontages of Table 4A. The key gives the Thoroughfare type followed by the right-of-way width, followed by the pavement width, and in some instances followed by specialized transportation capability.

KEY ST-57-20-BL
- Thoroughfare Type
- Right of Way Width
- Pavement Width
- Transportation

THOROUGHFARE TYPES

Highway:	HW
Boulevard:	BV
Avenue:	AV
Commercial Street:	CS
Drive:	DR
Street:	ST
Road:	RD
Rear Alley:	RA
Rear Lane:	RL
Bicycle Trail:	BT
Bicycle Lane:	BL
Bicycle Route:	BR
Path:	PT
Passage:	PS
Transit Route:	TR



	ST-50-26	ST-50-28
Thoroughfare Type	Street	Street
Transect Zone Assignment	T4, T5, T6	T4, T5, T6
Right-of-Way Width	50 feet	50 feet
Pavement Width	26 feet	28 feet
Movement	Slow Movement	Yield Movement
Design Speed	20 MPH	20 MPH
Pedestrian Crossing Time	7.4 seconds	7.6 seconds
Traffic Lanes	2 lanes	2 lanes
Parking Lanes	One side @ 8 feet marked	Both sides @ 8 feet unmarked
Curb Radius	10 feet	10 feet
Walkway Type	5 foot Sidewalk	5 foot Sidewalk
Planter Type	7 foot continuous Planter	6 foot continuous Planter
Curb Type	Curb	Curb
Landscape Type	Trees at 30' o.c. Avg.	Trees at 30' o.c. Avg.
Transportation Provision	BR	BR

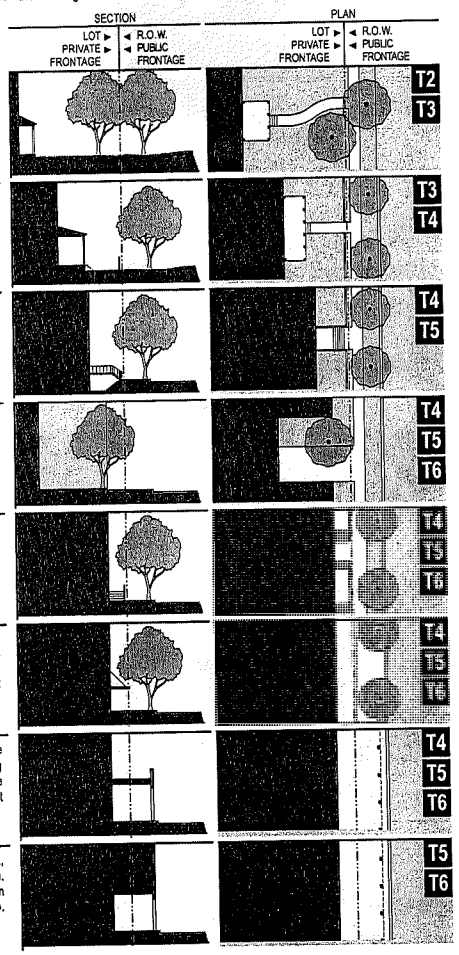
TABLE 5: Public Lighting. Lighting varies in brightness and also in the character of the fixture according to the Transect. The table shows five common types. A listed set of streetlights corresponding to these types would be approved by the utility company and listed on the page.

	T1	T2	T3	T4	T5	T6	SD	Specifications
Cobra Head	▪						▪	
Pipe	▪	▪	▪					
Post		▪	▪	▪				
Column			▪	▪	▪			
Double Column					▪	▪		

TABLE 6: Public Planting. This table shows six common types of street tree shapes and their appropriateness within the Transect Zones. The local planning office selects species appropriate for the bioregion.

	T1	T2	T3	T4	T5	T6	SD	Specific Lighting
Pole	▪	▪	▪	▪	▪	▪		
Oval	▪	▪	▪	▪	▪	▪		
Ball	▪	▪	▪	▪	▪	▪		
Pyramid	▪	▪	▪	▪				
Umbrella	▪	▪	▪	▪				
Vase	▪	▪	▪	▪				

TABLE 7: Private Frontages. The Private Frontage is the area between the building Facades and the Lot lines.



a. Common Yard: a planted Frontage wherein the Facade is set back substantially from the Frontage Line. The front yard created remains unfenced and is visually continuous with adjacent yards, supporting a common landscape. The deep Setback provides a buffer from the higher speed Thoroughfares.

b. Porch & Fence: a planted Frontage wherein the Facade is set back from the Frontage Line with an attached porch permitted to Encroach. A fence at the Frontage Line maintains street spatial definition. Porches shall be no less than 8 feet deep.

c. Terrace or Lightwell: a Frontage wherein the Facade is set back from the Frontage line by an elevated terrace or a sunken Lightwell. This type buffers Residential use from urban Sidewalks and removes the private yard from public Encroachment. Terraces are suitable for conversion to outdoor cafes. Syn: Dooryard.

d. Forecourt: a Frontage wherein a portion of the Facade is close to the Frontage Line and the central portion is set back. The Forecourt created is suitable for vehicular drop-offs. This type should be allocated in conjunction with other Frontage types. Large trees within the Forecourts may overhang the Sidewalks.

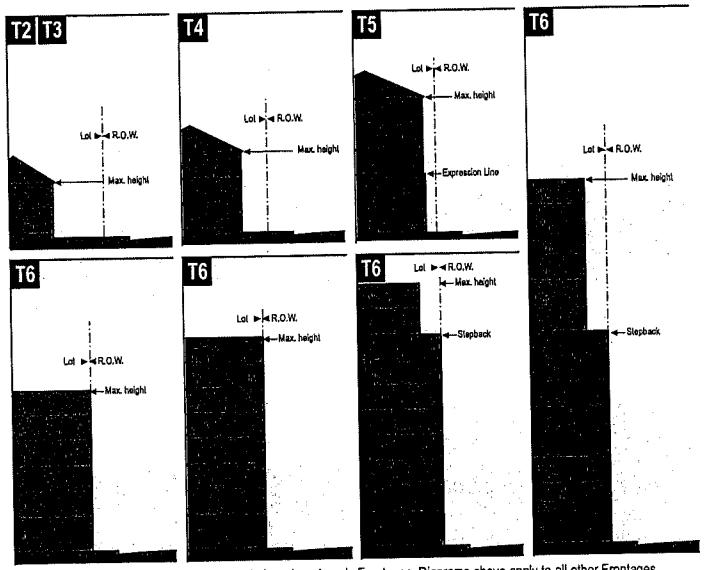
e. Stoop: a Frontage wherein the Facade is aligned close to the Frontage Line with the first Story elevated from the Sidewalk sufficiently to secure privacy for the windows. The entrance is usually an exterior stair and landing. This type is recommended for ground-floor Residential use.

f. Shopfront: a Frontage wherein the Facade is aligned close to the Frontage Line with the building entrance at Sidewalk grade. This type is conventional for Retail use. It has a substantial glazing on the Sidewalk level and an awning that may overlap the Sidewalk to within 2 feet of the Curb. Syn: Retail Frontage.

g. Gallery: a Frontage wherein the Facade is aligned close to the Frontage line with an attached cantilevered shed or a lightweight colonnade overlapping the Sidewalk. This type is conventional for Retail use. The Gallery shall be no less than 10 feet wide and should overlap the Sidewalk to within 2 feet of the Curb.

h. Arcade: a colonnade supporting habitable space that overlaps the Sidewalk, while the Facade at Sidewalk level remains at or behind the Frontage Line. This type is conventional for Retail use. The Arcade shall be no less than 12 feet wide and should overlap the Sidewalk to within 2 feet of the Curb. See Table 8.

TABLE 8: Building Configuration. This table shows the Configurations for different building heights for each Transect Zone. It must be modified to show actual calibrated heights for local conditions. Recess Lines and Expression Lines shall occur on higher buildings as shown. N = maximum height as specified in Table 14k.



Stepbacks/Arcade Heights. The diagrams below show Arcade Frontages. Diagrams above apply to all other Frontages.

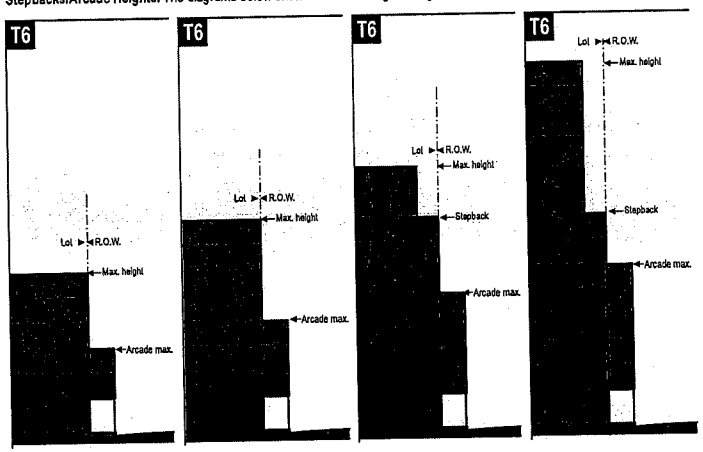
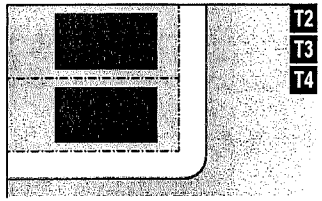


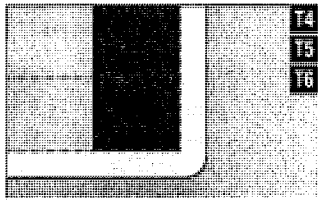
TABLE 9: Building Disposition. This table approximates the location of the structure relative to the boundaries of each individual Lot, establishing suitable basic building types for each Transect Zone.

a. **Edgeyard:** Specific Types - single family House, cottage, villa, estate house, urban villa. A building that occupies the center of its Lot with Setbacks on all sides. This is the least urban of types as the front yard sets it back from the Frontage, while the side yards weaken the spatial definition of the public Thoroughfare space. The front yard is intended to be visually continuous with the yards of adjacent buildings. The rear yard can be secured for privacy by fences and a well-placed Backbuilding and/or Outbuilding.

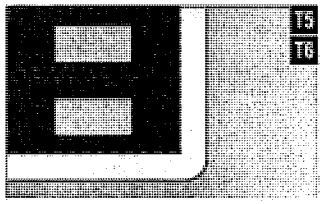


b. **Sideyard:** Specific Types - Charleston single house, double house, zero lot line house, twin. A building that occupies one side of the Lot with the Setback to the other side. A shallow Frontage Setback defines a more urban condition. If the adjacent building is similar with a blank side wall, the yard can be quite private. This type permits systematic climatic orientation in response to the sun or the breeze. If a Sideyard House abuts a neighboring Sideyard House, the type is known as a twin or double House. Energy costs, and sometimes noise, are reduced by sharing a party wall in this Disposition.

c. **Rearyard:** Specific Types - Townhouse, Rowhouse, Live-Work unit, loft building, Apartment House, Mixed Use Block, Flex Building, perimeter Block. A building that occupies the full Frontage, leaving the rear of the Lot as the sole yard. This is a very urban type as the continuous Facade steadily defines the public Thoroughfare. The rear Elevations may be articulated for functional purposes. In its Residential form, this type is the Rowhouse. For its Commercial form, the rear yard can accommodate substantial parking.



d. **Courtyard:** Specific Types - patio House. A building that occupies the boundaries of its Lot while internally defining one or more private patios. This is the most urban of types, as it is able to shield the private realm from all sides while strongly defining the public Thoroughfare. Because of its ability to accommodate incompatible activities, masking them from all sides, it is recommended for workshops, Lodging and schools. The high security provided by the continuous enclosure is useful for crime-prone areas.



e. **Specialized:** A building that is not subject to categorization. Buildings dedicated to manufacturing and transportation are often distorted by the trajectories of machinery. Civic buildings, which may express the aspirations of institutions, may be included.

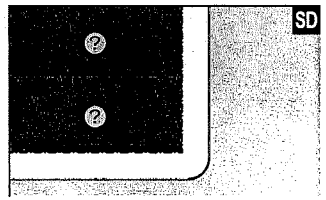


TABLE 10: Building Function. This table categorizes Building Functions within Transect Zones. Parking requirements are correlated to functional intensity. For Specific Function and Use permitted By Right or by Warrant, see Table 12.

	T2 T3	T4	T5 T6
a. RESIDENTIAL	**Restricted Residential:** The number of dwellings on each Lot is restricted to one within a Principal Building and one within an Accessory Building, with 2.0 parking places for each. Both dwellings shall be under single ownership. The habitable area of the Accessory Unit shall not exceed 440 sf, excluding the parking area.	**Limited Residential:** The number of dwellings on each Lot is limited by the requirement of 1.5 parking places for each dwelling, a ratio which may be reduced according to the shared parking standards (See Table 11).	**Open Residential:** The number of dwellings on each Lot is limited by the requirement of 1.0 parking places for each dwelling, a ratio which may be reduced according to the shared parking standards (See Table 11).
b. LODGING	**Restricted Lodging:** The number of bedrooms available on each Lot for lodging is limited by the requirement of 1.0 assigned parking place for each bedroom, up to five, in addition to the parking requirement for the dwelling. The Lodging must be owner occupied. Food service may be provided in the a.m. The maximum length of stay shall not exceed ten days.	**Limited Lodging:** The number of bedrooms available on each Lot for lodging is limited by the requirement of 1.0 assigned parking places for each bedroom, up to twelve, in addition to the parking requirement for the dwelling. The Lodging must be owner occupied. Food service may be provided in the a.m. The maximum length of stay shall not exceed ten days.	**Open Lodging:** The number of bedrooms available on each Lot for lodging is limited by the requirement of 1.0 assigned parking places for each bedroom. Food service may be provided at all times. The area allocated for food service shall be calculated and provided with parking according to Retail Function.
c. OFFICE	**Restricted Office:** The building area available for office use on each Lot is restricted to the first Story of the Principal or the Accessory Building and by the requirement of 3.0 assigned parking places per 1000 square feet of net office space in addition to the parking requirement for each dwelling.	**Limited Office:** The building area available for office use on each Lot is limited to the first Story of the principal building and/or to the Accessory building, and by the requirement of 3.0 assigned parking places per 1000 square feet of net office space in addition to the parking requirement for each dwelling.	**Open Office:** The building area available for office use on each Lot is limited by the requirement of 2.0 assigned parking places per 1000 square feet of net office space.
d. RETAIL	**Restricted Retail:** The building area available for Retail use is restricted to one Block corner location at the first Story for each 300 dwelling units and by the requirement of 4.0 assigned parking places per 1000 square feet of net Retail space in addition to the parking requirement of each dwelling. The specific use shall be further limited to neighborhood store, or food service seating no more than 20.	**Limited Retail:** The building area available for Retail use is limited to the first Story of buildings at corner locations, not more than one per Block, and by the requirement of 4.0 assigned parking places per 1000 square feet of net Retail space in addition to the parking requirement of each dwelling. The specific use shall be further limited to neighborhood store, or food service seating no more than 40.	**Open Retail:** The building area available for Retail use is limited by the requirement of 3.0 assigned parking places per 1000 square feet of net Retail space. Retail spaces under 1500 square feet are exempt from parking requirements.
e. CIVIC	See Table 12	See Table 12	See Table 12
f. OTHER	See Table 12	See Table 12	See Table 12

TABLE 11: Parking Calculations. The Shared Parking Factor for two Functions, when divided into the sum of the two amounts as listed on the Required Parking table below, produces the Effective Parking needed for each site involved in sharing. Conversely, if the Sharing Factor is used as a multiplier, it indicates the amount of building allowed on each site given the parking available.

REQUIRED PARKING (See Table 10)

	T2 T3	T4	T5 T6
RESIDENTIAL	2.0 / dwelling	1.5 / dwelling	1.0 / dwelling
LODGING	1.0 / bedroom	1.0 / bedroom	1.0 / bedroom
OFFICE	3.0 / 1000 sq. ft.	3.0 / 1000 sq. ft.	2.0 / 1000 sq. ft.
RETAIL	4.0 / 1000 sq. ft.	4.0 / 1000 sq. ft.	3.0 / 1000 sq. ft.
CIVIC	To be determined by Warrant		
OTHER	To be determined by Warrant		

SHARED PARKING FACTOR

Function	with	Function
RESIDENTIAL		RESIDENTIAL
LODGING		LODGING
OFFICE		OFFICE
RETAIL		RETAIL

	RESIDENTIAL	LODGING	OFFICE	RETAIL
RESIDENTIAL	1	1.1	1.1	1.4
LODGING	1.1	1	1.7	1.2
OFFICE	1.1	1.7	1	1.3
RETAIL	1.4	1.2	1.3	1

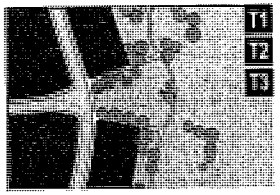
TABLE 12: **Specific Function & Use.** This table expands the categories of Table 10 to delegate specific Functions and uses within Transect Zones. Table 12 should be customized for local character and requirements.

a. RESIDENTIAL	T1	T2	T3	T4	T5	T6	SD
Mixed Use Block					■	■	
Flex Building				■	■	■	
Apartment Building				■	■	■	
Live/Work Unit			■	■	■	■	□
Row House				■	■		
Duplex House				■	■		
Courtyard House				■	■		
Sideyard House			■	■	■		
Cottage			■	■			
House		■	■	■			
Villa		■					
Accessory Unit		■	■	■	■		
b. LODGING							
Hotel (no room limit)					■	■	□
Inn (up to 12 rooms)		□		■	■	■	
Bed & Breakfast (up to 5 rooms)		□	■	■	■	■	
S.R.O. hostel			□	□	□	□	□
School Dormitory				■	■	■	■
c. office							
Office Building				■	■	■	□
Live-Work Unit			■	■	■	■	□
d. RETAIL							
Open-Market Building		■	■	■	■	■	■
Retail Building				■	■	■	□
Display Gallery				■	■	■	□
Restaurant				■	■	■	□
Kiosk				■	■	■	□
Push Cart					□	□	□
Liquor Selling Establishment					□	□	□
Adult Entertainment						□	□
e. CIVIC							
Bus Shelter			■	■	■	■	■
Convention Center						□	■
Conference Center					□	■	■
Exhibition Center						□	■
Fountain or Public Art		■	■	■	■	■	■
Library				■	■	■	■
Live Theater					■	■	■
Movie Theater					■	■	■
Museum					□	■	■
Outdoor Auditorium		□	■		■	■	■
Parking Structure					■	■	■
Passenger Terminal					□	□	■
Playground		■	■	■	■	■	■
Sports Stadium						□	■
Surface Parking Lot				□	□	□	■
Religious Assembly		■	■	■	■	■	■

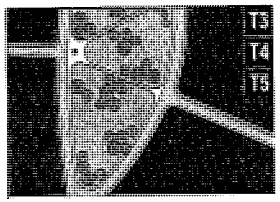
f. OTHER: AGRICULTURE	T1	T2	T3	T4	T5	T6	SD
Grain Storage	■	■					□
Livestock Pen	□	□					□
Greenhouse	■	■	□				□
Stable	■	■	□				□
Kennel	■	■	□	□	□	□	□
f. OTHER: AUTOMOTIVE							
Gasoline		□			□	□	■
Automobile Service							■
Truck Maintenance							■
Drive -Through Facility					□	□	■
Rest Stop	■	■					□
Roadside Stand	■	■					□
Billboard						□	□
Shopping Center							□
Shopping Mall							□
f. OTHER: CIVIL SUPPORT							
Fire Station			■	■	■	■	■
Police Station				■	■	■	■
Cemetery		■	□	□			■
Funeral Home				■	■	■	■
Hospital					□	□	■
Medical Clinic				□	■	■	■
f. OTHER: EDUCATION							
College					□	□	■
High School				□	□	□	■
Trade School					□	□	■
Elementary School			□	■	■	■	■
Other- Childcare Center		■	■	■	■	■	□
f. OTHER: INDUSTRIAL							
Heavy Industrial Facility							■
Light Industrial Facility						□	■
Truck Depot							■
Laboratory Facility						□	■
Water Supply Facility							■
Sewer and Waste Facility							■
Electric Substation	□	□	□	□	□	□	■
Wireless Transmitter	□	□					■
Cremation Facility							■
Warehouse						□	■
Produce Storage							■
Mini-Storage							■

■ BY RIGHT
□ BY WARRANT

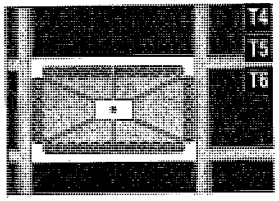
a. Park: A natural preserve available for unstructured recreation. A park may be independent of surrounding building Frontages. Its landscape shall consist of Paths and trails, meadows, waterbodies, woodland and open shelters, all naturalistically disposed. Parks may be lineal, following the trajectories of natural corridors. The minimum size shall be 8 acres. Larger parks may be approved by Warrant as Special Districts in all zones.



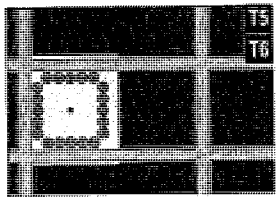
b. Green: An Open Space, available for unstructured recreation. A Green may be spatially defined by landscaping rather than building Frontages. Its landscape shall consist of lawn and trees, naturalistically disposed. The minimum size shall be 1/2 acre and the maximum shall be 8 acres.



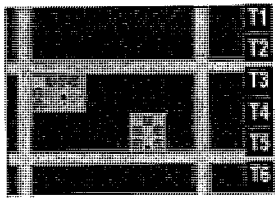
c. Square: An Open Space available for unstructured recreation and Civic purposes. A Square is spatially defined by building Frontages. Its landscape shall consist of paths, lawns and trees, formally disposed. Squares shall be located at the intersection of important Thoroughfares. The minimum size shall be 1/2 acre and the maximum shall be 5 acres.



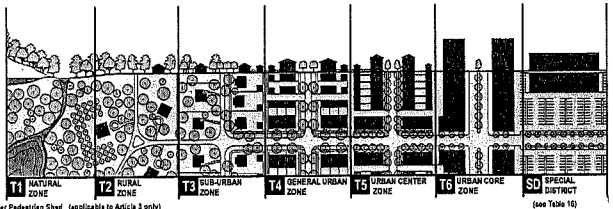
d. Plaza: An Open Space available for Civic purposes and Commercial activities. A Plaza shall be spatially defined by building Frontages. Its landscape shall consist primarily of pavement. Trees are optional. Plazas should be located at the intersection of important streets. The minimum size shall be 1/2 acre and the maximum shall be 2 acres.



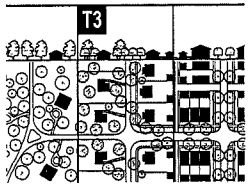
e. Playground: An Open Space designed and equipped for the recreation of children. A playground should be fenced and may include an open shelter. Playgrounds shall be interspersed within Residential areas and may be placed within a Block. Playgrounds may be included within parks and greens. There shall be no minimum or maximum size.



Note: All requirements in this Table are subject to calibration for local context.



	T1	T2	T3	T4	T5	T6	SD
a. ALLOCATION OF ZONES per Pedestrian Shed (applicable to Article 3 only)							
CLD requires	no minimum	50% min	10 - 30%	20 - 40%	not permitted	not permitted	
TND requires	no minimum	no minimum	10 - 30%	30 - 60 %	10 - 30%	not permitted	
RCD requires	no minimum	no minimum	not permitted	10 - 30%	10 - 30%	40 - 80%	
b. BASE RESIDENTIAL DENSITY (see Section 3.4)							
By Right	not applicable	1 unit / 20 ac avg.	2 units / ac. gross	4 units / ac. gross	6 units / ac. gross	12 units / ac. gross	
By TDR	by Variance	by Variance	6 units / ac. gross	12 units / ac. gross	24 units / ac. gross	96 units / ac. gross	
Other Functions	by Variance	by Variance	10 - 20%	20 - 30%	30 - 50%	50 - 70%	
c. BLOCK SIZE							
Block Perimeter	no maximum	no maximum	3000 ft. max	2400 ft. max	2000 ft. max	2000 ft. max *	
						* 3000 ft. max with parking structures	
d. THOROUGHFARES (see Table 2 and Table 4)							
HW	permitted	permitted	permitted	not permitted	not permitted	not permitted	
BV	not permitted	not permitted	permitted	permitted	permitted	permitted	
AV	not permitted	not permitted	permitted	permitted	permitted	permitted	
CS	not permitted	not permitted	not permitted	not permitted	permitted	permitted	
DR	not permitted	not permitted	permitted	permitted	permitted	permitted	
ST	not permitted	not permitted	permitted	permitted	permitted	not permitted	
RD	permitted	permitted	permitted	not permitted	not permitted	not permitted	
Rear Lane	permitted	permitted	permitted	permitted	not permitted	not permitted	
Rear Alley	not permitted	not permitted	permitted	required	required	required	
Path	permitted	permitted	permitted	permitted	not permitted	not permitted	
Passage	not permitted	not permitted	permitted	permitted	permitted	permitted	
Bicycle Trail	permitted	permitted	permitted	not permitted *	not permitted	not permitted	
Bicycle Lane	permitted	permitted	permitted	permitted	not permitted	not permitted	
Bicycle Route	permitted	permitted	permitted	permitted	permitted	permitted	
						* permitted within Open Spaces	
e. CIVIC SPACES (see Table 13)							
Park	permitted	permitted	permitted	by Warrant	by Warrant	by Warrant	
Green	not permitted	not permitted	permitted	permitted	permitted	not permitted	
Square	not permitted	not permitted	not permitted	permitted	permitted	permitted	
Plaza	not permitted	not permitted	not permitted	not permitted	permitted	permitted	
Playground	permitted	permitted	permitted	permitted	permitted	permitted	
f. LOT OCCUPATION							DISPOSITION
Lot Width	not applicable	by Warrant	72 ft. min 120 ft. max	18 ft. min 96 ft. max	18 ft. min 180 ft. max	18 ft. min 700 ft. max	
Lot Coverage	not applicable	by Warrant	60% max	70% max	80% max	90% max	
g. SETBACKS - PRINCIPAL BUILDING (see Table 15)							
(g.1) Front Setback (Principal)	not applicable	48 ft. min	24 ft. min	6 ft. min 18 ft. max	2 ft. min 12 ft. max	2 ft. min 12 ft. max	
(g.2) Front Setback (Secondary)	not applicable	48 ft. min	12 ft. min	6 ft. min 18 ft. max	2 ft. min 12 ft. max	2 ft. min 12 ft. max	
(g.3) Side Setback	not applicable	96 ft. min	12 ft. min	0 ft. min	0 ft. min 24 ft. max	0 ft. min 24 ft. max	
(g.4) Rear Setback	not applicable	96 ft. min	12 ft. min	3 ft. min *	3 ft. min *	0 ft. min	
Frontage Buildout	not applicable	not applicable	40% min	60% min	80% min	80% min	
h. SETBACKS - OUTBUILDING (see Table 15)							
(h.1) Front Setback	not applicable	20 ft. min +bldg setback	20 ft. min +bldg setback	20 ft. min +bldg setback	40 ft. max from rear prop	not applicable	
(h.2) Side Setback	not applicable	3 ft. or 6 ft	3 ft. or 6 ft.	0 ft. min or 3 ft.	0 ft min	not applicable	
(h.3) Rear Setback	not applicable	3 ft. min	3 ft. min	3 ft.	3 ft. max	not applicable	
i. BUILDING DISPOSITION (see Table 9)							
Edgeyard	permitted	permitted	permitted	permitted	not permitted	not permitted	
Sideyard	not permitted	not permitted	not permitted	permitted	permitted	not permitted	
Rearyard	not permitted	not permitted	not permitted	permitted	permitted	permitted	
Courtyard	not permitted	not permitted	not permitted	not permitted	permitted	permitted	
j. PRIVATE FRONTAGES (see Table 7)							CONFIGURATION
Common Yard	not applicable	permitted	permitted	not permitted	not permitted	not permitted	
Porch & Fence	not applicable	not permitted	permitted	permitted	not permitted	not permitted	
Terrace or Dooryard	not applicable	not permitted	not permitted	permitted	permitted	not permitted	
Forecourt	not applicable	not permitted	not permitted	permitted	permitted	permitted	
Stoop	not applicable	not permitted	not permitted	permitted	permitted	permitted	
Shopfront & Awning	not applicable	not permitted	not permitted	permitted	permitted	permitted	
Gallery	not applicable	not permitted	not permitted	permitted	permitted	permitted	
Arcade	not applicable	not permitted	not permitted	not permitted	permitted	permitted	
k. BUILDING CONFIGURATION (see Table 16)							
Principal Building	not applicable	2 Stories max	2 Stories max	3 Stories max, 2 min	5 Stories max, 2 min	8 Stories max, 2 min	
Outbuilding	not applicable	2 Stories max	2 Stories max	2 Stories max	2 Stories max	not applicable	
l. BUILDING FUNCTION (see Table 10 &Table 12)							FUNCTION
Residential	not applicable	restricted use	restricted use	limited use	open use	open use	
Lodging	not applicable	restricted use	restricted use	limited use	open use	open use	
Office	not applicable	restricted use	restricted use	limited use	open use	open use	
Retail	not applicable	restricted use	restricted use	limited use	open use	open use	
ARTICLE 5							
ARTICLE 2, 3, 4							



(see Table 1)

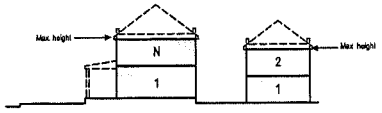
l. BUILDING FUNCTION (see Table 10 & Table 12)	
Residential	restricted use
Lodging	restricted use
Office	restricted use
Retail	restricted use
k. BUILDING CONFIGURATION (see Table 8)	
Principal Building	2 stories max.
Outbuilding	2 stories max.
f. LOT OCCUPATION (see Table 14f)	
Lot Width	72 ft. min 120 ft. max
Lot Coverage	60% max
i. BUILDING DISPOSITION (see Table 9)	
Edgeyard	permitted
Sideyard	not permitted
Rearyard	not permitted
Courtyard	not permitted
g. SETBACKS - PRINCIPAL BUILDING (see Table 14g)	
(g.1) Front Setback Principal	24 ft. min
(g.2) Front Setback Secondary	12 ft min.
(g.3) Side Setback	12 ft min.
(g.4) Rear Setback	12 ft min.
Frontage Buildout	40% min at setback
h. SETBACKS - OUTBUILDING (see Table 14h)	
(h.1) Front Setback	20 ft. min. + bldg setback
(h.2) Side Setback	3 ft. or 6 ft at corner
(h.3) Rear Setback	3 ft. min
j. PRIVATE FRONTAGES (see Table 7)	
Common Lawn	permitted
Porch & Fence	permitted
Terrace or L.C.	not permitted
Forecourt	not permitted
Stoop	not permitted
Shopfront & Awning	not permitted
Gallery	not permitted
Arcade	not permitted
	Refer to Summary Table 14
PARKING PROVISIONS	
See Table 10 & Table 11	

*or 15 ft. from center line of alley

"N" stands for any Stories above those shown, up to the maximum. Refer to metrics for exact minimums and maximums

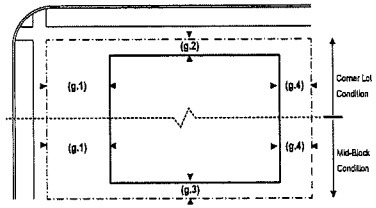
BUILDING CONFIGURATION

1. Building height shall be measured in number of Stories, excluding Attics and raised basements.
2. Stories may not exceed 14 feet in height, from finished floor to finished ceiling, except for a first floor Commercial function which must be a minumum of 11 ft with a maximum of 25 feet.
3. Height shall be measured to the eave or roof deck as specified on Table 8.



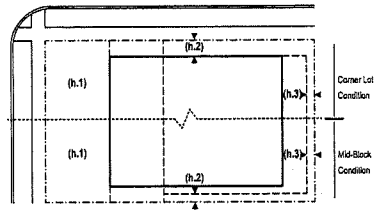
SETBACKS - PRINCIPAL BLDG

1. The Facades and Elevations of Principal Buildings shall be distanced from the Lot lines as shown.
2. Facades shall be built along the Principal Frontage to the minimum specified width in the table.



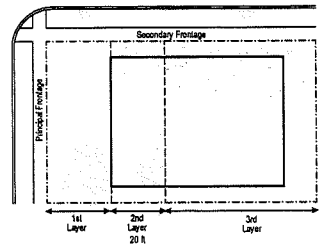
SETBACKS - OUTBUILDING

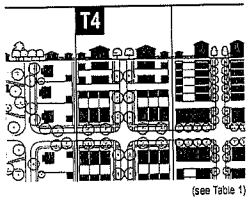
1. The Elevation of the Outbuilding shall be distanced from the Lot lines as shown.



PARKING PLACEMENT

1. Uncovered parking spaces may be provided within the second and third Layer as shown in the diagram (see Table 17d).
2. Covered parking shall be provided within the third Layer as shown in the diagram (see Table 17d). Side- or rear-entry garages may be allowed in the first or second Layer by Warrant.
3. Trash containers shall be stored within the third Layer.





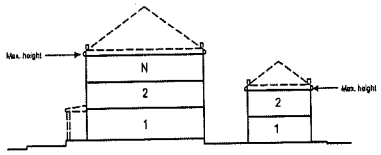
(see Table 1)

I. BUILDING FUNCTION (see Table 10 & Table 12)	
Residential	limited use
Lodging	limited use
Office	limited use
Retail	limited use
k. BUILDING CONFIGURATION (see Table 8)	
Principal Building	3 stories max, 2 min
Outbuilding	2 stories max.
f. LOT OCCUPATION (see Table 14f)	
Lot Width	18 ft min 96 ft max
Lot Coverage	70% max
i. BUILDING DISPOSITION (see Table 9)	
Edgeyard	permitted
Sideyard	permitted
Rearyard	permitted
Courtyard	not permitted
g. SETBACKS - PRINCIPAL BUILDING (see Table 14g)	
(g.1) Front Setback Principal	6 ft. min. 18 ft. max.
(g.2) Front Setback Secondary	6 ft. min. 18 ft. max
(g.3) Side Setback	0 ft. min.
(g.4) Rear Setback	3 ft. min.*
Frontage Buildout	60% min at setback
h. SETBACKS - OUTBUILDING (see Table 14h)	
(h.1) Front Setback	20 ft. min. + bldg. setback
(h.2) Side Setback	0 ft. min. or 3 ft at corner
(h.3) Rear Setback	3 ft. min
j. PRIVATE FRONTAGES (see Table 7)	
Common Lawn	not permitted
Porch & Fence	permitted
Terrace or L.C.	permitted
Forecourt	permitted
Stoop	permitted
Shopfront & Awning	permitted
Gallery	permitted
Arcade	not permitted
	Refer to Summary Table 14
PARKING PROVISIONS	
See Table 10 & Table 11	

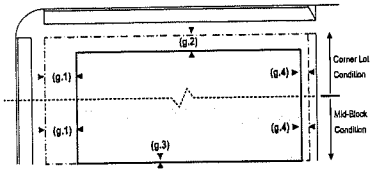
*or 15 ft. from center line of alley

"N" stands for any Stories above those shown, up to the maximum. Refer to metrics for exact minimums and maximums

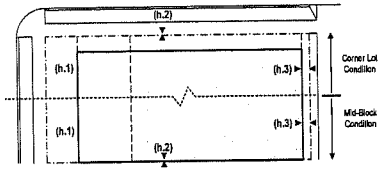
BUILDING CONFIGURATION
1. Building height shall be measured in number of Stories, excluding Attics and raised basements.
2. Stories may not exceed 14 feet in height from finished floor to finished ceiling, except for a first floor Commercial function which must be a minumum of 11 ft with a maximum of 25 ft.
3. Height shall be measured to the eave or roof deck as specified on Table 8.



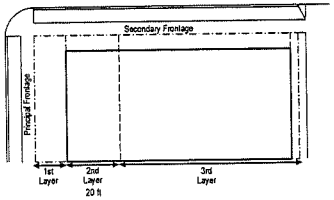
SETBACKS - PRINCIPAL BLDG
1. The Facades and Elevations of Principal Buildings shall be distanced from the Lot lines as shown.
2. Facades shall be built along the Principal Frontage to the minimum specified width in the table.

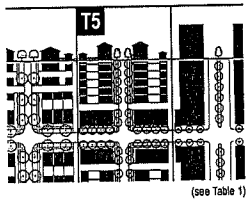


SETBACKS - OUTBUILDING
1. The Elevations of the Outbuilding shall be distanced from the Lot lines as shown.



PARKING PLACEMENT
1. Uncovered parking spaces may be provided within the third Layer as shown in the diagram (see Table 17d).
2. Covered parking shall be provided within the third Layer as shown in the diagram (see Table 17d).
3. Trash containers shall be stored within the third Layer.





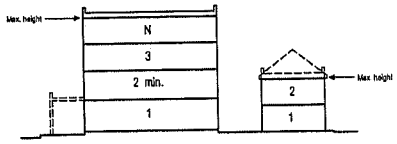
(see Table 1)

I. BUILDING FUNCTION (see Table 10 & Table 12)	
Residential	open use
Lodging	open use
Office	open use
Retail	open use
k. BUILDING CONFIGURATION (see Table 8)	
Principal Building	5 stories max. 2 min.
Outbuilding	2 stories max.
f. LOT OCCUPATION (see Table 14f)	
Lot Width	18 ft min 180 ft max
Lot Coverage	80% max
i. BUILDING DISPOSITION (see Table 9)	
Edgeyard	not permitted
Sideyard	permitted
Rearyard	permitted
Courtyard	permitted
g. SETBACKS - PRINCIPAL BUILDING (see Table 14g)	
(g.1) Front Setback Principal	2 ft. min. 12 ft. max.
(g.2) Front Setback Secondary	2 ft. min. 12 ft. max.
(g.3) Side Setback	0 ft. min. 24 ft. max.
(g.4) Rear Setback	3 ft. min.*
Frontage Buildout	80% min at setback
h. SETBACKS - OUTBUILDING (see Table 14h)	
(h.1) Front Setback	40 ft. max. from rear prop.
(h.2) Side Setback	0 ft. min. or 2 ft at corner
(h.3) Rear Setback	3 ft. max.
j. PRIVATE FRONTAGES (see Table 7)	
Common Lawn	not permitted
Porch & Fence	not permitted
Terrace or L.C.	permitted
Forecourt	permitted
Stoop	permitted
Shopfront & Awning	permitted
Gallery	permitted
Arcade	permitted
	Refer to Summary Table 14
PARKING PROVISIONS	
See Table 10 & Table 11	

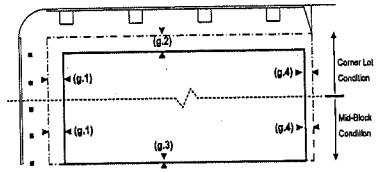
*or 15 ft. from center line of alley

"N" stands for any Stories above those shown, up to the maximum. Refer to metrics for exact minimums and maximums

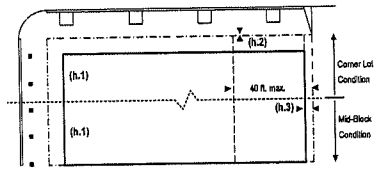
BUILDING CONFIGURATION
1. Building height shall be measured in number of Stories, excluding Attics and raised basements.
2. Stories may not exceed 14 feet in height from finished floor to finished ceiling, except for a first floor Commercial function which must be a minumum of 11 ft with a maximum of 25 ft.
3. Height shall be measured to the eave or roof deck as specified on Table 8.
4. Expression Lines shall be as shown on Table 8.



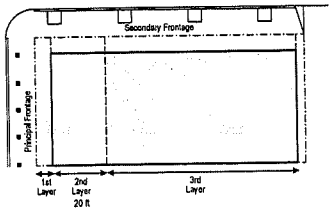
SETBACKS - PRINCIPAL BLDG
1. The Facades and Elevations of Principal Buildings shall be distanced from the Lot lines as shown.
2. Facades shall be built along the Principal Frontage to the minimum specified width in the table.

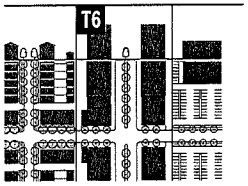


SETBACKS - OUTBUILDING
1. The Elevations of the Outbuilding shall be distanced from the Lot lines as shown.



PARKING PLACEMENT
1. Uncovered parking spaces may be provided within the third Layer as shown in the diagram (see Table 17d).
2. Covered parking shall be provided within the third Layer as shown in the diagram (see Table 17d).
3. Trash containers shall be stored within the third Layer.





(see Table 1)

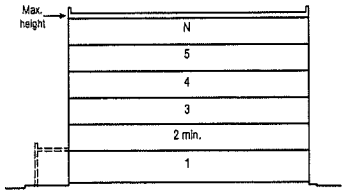
i. BUILDING FUNCTION (see Table 10 & Table 12)	
Residential	open use
Lodging	open use
Office	open use
Retail	open use
k. BUILDING CONFIGURATION (see Table 8)	
Principal Building	8 stories max. 2 min.
Outbuilding	N/A
f. LOT OCCUPATION (see Table 14f)	
Lot Width	16 ft. min 700 ft. max
Lot Coverage	90% max
i. BUILDING DISPOSITION (see Table 9)	
Edgeyard	not permitted
Sideyard	not permitted
Rearyard	permitted
Courtyard	permitted
g. SETBACKS - PRINCIPAL BUILDING (see Table 14g)	
(g.1) Front Setback Principal	2 ft. min. 12 ft. max.
(g.2) Front Setback Secondary	2 ft. min. 12 ft. max.
(g.3) Side Setback	0 ft. min. 24 ft. max.
(g.4) Rear Setback	0 ft. min.
Frontage Buildout	80% min. at setback
h. SETBACKS - OUTBUILDING (see Table 14h)	
Front Setback	N/A
Side Setback	N/A
Rear Setback	N/A
j. PRIVATE FRONTAGES (see Table 7)	
Common Lawn	not permitted
Porch & Fence	not permitted
Terrace or L.C.	not permitted
Forecourt	permitted
Stoop	permitted
Shopfront & Awning	permitted
Gallery	permitted
Arcade	permitted
	Refer to Summary Table 14
PARKING PROVISIONS	
See Table 10 & Table 11	

*or 15 ft. from center line of alley

"N" stands for any Stories above those shown, up to the maximum. Refer to metrics for exact minimums and maximums

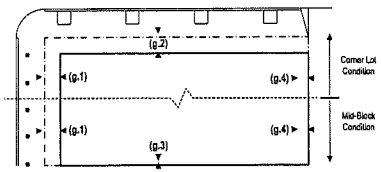
BUILDING CONFIGURATION

1. Building height shall be measured in number of Stories, excluding Attics and raised basements.
2. Stories may not exceed 14 feet in height from finished floor to finished ceiling, except for a first floor Commercial Function which must be a minumum of 11 ft with with a maximum of 25 ft.
3. Height shall be measured to the eave or roof deck as spacified on Table 8.
4. Stepbacks, Recess Lines, and Extension Lines shall be as shown on Table 8.



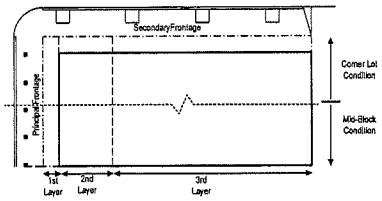
SETBACKS - PRINCIPAL BLDG

1. The Facades and Elevations of Principal Buildings shall be distanced from the Lot lines as shown.
2. Facades shall be built along the Principal Frontage to the minimum specified width in the table.



PARKING PLACEMENT

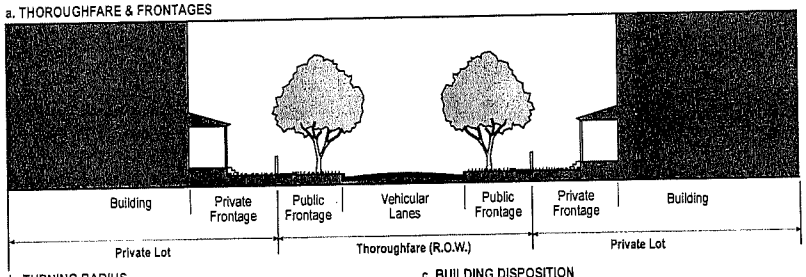
1. Uncovered parking spaces may be provided within the third Layer as shown in the diagram (see Table 17d).
2. Covered parking shall be provided within the third Layer as shown in the diagram (see Table 17d).
3. Trash containers shall be stored within the third Layer.



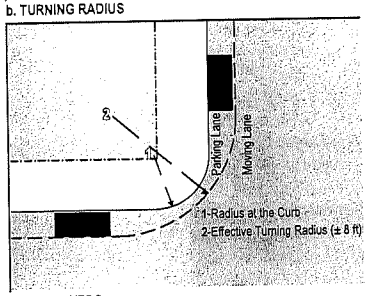
The metrics for each column of this table (SD1, SD2, etc.) are to be filled in for each Special District as they currently exist, or as they are permitted.More pages can be added. Special Districts that do not have provisions within this Code shall be governed by the standards of the pre-existing zoning.

	SD1	SD2	SD3	SD4	SD5	SD6	SD7	
a. ALLOCATION OF ZONES								
CLD	X							
TND	X							
TOD	X							
b. BASE RESIDENTIAL DENSITY								
By Right	X							
By TDR	X							
Other Functions	X							
c. BLOCK SIZE								
Block Perimeter	X							
d. THOROUGHFARES								
HW	X							
BV	X							
AV	X							
CS	X							
DR	X							
ST	X							
RD	X							
Rear Lane	X							
Rear Alley	X							
Path	X							
Passage	X							
Bicycle Trail	X							
Bicycle Lane	X							
Bicycle Route	X							
e. CIVIC SPACES								
Park	X							
Green	X							
Square	X							
Plaza	X							
Playground	X							
f. LOT OCCUPATION								DISPOSITION
Lot Width	X							
Lot Coverage	X							
g. SETBACKS - PRINCIPAL BUILDING								
Front Setback	X							
Side Setback	X							
Rear Setback	X							
h. BUILDING Disposition								
Edgeyard	X							
Sideyard	X							
Rearyard	X							
i. PRIVATE FRONTAGES								CONFIGURATION
Common Yard	X							
Porch & Fence	X							
Terrace, Dooryard	X							
Forecourt	X							
Stoop	X							
Shopfront	X							
Gallery	X							
Arcade	X							
Parking Lot	X							
j. BUILDING CONFIGURATION								
Principal Building	X							
Outbuilding	X							
k. BUILDING FUNCTION								FUNCTION
Residential	X							
Lodging	X							
Office	X							
Retail	X							

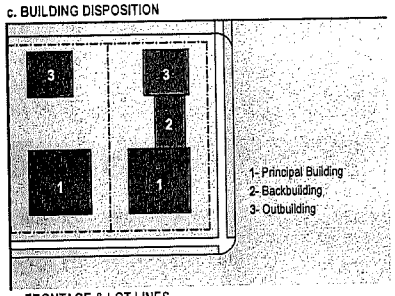
a. THOROUGHFARE & FRONTAGES



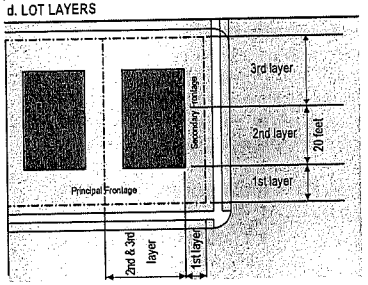
b. TURNING RADIUS



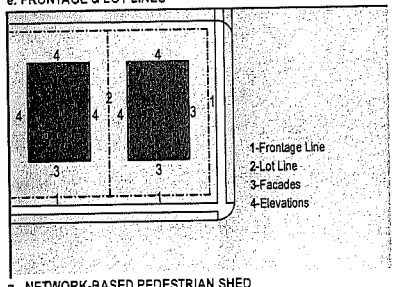
c. BUILDING DISPOSITION



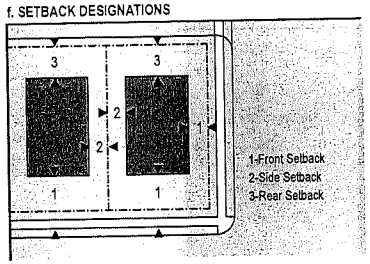
d. LOT LAYERS



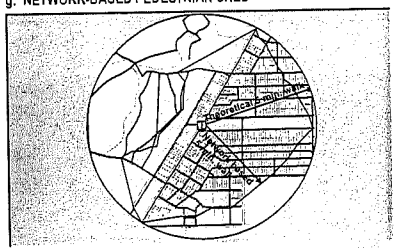
e. FRONTAGE & LOT LINES



f. SETBACK DESIGNATIONS



g. NETWORK-BASED PEDESTRIAN SHED



DEFINITIONS

This Article provides definitions for terms in this Code that are technical in nature or that otherwise may not reflect a common usage of the term. If a term is not defined in this Article, then the CRC shall determine the correct definition. Items in italics refer to *Articles*, *Sections*, or *Tables* in the SmartCode.

A-Grid: cumulatively, those Thoroughfares that by virtue of their pre-existing pedestrian-supportive qualities, or their future importance to pedestrian connectivity, are held to the highest standards prescribed by this Code. See B-Grid. (Syn: primary grid.)

Accessory Building: an Outbuilding with an Accessory Unit.

Accessory Unit: an Apartment not greater than 440 square feet sharing ownership and utility connections with a Principal Building; it may or may not be within an Outbuilding. *See Table 10 and Table 17.* (Syn: ancillary unit)

Adjusted Pedestrian Shed: a Pedestrian Shed that has been adjusted according to Section 3.2, creating the regulatory boundary of a Community Unit.

Affordable Housing: dwellings consisting of rental or for-sale units that have a rent (including utilities) or mortgage payment typically no more than 30% of the income of families earning no more than 80% of median incomes by family size for the county. (Alt. definition: rental or for-sale dwellings that are economically within the means of the starting salary of a local elementary school teacher.)

Allee: a regularly spaced and aligned row of trees usually planted along a Thoroughfare or Path.

Apartment: a Residential unit sharing a building and a Lot with other units and/or uses; may be for rent, or for sale as a condominium.

Arcade: a Private Frontage conventional for Retail use wherein the Facade is a colonnade supporting habitable space that overlaps the Sidewalk, while the Facade at Sidewalk level remains at the Frontage Line.

Attic: the interior part of a building contained within a pitched roof structure.

Avenue (AV): a Thoroughfare of high vehicular capacity and low to moderate speed, acting as a short distance connector between urban centers, and usually equipped with a landscaped median.

B-Grid: cumulatively, those Thoroughfares that by virtue of their use, location, or absence of pre-existing pedestrian-supportive qualities, may meet a standard lower than that of the A-Grid. See **A-Grid.** (Syn: secondary grid.)

BRT: see **Bus Rapid Transit.**

Backbuilding: a single-Story structure connecting a Principal Building to an Outbuilding. *See Table 17.*

Base Density: the number of dwelling units per acre before adjustment for other Functions and/or TDR. See **Density.**

Bed and Breakfast: an owner-occupied Lodging type offering 1 to 5 bedrooms, permitted to serve breakfast in the mornings to guests.

Bicycle Lane (BL): a dedicated lane for cycling within a moderate-speed vehicular Thoroughfare, demarcated by striping.

Bicycle Route (BR): a Thoroughfare suitable for the shared use of bicycles and automobiles moving at low speeds.

Bicycle Trail (BT): a bicycle way running independently of a vehicular Thoroughfare.

Block: the aggregate of private Lots, Passages, Rear Alleys and Rear Lanes, circumscribed by Thoroughfares.

Block Face: the aggregate of all the building Facades on one side of a Block.

Boulevard (BV): a Thoroughfare designed for high vehicular capacity and moderate speed, traversing an Urbanized area. Boulevards are usually equipped with Slip Roads buffering Sidewalks and buildings.

Brownfield: an area previously used primarily as an industrial site.

Bus Rapid Transit: a rubber tire system with its own right-of-way or dedicated lane along at least 70% of its route, providing transit service that is faster than a regular bus.

By Right: characterizing a proposal or component of a proposal for a Community Plan or Building Scale Plan *(Article 3, Article 4, or Article 5)* that complies with the SmartCode and is permitted and processed administratively, without public hearing. See **Warrant** and **Variance.**

CLD or **Clustered Land Development:** a Community Unit type structured by a Standard Pedestrian Shed oriented toward a Common Destination such as a general store, Meeting Hall, schoolhouse, or church. CLD takes the form of a small settlement standing free in the countryside. *See Table 2 and Table 14a.* (Syn: Hamlet, Conservation Land Development, cluster)

CRC: Consolidated Review Committee.

Civic: the term defining not-for-profit organizations dedicated to arts, culture, education, recreation, government, transit, and municipal parking.

Civic Building: a building operated by not-for-profit organizations dedicated to arts, culture, education, recreation, government, transit, and municipal parking, or for use approved by the legislative body.

Civic Parking Reserve: Parking Structure or parking lot within a quarter-mile of the site that it serves. *See Section 5.9.2.*

Civic Space: an outdoor area dedicated for public use. Civic Space types are defined by the combination of certain physical constants including the relationships among their intended use, their size, their landscaping and their Enfronting buildings. *See Table 13.*

Civic Zone: designation for public sites dedicated for Civic Buildings and Civic Space.

Commercial: the term collectively defining workplace, Office, Retail, and Lodging Functions.

Common Destination: An area of focused community activity, usually defining the approximate center of a Pedestrian Shed. It may include without limitation one or more of the following: a Civic Space, a Civic Building, a Commercial center, or a transit station, and may act as the social center of a neighborhood.

Common Yard: a planted Private Frontage wherein the Facade is set back from the Frontage line. It is visually continuous with adjacent yards. *See Table 7.*

Community Unit: a regulatory category defining the physical form, Density, and extent of a settlement. The three Community Unit types addressed in this Code are

CLD, TND, and RCD. Variants of TND and RCD for Infill *(Article 4)* are called Infill TND and Infill RCD. The TOD Community Unit type may be created by an overlay on TND or RCD.

Configuration: the form of a building, based on its massing, Private Frontage, and height.

Consolidated Review Committee (CRC): Usually part of the Planning Office, a CRC is comprised of a representative from each of the various regulatory agencies that have jurisdiction over the permitting of a project, as well as a representative of the Development and Design Center. *See Section 1.4.3.*

Corridor: a lineal geographic system incorporating transportation and/or Greenway trajectories. A transportation Corridor may be a lineal Transect Zone.

Cottage: an Edgeyard building type. A single-family dwelling, on a regular Lot, often shared with an Accessory Building in the back yard.

Courtyard Building: a building that occupies the boundaries of its Lot while internally defining one or more private patios. *See Table 9.*

Curb: the edge of the vehicular pavement that may be raised or flush to a Swale. It usually incorporates the drainage system. *See Table 4A and Table 4B.*

DDC: Development and Design Center.

Density: the number of dwelling units within a standard measure of land area.

Design Speed: is the velocity at which a Thoroughfare tends to be driven without the constraints of signage or enforcement. There are four ranges of speed: Very Low: (below 20 MPH); Low: (20-25 MPH); Moderate: (25-35 MPH); High: (above 35 MPH). Lane width is determined by desired Design Speed. *See Table 3A.*

Developable Areas: lands other than those in the O-1 Preserved Open Sector.

Development and Design Center (DDC): A component of the Planning Office assigned to advise on the use of this Code and to aid in the design of the Communities and buildings based on it.

Disposition: the placement of a building on its Lot. *See Table 9 and Table 17.*

Dooryard: a Private Frontage type with a shallow Setback and front garden or patio, usually with a low wall at the Frontage Line. *See Table 7.* (Variant: **Lightwell,** light court.)

Drive: a Thoroughfare along the boundary between an Urbanized and a natural condition, usually along a waterfront, Park, or promontory. One side has the urban character of a Thoroughfare, with Sidewalk and building, while the other has the qualities of a Road or parkway, with naturalistic planting and rural details.

Driveway: a vehicular lane within a Lot, often leading to a garage. *See Section 5.10 and Table 3B-f.*

Edgeyard Building: a building that occupies the center of its Lot with Setbacks on all sides. *See Table 9.*

Effective Parking: the amount of parking required for Mixed Use after adjustment by the Shared Parking Factor. *See Table 11.*

Effective Turning Radius: the measurement of the inside Turning Radius taking parked cars into account. *See Table 17.*

Elevation: an exterior wall of a building not along a Frontage Line. *See Table 17.* See: **Facade.**

Encroach: to break the plane of a vertical or horizontal regulatory limit with a structural element, so that it extends into a Setback, into the Public Frontage, or above a height limit.

Encroachment: any structural element that breaks the plane of a vertical or horizontal regulatory limit, extending into a Setback, into the Public Frontage, or above a height limit.

Enfront: to place an element along a Frontage, as in "porches Enfront the street."

Estate House: an Edgeyard building type. A single-family dwelling on a very large Lot of rural character, often shared by one or more Accessory Buildings. (Syn: country house, villa)

Expression Line: a line prescribed at a certain level of a building for the major part of the width of a Facade, expressed by a variation in material or by a limited projection such as a molding or balcony. *See Table 8.* (Syn: transition line.)

Extension Line: a line prescribed at a certain level of a building for the major part of the width of a Facade, regulating the maximum height for an Encroachment by an Arcade Frontage. *See Table 8.*

Facade: the exterior wall of a building that is set along a Frontage Line. *See* **Elevation.**

Forecourt: a Private Frontage wherein a portion of the Facade is close to the Frontage Line and the central portion is set back. *See Table 7.*

Frontage: the area between a building Facade and the vehicular lanes, inclusive of its built and planted components. Frontage is divided into **Private Frontage** and **Public Frontage.** *See Table 4A and Table 7.*

Frontage Line: a Lot line bordering a Public Frontage. Facades facing Frontage Lines define the public realm and are therefore more regulated than the Elevations facing other Lot Lines. *See Table 17.*

Function: the use or uses accommodated by a building and its Lot, categorized as *Restricted, Limited,* or *Open,* according to the intensity of the use. *See Table 10 and Table 12.*

Gallery: a Private Frontage conventional for Retail use wherein the Facade is aligned close to the Frontage Line with an attached cantilevered shed or lightweight colonnade overlapping the Sidewalk. *See Table 7.*

GIS (Geographic Information System): a computerized program in widespread municipal use that organizes data on maps.The protocol for preparing a *Regional Plan* should be based on GIS information. *See Section 2.1.*

Green: a Civic Space type for unstructured recreation, spatially defined by landscaping rather than building Frontages. *See Table 13.*

Greenfield: an area that consists of open or wooded land or farmland that has not been previously developed.

Greenway: an Open Space Corridor in largely natural conditions which may include trails for bicycles and pedestrians.

Greyfield: an area previously used primarily as a parking lot. Shopping centers and shopping malls are typical Greyfield sites. (Variant: Grayfield.)

Growth Sector: one of four Sectors where development is permitted By Right in the SmartCode, three for New Communities and one for Infill. *See Article 2.*

Hamlet: *See* **CLD.** (Syn: cluster, settlement.)

Highway: a rural and suburban Thoroughfare of high vehicular speed and capacity. This type is allocated to the more rural Transect Zones (T-1, T-2, and T-3).

Home Occupation: non-Retail Commercial enterprises. The work quarters should be invisible from the Frontage, located either within the house or in an Outbuilding. Permitted activities are defined by the Restricted Office category. *See Table 10.*

House: an Edgeyard building type, usually a single-family dwelling on a large Lot, often shared with an Accessory Building in the back yard. (Syn: single.)

Infill: *noun* - new development on land that had been previously developed, including most Greyfield and Brownfield sites and cleared land within Urbanized areas. *verb*- to develop such areas.

Infill RCD: a Community Unit type within an Urbanized, Greyfield, or Brownfield area based on a Long or Linear Pedestrian Shed and consisting of T-4, T-5, and/or T-6 Zones. An Infill RCD is permitted By Right in the G-4 Infill Growth Sector and is regulated by Article 4. *See Section 4.2.3.* (Var: downtown.)

Infill TND: a Community Unit type within an Urbanized, Greyfield, or Brownfield area based on a Standard Pedestrian Shed and consisting of T-3, T-4, and/or T-5 Zones. An Infill TND is permitted By Right in the G-4 Infill Growth Sector and is regulated by Article 4. *See Section 4.2.2.* (Var: neighborhood.)

Inn: a Lodging type, owner-occupied, offering 6 to 12 bedrooms, permitted to serve breakfast in the mornings to guests. *See Table 10.*

Layer: a range of depth of a Lot within which certain elements are permitted. *See Table 17.*

Lightwell: A Private Frontage type that is a below-grade entrance or recess designed to allow light into basements. *See Table 7.* (Syn: light court.)

Linear Pedestrian Shed: A Pedestrian Shed that is elongated along an important Mixed Use Corridor such as a main street. A Linear Pedestrian Shed extends approximately 1/4 mile from each side of the Corridor for the length of its Mixed Use portion. The resulting area is shaped like a lozenge. It may be used to structure a TND, RCD, Infill TND, or Infill RCD. (Syn: elongated pedestrian shed.)

Liner Building: a building specifically designed to mask a parking lot or a Parking Structure from a Frontage.

Live-Work: a Mixed Use unit consisting of a Commercial and Residential Function. The Commercial Function may be anywhere in the unit. It is intended to be occupied by a business operator who lives in the same structure that contains the Commercial activity or industry. *See* **Work-Live.** (Syn.: flexhouse.)

Lodging: premises available for daily and weekly renting of bedrooms. *See Table 10 and Table 12.*

Long Pedestrian Shed: a Pedestrian Shed that is an average 1/2 mile radius or 2640 feet, used when a transit stop (bus or rail) is present or proposed as the Common Destination. A Long Pedestrian Shed represents approximately a ten-minute walk at a leisurely pace. It is applied to structure an RCD Community Unit type. *See* **Pedestrian Shed.**

Lot: a parcel of land accommodating a building or buildings of unified design. The size of a Lot is controlled by its width in order to determine the grain (i.e., fine grain or coarse grain) of the urban fabric.

Lot Line: the boundary that legally and geometrically demarcates a Lot.

Lot Width: the length of the Principal Frontage Line of a Lot.

Main Civic Space: the primary outdoor gathering place for a community.The Main Civic Space is often, but not always, associated with an important Civic Building.

Manufacturing: premises available for the creation, assemblage and/or repair of artifacts, using table-mounted electrical machinery or artisanal equipment, and including their Retail sale.

Meeting Hall: a building available for gatherings, including conferences, that accommodates at least one room equivalent to a minimum of 10 square feet per projected dwelling unit within the Pedestrian Shed in which it is located.

Mixed Use: multiple Functions within the same building through superimposition or adjacency, or in multiple buildings by adjacency, or at a proximity determined by Warrant.

Net Site Area: all developable land within a site including Thoroughfares but excluding land allocated as Civic Zones.

Network Pedestrian Shed: a Pedestrian Shed adjusted for average walk times along Thoroughfares. This type may be used to structure Infill Community Plans. *See Table 17.*

Office: premises available for the transaction of general business but excluding Retail, artisanal and Manufacturing uses. *See Table 10.*

Open Space: land intended to remain undeveloped; it may be for Civic Space.

Outbuilding: an Accessory Building, usually located toward the rear of the same Lot as a Principal Building, and sometimes connected to the Principal Building by a Backbuilding. *See Table 17.*

Park: a Civic Space type that is a natural preserve available for unstructured recreation. *See Table 13.*

Parking Structure: a building containing one or more Stories of parking above grade.

Passage (PS): a pedestrian connector, open or roofed, that passes between buildings to provide shortcuts through long Blocks and connect rear parking areas to Frontages.

Path (PT): a pedestrian way traversing a Park or rural area, with landscape matching the contiguous Open Space, ideally connecting directly with the urban Sidewalk network.

Pedestrian Shed: An area that is centered on a Common Destination. Its size is related to average walking distances for the applicable Community Unit type. Pedestrian Sheds are applied to structure Communities. *See* **Standard, Long, Linear** or **Network Pedestrian Shed.** (Syn: walkshed, walkable catchment.)

Planter: the element of the Public Frontage which accommodates street trees, whether continuous or individual.

Plaza: a Civic Space type designed for Civic purposes and Commercial activities in the more urban Transect Zones, generally paved and spatially defined by building Frontages.

Principal Building: the main building on a Lot, usually located toward the Frontage. *See Table 17.*

Principal Entrance: the main point of access for pedestrians into a building.

Principal Frontage: On corner Lots, the Private Frontage designated to bear the address and Principal Entrance to the building, and the measure of minimum Lot width. Prescriptions for the parking Layers pertain only to the Principal Frontage. Prescriptions for the first Layer pertain to both Frontages of a corner Lot. *See* **Frontage.**

Private Frontage: the privately held Layer between the Frontage Line and the Principal Building Facade. *See Table 7 and Table 17.*

Public Frontage: the area between the Curb of the vehicular lanes and the Frontage Line. *See Table 4A and Table 4B.*

RCD: *see* **Regional Center Development.**

Rear Alley (RA): a vehicular way located to the rear of Lots providing access to service areas, parking, and Outbuildings and containing utility easements. Rear Alleys should be paved from building face to building face, with drainage by inverted crown at the center or with roll Curbs at the edges.

Rear Lane (RL): a vehicular way located to the rear of Lots providing access to service areas, parking, and Outbuildings and containing utility easements. Rear Lanes may be paved lightly to Driveway standards. The streetscape consists of gravel or landscaped edges, has no raised Curb, and is drained by percolation.

Rearyard Building: a building that occupies the full Frontage Line, leaving the rear of the Lot as the sole yard. *See Table 9.* (Var: Rowhouse, Townhouse, Apartment House)

Recess Line: a line prescribed for the full width of a Facade, above which there is a Stepback of a minimum distance, such that the height to this line (not the overall building height) effectively defines the enclosure of the Enfronting public space. Var: Extension Line. *See Table 8.*

Regional Center: Regional Center Development or **RCD.**

Regional Center Development (RCD): a Community Unit type structured by a Long Pedestrian Shed or Linear Pedestrian Shed, which may be adjoined without buffers by one or several Standard Pedestrian Sheds, each with the individual Transect Zone requirements of a TND. RCD takes the form of a high-Density Mixed Use center connected to other centers by transit. See **Infill RCD,** *Table 2 and Table 14a.* (Var: town center, downtown. Syn: **Regional Center)**

Regulating Plan: a Zoning Map or set of maps that shows the Transect Zones, Civic Zones, Special Districts if any, and Special Requirements if any, of areas subject to, or potentially subject to, regulation by the SmartCode.

Residential: characterizing premises available for long-term human dwelling.

Retail: characterizing premises available for the sale of merchandise and food service. *See Table 10 and Table 12.*

Retail Frontage: Frontage designated on a Regulating Plan that requires or recommends the provision of a Shopfront, encouraging the ground level to be available for Retail use. *See* **Special Requirements.**

Road (RD): a local, rural and suburban Thoroughfare of low-to-moderate vehicular speed and capacity. This type is allocated to the more rural Transect Zones (T1-T3). *See Table 3A.*

Rowhouse: a single-family dwelling that shares a party wall with another of the same type and occupies the full Frontage Line. See **Rearyard Building.** (Syn: **Townhouse**)

Rural Boundary Line: the extent of potential urban growth as determined by existing geographical determinants. The Rural Boundary Line is permanent.

Sector: a neutral term for a geographic area. In the SmartCode there are six specific Sectors for regional planning that establish the legal boundaries for Open Space and development.

Secondary Frontage: on corner Lots, the Private Frontage that is not the Principal Frontage. As it affects the public realm, its First Layer is regulated. *See Table 17.*

Setback: the area of a Lot measured from the Lot line to a building Facade or Elevation that is maintained clear of permanent structures, with the exception of Encroachments listed in *Section 5.7. See Table 14g.* (Var: build-to-line.)

Shared Parking Factor: an accounting for parking spaces that are available to more than one Function. *See Table 11.*

Shopfront: a Private Frontage conventional for Retail use, with substantial glazing and an awning, wherein the Facade is aligned close to the Frontage Line with the building entrance at Sidewalk grade. *See Table 7.*

Sidewalk: the paved section of the Public Frontage dedicated exclusively to pedestrian activity.

Sideyard Building: a building that occupies one side of the Lot with a Setback on the other side. This type can be a Single or Twin depending on whether it abuts the neighboring house. *See Table 9.*

Slip Road: an outer vehicular lane or lanes of a Thoroughfare, designed for slow speeds while inner lanes carry higher speed traffic, and separated from them by a planted median. (Syn: access lane, service lane)

Specialized Building: a building that is not subject to Residential, Commercial, or Lodging classification. *See Table 9.*

Special District (SD): an area that, by its intrinsic Function, Disposition, or Configuration, cannot or should not conform to one or more of the normative Community Unit types or Transect Zones specified by the SmartCode. Special Districts may be mapped and regulated at the regional scale or the community scale.

Special Flood Hazard Area: a designation by the Federal Emergency Management Agency (FEMA) that may include the V (Velocity) Zones and Coastal A Zones where building construction is forbidden, restricted, or contingent upon raising to the Base Flood Elevation.

Special Requirements: provisions of Section 3.9, Section 4.7, and Section 5.3 of this Code and/or the associated designations on a Regulating Plan or other map for those provisions.

Square: a Civic Space type designed for unstructured recreation and Civic purposes, spatially defined by building Frontages and consisting of Paths, lawns and trees, formally disposed. *See Table 13.*

Standard Pedestrian Shed: a Pedestrian Shed that is an average 1/4 mile radius or 1320 feet, about the distance of a five-minute walk at a leisurely pace. See Pedestrian Shed.

Stepback: a building Setback of a specified distance that occurs at a prescribed number of Stories above the ground. *See Table 8.*

Stoop: a Private Frontage wherein the Facade is aligned close to the Frontage Line with the first Story elevated from the Sidewalk for privacy, with an exterior stair and landing at the entrance. *See Table 7.*

Story: a habitable level within a building, excluding an Attic or raised basement. *See Table 8.*

Street (ST): a local urban Thoroughfare of low speed and capacity. *See Table 3B and Table 4B.*

Streetscreen: a freestanding wall built along the Frontage Line, or coplanar with the Facade. It may mask a parking lot from the Thoroughfare, provide privacy to a side yard, and/or strengthen the spatial definition of the public realm. (Syn: streetwall.) *See Section 5.7.5f.*

Substantial Modification: alteration to a building that is valued at more than 50% of the replacement cost of the entire building, if new.

Swale: a low or slightly depressed natural area for drainage.

T-zone: Transect Zone.

TDR: Transfer of Development Rights, a method of relocating existing zoning rights from areas to be preserved as Open Space to areas to be more densely urbanized.

TDR Receiving Area: an area intended for development that may be made more dense by the purchase of development rights from TDR Sending Areas.

TDR Sending Area: an area previously zoned for development within a designated Reserved Open Sector (O-2), from which development rights may be transferred to a Growth Sector.

Terminated Vista: a location at the axial conclusion of a Thoroughfare. A building located at a Terminated Vista designated on a Regulating Plan is required or recommended to be designed in response to the axis.

Thoroughfare: a way for use by vehicular and pedestrian traffic and to provide access to Lots and Open Spaces, consisting of Vehicular Lanes and the Public Frontage. *See Table 3A, Table 3B and Table 17a.*

TND: Traditional Neighborhood Development, a Community Unit type structured by a Standard Pedestrian Shed oriented toward a Common Destination consisting of a Mixed Use center or Corridor, and in the form of a medium-sized settlement near a transportation route. *See Table 2 and Table 14a.* (Syn: village. Variant: **Infill TND**, neighborhood.)

TOD: Transit Oriented Development. TOD is created by an overlay on all or part of a TND or RCD, or by designation on a Regional Plan, permitting increased Density to support rail or Bus Rapid Transit (BRT) as set forth in *Section 5.9.2d.*

Townhouse: See **Rearyard Building.** (Syn: **Rowhouse**)

Transect: a cross-section of the environment showing a range of different habitats. The rural-urban Transect of the human environment used in the SmartCode template is divided into six Transect Zones. These zones describe the physical form and character of a place, according to the Density and intensity of its land use and Urbanism.

Transect Zone (T-zone): One of several areas on a Zoning Map regulated by the SmartCode. Transect Zones are administratively similar to the land use zones in conventional codes, except that in addition to the usual building use, Density, height, and Setback requirements, other elements of the intended habitat are integrated, including those of the private Lot and building and Public Frontage. *See Table 1.*

Turning Radius: the curved edge of a Thoroughfare at an intersection, measured at the inside edge of the vehicular tracking. The smaller the Turning Radius, the smaller the pedestrian crossing distance and the more slowly the vehicle is forced to make the turn. *See Table 3B and Table 17.*

Urban Boundary Line: the extent of potential urban growth as determined by the projected demographic needs of a region. The Urban Boundary Line may be adjusted from time to time.

Urbanism: collective term for the condition of a compact, Mixed Use settlement, including the physical form of its development and its environmental, functional, economic, and sociocultural aspects.

Urbanized: generally, developed. Specific to the SmartCode, developed at T-3 (Sub-Urban) Density or higher.

Variance: a ruling that would permit a practice that is not consistent with either a specific provision or the Intent of this Code *(Section 1.3)*. Variances are usually granted by the Board of Appeals in a public hearing. *See Section 1.5.*

Warrant: a ruling that would permit a practice that is not consistent with a specific provision of this Code, but that is justified by its Intent *(Section 1.3)*. Warrants are usually granted administratively by the CRC. *See Section 1.5.*

Work-Live: a Mixed Use unit consisting of a Commercial and Residential Function. It typically has a substantial Commercial component that may accommodate employees and walk-in trade. The unit is intended to function predominantly as work space with incidental Residential accommodations that meet basic habitability requirements. See Live-Work. (Syn: Live-With.)

Yield: characterizing a Thoroughfare that has two-way traffic but only one effective travel lane because of parked cars, necessitating slow movement and driver negotiation. Also, characterizing parking on such a Thoroughfare.

Zoning Map: the official map or maps that are part of the zoning ordinance and delineate the boundaries of individual zones and districts. See **Regulating Plan.**

APPENDIX B.

Zoning and Flood Confirmation Forms

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI
OCT 13 2014
RECEIVED

ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. **TELEPHONE** 244-2015

PROJECT NAME Olowalu Town Master Plan **E-MAIL** planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii **TAX MAP KEY** (2)4-8-003:084

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☑ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☑ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☐ Rural ☑ Planned Growth Area ☑ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☑ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN:[2] AG - Agriculture PK - Park + OS - Open Space (portion)

COUNTY ZONING: AG - Agriculture, A2 Apartment Dstrct, Hotel, R3 Industrial Dstrct

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: VE (elev 11') AO (depth 1') X, AE (elev 8')

☐ FEMA DESIGNATED FLOODWAY | For Flood Zone AO, FLOOD DEPTH:

☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:

1 The conditions and/or representations made in the approval of a State District Boundary Amendment, Community Plan Amendment, County Change in Zoning, SMA Permit, Planned Development, Project District and/or a previous subdivision, may affect building permits, subdivisions, and uses on the land.
2 Please review the Maui Island Plan and the Community Plan document for any goals, objectives, policies or actions that may affect this parcel.
3 Flood development permits might be required in zones X and XS for any work done in streams, gulches, low-lying areas, or any type of drainageway; Flood development permits are required for work in all other zones. Subdivisions that include/adjoin streams, gulches, low-lying areas, or any type of drainageway might require the following designations to be shown on the subdivision map: 100-year flood inundation limits; base flood elevations; drainage reserves.
4 Subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030.D, Maui County Code].

REVIEWED & CONFIRMED BY:

(Signature) (Date) 10/14/14

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI
OCT 13 2014
RECEIVED

ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. **TELEPHONE** 244-2015

PROJECT NAME Olowalu Town Master Plan **E-MAIL** planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii **TAX MAP KEY** (2)4-8-003:098

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☑ Rural ☑ Planned Growth Area ☐ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN:[2] AG - Agriculture

COUNTY ZONING: AG - Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: X

☐ FEMA DESIGNATED FLOODWAY | For Flood Zone AO, FLOOD DEPTH:

☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
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☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:

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REVIEWED & CONFIRMED BY:

(Signature) (Date) 10/14/14

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI
OCT 1 3 2014
RECEIVED

ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. **TELEPHONE** 244-2015

PROJECT NAME Olowalu Town Master Plan **E-MAIL** planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii **TAX MAP KEY** (2)4-8-003:099

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

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3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN
Growth Boundary: [2] ☐ Urban ☐ Small Town ☑ Rural ☑ Planned Growth Area ☑ Outside Growth Boundaries
Protected Area: [2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN: [2] AG- Agriculture

COUNTY ZONING: AG- Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: X

☐ FEMA DESIGNATED FLOODWAY | For Flood Zone AO, FLOOD DEPTH:

☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
(Signature) ☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:
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REVIEWED & CONFIRMED BY:

(Signature) (Date) 10/14/14

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI
OCT 1 3 2014
RECEIVED

ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:100

☐ Yes ■ No Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:
A) ☐ Yes ☐ No Will it be processed under a consistency exemption from Section 18.04.030(B), MCC?
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN
Growth Boundary: [2] ☐ Urban ☐ Small Town ☑ Rural ☑ Planned Growth Area ☑ Outside Growth Boundaries
Protected Area: [2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN: [2] AG- Agriculture

COUNTY ZONING: AG- Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: X + AO (depth 1')

☐ FEMA DESIGNATED FLOODWAY | For Flood Zone AO, FLOOD DEPTH:

☑ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
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4 Subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030.D, Maui County Code].

REVIEWED & CONFIRMED BY:

(Signature) (Date) 10/14/14

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI RECEIVED MAR 1 9

ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:101

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☑ (SMA) Special Management Area (portion)

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☑ Conservation

MAUI ISLAND PLAN Growth Boundary: [2] ☑ Urban ☐ Small Town ☑ Rural ☑ Planned Growth Area ☐ Outside Growth Boundaries
Protected Area: [2] ☐ Preservation ☑ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN: [2] AG (Agriculture) + OT - Single Family + PARK

COUNTY ZONING: AG (Agriculture) + R-2 Residential District

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: X, AO (depth 1')

☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH: 1'

☑ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
(Signature) ☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).
☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:
1 The conditions and/or representations made in the approval of a State District Boundary Amendment, Community Plan Amendment, County Change in Zoning, SMA Permit, Planned Development, Project District and/or a previous subdivision, may affect building permits, subdivisions, and uses on the land.
2 Please review the Maui Island Plan and the Community Plan document for any goals, objectives, policies or actions that may affect this parcel.
3 Flood development permits might be required in zones X and XS for any work done in streams, gulches, low-lying areas, or any type of drainageway; Flood development permits are required for work in all other zones. Subdivisions that include/adjoin streams, gulches, low-lying areas, or any type of drainageway might require the following designations to be shown on the subdivision map: 100-year flood inundation limits; base flood elevations; drainage reserves.
4 Subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030.D, Maui County Code].

REVIEWED & CONFIRMED BY:
(Signature) 3/19/15 (Date)
For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI OCT 1 3 2014 RECEIVED

ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:102

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☑ (SMA) Special Management Area (portion)

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary: [2] ☑ Urban ☐ Small Town ☑ Rural ☑ Planned Growth Area ☐ Outside Growth Boundaries
Protected Area: [2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN: [2] AG - Agriculture

COUNTY ZONING: AG - Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: X + AO (depth 1')

☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

☑ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
(Signature) ☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).
☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:
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REVIEWED & CONFIRMED BY:
(Signature) 10/14/14 (Date)
For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI
OCT 13 2014
RECEIVED

ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:103

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5) _____

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☑ Urban ☐ Small Town ☐ Rural ☑ Planned Growth Area ☐ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN:[2] AG - Agriculture

COUNTY ZONING: AG - Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: X + AO (depth 1')

☐ FEMA DESIGNATED FLOODWAY | For Flood Zone AO, FLOOD DEPTH:

☑ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

_____ (Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
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REVIEWED & CONFIRMED BY:

(Signature) (Date) 10/14/14

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

COUNTY OF MAUI
DEPARTMENT OF PLANNING
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Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI
OCT 13 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:104

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5) _____

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☑ Urban ☐ Small Town ☐ Rural ☑ Planned Growth Area ☑ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN:[2] AG - Agriculture

COUNTY ZONING: AG - Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: AO (depth 1'), XS, X, AEF (BFE: 33'-41')

☑ FEMA DESIGNATED FLOODWAY | For Flood Zone AO, FLOOD DEPTH: 1'

☑ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

_____ (Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
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REVIEWED & CONFIRMED BY:

(Signature) (Date) 10/14/14

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

COUNTY OF MAUI
DEPARTMENT OF PLANNING
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Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

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COUNTY OF MAUI
OCT 1 3 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:105

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary: [2] ☑ Urban ☐ Small Town ☑ Rural ☑ Planned Growth Area ☑ Outside Growth Boundaries
Protected Area: [2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN: [2] AG- Agriculture

COUNTY ZONING: AG- Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: X & AO (depth 1')

☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

☑ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
(Signature) ☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).
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REVIEWED & CONFIRMED BY:
(Signature) 10/14/14 (Date)
For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
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COUNTY OF MAUI
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:106

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary: [2] ☐ Urban ☐ Small Town ☑ Rural ☑ Planned Growth Area ☑ Outside Growth Boundaries
Protected Area: [2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN: [2] AG- Agriculture

COUNTY ZONING: AG- Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES [3] & BASE FLOOD ELEVATIONS: X, A, XS, AEF (BFE-61'-73')

☑ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

☑ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
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REVIEWED & CONFIRMED BY:
(Signature) 10/14/14 (Date)
For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

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DEPARTMENT OF PLANNING
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DEPT OF PLANNING COUNTY OF MAUI
OCT 13 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. **TELEPHONE** 244-2015

PROJECT NAME Olowalu Town Master Plan **E-MAIL** planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii **TAX MAP KEY** (2)4-8-003:107

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5) _____

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INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
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3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☑ Rural ☑ Planned Growth Area ☑ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN:[2] AG-Agriculture

COUNTY ZONING: AG-Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: X

☐ FEMA DESIGNATED FLOODWAY | For Flood Zone AO, FLOOD DEPTH:

☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

_____ (Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:

1 The conditions and/or representations made in the approval of a State District Boundary Amendment, Community Plan Amendment, County Change in Zoning, SMA Permit, Planned Development, Project District and/or a previous subdivision, may affect building permits, subdivisions, and uses on the land.
2 Please review the Maui Island Plan and the Community Plan document for any goals, objectives, policies or actions that may affect this parcel.
3 Flood development permits might be required in zones X and XS for any work done in streams, gulches, low-lying areas, or any type of drainageway. Flood development permits are required for work in all other zones. Subdivisions that include/adjoin streams, gulches, low-lying areas, or any type of drainageway might require the following designations to be shown on the subdivision map: 100-year flood inundation limits; base flood elevations; drainage reserves.
4 Subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030.D, Maui County Code].

REVIEWED & CONFIRMED BY:

(Signature) (Date) 10/20/14

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT OF PLANNING COUNTY OF MAUI
OCT 13 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:108

☐ Yes ■ No Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No Will it be processed under a consistency exemption from Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (ie 1-lot into 2-lots for all land uses allowed by law):

INSTRUCTIONS:
1) Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.
2) If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.
3) If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☑ Agriculture ☑ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☐ Rural ☐ Planned Growth Area ☑ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☑ Sensitive Land ☑ Outside Protected Areas

COMMUNITY PLAN:[2] AG-Agriculture + Conservation

COUNTY ZONING: AG-Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: X, AO (depth 1'), AE (BFE 33'-73'), XS, A

☑ FEMA DESIGNATED FLOODWAY | For Flood Zone AO, FLOOD DEPTH:

☑ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

_____ (Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

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REVIEWED & CONFIRMED BY:

(Signature) (Date) 10/20/14

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

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COUNTY OF MAUI
DEPARTMENT OF PLANNING
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E-mail: planning@mauicounty.gov

DEPT. OF PLANNING COUNTY OF MAUI
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:109

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☒ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries
Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☒ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:
FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: A, X
☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:
☒ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).
☐[4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐[4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐[4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:
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2 Please review the Maui Island Plan and the Community Plan document for any goals, objectives, policies or actions that may affect this parcel.
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REVIEWED & CONFIRMED BY:
(Signature) 10/15/14 (Date)
For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
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DEPT. OF PLANNING COUNTY OF MAUI
OCT 13 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:110

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☒ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries
Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:
FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: AEF (ST-T3'), A, XS, X
☒ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:
☒ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).
☐[4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐[4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐[4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

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REVIEWED & CONFIRMED BY:
(Signature) 10/15/14 (Date)
For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and
Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

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COUNTY OF MAUI
OCT 13 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:111

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1] ☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☒ Urban ☐ Small Town ☒ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: AEF (55'-59'), XS, X

☒ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

☒ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).

☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.

☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

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REVIEWED & CONFIRMED BY:

(Signature) 10/15/14 (Date)

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
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E-mail: planning@mauicounty.gov

DEPT. OF PLANNING
COUNTY OF MAUI
OCT 13 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:112

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1] ☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☒ Urban ☐ Small Town ☐ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: AEF (33'-56'), AO, XS, X

☒ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH: 1'

☒ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
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REVIEWED & CONFIRMED BY:

(Signature) 10/15/14 (Date)

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

COUNTY OF MAUI
DEPARTMENT OF PLANNING
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COUNTY OF MAU
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:113

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

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2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☒ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☒ Urban ☐ Small Town ☒ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: X

☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:
1 The conditions and/or representations made in the approval of a State District Boundary Amendment, Community Plan Amendment, County Change in Zoning, SMA Permit, Planned Development, Project District and/or a previous subdivision, may affect building permits, subdivisions, and uses on the land.
2 Please review the Maui Island Plan and the Community Plan document for any goals, objectives, policies or actions that may affect this parcel.
3 Flood development permits might be required in zones X and XS for any work done in streams, gulches, low-lying areas, or any type of drainageway; Flood development permits are required for work in all other zones. Subdivisions that include/adjoin streams, gulches, low-lying areas, or any type of drainageway might require the following designations to be shown on the subdivision map: 100-year flood inundation limits; base flood elevations; drainage reserves.
4 Subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030.D, Maui County Code].

REVIEWED & CONFIRMED BY:

(Signature) 10/15/14 (Date)

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and
Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

DEPT. OF PLANNING
COUNTY OF MAUI
OCT 1 3 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:114

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☒ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☒ Urban ☐ Small Town ☒ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: X

☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:
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REVIEWED & CONFIRMED BY:

(Signature) 10/15/14 (Date)

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and
Enforcement Division (ZAED)
Telephone: (808) 270-7253
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E-mail: planning@maulcounty.gov

DEPT. OF PLANNING
COUNTY OF MAUI
OCT 1 3 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:115

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5) _____

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:

1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☒ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☒ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☒ Park ☐ Greenbelt ☐ Greenway ☒ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: X

☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

_____ (Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).

☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.

☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:

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REVIEWED & CONFIRMED BY:

_____ (Signature) 10/15/14 (Date)

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
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2200 Main Street, Suite 335
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Facsimile: (808) 270-7634
E-mail: planning@maulcounty.gov

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COUNTY OF MAUI
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. TELEPHONE 244-2015

PROJECT NAME Olowalu Town Master Plan E-MAIL planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii TAX MAP KEY (2)4-8-003:116

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5) _____

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:

1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION:[1]

☒ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☐ Rural ☐ Planned Growth Area ☒ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☒ Park ☐ Greenbelt ☐ Greenway ☒ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: X

☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:

☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

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☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.

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REVIEWED & CONFIRMED BY:

_____ (Signature) 10/15/14 (Date)

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

S:\ALL\FORMS\ZAED\ZoneFldConf\ZonFldConf_Rev12-13.doc Page 1

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
Wailuku, Hawaii 96793

Zoning Administration and Enforcement Division (ZAED)
Telephone: (808) 270-7253
Facsimile: (808) 270-7634
E-mail: planning@mauicounty.gov

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OCT 13 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. **TELEPHONE** 244-2015

PROJECT NAME Olowalu Town Master Plan **E-MAIL** planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii **TAX MAP KEY** (2)4-8-003:117

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
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3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☐ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☐ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☐ Urban ☐ Small Town ☒ Rural ☒ Planned Growth Area ☐ Outside Growth Boundaries
Protected Area:[2] ☐ Preservation ☐ Park ☐ Greenbelt ☐ Greenway ☒ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:
FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: X
☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH:
☐ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).
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REVIEWED & CONFIRMED BY:
(Signature) 10/15/14 (Date)
For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
2200 Main Street, Suite 335
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OCT 13 2014
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. **TELEPHONE** 244-2015

PROJECT NAME Olowalu Town Master Plan **E-MAIL** planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii **TAX MAP KEY** (2)4-8-003:118

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5)

B) State the purpose of subdivision and the proposed land uses (*ie 1-lot into 2-lots for all land uses allowed by law*):

INSTRUCTIONS:
1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
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(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☒ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☒ Conservation

MAUI ISLAND PLAN Growth Boundary:[2] ☒ Urban ☐ Small Town ☒ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries
Protected Area:[2] ☐ Preservation ☒ Park ☐ Greenbelt ☐ Greenway ☒ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture

COUNTY ZONING: Agriculture

OTHER/COMMENTS:

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:
FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: VE (11'), AE (8'), AO, XS, X
☐ FEMA DESIGNATED FLOODWAY For Flood Zone AO, FLOOD DEPTH: /'
☒ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).
(Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
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☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).
☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.
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REVIEWED & CONFIRMED BY:
(Signature) 10/15/14 (Date)
For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

COUNTY OF MAUI
DEPARTMENT OF PLANNING
One Main Plaza Building
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COUNTY OF MAUI
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ZONING AND FLOOD CONFIRMATION FORM

(This section to be completed by the Applicant)

APPLICANT NAME Munekiyo & Hiraga, Inc. **TELEPHONE** 244-2015

PROJECT NAME Olowalu Town Master Plan **E-MAIL** planning@mhplanning.com

PROPERTY ADDRESS Olowalu, Maui, Hawaii **TAX MAP KEY** (2)4-8-003:124

☐ Yes ■ No **Will this Zoning & Flood Confirmation Form be used with a Subdivision Application?**
IF YES, answer questions A and B below and comply with instructions 2 & 3 below:

A) ☐ Yes ☐ No **Will it be processed under a consistency exemption from** Section 18.04.030(B), MCC?
IF YES, which exemption? (No. 1, 2, 3, 4 or 5) _____

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INSTRUCTIONS:

1) **Please use a separate Zoning & Flood Confirmation Form for each Tax Map Key (TMK) number.**
2) **If this will be used with a subdivision application AND the subject property contains multiple districts/designations of (1) State Land Use Districts, (2) Maui Island Plan Growth Boundaries, (3) Community Plan Designations, or (4) County Zoning Districts; submit a signed and dated Land Use Designations Map, prepared by a licensed surveyor, showing the metes & bounds of the subject parcel and of each district/designation including any subdistricts.**
3) **If this will be used with a subdivision application AND the subject property contains multiple State Land Use Districts; submit an approved District Boundary Interpretation from the State Land Use Commission.**

(This section to be completed by ZAED)

LAND USE DISTRICTS/DESIGNATIONS (LUD) AND OTHER INFORMATION: [1]

☒ (SMA) Special Management Area

STATE DISTRICT: ☐ Urban ☐ Rural ☒ Agriculture ☒ Conservation

MAUI ISLAND PLAN — Growth Boundary:[2] ☐ Urban ☐ Small Town ☐ Rural ☒ Planned Growth Area ☒ Outside Growth Boundaries

Protected Area:[2] ☐ Preservation ☒ Park ☐ Greenbelt ☐ Greenway ☐ Sensitive Land ☒ Outside Protected Areas

COMMUNITY PLAN:[2] Agriculture, Open Space

COUNTY ZONING: Agriculture, R-3 Residential Dist.

OTHER/COMMENTS: portion includes Cultural Reserve Easement

☐ (PD) Planned Development
☐ (PH) Project District
☐ See Additional Comments (Pg.2)
☐ See Attached LUD Map

FEMA FLOOD INFORMATION:

FLOOD HAZARD AREA ZONES[3] & BASE FLOOD ELEVATIONS: VE (9'), AO, X5, X

☐ FEMA DESIGNATED FLOODWAY — For Flood Zone AO, FLOOD DEPTH: 1'

☒ FLOOD DEVELOPMENT PERMIT REQUIRED (Zones V, VE, A, AO, AE, AH, D, & Floodways)

SUBDIVISION LAND USE CONSISTENCY: ☐ Not Consistent, (LUDs appear to have NO permitted uses in common).

_____ (Signature) ☐ Not Applicable, (Due to processing under consistency exemption No. ☐1, ☐2, ☐3, ☐4, ☐5).
☐ Interim Zoning, (The parcel or portion of the parcel that is zoned interim shall not be subdivided).

☐ [4] Consistent, (LUDs appear to have ALL permitted uses in common).

☐ [4] Consistent, upon obtaining an SMA, PD, or PH subdivision approval from Planning.

☐ [4] Consistent, upon recording a permissible uses unilateral agreement processed by Public Works (See Pg.2).

NOTES:

1 The conditions and/or representations made in the approval of a State District Boundary Amendment, Community Plan Amendment, County Change in Zoning, SMA Permit, Planned Development, Project District and/or a previous subdivision, may affect building permits, subdivisions, and uses on the land.
2 Please review the Maui Island Plan and the Community Plan document for any goals, objectives, policies or actions that may affect this parcel.
3 Flood development permits might be required in zones X and X5 for any work done in streams, gulches, low-lying areas, or any type of drainageway; Flood development permits are required for work in all other zones. Subdivisions that include/adjoin streams, gulches, low-lying areas, or any type of drainageway might require the following designations to be shown on the subdivision map: 100-year flood inundation limits; base flood elevations; drainage reserves.
4 Subdivisions will be further reviewed during the subdivision application process to verify consistency, unilateral agreement requirements, and the conditions associated with a unilateral agreement [Section 18.04.030.D, Maui County Code].

REVIEWED & CONFIRMED BY:

_____ (Signature) 10/15/14 (Date)

For: John S. Rapacz, Planning Program Administrator, Zoning Administration and Enforcement Division

APPENDIX BC.

Preliminary Engineering Report

PRELIMINARY ENGINEERING REPORT

FOR

OLOWALU TOWN

Olowalu, Maui, Hawaii

T.M.K.: (2) 4-8-003: 84, 98 - 118, 124

Prepared for:

Olowalu Town, LLC
2073 Wells St., Ste. 101
Wailuku, Maui, Hawaii 96793

Prepared by:

OTOMO ENGINEERING, INC.

CONSULTING CIVIL ENGINEERS
305 SOUTH HIGH STREET, SUITE 102
WAILUKU, MAUI, HAWAII 96793
PHONE: (808) 242-0032
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October 2011

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PRELIMINARY ENGINEERING REPORT
FOR
OLOWALU TOWN
T.M.K.: (2) 4-8-003: 84, 98-118, 124

1.0 BACKGROUND

The Olowalu Town (OT) Master Plan is proposing to establish a community at Olowalu, located on the west side of the island of Maui (See Exhibits 1 and 2). The subject property encompasses the lower coastal reaches of Olowalu ahupua'a; between the base of the south-west facing slopes of West Maui Mountains and the shoreline of Olowalu. OT will be a small-scale and mixed-use community designed to be a pedestrian-friendly community which will allow residents to live within walking distance of corner stores, schools, parks, employment opportunities, community centers, beaches, and social and civic resources, ultimately reducing reliance on automobiles. The Master Plan is guided by values and principles of sustainability by balancing the needs of Maui's growing population; yet maintaining and respecting our cultural, historical and natural resources.

At final build-out, OT will consists of approximately 1,500 residential dwelling units to be built concurrent with appropriate infrastructure in phases spread out over a period of approximately 10 years. There will be a wide variety of single-family and multi-family dwelling types, including houses, apartments, live-work units, townhomes, cottages, rural homes and farmsteads, to be offered at a wide-range of income levels, including both rental and fee-ownership. A substantial portion of the homes are planned for much-needed affordable housing and senior living.

The design of OT incorporates smart growth and sustainable land use principles of New Urbanism. As a result, OT's spatial layout of land uses, varying density, connective transportation, parks/greenways, civic/social facilities, housing, employment and other land uses are balanced to create a mixed-use community. Neighborhood town centers provide economic sustainability with a range of business and employment opportunities. OT is also designed to meet the certification requirements of Leadership in Energy and Environmental Design for Neighborhood Development (LEED ND). As such, the Master Plan will be

built using strategies aimed at improving performance in regards to energy savings, water efficiency, reducing CO2 emissions, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

2.0 INTRODUCTION

The purpose of this Preliminary Engineering Report is to provide information on the existing infrastructure systems in Olowalu; assess future infrastructure needs, demands, and requirements for the proposed OT Master Plan; and describe the proposed innovative and sustainable infrastructure systems which will be built to support OT.

The subject properties are identified as T.M.K.: (2) 4-8-003: 084, 98-118, 124, which contains a total of approximately 636 acres. The properties are bordered by vacant/unused State conservation lands to the north, State agricultural lands to the east and west, and the Pacific Ocean to the south. The project area is divided by the existing Honoapiilani Highway and several existing, privately owned agricultural parcels and subdivisions located within and abutting to the project limits. The combined area of the subject properties and some of the privately owned parcels and subdivisions immediately adjacent to the project, which totals approximately 790 acres, will be included in some sections of the project analysis.

OT's proposed infrastructure improvements will be constructed concurrently with the project and will incorporate innovative, efficient, and sustainable technology to minimize adverse impacts upon the natural environment. OT's transportation system includes the relocation of the existing high speed/high volume Honoapiilani Highway away from the coastal resources to a new mauka alignment, which will be designed to accommodate mass transit or light rail, if needed in the future. The existing highway corridor with monkey-pod trees will be incorporated into OT's master plan and converted to a low speed/low volume coastal roadway. The project will include an internal roadway network, as well as an assortment of interconnected greenways and bikeways throughout the community that supports the overall well-being and health of residents by reducing the dependency on automobiles.

Additionally, other infrastructure system improvements will require an expansion of both the existing potable and non-potable water system, additional ground water wells to supplement the existing well, and an extensive drainage system to capture storm-water runoff. The project will also include the construction of an onsite wastewater treatment facility, which will include an R-1 water storage tank, constructed vertical flow wetlands, and a soil aquifer treatment system. Additionally, the project is proposing to incorporate the use of renewable energy systems to help generate electricity for the Master Plan.

3.0 EXISTING INFRASTRUCTURE

3.1 ROADWAYS

Honoapiilani Highway is the major arterial highway which links Wailuku and West Maui. It is a two-way roadway with varying widths of two and four lanes. In the vicinity of the project site, Honoapiilani Highway is a two-lane highway aligned in generally the southeast-northwest direction following the coastline.

There are several minor roads connecting to Honoapiilani Highway fronting the project site providing access to the existing subdivisions in the area such as Luawai Street which provides access to Kapaiki and the Olowalu Mauka Subdivision. There are also several access driveways on both the mauka (north) and makai (south) side of the existing highway which provides access to the Olowalu Makai Komohana Subdivsion and Olowalu Makai Hikina Subdivision, as well as the Olowalu General Store.

3.2 DRAINAGE

The subject property is situated along the base of the southwest facing slopes of the West Maui Mountains, along the lower portions of Olowalu Valley. The steep and rugged mountain slopes and ridges of the West Maui Mountains dramatically rise upwards above the project site in excess of 4,000 feet above mean sea level. The upper most project limits (mauka) along the northeastern section of the property is at approximately 500 feet above mean sea level. From this mauka section, the land slopes downward to the southwest to the coastline along its makai boundary at near sea level.

The subject property is well-defined by significant land and natural topographic

features; including the lower sections of Olowalu Valley's sloping ridges, the prominent land feature of Pu'u Kaiwaloa, the Olowalu Stream corridor, the near-level interior portion of the property, and the coastal/shoreline section. The topography or slope of the property ranges from between 5%-15% slope near the mauka limits, to 3% to 5% slope near the mid-section of the property, to near-level to 3% along the coastal portions of the property.

According to the "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii (August, 1972)," prepared by the United States Department of Agriculture Soil Conservation Service, the soils within the project site are classified as Ewa silty clay loam (EaA), Jaucas sand (JaC), Kealia Silt Loam (KMW), Wainee extremely stony silty clay (Wyc), Pulehu silt loam, 0 to 3% slopes (PpA), Pulehu clay loam (PsA), Pulehu cobbly clay loam (PtA, PtB), Rock Land (rRK), Rock Outcrop (rRO), Rough Broken and Stony Land (rRS), and Stony Alluvial Land (rSM) (See Exhibit 3). Ewa silty clay loam has runoff that is very slow and the erosion hazard is no more than slight. Jaucas sand is characterized as having rapid permeability, very slow to slow runoff, a slight water erosion hazard, and a severe wind erosion hazard. Kealia silt loam is characterized as having moderately rapid permeability, slow to very slow runoff, the hazard of water erosion is no more than slight, but the hazard of wind erosion is severe when the soil is dry. Wainee extremely stony silty clay is characterized as having moderately rapid permeability, slow to medium runoff and slight to moderate erosion hazard. Pulehu silt loam is characterized as having slow runoff and a slight erosion hazard and is similar to the Pulehu clay loam except for the silty loam texture. Pulehu clay loam is classified as having moderate permeability, slow runoff, and an erosion hazard no more than slight. Pulehu cobbly clay loam is similar to Pulehu clay loam except that it is cobbly. It is classified as having slow runoff and slight erosion hazard. Rock land is made up of areas where exposed rock covers 20 to 90 percent of the surface and consist of rock outcrops and very shallow soils. Rock Outcrop consists of areas where exposed bedrock covers more than 90 percent of the surface. This land type is gently sloping to precipitous. Rough Broken and Stony Land is characterized as having rapid runoff with very steep and stony gulches. Stony Alluvial Land consists of stones, boulders, and soil deposited by streams along the bottoms of gulches and on alluvial fans. Improvements of this land is difficult because of the stones and boulders.

According to Panel Number 150003 0531E of the Flood Insurance Rate Map, September 25, 2009, prepared by the United States Federal Emergency Management Agency (FEMA), a majority of the subject parcel is situated in Flood Zone X (shaded and unshaded). There are also areas of Flood Zone AE, AO, A, which mainly occur along the existing Olowalu Stream, and Flood Zone VE along the shoreline (See Exhibit 4). Flood Zone X (unshaded) represents areas outside the 0.2% annual chance flood plain and is not considered a special flood hazard area. The shaded Flood Zone X region are the areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. Flood Zone AE represents special flood hazard areas subject to inundation by the 1% annual chance flood with base flood elevations determined. Flood Zone AO represents special flood hazard areas subject flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities are also determined. Flood Zone A represents special flood hazard areas subject to inundation by the 1% annual chance flood with no base flood elevations determined. Flood Zone VE represents coastal flood zone areas with velocity hazard (wave action). Base flood elevations have been determined for this zone. Development is allowed within the special flood hazard areas (Flood Zones AE, AO, A, VE) but may require additional flood hazard permitting prior to development at which time any specific requirements and restrictions for development within these areas will be determined. Flood development permits are reviewed by the County of Maui Department of Planning and FEMA, as required.

There are no existing drainage improvements within the project site, however there are several unnamed drainageways that traverse the site in the northeast to southwest direction, including Olowalu Stream which direct both onsite and offsite surface runoff towards Honoapiilani Highway. At the existing highway there are several drainage culverts which convey surface runoff from the mauka side of Honoapiilani Highway to the makai side to allow runoff to continue downstream. There are also several retention basins and drainage culverts within the surrounding existing subdivisions and improved areas that have been developed. The existing retention basins were designed to accommodate only

the increase in surface runoff due to the development of those areas.

There are four distinct drainage areas within the project site and extend mauka (See Exhibits 5 & 6). It is estimated that the present onsite runoff for a 100-year, 24-hour storm from the four drainage areas within the entire project area is approximately 1,010 cfs and approximately 322 acre-ft. of runoff volume (See Appendix A). As previously mentioned, onsite and offsite runoff sheet flows in the northeast to southwest direction across the project site. The existing Honoapiilani Highway which is near the makai or western boundary of the project acts as a berm and retains much of the runoff that sheet flows mauka of the highway. When the runoff reaches the highway, it follows existing swales along the highway and enters the State Department of Transportation (DOT) drainage system at various locations. The DOT drainage system consists of grated inlet catch basins and inlet headwall structures which intercept surface runoff along the highway shoulder and conveys it under the highway via several drainage culverts to allow the runoff to continue downstream.

3.3 WASTEWATER

There are no existing wastewater systems on the subject property. The existing Olowalu community residences are serviced by independent private wastewater facilities. The residences at Kapaiki have individual cesspools.

3.4 WATER

The Olowalu area is not serviced by the County of Maui water system, but the various existing users on the project site as well as the surrounding existing subdivisions are serviced by an existing Public Utilities Commission (P.U.C.) regulated private water system operated by the Olowalu Water Company (State of Hawaii, Department of Health Public Water System No. 209 and State Well No. 4937-02). The existing system includes a well capable of pumping approximately 250 gpm and a 500,000 gallon storage tank located above the Olowalu Mauka Subdivision. Current demand of the existing system is approximately 75,000 gpd. This system also provides fire protection to the existing Olowalu Mauka and Makai subdivisions.

The subject property and surrounding lands are also serviced by an existing P.U.C. regulated non-potable water system also operated by the Olowalu Water

Company. Non-potable water for the system is provided by an existing stream diversion in Olowalu Stream which was previously used by the former plantation companies for growing sugar cane in Olowalu. (See Impact on Water Resources of the Olowalu Town Project, prepared by Tom Nance Water Resource Engineering)

3.5 ELECTRIC, TELEPHONE AND CABLE TV

Maui Electric Company has large 69 Kv transmission lines which go over the West Maui Mountains delivering electric power from their Maalaea Power station to West Maui. These large lines traverse the upper mauka portions of the subject property through an existing utility easement. There are overhead electrical and telephone lines along Honoapiilani Highway which extend mauka to service the existing subdivisions. The area is currently not serviced by local cable television service.

Historically, the previous sugar plantation companies operating in Olowalu had utilized water from the Olowalu stream to generate hydro-electricity for various plantation needs. This hydro-electric facility has been out of use for several decades.

4.0 ANTICIPATED INFRASTRUCTURE IMPROVEMENTS

4.1 ROADWAYS

The Master Plan proposes the realignment of the existing Honoapiilani Highway to a more mauka route. Access to the project from the new highway will be via two (2) primary access points, as well as a limited right-in/right-out access point. The new highway alignment will consist of a 200' wide right-of-way containing four lanes with deceleration and acceleration lanes as required. The highway will also incorporate O-turns to eliminate the need for signalized intersections at the projects access points. The existing highway will be preserved and utilized as a low speed scenic drive. (See Olowalu Town - Preliminary Traffic Impact Analysis Report, prepared by Roger D. Dyar)

The project's interior streets will have right-of-way widths between 60 ft. to 20 ft. depending on the classification and proposed use, and will be improved to standards set forth in the proposed smart code. Streets will be designed to be

pedestrian-friendly and accommodate bicycles, therefore accordingly the streets will be narrower, slower moving streets, with on-street parking, landscaped medians and tree-lined sidewalks. Appropriate striping and signage will be installed in accordance with the Department of Public Works standards. Access to the existing subdivisions and residences within the project area will continue to be provided by means of the proposed roadway system.

4.2 DRAINAGE

It is estimated that the post development runoff from the built out project site for a 100-year 24-hour design storm will be approximately 1,710 cfs and approximately 395 acre-feet of runoff volume, creating an increase of 700 cfs and 73 acre-feet of runoff volume. (See Appendix A)

The project will not involve significant alterations to the existing drainage pattern. Runoff from the project site will be collected by various methods, such as curb and grated inlet catch basins and conveyed by an underground drainage system to onsite retention basins and underground retention systems at various locations of the property. The retention basins will generally be located within the parks and green space areas throughout the project site and will have a total storage volume of approximately 105 acre-feet for surface runoff. The development plan proposes approximately 140 acres of green space which includes parks, open space, landscape medians and grassed swales along roadways, and large lawns at public and civic facilities which could be utilized as part of the drainage system. The Master Plan was designed such that approximately 15% - 20% of these green areas would be used for storm water retention. The proposed total retention basin storage volume of 105 acre-feet will accommodate the increase in surface runoff volume due to the proposed development as well as reduce the existing surface runoff volume by at least 10%. The retention basins will be located in areas to minimize direct release of surface runoff into downstream properties. Overflow from the retention basins will be allowed to continue downstream along the existing drainage patten at no greater than pre-development rates therefore will not have an adverse effect to downstream properties.

During development of the individual transects and parcels such as the larger parking areas in the commercial zones, additional stormwater retention will be

incorporated in the project plan further reducing post development runoff continuing downstream.

The design intent of the development plan will be to utilize the existing topography as much as possible and limit the need for extensive grading. Development of the project will include implementation of site specific best management practices (BMP's) during construction to provide erosion control and minimize impacts to downstream properties. Further, Brown and Caldwell prepared a project specific Stormwater Quality Enhancement Report which describes post construction structural BMP's which will also be implemented to improve the quality of stormwater runoff in order to reduce the impact to downstream properties due to runoff from the proposed development of the project.

The existing drainageways, including Olowalu Stream, which traverses the project site will remain generally in the naturally occurring conditions except at road crossings where appropriate sized drainage culverts will be installed to allow runoff to continue downstream. The area around the drainageways will be graded and vegetated such that it will not have the existing runoff rates increased by the addition of runoff from the project improvements.

The proposed drainage system will be designed in accordance with Chapter 4, "Rules for the Design of Storm Drainage Facilities in the County of Maui."

4.3 WASTEWATER

The proposed project consisting of 1,500 dwelling units, commercial, educational facilities and park areas will generate an average dry weather flow of approximately 533,000 gallons per day of wastewater (See Olowalu Town Wastewater Management Plan, prepared by Brown and Caldwell). The onsite wastewater collection system will consist of gravity sewer lines which will collect and convey the wastewater to the proposed wastewater treatment plant to be constructed at the northern end of the project site. Pump stations may be required to service the lower elevations of the project site to pump wastewater to the treatment facility.

The proposed treatment facility will utilize an innovative and advanced treatment

process to produce R-1 recycled water. The recycled treated water will be pumped back across the project site to a storage tank to distribute the reclaimed water to irrigate parks, landscaping, open-space areas, and certain agricultural crops throughout the project site. Unutilized recycled water (generated mainly during the wet weather periods) will be diverted to a constructed wetland and soil aquifer treatment system which will be sized to allow disposal of 100 percent of the peak day wet weather flow from the treatment plan. The constructed wetland and soil aquifer treatment system will provide additional treatment of the recycled water prior to percolation.

4.4 WATER

The proposed plan is to expand the existing private water system, in accordance with the State of Hawaii, Department of Health standards, to provide the necessary domestic and fire flow demands for the project as well as continue to service the surrounding area. The average daily potable demand for the proposed project is approximately 672,300 gallons per day, which includes the new residential and commercial users, as well as the adjacent users on the existing water system (See Appendix B). The water system will include the existing well adjacent to Olowalu Stream at approximately elevation 350 feet which will be one of the sources of water for the system. Currently, the water from the well is pumped to the existing 500,000 gallon storage tank located above the existing Olowalu Mauka Subdivision. The project will require the installation of a second well to meet the increased demand and a third well for back-up purposes. A new storage tank will also be constructed near the existing storage tank to meet the storage requirements of the project. Distribution lines will be installed from the storage tanks throughout the project site to service each lot and will also include the installation of fire hydrants at appropriately spaced intervals.

The maximum fire flow demand for the project will be based on the business commercial and multi-family portions of the development at 2,000 gallons per minute for a 2 hour duration with a maximum fire hydrant spacing of 250 feet. County of Maui, Department of Water Supply Standards also requires a minimum flow of 500 gallons per minute with 500 foot hydrant spacing for agricultural use, 1,000 gallons per minute with 500 foot hydrant spacing for rural use, and 1,000 gallons per minute with 350 foot hydrant spacing for single family

use. The existing water system includes fire protection to service the existing Olowalu Mauka and Makai subdivisions, but there are no existing fire hydrants within the project perimeter which can provide fire protection for the proposed development, therefore all fire protection requirements will be met by the expansion of the existing water system within the project boundaries.

The existing non-potable water system will also be expanded to service the proposed project. The system will utilize the existing sources and storage facilities as well as include the use of the R-1 water generated by the wastewater system to service appropriate areas allowed by the Department of Health regulations. Additional storage and distribution lines will be constructed as part of the project infrastructure to provide non-potable water throughout the project as necessary (See Exhibit 7).

4.5 ELECTRIC, TELEPHONE AND CABLE TV

The proposed electrical distribution system for the subject project will be extended from the existing facilities along Honoapiilani Highway or the adjacent developments. Coordination with the utility companies will be made so the system will be able to provide adequate service to the project.

A significant component of OT's use of integrated Resource Planning is the proposal to incorporate the use of renewable energy systems to help generate electricity for the project. The conceptual renewable energy plan at this time proposes to integrate a combination of several forms of non-fossil fuel energy systems, including but not limited to, hydro-power, photovoltaic, wind and solar. The Master Plan's natural resource engineers will work with Maui Electric Company to insure that the proposed renewable energy systems are designed to maintain reliability and high power quality, as well as provide a firm energy source to meet OT's energy needs.

Existing phone services will be expanded, and cable television likely added to supply the Master Plan with adequate phone and TV services.

5.0 SUMMARY

The proposed project will encompass approximately 636 acres and develop up

to 1,500 dwelling units in a combination of agricultural, rural, and urban land uses. The proposed project will also include commercial areas, open space and conservation areas, educational facilities and other community oriented uses.

The proposed roadway system to service the area will include a realigned Honoapiilani Highway further mauka than the existing highway. The existing highway will then be utilized as a minor road as part of the projects improvements to service the community on the makai side of the new highway. The project will include narrower streets designed to slow vehicle speed and increase pedestrian safety. This will also reduce the amount of impervious surfaces which reduces storm runoff.

The project drainage plan will be to construct a comprehensive drainage system to collect and convey surface runoff to onsite retention basins and underground retention systems at various locations throughout the project site. The proposed retention areas will retain the increase in surface runoff due to the development of the project as well as reduce the existing surface runoff volume by at least 10%. Innovative drainage improvements will meet or exceed government requirements for storm water runoff quantity and quality to prevent adverse impacts to the pristine coastal resources.

The existing topography across the project site generally provides adequate but not excessive slopes for the purposes of roadway and utility design. Therefore the design intent will be to utilize the topography as much as possible and limit the need for extensive grading. Improvements will conform to the existing topography and the natural drainage patterns will be retained to the extent practicable. Part of the proposed plan to minimize grading during development of the project is to retain the existing topography across the proposed agricultural and rural lots , as well as some of the open space and park areas. Only the proposed roadways and areas such as for drainage purposes would be graded within these land uses.

All land disturbance greater than one acre or part of a larger common plan of development will require a National Pollutant Discharge Elimination System (NPDES) permit issued by the State Department of Health. Part of the permit application will be to outline the proposed Best Management Practices (BMPs)

to minimize erosion and discharge of non-storm water pollutants from continuing downstream. BMPs will be implemented to all areas of disturbance during construction of the development to provide erosion control and minimize any potential impacts. Detailed site specific plans will be prepared as the project prepares for development.

The project will construct an onsite wastewater treatment plant to accommodate all of the wastewater produced by the development. The treatment plant will produce R-1 quality recycled water which will be utilized throughout the project site for irrigation, which will significantly reduce the demand for ground water resources ensuring the sustainable use of the water resources. The proposed plan will also include a constructed wetland and storage facilities to accommodate the R-1 water during wet weather periods.

The Olowalu area is currently serviced by a private water company which provides both potable and non-potable water. The proposed development includes the expansion of the existing water systems to service all of the parcels to be developed. The proposed expansion includes the development of two additional wells and storage tank for the potable system, and a storage tank for the non-potable system. These improvements will provide a sufficient and reliable water supply to meet all of the potable, non-potable and fire protection needs for the proposed project and existing users.

EXHIBITS

1 Location Map

2 Vicinity Map

3 Soil Survey Map

4 Flood Insurance Rate Map

5 Preliminary Drainage Area Map

6 Onsite Drainage Area Map

7 Schematic Water System Map

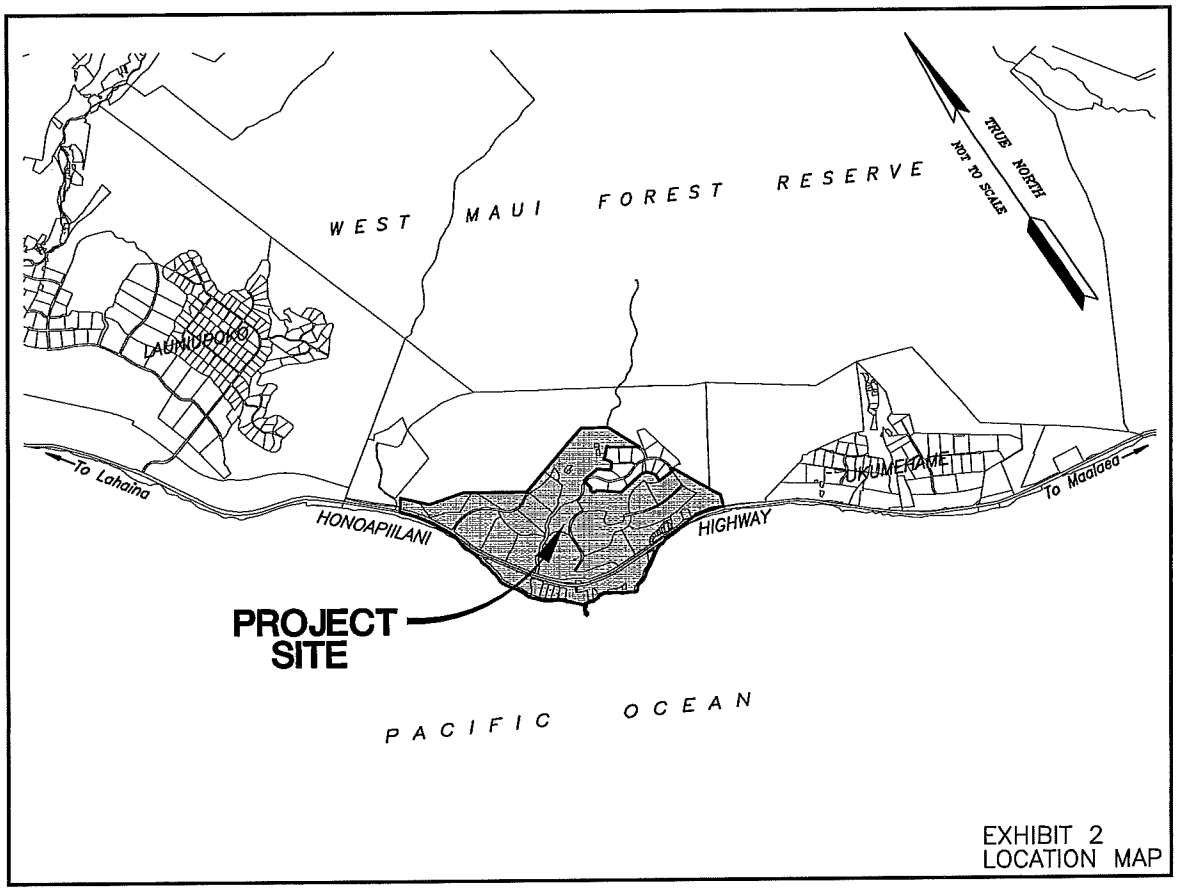


EXHIBIT 2
LOCATION MAP

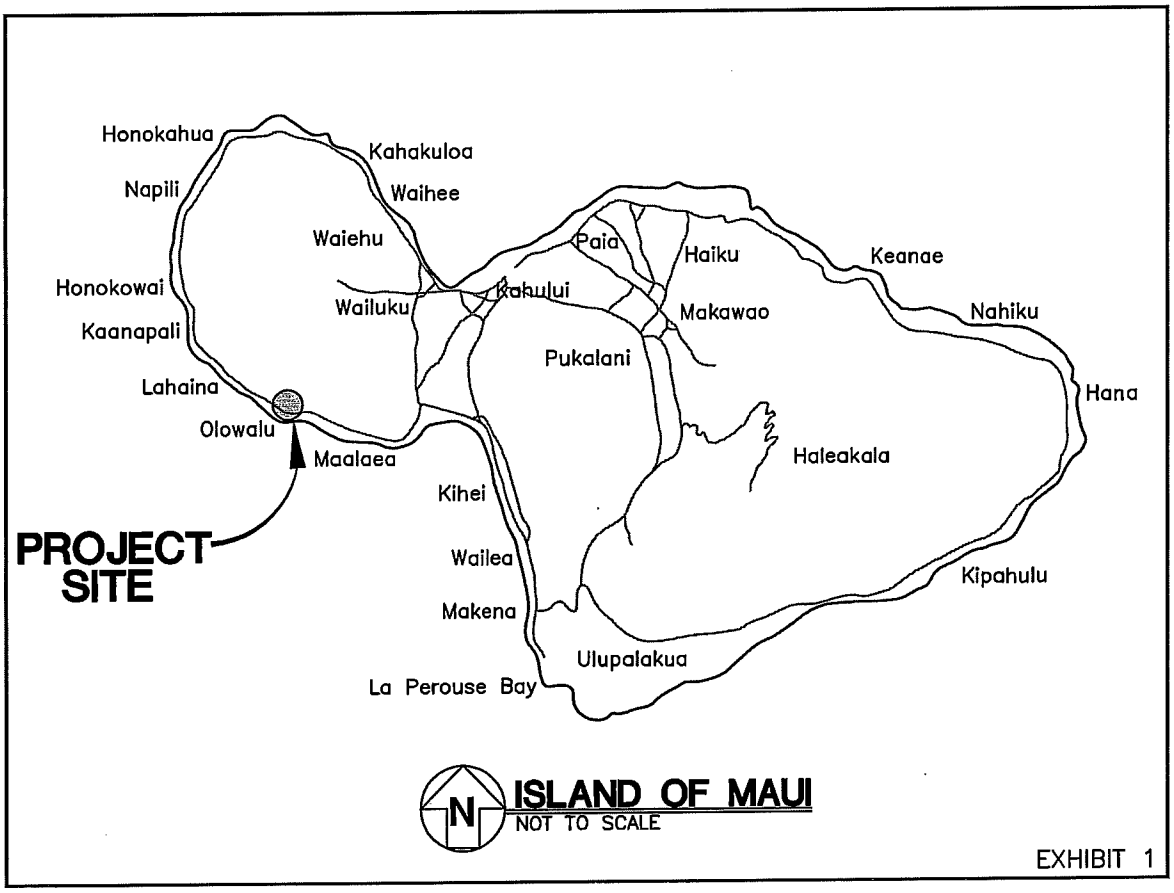


EXHIBIT 1

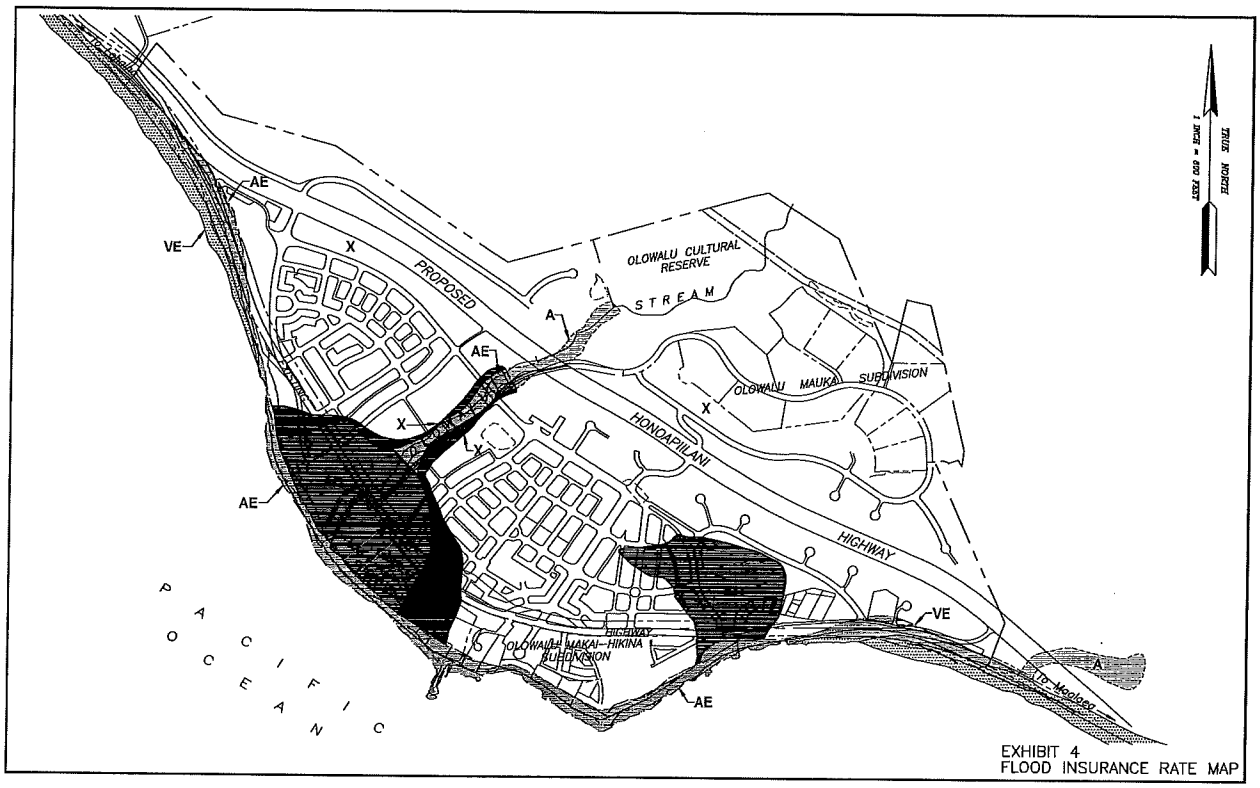


EXHIBIT 4
FLOOD INSURANCE RATE MAP

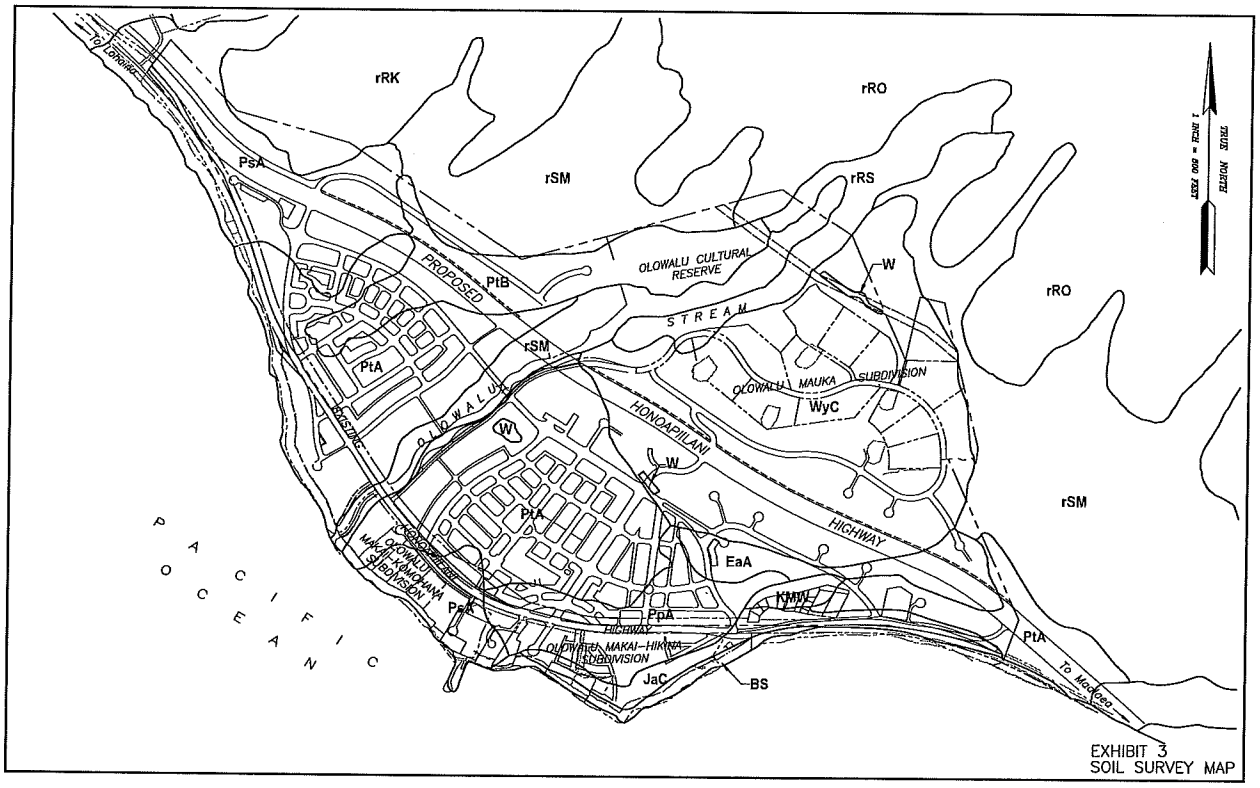


EXHIBIT 3
SOIL SURVEY MAP

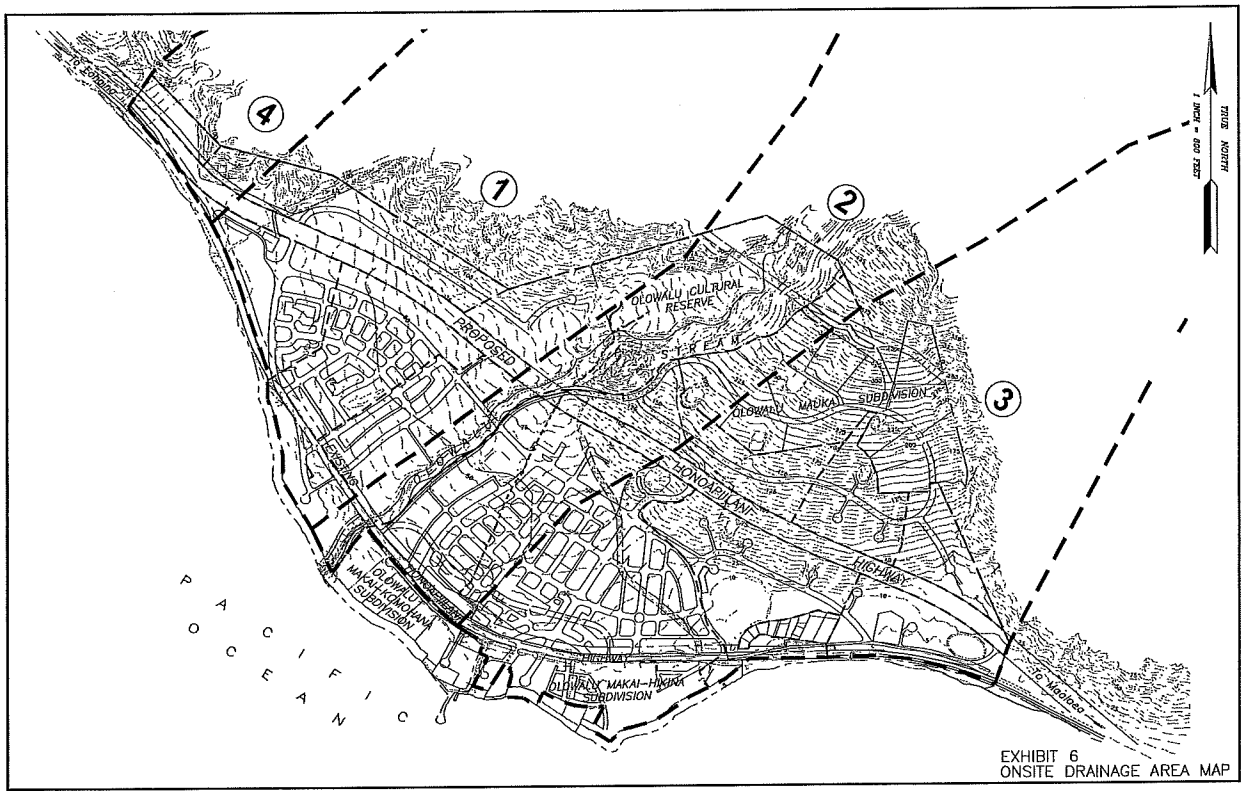


EXHIBIT 6
ONSITE DRAINAGE AREA MAP

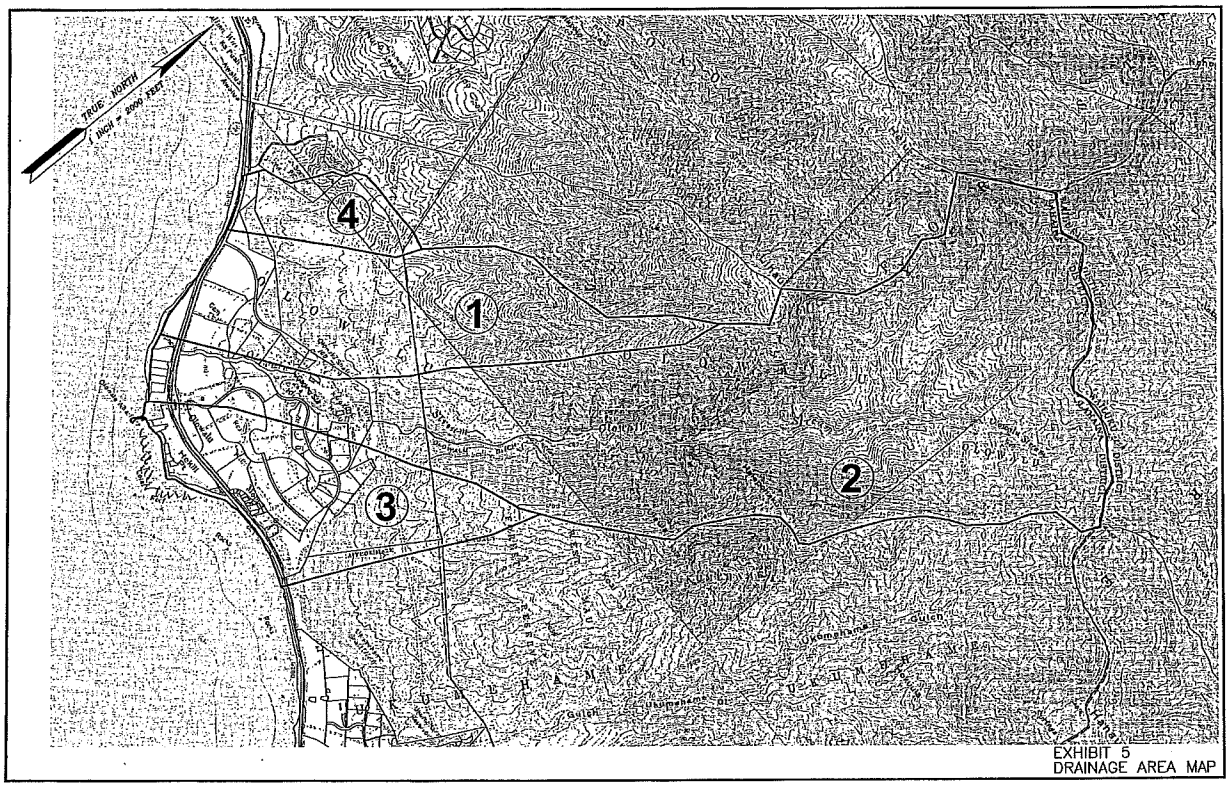
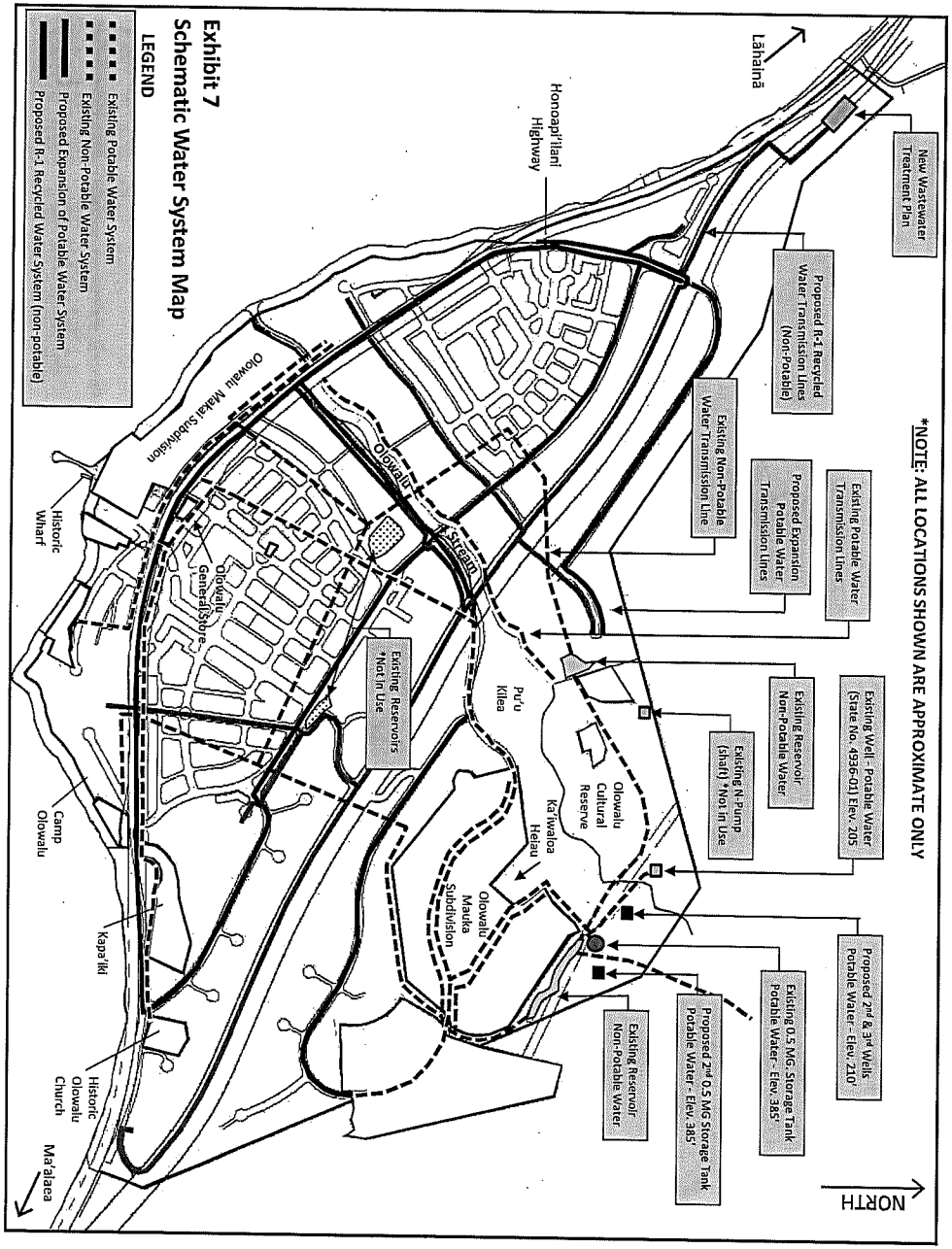


EXHIBIT 5
DRAINAGE AREA MAP



APPENDIX A
HYDROLOGIC CALCULATIONS

Hydrologic Calculations

Purpose: Determine the storage volume required to mitigate the increase in runoff due to the proposed improvements for a 100-year, 24-hour storm. See attached hydrograph calculations.

Runoff created by pre-development conditions = 1,010 cfs
Runoff Volume created by pre-development conditions = 322 acre-feet

Runoff created by post-developed conditions = 1,710 cfs
Runoff Volume created by post-development conditions = 395 acre-feet

Runoff increase due to the development of the project is 700 cfs
Required storage volume for the project is 73 acre-feet

Approximately 105 acre-feet of storage is intended to be provided by the onsite retention basins located within the proposed green space areas. The proposed total retention basin storage volume will accommodate the increase in surface runoff volume due to the proposed development as well as reduce the existing surface runoff volume by at least 10%.

OLOWALU TOWN - TOTAL RUNOFF

PRE DEVELOPMENT (TOTAL)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	852	24.38%	73	1,926	545
2	2788	15.61%	83	5,609	2,038
3	565	25.06%	70	1,434	327
4	184	18.90%	81	769	132
	4,389				3,043

100 year - 24 hour Rainfall = 11 inches

PRE DEVELOPMENT (ONSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
	636	4.96%	62	883	322
1	185	4.46%	62	350	93
2	180	4.96%	64	265	96
3	251	8.51%	61	338	124
4	20	4.71%	62	55	10
	636			1,008	322

100 year - 24 hour Rainfall = 11 inches

Hydrograph Plot

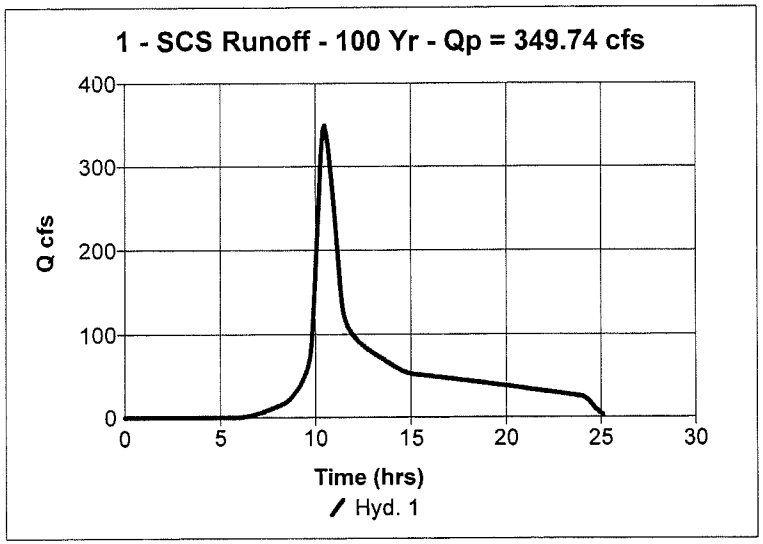
English

Hyd. No. 1

AREA 1 (PRE)

Hydrograph type	= SCS Runoff	Peak discharge	= 349.74 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 185.00 ac	Curve number	= 62
Basin Slope	= 4.5 %	Hydraulic length	= 2690 ft
Tc method	= LAG	Time of conc. (Tc)	= 54.5 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 4,034,177 cuft



Hydrograph Plot

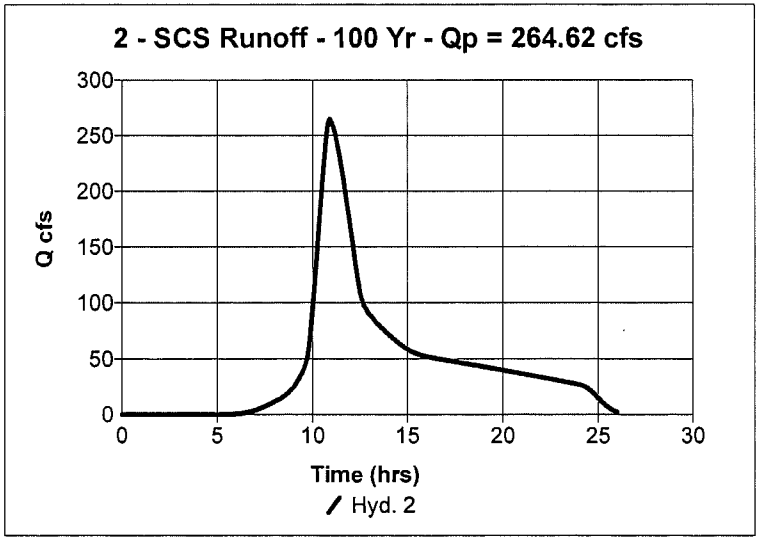
English

Hyd. No. 2

AREA 2 (PRE)

Hydrograph type	= SCS Runoff	Peak discharge	= 264.62 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 180.00 ac	Curve number	= 64
Basin Slope	= 5.0 %	Hydraulic length	= 6050 ft
Tc method	= LAG	Time of conc. (Tc)	= 93.9 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 4,162,139 cuft



Hydrograph Plot

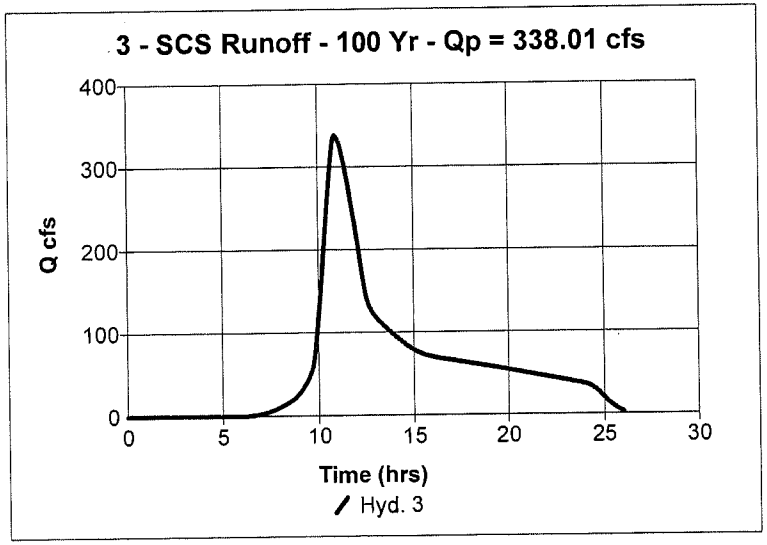
English

Hyd. No. 3

AREA 3 (PRE)

Hydrograph type	= SCS Runoff	Peak discharge	= 338.01 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 251.00 ac	Curve number	= 61
Basin Slope	= 8.5 %	Hydraulic length	= 7582 ft
Tc method	= LAG	Time of conc. (Tc)	= 93.2 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 5,410,055 cuft



Hydrograph Plot

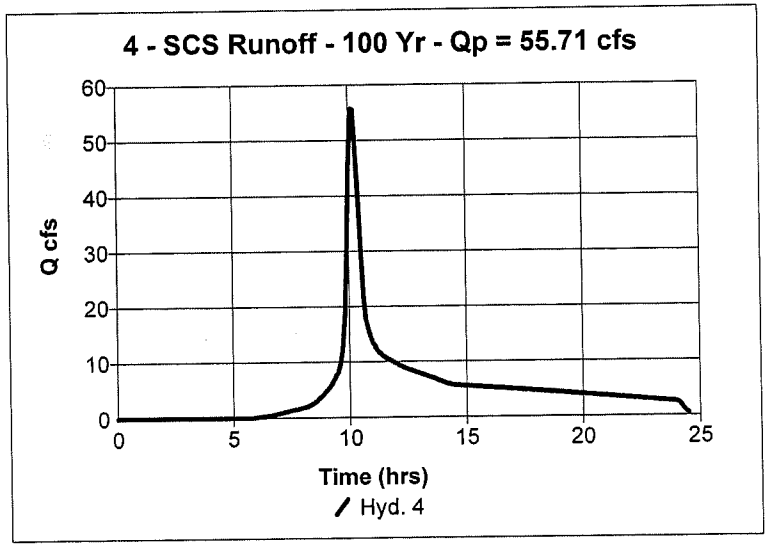
English

Hyd. No. 4

AREA 4 (PRE)

Hydrograph type	= SCS Runoff	Peak discharge	= 55.71 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 20.00 ac	Curve number	= 62
Basin Slope	= 4.7 %	Hydraulic length	= 850 ft
Tc method	= LAG	Time of conc. (Tc)	= 21.2 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 436,127 cuft



OLOWALU TOWN - TOTAL RUNOFF

POST DEVELOPMENT (TOTAL)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	852	24.38%	76	2,036	574
2	2788	15.61%	84	5,683	2,068
3	565	25.06%	74	1,803	373
4	184	18.90%	82	780	134
	4,389				3,149

100 year - 24 hour Rainfall = 11 inches

POST DEVELOPMENT (ONSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
	636	4.96%	73	1,311	393
1	185	4.46%	75	602	124
2	180	4.96%	72	364	109
3	251	8.51%	72	664	151
4	20	4.71%	69	81	11
	636			1,711	395

100 year - 24 hour Rainfall = 11 inches

Hydrograph Plot

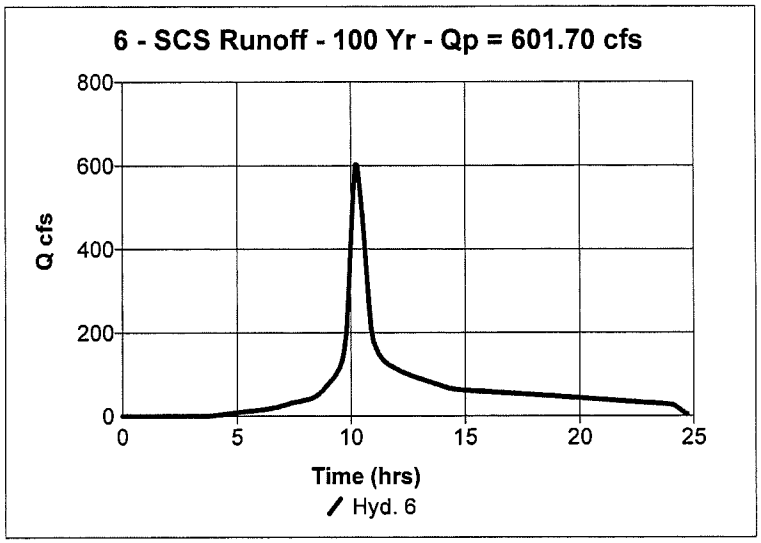
English

Hyd. No. 6

AREA 1 (POST)

Hydrograph type	= SCS Runoff	Peak discharge	= 601.70 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 185.00 ac	Curve number	= 75
Basin Slope	= 4.5 %	Hydraulic length	= 2690 ft
Tc method	= LAG	Time of conc. (Tc)	= 38.4 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 5,410,788 cuft



Hydrograph Plot

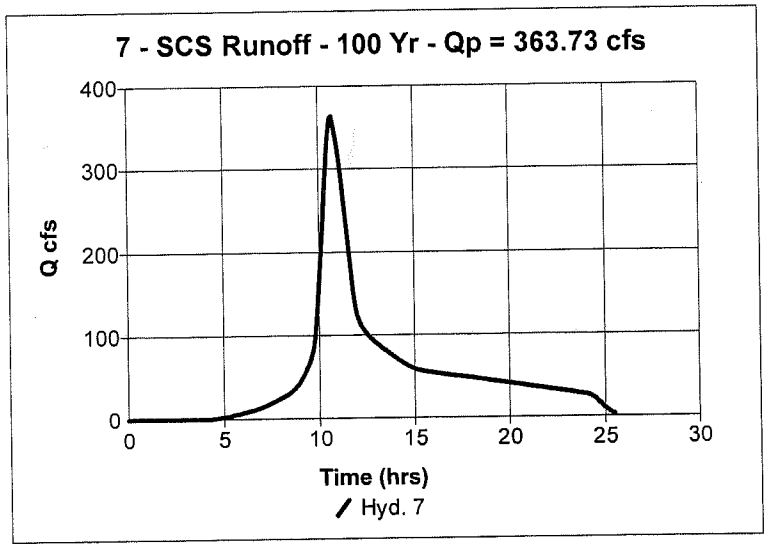
English

Hyd. No. 7

AREA 2 (POST)

Hydrograph type	= SCS Runoff	Peak discharge	= 363.73 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 180.00 ac	Curve number	= 72
Basin Slope	= 5.0 %	Hydraulic length	= 6050 ft
Tc method	= LAG	Time of conc. (Tc)	= 75.9 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 4,762,875 cuft



Hydrograph Plot

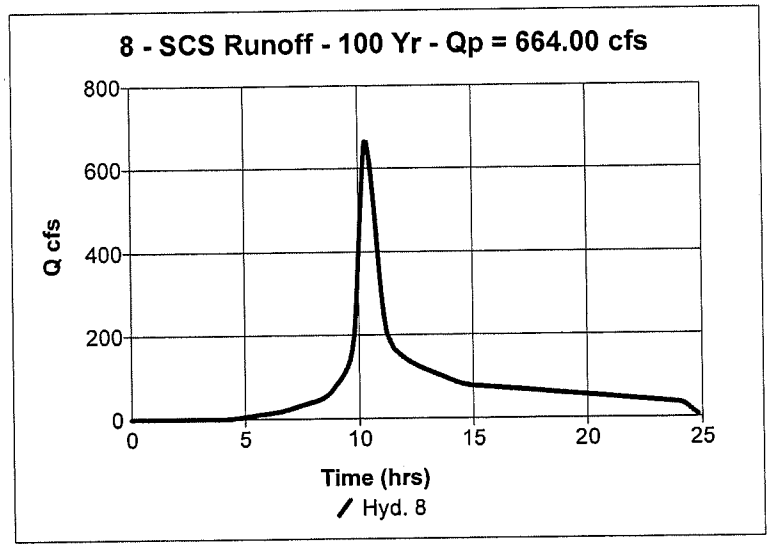
English

Hyd. No. 8

AREA 3 (POST)

Hydrograph type	= SCS Runoff	Peak discharge	= 664.00 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 251.00 ac	Curve number	= 72
Basin Slope	= 8.5 %	Hydraulic length	= 4700 ft
Tc method	= LAG	Time of conc. (Tc)	= 47.5 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 6,578,314 cuft



Hydrograph Plot

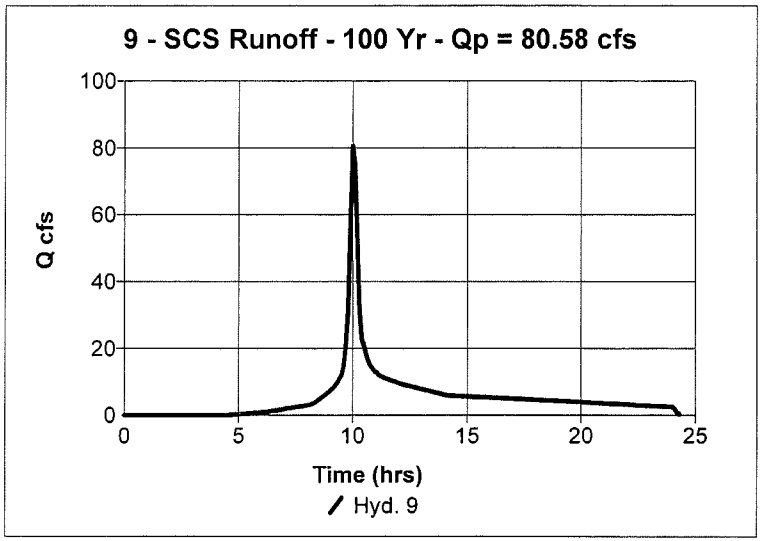
English

Hyd. No. 9

AREA 4 (POST)

Hydrograph type	= SCS Runoff	Peak discharge	= 80.58 cfs
Storm frequency	= 100 yrs	Time interval	= 6 min
Drainage area	= 20.00 ac	Curve number	= 69
Basin Slope	= 4.7 %	Hydraulic length	= 850 ft
Tc method	= LAG	Time of conc. (Tc)	= 17.6 min
Total precip.	= 11.00 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

Total Volume = 475,877 cuft



APPENDIX B

WATER DEMAND CALCULATIONS

POTABLE WATER DEMAND CALCULATIONS

Project Data:

900 Single Family Residential Units, including Rural (223 acres)
580 Multi Family Residential Units (70 acres)
20 Agriculture Units (32 acres)
24 acres Commercial
75 acres Open Space/Parks
25 acres Public/Quasi-Public

Domestic Consumption Guidelines:

Single Family Residential	= 550 gallons/unit (w/o non-potable service) or
	= 275 gallons/unit (w/ non-potable service)
Multi Family Residential	= 400 gallons/unit (w/o non-potable service) or
	= 225 gallons/unit (w/ non-potable service)
Agriculture	= 275 gallons/unit (w/ non-potable service)
Commercial	= 1,200 gallons/acre (w/ non-potable service)
Open Space/Parks	= 250 gallons/acre (w/ non-potable service)
Public/Quasi-Public	= 1,200 gallons/acre (w/ non-potable service)

Average Daily Demand (ADD) =

Single Family Residential	= 550 x 400 units = 220,000 gallons
	= 275 x 500 units = 137,500 gallons
Multi Family Residential	= 400 x 150 units = 60,000 gallons
	= 225 x 430 units = 96,750 gallons
Agriculture	= 275 x 20 units = 5,500 gallons
Commercial	= 1,200 x 24 acres = 28,800 gallons
Open Space/Parks	= 250 x 75 acres = 18,750 gallons
Public/Quasi-Public	= 1,200 x 25 acres = 30,000 gallons
Existing Users	= 75,000 gallons

Total Average Daily Demand = 672,300 gpd
Max. Daily Demand (1.5 x ADD) = 1.5 x 672,300 = 1,008,450 gpd

Max. Fire Flow = 1,000 gpm (Single Family & Rural)
500 gpm (Agriculture)
2,000 gpm (Multi Family, Commercial)

REFERENCES

A. Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii, prepared by U.S. Department of Agriculture, Soil Conservation Service, August, 1972.

B. Erosion and Sediment Control Guide for Hawaii, prepared by U.S. Department of Agriculture, Soil Conservation Service, March, 1981.

C. Rainfall-Frequency Atlas of the Hawaiian Islands, Technical Paper No. 43, U.S. Department of Commerce, Weather Bureau, 1962.

D. Flood Insurance Rate Maps of the County of Maui, Sept. 29, 2009

E. Chapter 4, Rules for the Design of Storm Drainage Facilities in the County of Maui, prepared by the Department of Public Works and Waste Management, County of Maui, 1995.

F. Water System Standards, Department of Water Supply, County of Maui, 2002.

G. Olowalu Town - Preliminary Traffic Impact Analysis Report, prepared by Roger D. Dyar, P.E., September 16, 2011.

H. Olowalu Town Wastewater Management Plan, prepared by Brown and Caldwell, June 2011.

I. Impact on Water Resources of the Olowalu Town Project, prepared by Tom Nance Water Resource Engineering, August 2011.

J. Olowalu Town Stormwater Quality Enhancements, prepared by Brown and Caldwell, October 2011.

APPENDIX C-1.

June 2, 2015 Letter from Otomo Engineering, Inc.

OTOMO
ENGINEERING, INC.

CONSULTING CIVIL ENGINEERS
305 SOUTH HIGH STREET, SUITE 102
WAILUKU, MAUI, HAWAII 96793
PHONE: (808) 242-0032

June 2, 2015

Mr. Bill Frampton & Mr. David Ward
Frampton & Ward, LLC
2035 Main Street, #1
Wailuku, Hawaii 96793

Subject: Olowalu Town
Supplement to Preliminary Engineering Report
Maui Island Plan Alternative Infrastructure Assessment & Additional Comments
Project No. 2010-17

Please note that this letter supersedes our Feb. 13, 2015 letter regarding this topic. In response to your request, we reviewed the overall infrastructure requirements for the project based on an alternative subject area which removed the proposed development areas makai of the existing Honoapiilani Highway from the project plans. The Olowalu Town subject area was analyzed based on an updated area of 591 acres, reduced from 636 acres while maintaining the same unit count of 1,500 and same commercial area of approximately 300,000 – 375,000 sq. ft. By maintaining the original unit count, impacts to the proposed water and wastewater demand, and roadways requirements will not change significantly from the analysis based on the original project limits.

Due to the reduction of project area, the surface runoff for the existing conditions and post development conditions both decrease in value. Therefore, the increase in onsite surface runoff volume due to the development of the project is estimated to be reduced from 73 acre-ft to 57 acre-ft. The drainage system will still include onsite retention basins throughout the project area to accommodate this increase in onsite surface runoff volume due to the development of the project. The removal of the makai areas will require any potential storm water retention and siltation areas for surface runoff to be incorporated into the design plan of the remainder of the project area. The Master Plan will still utilize approximately 15% - 20% of the approximately 120 acres of green space for storm water retention. The proposed total retention basin storage volume of approximately 88 acre-feet will accommodate the increase in surface runoff volume due to the proposed development as well as reduce the existing surface runoff volume by at least 10%. Storm water runoff from the areas makai of the existing highway will remain in it's existing conditions and will not be included with the proposed drainage improvements for the Olowalu Town project.

In response to additional comments received on the Preliminary Engineering Report, we acknowledge that Olowalu Stream is a named drainageway. Based on information provided, we note that Olowalu Stream has been realigned form its original outlet at Hekili Point to its present

location north of Olowalu Wharf. We have also confirmed that the other drainageways in the project limits are unnamed based on the USGS quadrangle maps.

We also acknowledge that referenced natural feature in the project limits is Puu Kilea.

Please feel free to let me know if you have any questions or need any additional information.

Sincerely,

Mark M. Matsuda, P.E.
Senior Project Manager

attachment

OLOWALU TOWN - SURFACE RUNOFF (MIP ALTERNATIVE)

PRE DEVELOPMENT (ONSITE & OFFSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	836	24.38%	73	1,890	535
2	2788	15.61%	83	5,609	2,038
3	536	25.06%	70	1,360	310
4	184	18.90%	81	769	132
	4,344				3,015

100 year - 24 hour Rainfall = 11 inches

PRE DEVELOPMENT (ONSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	169	4.46%	62	319	85
2	180	4.96%	64	265	96
3	222	8.51%	61	299	110
4	20	4.71%	62	55	10
	591			938	301

100 year - 24 hour Rainfall = 11 inches

OLOWALU TOWN - SURFACE RUNOFF (MIP ALTERNATIVE)

POST DEVELOPMENT (ONSITE & OFFSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	836	24.38%	76	1,998	564
2	2788	15.61%	84	5,683	2,068
3	536	25.06%	74	1,710	354
4	184	18.90%	82	780	134
	4,344				3,120

100 year - 24 hour Rainfall = 11 inches

POST DEVELOPMENT (ONSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	169	4.46%	75	447	102
2	180	4.96%	72	364	109
3	222	8.51%	73	599	136
4	20	4.71%	69	81	11
	591			1,491	358

100 year - 24 hour Rainfall = 11 inches

OLOWALU TOWN - SURFACE RUNOFF (ORIGINAL PROJECT LIMITS)

PRE DEVELOPMENT (ONSITE & OFFSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	852	24.38%	73	1,926	545
2	2788	15.61%	83	5,609	2,038
3	565	25.06%	70	1,434	327
4	184	18.90%	81	769	132
	4,389				3,043

100 year - 24 hour Rainfall = 11 inches

PRE DEVELOPMENT (ONSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	185	4.46%	62	350	93
2	180	4.96%	64	265	96
3	251	8.51%	61	338	124
4	20	4.71%	62	55	10
	636			1,008	322

100 year - 24 hour Rainfall = 11 inches

OLOWALU TOWN - SURFACE RUNOFF (ORIGINAL PROJECT LIMITS)

POST DEVELOPMENT (ONSITE & OFFSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	852	24.38%	76	2,036	574
2	2788	15.61%	84	5,683	2,068
3	565	25.06%	74	1,803	373
4	184	18.90%	82	780	134
	4,389				3,149

100 year - 24 hour Rainfall = 11 inches

POST DEVELOPMENT (ONSITE)

Drainage #	Area (acres)	S (%)	Cn	Q (cfs)	Vol. (acre.-ft.)
1	185	4.46%	75	602	124
2	180	4.96%	72	364	109
3	251	8.51%	72	664	151
4	20	4.71%	69	81	11
	636			1,711	395

100 year - 24 hour Rainfall = 11 inches

APPENDIX ~~B-1~~C-2.

Stormwater Quality Enhancements

Olowalu Town
Stormwater Quality Enhancements

Prepared for
Olowalu Town LLC
Wailuku, HI
October 2011

Olowalu Town
Stormwater Quality Enhancements

Prepared for
Olowalu Town LLC, Wailuku, HI
October 2011

CRAIG CARSTEN LEKVEN
LICENSED PROFESSIONAL ENGINEER
No. 13003-C
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Signature

April 30, 2012
Expiration Date of License

Brown AND Caldwell
1955 Main Street, Suite 200
Wailuku, Maui, HI 96793

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List of Abbreviations

BMPs	Best management practices
DOH	State of Hawaii Department of Health
LEED ND	Leadership in Energy and Environmental Design for Neighborhood Development
O&M	Operation and maintenance
USBR	United States Bureau of Reclamation

Section 1
Introduction

1.1 Olowalu Town Master Plan

The Olowalu Town Master Plan is proposing to re-establish the once thriving village of Olowalu, located on the west side of the island of Maui. The subject property encompasses the lower coastal reaches of Olowalu ahupuaa; between the base of the south-west facing slopes of the West Maui Mountains and the shoreline of Olowalu. Olowalu Town will be a small-scale and mixed-use community designed to be a pedestrian-friendly community which will allow residents to live within walking distance of corner stores, schools, parks, employment opportunities, community centers, beaches, and social and civic resources, ultimately reducing reliance on automobiles. The Master Plan is guided by values and principles of sustainability by balancing the needs of Maui's growing population; yet maintaining and respecting our cultural, historical and natural resources.

At final build-out, Olowalu Town will consists of approximately 1,500 residential dwelling units to be built concurrent with appropriate infrastructure in phases spread out over a period of approximately 10 years. There will be a wide variety of single-family and multi-family dwelling types, including houses, apartments, live-work units, cottages, rural homes and farmsteads, to be offered at a wide-range of income levels, including both rental and fee-ownership. A substantial portion of the homes are planned for much-needed affordable housing and senior living.

The design of Olowalu Town incorporates smart growth and the sustainable land use principles of New Urbanism. As a result, Olowalu Town's spatial layout of land uses, varying density, connective transportation, parks/greenways, civic/social facilities, housing, employment and other land uses are balanced to create a mixed-use community. Neighborhood town centers provide economic sustainability with a range of business and employment opportunities. Olowalu Town is also designed to meet the certification requirements of *Leadership in Energy and Environmental Design for Neighborhood Development* (LEED ND). As such, the Master Plan will be built using strategies aimed at improving performance in regards to energy savings, water efficiency, reducing CO_2 emissions, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

Olowalu Town's proposed infrastructure improvements will be constructed concurrently with the project and will incorporate innovative, efficient, and sustainable technology to minimize adverse impacts upon the natural environment. Olowalu Town's Transportation system includes the relocation of the existing high speed/high volume Honoapiilani highway away from coastal resources to a new mauka alignment, which will be designed to accommodate mass transit or light rail, if needed in future. The existing highway corridor with monkey-pod trees will be preserved and converted to low speed/low volume coastal roadway. The project includes an internal roadway network, as well as an assortment of interconnected greenways and bikeways that link the community and supports overall well-being and health of residents; reducing dependency on automobiles.

Additionally, other infrastructure system improvements will require an expansion of both the existing potable and non-potable water system, the likely addition of a second ground water well to supplement the existing well; and an extensive drainage system to capture storm-water runoff.

1.2 Stormwater Quality Management

Traditional approaches to development have affected the environment of the islands. Impervious surfaces (e.g., pavement, structures) reduce rainfall infiltration and increase stormwater runoff. Stormwater runoff carries sediment and pollutants that impact the near-shore coastal waters. Olowalu Town's location adjacent to one of the most significant, accessible coral reef systems on the island of Maui dictates that stormwater quality management best management practices (BMPs) be implemented.

The United States Bureau of Reclamation (USBR) partnered with the State of Hawaii, Department of Land and Natural Resources, Commission on Water Resource Management to produce the guidance document "A Handbook for Stormwater Reclamation and Reuse Best Management Practices in Hawaii" that describes BMPs that can be implemented to reduce the amount of stormwater runoff from a development and improve the quality of the runoff that occurs (USBR, December 2008). The publication is available online at:

http://hawaii.gov/dlnr/cwrm/planning/hsrar_handbook.pdf

The BMPs outlined in the guidance document were reviewed for applicability to Olowalu Town, and the measures considered most-suitable for the project are presented in this report.

1.3 Report Organization

Section 2 presents BMPs that are applicable to residential areas. Section 3 summarizes BMPs for commercial and public facilities. BMPs for green space and recreational sites are discussed in Section 4. Conclusions are presented in Section 5.

Section 2
Residential BMPs

The most effective stormwater management techniques are practiced at the source of runoff. Stormwater management at the individual home level offers some of the lowest cost and simplest methods to reduce stormwater runoff and improve stormwater quality. Individual homes include single family residences and multi-family residential units. These techniques have the following benefits:

- Reducing water bills.
- Reducing the size of or eliminating the need for stormwater ponds.
- Reducing stormwater infrastructure capital and operation and maintenance (O&M) costs.
- Protecting downstream areas from flooding, erosion, and sedimentation.
- Protecting downstream water quality.
- Increasing the quantity and quality of groundwater recharge.

Practices and technologies that could be implemented at single-family and multi-family residential parcels include bio-retention rain gardens, rain barrels and rain tanks, and subsurface tanks.

2.1 Bio-Retention Rain Gardens

Rain gardens consist of shallow depressions, which are typically underlain with a gravel layer, planted with native vegetation and sized to capture and treat a specified amount of runoff volume from an impervious surface. Home builders can design lawns to function as total treatment systems by providing vegetated forebays with recessed portions of the lawn acting as the rain garden. Depending on the design, the runoff can undergo sedimentation, filtration, adsorption, phytoremediation, evapotranspiration, and infiltration. They can be configured for treatment only or for both flow control and treatment. Figure 2-1 is a photograph of a typical rain garden. Figure 2-2 depicts the typical components of a rain garden. Rain gardens can also take to form of vegetated swales or grassy swales, as illustrated in Figures 2-3 and 2-4, respectively. The University of Hawaii has identified native plants that could be suitable for bio-retention rain gardens. Table 2-1 is a partial list of some candidate species.

Figure 2-1. A bio-retention rain garden

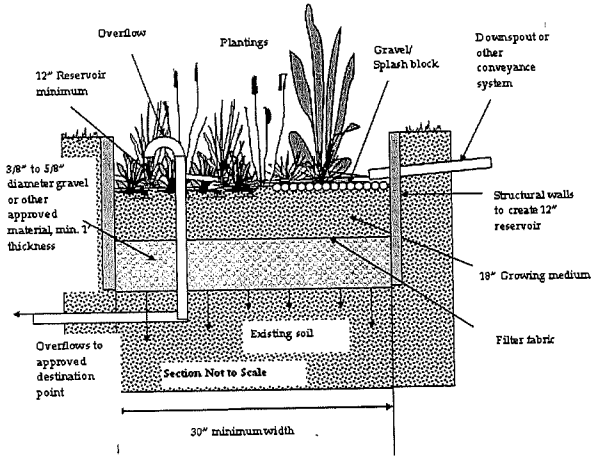

Figure 2-2. Schematic of a bio-retention rain garden

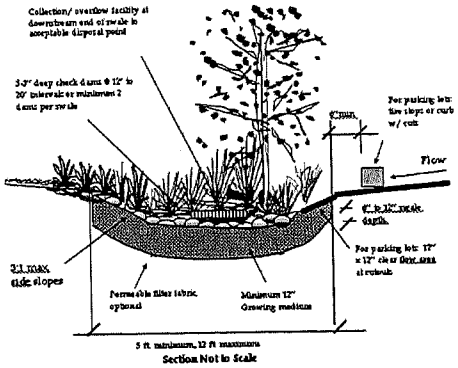

Figure 2-3. Vegetated swale

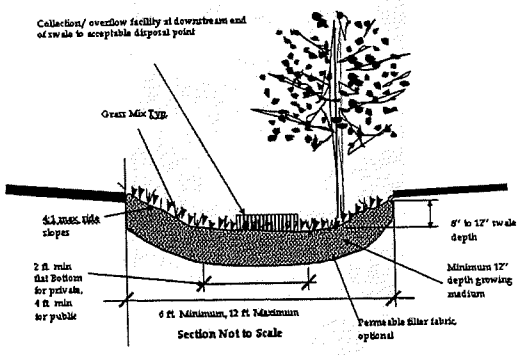

Figure 2-4. Grassy swale

Table 2-1. Potential Native Plants for Bio-Retention Rain Gardens (Partial List)

Scientific Name	Hawaiian Name
Bacopa monnieri	*`ae`ae*
Carex wahuensis	*makaloa*
Dianella sandwichensis	*ukiuki*
Gossypium tomentosum	*ma`o*
Heliotropum anomalum var. argenteum	*hinahina*
Heterpogon contortus	*pili grass*
Ipomoea imperati	*hunakai*
Ipomoea pescaprae	*pohuehue*
Mariscus javanicus	*ahu awa*
Ostomeles anthyllidifolia	*ulei*
Plumbago zeylanica	*`ilie`e*
Sesbania tomentosa	*`ohai*

Source: Cabugos, et.al., 2007

Properly designed rain gardens can be highly effective at reducing runoff and removing contaminants, including metals, suspended solids, carbon, phosphorus, ammonia, and nitrogen.

2.2 Rain Barrels and Rain Tanks

A rain barrel or above-ground tank is intended to capture stormwater runoff that is generated from roofs or other elevated surfaces. They may be used individually or in tandem, and can be used for irrigation supply. Figure 2-5 is an example of a rain barrel.

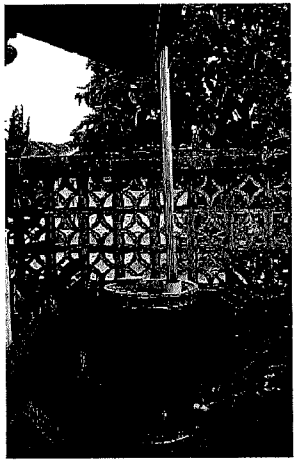

Figure 2-5. Rain barrel receiving water from a roof gutter system

Typical rain barrel sizes range from 30 to 80 gallons. One inch of rain falling on 1,000 square feet of roof will produce approximately 600 gallons of runoff, therefore rain barrels are best used in conjunction with rain gardens so that rain barrel overflow does not run off the site.

2.3 Subsurface Tanks

Subsurface tanks can range from standard cylindrical tanks to component systems that can be constructed to suit site characteristics. Component tanks can be made from interlocking concrete or perforated plastic blocks of various dimensions. The assembled blocks can be wrapped in an impervious liner to harvest rain water and retain rainwater for later use. Subsurface tanks can be constructed with or without a liner, the latter allowing for infiltration. Subsurface tanks are typically connected to a pre-treatment system to prevent fouling and/or to improve the water quality for reuse or discharge. Figure 2-6 is an illustration of a subsurface tank system. Water must be pumped from the tank for irrigation reuse, making subsurface tanks more complex to operate and maintain than above-ground rain barrels. For this reason subsurface tanks are more-appropriate for implementation at multi-family housing complexes with common landscaping.

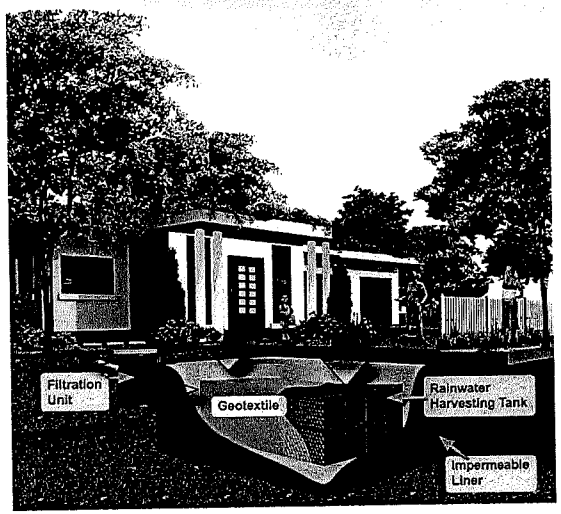

Figure 2-6. Schematic of a subsurface tank

Section 3
Commercial and Public Facility BMPs

Practices and technologies that can be applied at the commercial properties and public facilities within Olowalu Town include vegetated roofs, permeable paving, subsurface chambers, hydrodynamic devices, rain gardens, and subsurface tanks. The BMPs that were presented in the previous section can also be applied at commercial properties and public facilities.

3.1 Vegetated Roofs

Vegetated roofs consist of roofing material that includes media on which drought-tolerant native vegetation grows. The vegetation and growth media act to intercept and store rainfall. Thirty to 100 percent of the potential runoff can be stored, depending on size of the storm event. The retained stormwater percolates through the media, effectively increasing the time of concentration of the runoff. Figure 3-1 is a schematic diagram of a vegetated roof. A partial listing of some drought-tolerant native plant species that could potentially be used on a vegetated roof is provided in Table 3-1.

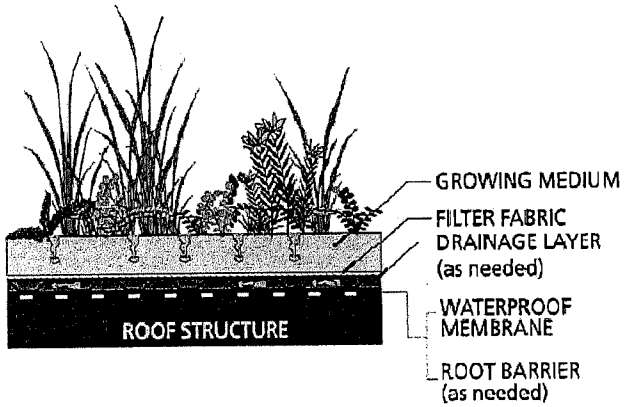

Figure 3-1. Vegetated roof schematic diagram

Table 3-1. Potential Native Plants for Vegetated Roofs (Partial List)

Scientific Name	Hawaiian Name
Bacopa monnieri	*`ae`ae*
Carex wahuensis	*makaloa*
Gossypium tomentosum	*ma`o*
Heliotropum anomalum var. argenteum	*hinahina*
Heterpogon contortus	*pili grass*
Ipomoea imperati	*hunakai*
Ipomoea pescaprae	*pohuehue*
Mariscus javanicus	*ahu awa*
Ostomeles anthyllidifolia	*ulei*
Plumbago zeylanica	*`ilie`e*
Scaevola sericea	*beach naupaka*
Sesbania tomentosa	*`ohai*
Sesuvium portulacastrum	*`akulikuli*
Sida fallax	*ilima papa*
Wilkstroemia uva ursi	*akia*

Source: Cabugos, et.al., 2007

3.2 Permeable Paving

Permeable paving is designed to allow stormwater to infiltrate through the pavement structure. The pavement structure can consist of porous asphalt, porous concrete, interlocking blocks, or plastic grid systems. A uniformly-graded stone bed is laid underneath the permeable pavement. The stone bed provides temporary storage until stormwater can infiltrate into the un-compacted soil layers below. Under-drains can also be incorporated as required or desired. Figure 3-2 is an example application of permeable paving.

Figure 3-2. An application of permeable paving

3.3 Subsurface Chamber Stormwater Management Systems

Subsurface chamber systems are designed to function as stormwater detention, retention, infiltration and/or first-flush storage. These component systems come in dimensions that make them easy to configure for most sites. Their shape makes them durable and able to be placed under roads and parking lots with adequate cover. Concrete chambers are an alternative that can also be used with minimal cover requirements. Figure 3-3 is an illustration of a subsurface chamber stormwater management system installed under a parking lot.

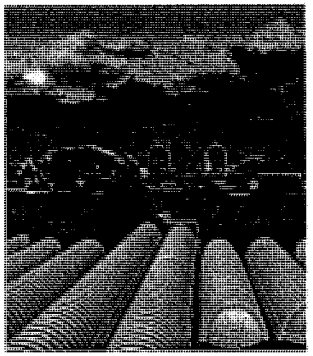

Figure 3-3. Subsurface chambers under a parking lot

3.4 Hydrodynamic Devices

Hydrodynamic devices rely on the energy and velocity of stormwater flow to remove sediment, debris, floatables and oil. Hydrodynamic devices function to improve the quality of stormwater that flows through the stormwater system before it is discharged to the receiving waters.

One configuration utilizes baffles and chambers to rotate the flow and create a vortex, which causes the heavier elements in the flow to collect in the center of the chamber. These systems can also incorporate weirs and orifices to further reduce the velocity of the flow to allow finer sediments to settle out and trap material lighter than water (e.g. oil). Another configuration uses baffles and weirs to lengthen the flow path and reduce the velocity of the storm flow through the system. These configurations allow sediment to settle and trap material lighter than water.

Hydrodynamic devices are typically installed below grade, making them especially suited for urban area and stormwater hotspots like gas stations islands, equipment storage aprons, and vehicle maintenance areas.

3.5 Rain Gardens and Subsurface Tanks

Bio-retention rain gardens and subsurface tanks (described in the previous section) are BMPs that are also suitable for implementation at commercial properties and public facilities.

Section 4

Green Space/Recreational Area BMPs

Green space and recreational areas offer opportunities to manage stormwater by using portions of the areas as detention basins and stormwater infiltration areas. These areas offer opportunities to attenuate stormwater quality and quantity as well as provide for reclamation and reuse.

Practices and technologies discussed for green space and recreational areas are reinforced turf surfaces and infiltration trenches. The BMPs that were presented in the previous sections can also be applied to green space and recreational areas.

4.1 Reinforced Turf Surfaces

Installation of reinforced turf surfaces helps to maintain higher stormwater percolation rates, and therefore less stormwater runoff. Reinforced turf surfaces are high-density polyethylene grid structures designed to house turf grass similar to those used for permeable paving. The grass reinforcement structure distributes loads from pedestrian and vehicle traffic to the base course. The individual cells in the grass pavers minimize grass and root compaction maintaining its infiltration capability. Figure 4-1 is an illustration of a reinforced turf surface.

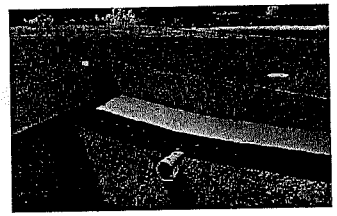

Figure 4-1. Illustration of a reinforced turf surface

4.2 Infiltration Trenches

Typical vadose zone infiltration trenches are wider than they are deep, and therefore are not considered injection wells by the Hawaii Department of Health (DOH). The trenches are backfilled with porous media. Water may enter at one end into a perforated pipe for distribution along the length of the trench or a riser pipe that allows water to enter at the bottom of the trench to prevent air entrainment. Figure 4-2 is an illustration of an infiltration trench. A disadvantage of infiltration trenches is that they cannot be backwashed and a severely clogged trench is ineffective. Therefore, reliable pretreatment is considered essential to maintaining the performance. Since vadose zone infiltration trenches allow for percolation

of water through the vadose zone, water quality improvements commonly associated with soil-aquifer treatment can be expected.

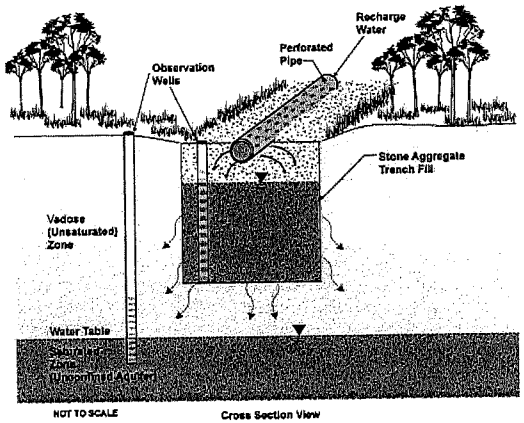

Figure 4-2. Cross section of an infiltration trench

Section 5

Conclusions

Olowalu Town's location adjacent to one of the most significant, accessible coral reef systems on the island of Maui dictates that stormwater quality BMPs be aggressively implemented to:

- Increase the volume of stormwater that infiltrates into the soil.
- Reuse stormwater where feasible.
- Improve the quality of stormwater that does run off.

The BMPs presented in this report will support these goals. Olowalu Town will develop stormwater BMP guidance documents for use by the designers of residential, commercial, public, and green space/recreational facilities within the community. Table 5-1 summarizes the stormwater quality BMPs for Olowalu Town and the areas of the community where they will be implemented.

Table 5-1. Stormwater BMPs for Olowalu Town

	Applicable Olowalu Town Parcels				
	Residential				
BMP	Single Family	Multi-Family	Commercial	Public Facilities	Green Space/ Recreational
Bio-retention rain gardens	♦	♦	♦	♦	♦
Rain barrels and rain tanks	♦				
Subsurface tanks		♦	♦	♦	♦
Vegetated roofs				♦	♦
Permeable paving			♦	♦	♦
Subsurface chamber stormwater management systems		♦	♦	♦	♦
Hydrodynamic devices			♦	♦	
Reinforced turf surfaces					♦
Infiltration trenches					♦

Section 6

Limitations

This document was prepared solely for Olowalu Town, LLC in accordance with professional standards at the time the services were performed and in accordance with the contract between Olowalu Town, LLC and Brown and Caldwell dated September 30, 2010. This document is governed by the specific scope of work authorized by Olowalu Town, LLC; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Olowalu Town, LLC and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

References

Cabugos, Leyla, Andrew J. Kaufman, Linda J. Cox, Tomoaki Miura, and Dawn Easterday. Feasibility of Rooftop Landscaping with Native Hawaiian Plants in Urban Districts of Hawaii. Proceedings or Fifth Annual Greening Rooftops for Sustainable Communities. http://www.botany.hawaii.edu/gradstudentpages/Grad_Student_Pubs/Cabugosetal2007.pdf. 2007.

United States Bureau of Reclamation (USBR). A Handbook for Stormwater Reclamation and Reuse Best Management Practices in Hawaii. December 2008.

APPENDIX C-3.

August 25, 2015 Letter from Brown and Caldwell

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Brown AND Caldwell

August 25, 2015

Mr. Bill Frampton and Mr. Dave Ward
Olowalu Town, LLC
2035 Main Street, Suite No. 1
Wailuku, Hawaii 96793

143089.001

Subject: Olowalu Town Wastewater Management Plan Report (Dated October, 2011) and Olowalu Town Stormwater Quality Enhancements Report (Dated October, 2011)

Dear Mr. Frampton and Mr. Ward:

At your request, Brown and Caldwell prepared the subject reports for inclusion in the Olowalu Town Master Plan Environmental Impact Statement. Both reports addressed Alternative 1, the Preferred Alternative. With the adoption of the Maui Island Plan (MIP) in December 2012, Alternative 2 was introduced as a second alternative within the realm of implementation potential. Alternative 2 reflects a master plan concept which follows the MIP's growth boundaries. That is, lands makai of Honoapiilani Highway are not included as part of the Master Plan. Both Alternatives 1 and 2 call for the development of up to 1,500 residential units and between 300,000 to 375,000 square feet of commercial space.

The Stormwater Quality Enhancement Report identifies Best Management Practices (BMPs) that will support Olowalu Town's sustainability objectives, including residential BMPs, commercial and public facility BMPs, and green space/recreational area BMPs. The BMPs identified in our report are state-of-the-art recommendations which continue to be valid and appropriate today, as they were in 2011. The BMPs would apply equally to both Alternative 1 and Alternative 2.

Similarly, the Wastewater Management Plan's analysis and recommendations, including our discussion on the proposed wastewater treatment plant facility and processes remain current in terms of technology and design parameters. The engineering elements of the wastewater treatment facility would serve both Alternative 1 and Alternative 2 in the same capacity with equal results.

No new circumstances have arisen with respect to the subject project or property that will result in different or likely increased environmental impacts not previously dealt with in our 2011 reports. Accordingly, we confirm that the analysis, conclusions, and recommendations presented in the foregoing reports remain applicable and are valid for both Alternative 1 and Alternative 2.

Very truly yours,

Brown and Caldwell

Craig C. Lekven, P.E
Supervising Engineer
Project Manager

CCL:ic

cc: Colleen Suyama, Munekiyo Hiraga

APPENDIX ~~C~~D.

Impact on Water Resources Study

Impact on Water Resources of the Olowalu Town Project

Prepared for:

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September 2011

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Introduction

The proposed Olowalu Town Master Plan project would create a new residential community on 635 acres in Olowalu, West Maui (refer to the land use plan on Figure 1). At full build-out, the community would consist of up to 1500 residential units and related commercial, public, park, and open space land uses. Figure 2 identifies the land areas that would require a State District boundary amendment from agriculture to urban and rural in order to develop the project. The objective of this report is to quantify and assess the project's potential impact on water resources.

Project Infrastructure That Will Impact Water Resources

Potable Water System. The potable water system run by Olowalu Water Company, Inc. (OWC) has been designated by the State Department of Health as Public Water System No. 209. The water system presently supplies the 14-lot Olowalu Agricultural Subdivision, the five-lot Olowalu Makai Subdivision, Kapalki Village, Olowalu General Store, and a number of other users within Olowalu. The system consists of one well (State No. 4936-01) at 205-foot elevation which is outfitted with a 250 GPM pump, a 0.50-million gallon (MG) storage tank with a 385-foot spillway, and distribution system piping. As shown on Figure 3, year-round average supply for PWS 209 has varied between 0.04 and 0.06 million gallons per day (MGD) over the four-year period from January 2007 through December 2010.

All of the Olowalu Town Master Plan project site is within the service area of PWS 209. Required expansion of the system to supply the Olowalu Town Master Plan project will be done incrementally and will ultimately include:

- Replacing the existing 250 GPM pump in Well 4936-01 with a unit of larger capacity on the order of 400 GPM;
- Constructing two more wells of similar (400 GPM) capacity, one of which will serve as standby;
- Adding additional reservoir storage next to the 0.50 MG tank, possibly of 0.50 or 1.0 MG size depending on actual water use; and
- Expansion of the existing distribution pipe network, including hydrants for fire protection.

Non-Potable Irrigation System. OWC also operates and maintains an existing non-potable irrigation system which serves ongoing agricultural and landscape irrigation in the project area. It consists of a diversion from Olowalu Stream at 502-foot elevation, a 1.1-mile long conveyance ditch and tunnel system, and a main open storage reservoir at about 360-foot elevation. The low head diversion dam on Olowalu Stream and the conveyance ditch system, referred to as Olowalu Ditch, was installed by Pioneer Mill Company sometime prior to 1911. The open reservoir, which has an impervious liner and was also installed by Pioneer Mill, is of more recent vintage. The system also has three other lower elevation and unlined reservoirs, one of which is still in use.

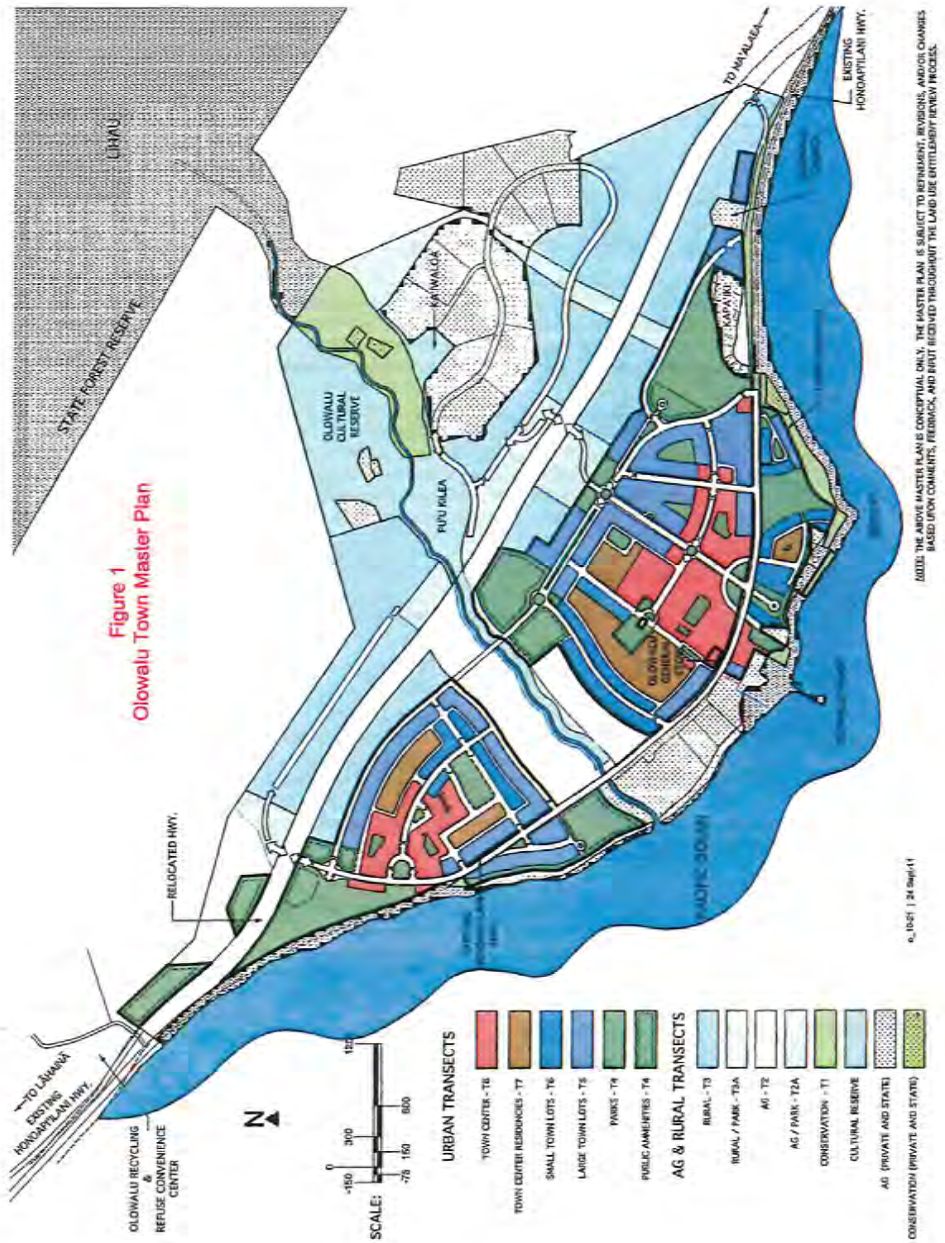


Figure 1
Olowalu Town Master Plan

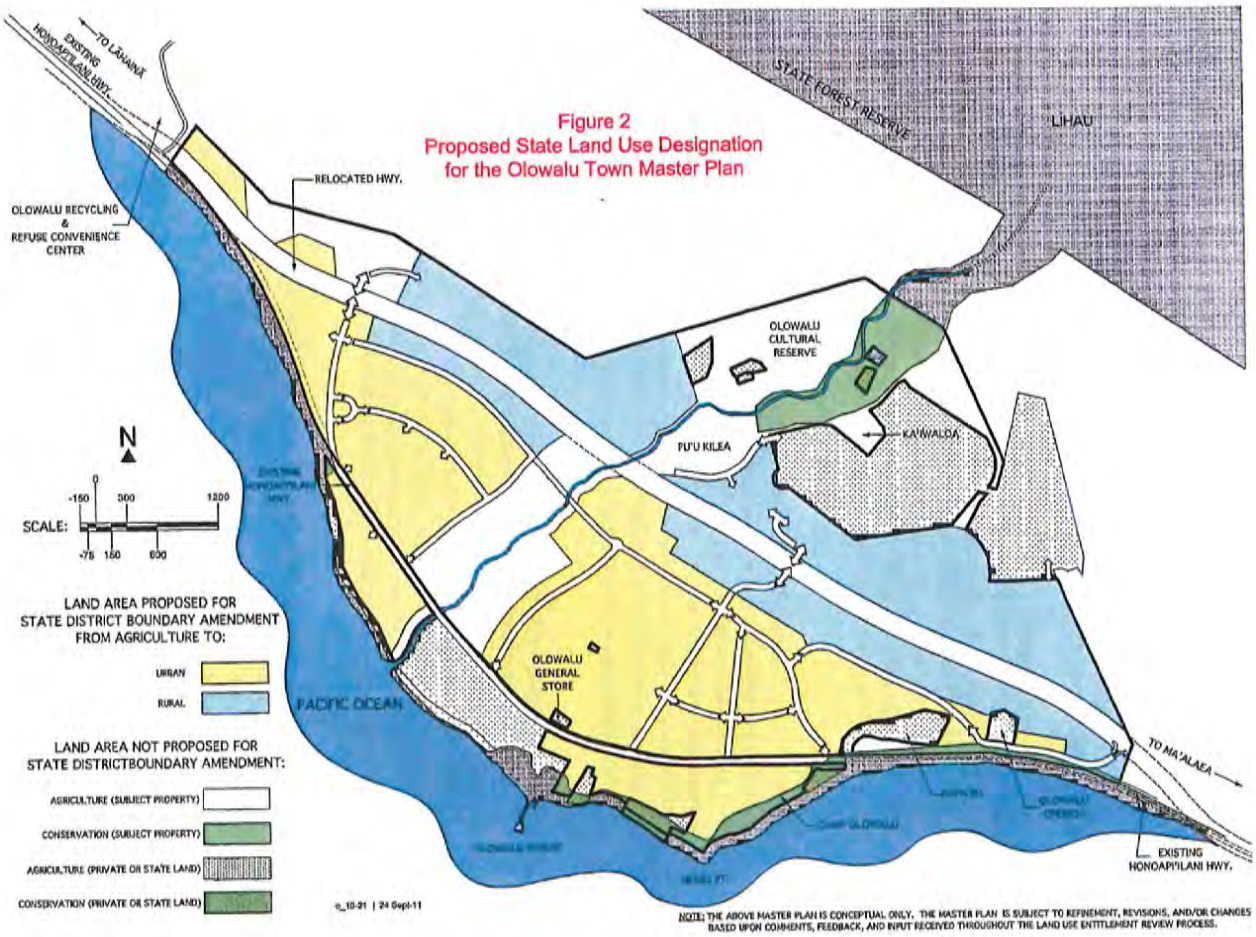
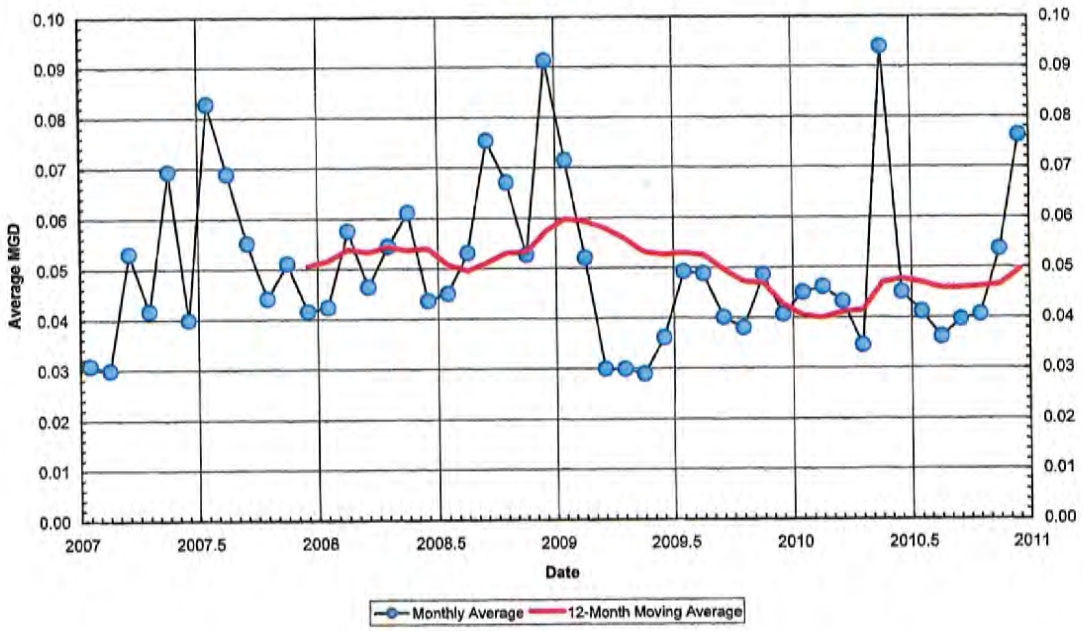


Figure 3. Monthly Pumpage of the Olowalu-Elua Well, State No. 4936-01, January 2007 through December 2010 (Data from Olowalu Water Company)



Historically, the ditch system has averaged four to five MGD and daily flows have rarely dropped below two MGD. With proper maintenance, including cleaning of sediment and debris and repairing of leaks, the ditch system should be able to accommodate the additional non-potable irrigation requirements of the Olowalu Town project. However, there are also two existing skimming wells within the project site. One is identified as State Well No. 4937-01. It is also known as the Olowalu Shaft and Pump N. It was previously used by Pioneer Mill, but is currently unused and is available as a back up source of slightly brackish non-potable supply. The other onsite skimming well, State Well 4837-01 (the O Pump), is also unused and available.

Wastewater Treatment, Reuse, and Disposal. A membrane bioreactor (MBR) treatment plant will be constructed onsite to treat project-generated wastewater to R-1 (tertiary) quality. Most of the treated effluent will be reused for the project's irrigation. About 100 acres within the project have been identified for this irrigation reuse. Early in the project's development and possibly on a seasonal basis at full build out, the non-potable irrigation system will provide supplemental supply to the 100-acre area. In wet periods when there is an excess of R-1 treated effluent, the excess will pass through a two-acre constructed wetlands and the effluent from the wetlands will be disposed of in a large (4.7-acre) leach field.

Drainage System. The project site is crossed by Olowalu Stream and several other, much smaller and unnamed normally dry gulches. Due to the impervious surfaces that would be created, development of the Olowalu Town project would increase the peak rate of surface runoff and the runoff volume. The intent of the project's drainage system is to provide sufficient volume in onsite retention basins so that the peak runoff rates and volumes for a 100-year, 24-hour design storm will not be increased over existing conditions. By providing these retention volumes, runoff rates and volumes for lesser storms from the project site are likely to be less than for existing conditions.

Hydro-Geologic Description of the Project Site

Overview of the Olowalu Watershed. The Olowalu watershed, which extends inland to the mountain crest above 4000-foot elevation, encompasses 5.05 square miles. Above 400-foot elevation, the exposed valley walls are deeply eroded Wailuku series basalts with numerous intruded dikes. Below 400-foot elevation, the land is covered with alluvium washed down by Olowalu Stream to form the fan-shaped coastal area. A prominent protrusion through the alluvium is Puu Kilea. It was formed by a more recent, Lahaina series eruption, but its flow lavas, if any, are buried under the alluvium. Notably, all of the Olowalu Town project site, as well as the existing Olowalu Agricultural Subdivision, are on the alluvium.

At the inland edge of watershed, rainfall averages about 200 inches per year. However, it rapidly drops off moving makai and is typically less than 20 inches a year across the project site.

Olowalu Stream and Ditch Flow. Despite the watershed's relatively small size and modest rainfall on its lower half, its streamflow is highly productive and perennial down to 200-foot elevation. Sometime prior to 1911, Pioneer Mill installed two ditch diversions for hydropower, sugarcane irrigation, and potable consumption in Olowalu camp. The upper diversion was created by the construction of a low head, boulder and concrete dam across the stream at 520-foot elevation. This diversion captures essentially all of the stream's base flow at that point. The U.S. Geological Survey (USGS), with assistance from Pioneer Mill personnel, measured the flow diverted into the ditch from 1911 to 1967. This measurement, essentially a depiction of the stream's base flow at 520-foot elevation, was remarkably consistent:

- Figure 4 is a plot of daily ditch flowrates over the 56-year period of record. Average flowrate over this period was 4.8 MGD. Some of the days when recorded flowrates were less than 2.0 MGD were the result of shutdowns for maintenance rather than actual low flows.
- Figure 5 is the duration-discharge curve for the 56 years of record, again showing the consistency of the ditch flow. Daily flowrates greater than 2.0 MGD occurred on 98 percent of the days.
- As shown by the high silica concentrations in samples of the stream and ditch taken on July 11, 2010 during an extended dry period, flow in the stream at the point of diversion is primarily groundwater discharged from high level, dike confined compartments (refer to Table 1). This explains the consistency of the stream's base flow captured at the ditch diversion.

It should be noted that West Maui Land Company Inc. has resumed measurement of the flow diverted into the Olowalu Ditch, albeit at a location further from the point of diversion than previously measured by Pioneer Mill and the USGS. Over the four-year period ending in December 2010, the ditch flowrate averaged 3.5 MGD. This is less than the 4.8 MGD average over the 1911 to 1967 period. Some of this difference is attributable to the dry recent period. However, ditch maintenance and leakage between the point of diversion and the location of current flowrate measurements are also contributing factors.

On low flow days such as observed on June 11 and 26, 2010, the upper ditch diversion captures all of the stream's flow. Except for minor seepage around and beneath the low head diversion dam, the streambed immediately downgradient is dry. However, within 100 yards, streamflow emerges and gradually gains in magnitude down to about 215-foot elevation, a distance of over a mile. At this lower location, Pioneer Mill installed a second ditch diversion. Although it is not known which of the two ditch diversions was installed first, notes in a 1911 USGS publication indicate that both diversions were being used at that time. However, the lower one, with obviously less yield, appears to have been abandoned sometime before the mid-1950s. The lower diversion dam, similar in structure to the upper one, has been destroyed by past storms. As observed on June 11 and 26, 2010, the stream's flowrate at the lower diversion structure was on the order of 15 to 20 percent of the flowrate at the upper diversion. Also, the

Figure 4. Daily and Moving Annual Average of Olowalu Ditch Flowrate as Measured at USGS Gage 6450 from 1911 to 1967 (Data from USGS Website)

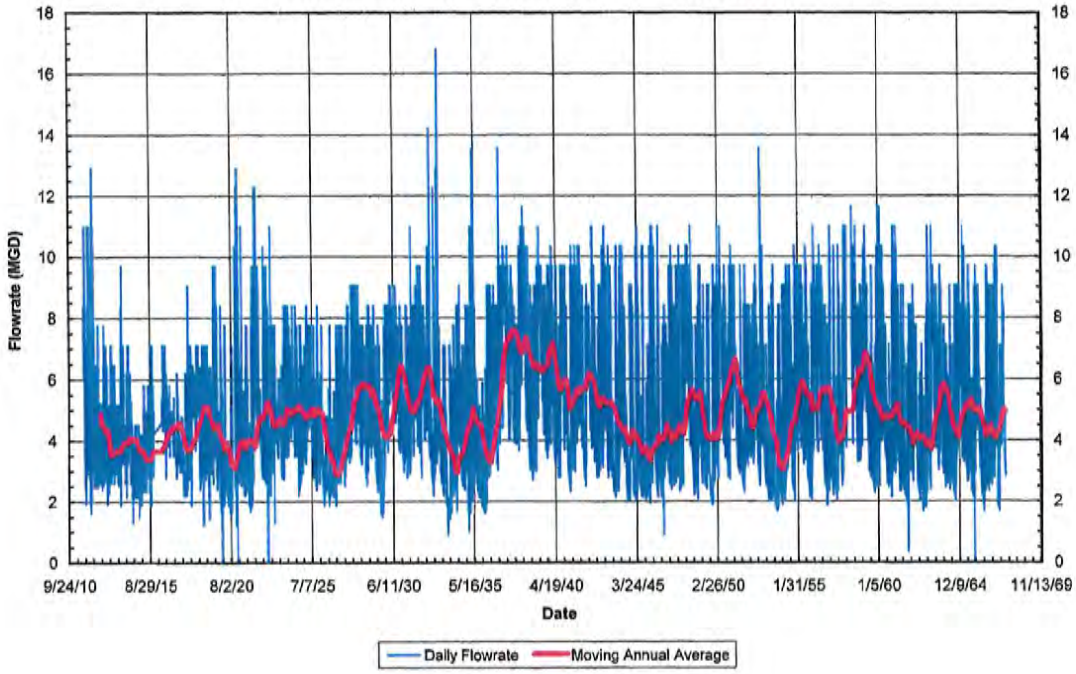


Figure 5. Duration-Discharge Characteristics of Olowalu Ditch at USGS Gage 6450 Based on 1911 to 1967 Daily Flowrates

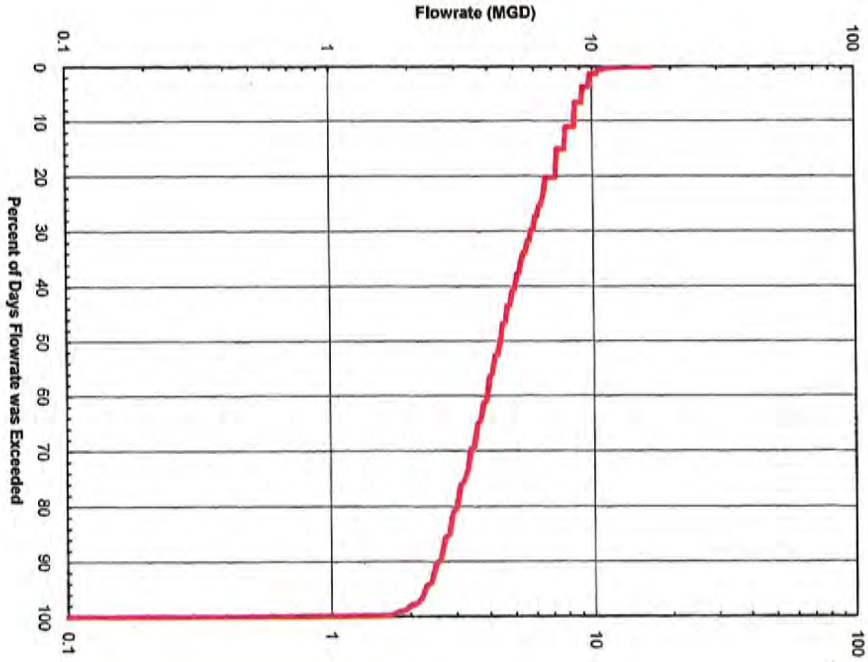


Table 1

Water Quality of Samples From Olowalu Wells and Olowalu Stream

Sample Location	Sample Date	Forms of Nitrogen				Forms of Phosphorus			Silica (µM)	Salinity (PPT)
		NO_3 (µM)	NH_4 (µM)	DON (µM)	TN (µM)	PO_4 (µM)	DOP (µM)	TP (µM)		
Olowalu-Elua Well	6-11-10	4.00	0.90	16.70	21.60	0.70	1.60	2.30	760	0.175
Olowalu-Elua Well	6-09-11	7.60	39.40	12.50	59.40	0.64	1.36	2.00	726	0.183
Olowalu Shaft - Pump N	6-11-10	34.40	2.10	2.80	39.30	3.30	1.70	5.00	844	0.294
Olowalu Stream at 520'	6-11-10	0.40	0.80	20.20	21.40	0.60	1.70	2.30	721	0.160
Olowalu Stream at 210'	6-11-10	0.20	0.80	22.40	23.40	0.40	1.50	1.90	698	0.177

Notes: 1. Samples collected by Tom Nance of TNWRE Inc.
2. Water quality analyses by Marine Analytical Specialists.
3. The symbol µM stands for micro-molar. To convert µM to milligrams per liter (mg/l), multiply by the atomic weight and divide by 1000.

water chemistry at the lower site was essentially identical to the upper one (Table 1), indicating that the water that had emerged into the stream was probably discharged from high level groundwater compartments.

Over a distance of a few hundred yards downstream of the lower diversion, all of the dry-period streamflow disappears into the streambed of boulders and alluvium. The USGS maintained a stream gaging station a little further makai where the stream is normally dry. Flowrates over the 1963 to 1967 common record period at the USGS' upper ditch and lower stream gages are illustrated on Figure 6. That record and the comparative duration-discharge curves on Figure 7 demonstrate that streamflow at the USGS gaging site is almost entirely freshets. There was no flow on 80 percent of the days. Streamflow reaches the shoreline to discharge into the marine environment, a distance of 4,000 feet from the USGS stream gage, on an even fewer number of days.

Groundwater Occurrence. In addition to the indicators of groundwater occurrence as discharge into Olowalu Stream, information on groundwater occurrence is provided by:

- Results of two high elevation development tunnels further back in Olowalu Valley (Well Nos. 5035-01 and 5134-01);
- Numerous mapped dikes [Plate 1 of Stearns & MacDonald, 1942 and Sheet 7 of Sherrod et al. (2007)];
- Pumpage records in Hatton (1976) of Pioneer Mill's Shafts "N" and "O" (Well Nos. 4937-01 and 4837-01, respectively) which tap basal groundwater; and
- Results of the Olowalu Elua Well (No. 4936-01) which was developed in 1999 and is the source of potable supply for PWS 209.

The lower of the two high elevation development tunnels was dug by Pioneer Mill in 1912 at elevation 775 feet and on the north side of the stream channel. Although located in an area of numerous dikes, it produced no flow (page 213 of Stearns & MacDonald, 1942). No other information on this tunnel is available. The upper tunnel is far back in the valley at 1710-foot elevation. The 3000-foot long tunnel produced only a modest flow (100,000 GPD), probably intercepting groundwater that otherwise would have discharged into the stream.

The two wells that tap basal groundwater on the property were developed by Pioneer Mill in 1905 (Well 4837-01, the "O" Pump) and 1933 (Well 4937-01, the "N" Pump). The older Well 4837-01 has four horizontal development tunnels and seven drilled wells in the tunnels. The more recent Well 4937-01 has one, 230-foot long horizontal development tunnel. Large capacity pumps were installed in both wells. Increased use in the 1970s caused significant salinity increases in both wells. At more modest rates of use, on the order of 1.0 MGD, both wells are capable of producing slightly brackish water suitable for supplemental irrigation use.

Figure 6. Olowalu Ditch and Stream Flowrates as Measured at USGS Gaging Stations Over their Common Period of Record, June 1963 through September 1967

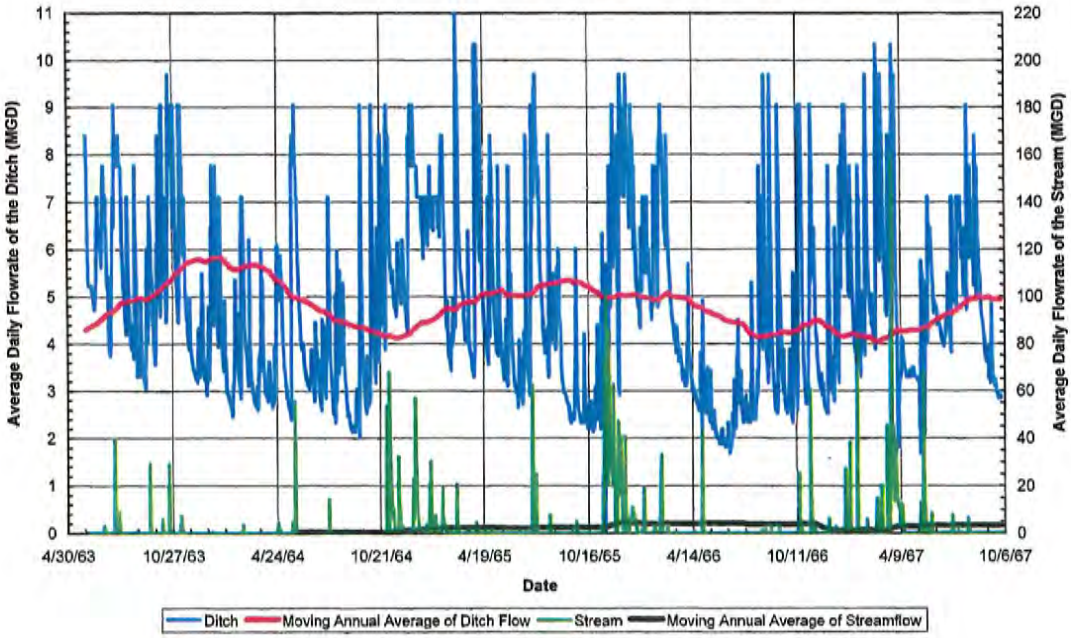
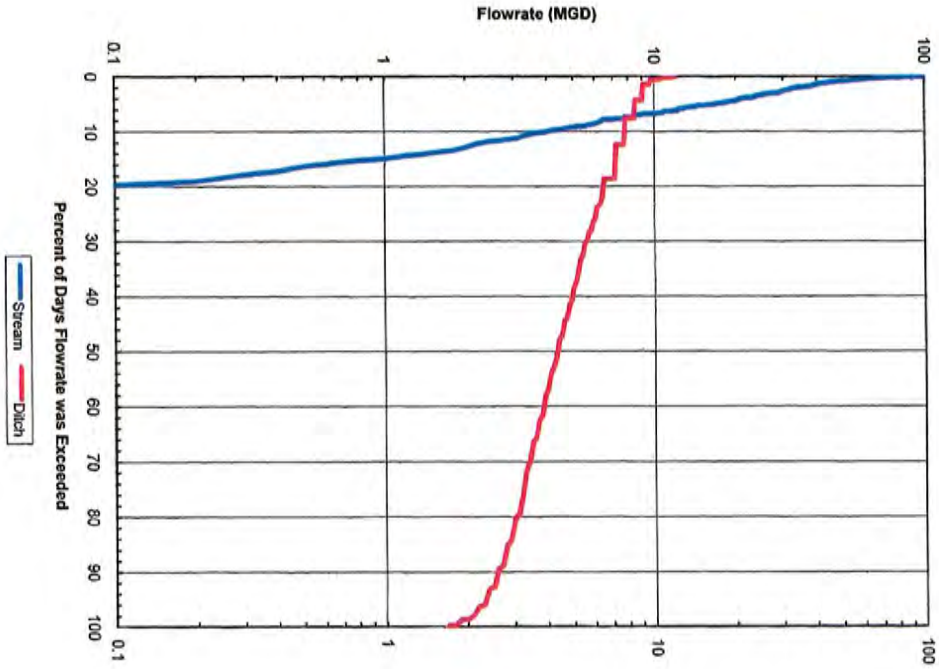


Figure 7. Comparison of Duration-Discharge Characteristics of Olowalu Ditch and Olowalu Stream, June 1963 to September 1967



Results of the Olowalu-Elua well, the sole drinking water source for PWS 209, are worthy of further discussion. It was initially assumed to tap into basal groundwater, but in retrospect, that may not actually be the case:

- Its water level is about two feet higher than Well 4937-01, an anomalous difference for basal groundwater over the relatively short distance between the wells.
- The driller reported that there was no water in the borehole until drilling reached 10 feet below sea level [Well Completion Report on file at the State Commission on Water Resource Management (CWRM)].
- Its semi-diurnal water level variations are barometric rather than tidal.
- Its very low and unchanging salinity in response to pumping (chlorides of 20 MG/L) are anomalous for basal groundwater at this location, particularly in comparison to basal Well 4937-01.
- Its water chemistry, at least for the limited number of parameters tested for this assessment, is essentially identical to the streamflow maintained by high level groundwater discharge (refer back to Table 1).

Whether the well taps a high level groundwater compartment or simply a portion of the basal aquifer where leakage of high level groundwater is the primary source of recharge is not known. In either case, however, the well's consistently low salinity is substantially better than would otherwise be expected in this location.

Estimates of Impacts on Water Resources

Existing Conditions. To create a baseline of existing conditions against which the changes due to the project's development will be compared, the following flowrates have been assumed:

- Discharge of Groundwater Along the Project's Shoreline. Using the State CWRM's methodology for establishing the sustainable yield of the Olowalu Aquifer System, groundwater discharging along the Olowalu Town project's shoreline is approximated as seven (7) MGD. A more recent and sophisticated groundwater recharge study by the U.S. Geological Survey (Engott and Vana, 2007) indicates that the groundwater flowrate may be as much as 16 MGD. However, the lower (and more conservative) flowrate is used for the assessment of impacts herein.
- Surface Runoff to the Shoreline. Streamflow at USGS Gage Station 6462 averaged 2.34 MGD over its 10-year period of record (June 1963 to September 1973). This gaging station is 4000 feet from the shoreline, meaning that losses along the section of the streambed downgradient of the USGS gaging station reduce the amount of actual shoreline discharge. However, there is also runoff from other areas of the project site which offset the seepage loss in the nearshore Olowalu streambed. As a first order approximation, it is assumed that existing surface runoff to the shoreline averages 2.3 MGD year-round and that 85 percent of this occurs at the point of shoreline discharge of Olowalu Stream. The remainder represents about one-third of the 20 inches of annual rainfall on the 635-acre project site.

Project Water Uses and Wastewater Generation. Table 2 presents estimates of potable and non-potable water uses by land use category at the project's full build-out. It also presents estimates of the amount of R-1 treated wastewater that will be available for irrigation reuse. Several aspects of these estimates should be noted:

- The amounts in Table 2 are year-round averages at full build out.
- The water use and wastewater generation amounts are, in every case, less than design numbers for each land use as presented in the project's engineering reports (Otomo, 2011 and Brown and Caldwell, 2011). The numbers in the table are the expectable actual use amounts. The design numbers in the two engineering reports, which are the basis for sizing infrastructure, by definition are conservative. If they do not exceed actual use, the infrastructure would be undersized.
- The treated R-1 effluent available for irrigation reuse is generally estimated at 85 percent of the within-building potable water use. The remaining 15 percent would be lost in conveyance hardware, lost to evaporation and leakage at the wastewater treatment plant, or simply not be discharged into the wastewater system at the points of use.
- About 100 acres in four land use categories (Public/Quasi Public, Park/Open Space, Agriculture, and the relocated State Highway) have been identified for the irrigation reuse of the R-1 treated wastewater (Brown and Caldwell, 2011). At full build out, it is estimated that about 0.24 MGD of the R-1 effluent would be used for this irrigation. The remainder, ultimately amounting to 0.14 MGD, would be directed into the two-acre constructed wetlands and then disposed of in the 4.7-acre leach field.

Estimated Changes to the Amount and Quality of Groundwater Discharging Along the Project's Shoreline. Based on expected water use and wastewater generation amounts, Table 3 presents the estimated changes to groundwater flowrate and the loading of nitrogen and phosphorus that would ultimately reach and be discharged along the project's shoreline. The series of assumptions and calculations incorporated into this table are as follows:

- Concentrations of nitrogen and phosphorus in groundwater presently discharging along the project's shoreline are the same as in Well 4937-01 (Pioneer's "N" Pump) as shown in Table 1.

Table 2

Projected Potable and Non-Potable Water Use and
R-1 Treated Wastewater Effluent Available for Irrigation Reuse

Land Use	No. of Units	Area (Acres)	Potable Water Use		Non-Potable Water Use		R-1 Treated Wastewater Effluent	
			Unit Use Rate (GPD / Unit)	Amount (GPD)	Unit Use Rate (GPD / Unit)	Amount (GPD)	Unit Amount Rate (GPD / Unit)	Amount (GPD)
SF Residential								
• Served by Dual System	500	–	275	137,500	275	137,500	235	117,500
• Served Only by Potable System	400	–	550	220,000	–	–	235	94,000
MF Residential								
• Served by Dual System	430	--	225	96,750	175	75,250	190	81,700
• Served Only by Potable System	150	–	400	60,000	–	–	190	28,500
Commercial	375,000 ft^2	24	1,200	28,800	800	19,200	1,020	24,480
Public / Quasi-Public	–	25	1,200	30,000	800	20,000	1,020	25,500
Park and Open Space	–	75	250	18,750	2,500	187,500	200	15,000
Conservation	–	75	--	–	1,500	112,500	–	–
Agriculture	20 Lots	30	275	5,500	2,500	75,000	235	4,700
Highway and Interior Roads	--	50	–	–	500	25,000	–	–
Totals	1,500			597,300		651,950		391,380

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Table 3

Projected Changes in the
Groundwater Discharged Along the Project's Shoreline

Item	Flowrate (MGD)	Nitrogen (lbs/day)	Phosphorus (lbs/day)
Existing Conditions	7.0	32.07	9.04
Drafts From Groundwater			
• For the Potable System	0.60	1.539	0.333
• Brackish Supplement to Non-Potable System	0.02	0.092	0.026
Total Drafts From Groundwater	0.62	1.631	0.359
Returns to Groundwater			
• Irrigation Return of Potable Water	0.014	0.652	0.016
• Irrigation Return of Brackish Groundwater	0.002	0.095	0.002
• Irrigation Return of Surface Water	0.039	1.862	0.046
• Irrigation Return of R-1 Effluent	0.024	0.054	0.008
• R-1 Effluent of Leach Field	0.126	2.099	0.210
Total of Returns to Groundwater	0.205	4.762	0.282
Post-Development Projected Condition			
• Amounts	6.585	35.201	8.963
• Percent Change	5.9%	9.8%	0.9%
	Decrease	Increase	Decrease

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- Nitrogen and phosphorus in groundwater pumped for the potable system will be the same as in the Olowalu-Elua well, also in Table 1.

- The treated R-1 effluent will have a total nitrogen (TN) concentration of 10 mg/l or less and total phosphorus (TP) of 5 mg/l or less (Brown and Caldwell, 2011). For the calculations herein, it is assumed that average concentrations are 80 percent of these upper limits.

- For the 0.24 MGD of R-1 effluent reused for irrigation, it is assumed that its dissolved nitrogen and phosphorus are sufficient for plant growth, meaning that no fertilizer would have to be applied in these areas. This has proven to be the case in other R-1 irrigation applications.

- Of the 0.65 MGD of total non-potable water use, 0.24 MGD would be R-1 effluent, 0.39 MGD would be surface water supplied by the Olowalu Ditch, and 0.02 MGD (as a year-round average) would be a periodic supplement by Well 4937-01.

- In areas of landscape irrigation by sources other than the R-1 effluent, fertilizer would be applied at an average for nitrogen of three (3) pounds per 1000 square feet per year. Phosphorus would be applied at 0.5 pounds per 1000 square feet per year.

- For all landscape irrigation regardless of source, 10 percent of the applied water passes below the plant root zone to groundwater below. It carries with it 10 percent of the applied nitrogen and five percent of the applied phosphorus.

- For the 0.14 MGD of R-1 effluent that is directed to the two-acre constructed wetlands, 10 percent is lost to evaporation and the remaining 0.126 MGD is disposed of in the 4.7-acre leach field. In passage through the wetlands half of the nitrogen and phosphorus are taken up in plant growth.

- For all uses of water for which a portion is ultimately returned to groundwater as excess applied landscape irrigation or leach field disposal, natural processes will reduce the nutrient loading. These processes take place during the downward passage through the vadose (unsaturated) zone and lateral movement in groundwater to the shoreline. Nitrogen removal, primarily by denitrification, is assumed to be 75 percent. Phosphorus removal, primarily by adsorption, is assumed to be 90 percent. Based on admittedly limited available data, these assumptions appear to be conservative.

In round numbers, the end result of the series of assumptions and calculations incorporated into Table 3 are a reduction by six (6) percent of the groundwater flowrate discharged into the marine environment, a 10 percent increase in the amount of nitrogen, and a one (1) percent decrease in phosphorus.

Projected Use of Groundwater versus the Regulatory Sustainable Yield of the Olowalu Aquifer System (60205). Present use of groundwater in the Olowalu Aquifer Sector is exclusively the water drawn by the Olowalu-Elua well (4936-01) to supply PWS No. 209. As shown on Figure 3, this is approximately 0.055 MGD as a year-round average. As projected herein, additional groundwater use for the Olowalu Town Master Plan project would be 0.60 MGD for potable use (Table 2) and on the order 0.02 MGD of brackish water from the N and/or O Pump wells previously used by Pioneer Mill. This would increase the ultimate use of groundwater to about 0.7 MGD.

The CWRM is the State agency which regulates the use of groundwater. In its 1990 Water Resources Protection Plan (George A.L. Yuen and Associates, 1990), it set sustainable yields for all aquifer systems in the State. For the Olowalu Aquifer System, it initially set its sustainable yield at three (3) MGD based on: (i) recharge to groundwater on the order of 4 to 7 MGD; (ii) the assumption of all of the developable supply is basal groundwater with an initial head [ie. water level] of 5 feet; and (iii) an analytical method that, for the basal groundwater conditions assumed, calculated that 44 percent of the aquifer's recharge can be developed as its sustainable yield. In 2008, the CWRM issued the final version of its updated Water Resource Protection Plan (Wilson Okamoto Corporation, 2008). In it, the sustainable yield of the Olowalu Aquifer System was reduced from three (3) to two (2) MGD using the lower end of the estimated aquifer recharge (Table 3-10 on page 3-65 of Wilson Okamoto Corporation, 2008). Projected future groundwater use of 0.7 MGD by existing users and the addition of the Olowalu Town project would still be substantially below this lowered, sustainable yield amount.

Recharge calculations utilized by the CWRM for the Olowalu Aquifer System are based on annual averages (measured and estimated) of rainfall, surface runoff, and evapotranspiration (ET). In relatively dry areas such as Olowalu, the use of annual averages to compute recharge often results in an overestimate of ET and a resulting underestimate of recharge and the sustainable yield. The more sophisticated and detailed recharge calculations in Engott and Vana (2007) illustrate this. Using a daily time step method of computation, it calculated the recharge of the Olowalu Aquifer System to be 16 MGD (Table 14, page 43 of Engott and Vana, 2007). Using the CWRM's methodology to derive the sustainable yield from recharge, the USGS study suggests that the Olowalu Aquifer System may have a developable supply on the order of seven (7) MGD.

Estimated Changes to the Amount and Quality of Surface Runoff Discharged From the Project's Shoreline. There are two aspects of surface runoff to assess, the use of Olowalu Ditch and the changes to rainfall-runoff. It has previously been estimated that the project would use an average of 0.39 MGD from the ditch. The ditch flow is now measured at a location close to the system's storage reservoir and about 1.1 miles downstream from the point of stream diversion. As observed on June 11 and 26, 2010, water diverted from the stream and into the ditch was visually estimated to be about 2.0 MGD. The

flowrate recorded prior to discharge into the open storage reservoir was less than 0.9 MGD. The difference was lost to leakage in transit, with essentially all of that leakage returning back to the stream and ultimately disappearing into the streambed below 200-foot elevation.

Currently during low flow periods, all of the Olowalu Ditch flow is used for various ongoing irrigation uses or is lost in the irrigation system's distribution network. In order for the ditch system to provide the estimated 0.39 MGD for the Olowalu Town project, it will be necessary to make repairs to Olowalu Ditch and the distribution system and to institute an appropriate maintenance program. This more efficient use of water diverted from Olowalu Stream will not create a significant difference in surface water discharge at the shoreline by Olowalu Stream.

Present surface runoff from the project's 635-acre area was previously estimated as one-third of its 20 inches of annual rainfall. This is equivalent to 0.31 MGD as a year-round average. The project's retention basins are to be designed to keep post-development peak rates and volumes of stormwater runoff the same or less than existing conditions during a 100-year, 24-hour design storm. The installed retention volumes for this hypothetical design storm will have a more substantial impact on smaller rainfall events, meaning that the actual surface runoff from the project site may actually be less than under the existing, undeveloped condition. Since it is virtually impossible to estimate that reduction for the spectrum of actual rainfall-runoff events that will occur, it is simply assumed that there will be no increase in surface runoff discharge along the shoreline as a results of the project's development.

Water quality data of surface runoff from developed areas are scarce and widely varying. In general, these data indicate that nitrogen and phosphorus levels in stormwater runoff are lower than background levels in groundwater. On this basis and as an order of magnitude estimate, it is assumed that increases of 30 μM of nitrogen and 2 μM of phosphorus in surface runoff from the project site and discharged at the shoreline will occur. For an average discharge of 0.31 MGD, the increased loading would amount to 1.08 pounds per day of nitrogen and 0.16 pounds per day of phosphorus. Together with the groundwater charges presented in Table 3, the nitrogen increase over existing conditions would be 13 percent and the phosphorus increase would be about one (1) percent.

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APPENDIX D-1.

August 26, 2015 Letter from Tom Nance Water Resource Engineering

TNWRE
Tom Nance Water
Resource Engineering

No. of pages: 1
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dschaefer@pulamalanai.com
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Original ☑ will ☐ will not
be mailed to you.

August 26, 2015
15-187 | 10-21

Dave Ward and Bill Frampton
Olowalu Town, LLC
2035 Main Street, Suite No. 1
Wailuku, Hawaii 96793

SUBJECT: Report Entitled *Impact on Water Resources of the Olowalu Town Project* (Dated September, 2011)

Dear Mr. Ward and Mr. Frampton:

My report addresses hydro-geologic conditions at Olowalu and provides an estimate of impacts on water resources associated with the proposed action. The report, when prepared in September, 2011, addressed Alternative 1, the Preferred Alternative. With the adoption of the Maui Island Plan (MIP) in December 2012, Alternative 2 was introduced as a second alternative within the realm of implementation potential. Alternative 2 reflects a master plan concept which follows the MIP's growth boundaries. That is, lands makai of Honoapiilani Highway are not included as part of the Master Plan. Both Alternatives 1 and 2 call for the development of up to 1,500 residential units and between 300,000 to 375,000 square feet of commercial space.

The analysis in my report addresses project water use (potable water and non-potable irrigation water) and wastewater generation. Since residential unit count and commercial space development plans under both Alternative 1 and Alternative 2 are identical, the analysis contained in our report would apply to both scenarios. Similarly, the drainage system and wastewater system assumptions used in our study are applicable to both alternatives.

Significantly, the hydro-geological analysis contained in my report reflects existing technical characteristics such as watershed parameters, water quality, flow rates, and groundwater occurrence. Since the 2011 preparation of my report, no new circumstances have arisen that would suggest the possibility of different or likely increased environmental impacts not previously dealt with in the 2011 report. Accordingly, the research, analysis, and conclusions presented in my report remain applicable for both Alternative 1 and Alternative 2.

Sincerely,

Tom Nance

Tom Nance

ec: Colleen Suyama – Munekiyo Hiraga
Greg Fukumitsu and Todd Yonamine – TNWRE, Inc.

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APPENDIX ~~D~~E.

Assessment of Marine Water Chemistry and Biotic Community Structure in the Vicinity of the Olowalu Town Master Plan

ASSESSMENT OF MARINE WATER CHEMISTRY AND BIOTIC COMMUNITY STRUCTURE IN THE VICINITY OF THE OLOWALU TOWN MASTER PLAN OLOWALU, MAUI, HAWAII

Prepared for:

Olowalu Town, LLC and Olowalu Ekolu, LLC
2073 Wells St., Suite 101
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Prepared by:

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1039 Waakaua Pl.
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July 2011

EXECUTIVE SUMMARY

The ownership of the majority of lands surrounding the existing village at Olowalu, West Maui, Hawaii is proposing to develop a Master Planned community (Olowalu Town Master Plan) that encompassed approximately 636.48 acres. The Master Plan for this acreage defines a mixed-use community that will include residential, commercial/business, agriculture, civic, and social interests, as well as parks and open space. While most of the area lies mauka of Honoapiilani Highway, several segments lie on the makai side of the Highway and extend to near the shoreline. The concept for the Olowalu Town Master Plan centers on recognition and appreciation of the value of the natural and cultural resources, and will provide for the long-term stewardship and preservation of these resources.

Evaluation of the nearshore marine environment off the Olowalu Master Plan project site in west Maui was carried out in 2010-2011. Assessment of nearshore marine water chemistry was carried out by evaluating data from 60 water samples that were collected at five ocean sites spaced within the project boundaries. Water samples were collected on transects perpendicular to shore, extending from the shoreline to distances of approximately 500-600 meters (m) offshore. Analysis of fourteen water chemistry constituents included all specific constituents in DOH water quality standards.

Several dissolved nutrients (Si, NO_3^-, PO_4^{3-}, TN and TP) displayed strong horizontal gradients at multiple transect sites, with highest values closest to shore and lowest values at the most seaward sampling locations. Correspondingly, salinity was lowest closest to the shoreline and increased with distance from shore. These gradients were most pronounced at the northern boundary of the project site and weakest in the southern region of the project area southwest of Olowalu Point. These patterns are indicative of groundwater efflux at the shoreline, producing a zone of mixing where nearshore waters are a combination of ocean water and groundwater. In all cases, the nearshore zone of mixing was restricted to a narrow region that extended a maximum of only tens of meters from the shoreline. Beyond this distance, water chemistry at all sites was representative of pristine open coastal waters.

Water chemistry constituents that are not major components of groundwater also displayed distinct gradients with respect to either distance from the shoreline or depth in the water column. Chl a and turbidity were generally elevated in nearshore samples with decreasing values moving seaward.

Application of a hydrographic mixing model to the water chemistry data was used to determine if increased nutrient concentrations in nearshore waters are the result of mixing of natural groundwater with oceanic water or inputs from activities on land. The model indicates that, at the time of sampling, there was a distinct subsidy of nitrate nitrogen (NO_3^-) to the ocean at the survey site located near the northern boundary of the property (Site 1) and off the eastern side of Olowalu Point (Site 4). There was no external supply of nitrate at Site 2, located directly off of Olowalu Stream. However, there was a subsidy of phosphate phosphorus (PO_4^{3-}) off Olowalu Stream, which did not occur at any other location.

Evaluating water chemistry from the single sampling in 2010 using DOH specific criteria for Open Coastal Waters indicates many of the measurements in the nearshore areas (within 10 m of the shoreline) exceed standards, particularly for various forms of nitrogen. As these standards do not take into consideration the mixing of high-nutrient, naturally occurring groundwater with ocean water in the nearshore zone, such exceedances are expected and normally occur throughout most Hawaiian nearshore marine areas.

Characterization of the marine habitat and biotic community structure was carried out using a fully georeferenced WorldView-2 multispectral satellite image of the Olowalu area purchased from the Image Library at DigitalGlobe.com (image data originally acquired on February 10, 2010). Ground-truth, termed calibration-validation (cal/val), data derived from georeferenced digital photographs collected *in-situ* at 200 representative points provided the input to create benthic habitat maps of the Olowalu reefs. Spectral data within the satellite image were classified and analyzed using the aforementioned georeferenced ground-truth data, covering an area of about 1.8 million square meters, or 454 acres. Overall coral cover in the mapped area was about 37% of bottom cover, while macroalgae accounted for about 8% of bottom cover; 21% of the bottom was covered with sand and 33% of the bottom consisted of mud and sediment bound in algal turf.

In most open coastal areas of Hawaii physical forces from wave energy are the dominant factors responsible for reef structure and species assemblages. The reefs at Olowalu are considered somewhat unique in that sediment deposition (or lack thereof), rather than wave forces, appears to be the major determinant of physical and biotic reef structure. Along the northern side of Olowalu Point, deposition of terrigenous sediment emanating from Olowalu Stream creates a habitat where coral communities are limited to species and growth forms that can withstand the sub-optimal conditions created by high rates of sediment deposition. South of Olowalu Point, a shallow, wide, triangular-shaped reef flat, formed from deposition of alluvial material from Olowalu Stream, terminates in a fore-reef composed of actively accreting coral assemblages that show little or no effect of sediment stress. Reefs at the southeastern end of the project site (14-Mile Marker) also showed distinct indications of sediment stress, although no major streams discharge regularly in this area.

Populations of reef fish in the area were typical of Hawaii reefs, although numbers of larger fish were very low, likely as a result of fishing pressure. The most abundant families consisted of wrasses, damselfish and surgeonfish. As is generally the case, density of fish was a function of vertical complexity of the benthic surface, with the highest abundance on the outer fore-reef. Reef fish were rarest in the areas with heaviest deposition of mud. Numerous sharks were observed on the inner reef flat.

Overall, results of this study indicate that existing episodic discharge to the ocean of land-derived sediment is the most pervasive stress to the reefs off Olowalu. However, the geographic extent of such deposition is limited and does not impact all areas of the reef. Reef communities on the outer reef flat and fore-reef represent essentially pristine ecological settings unaffected by most activities of man (fishing being the exception).

Engineering analysis indicates that, with full build-out of the planned project, groundwater flow to the ocean will be slightly reduced. Groundwater nutrient fluxes to the ocean will be reduced

by about 1% and increased by about 10% for phosphorus and nitrogen, respectively. Combining groundwater flux with episodic surface runoff is projected to result in increases of both nitrogen (13%) and phosphorus (1%) to discharge to the nearshore ocean over present conditions. Depiction of the existing marine environment indicates that, at present, groundwater is so restricted in distribution that there is essentially no effect on marine community structure. Thus, the small changes in groundwater dynamics projected to result from the project do not present a mechanism for future negative effects to offshore marine communities.

A planned component of the Olowalu Town Master Plan is a series of retention basins within the project boundaries for the purpose of retaining stormwater runoff prior to discharge to the ocean. While the project will increase the area of impervious surfaces, the inclusion of retention basins is predicted to result in no change to the discharge of water to the ocean compared to the present scenario. However, should the retention basins function to reduce sediment discharge to the ocean relative to present conditions, they can be viewed as a positive aspect contributing to recovery of impacted reefs.

Planning for the Olowalu Town Master Plan focuses on continued maintenance and stewardship of the unique natural resources of the area. As a result, as long as best management practices are utilized to avoid any unforeseen impacts during the construction and operational phases of the project, and engineering considerations in the design of the retention basins include maximizing sediment trapping, there is no rationale to indicate a potential changes that could be considered negative impacts to the marine environment.

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I. INTRODUCTION AND PURPOSE

Olowalu is located on the foothills of the West Maui Mountains, approximately four miles south of Lahaina Town. Since the termination of sugar cultivation by Pioneer Mill in 1999, the lands surrounding Olowalu have either been utilized for small farming operations or remained fallow. Lands have been subdivided, with a limited number of lots sold to individual purchasers. The ownership of the majority of lands surrounding the existing village are applying for a proposed Master Planned community, called the Olowalu Master Plan, that encompasses approximately 636.48 acres. The Master Plan for this acreage defines a mixed-use community that will include residential, commercial/business, agriculture, civic, and social interests, as well as parks and open space. While most of the area lies mauka of Honoapiilani Highway, several segments lie on the makai side of the Highway and extend to near the shoreline. The concept for the Olowalu Town Master Plan centers on recognition and appreciation of the value of the natural and cultural resources of the land, and will provide for the long-term stewardship and preservation of these resources.

While all planning and construction activities for the Master Plan will place a high priority on maintaining or improving the existing nature of the coastal and marine environments off Olowalu, it remains necessary to address any potential impacts that may be associated with the proposed project. None of the projected land uses include any direct alteration of the coastal areas or nearshore waters. The potential exists, however, for the project to affect the composition and volume of groundwater that flows beneath the project site, as well as possible effects of surface runoff and stream flow that may emanate from the project during storm events. As most of the groundwater and stream flow that could be affected by the project subsequently reaches the ocean, it is recognized that there is potential for the project to affect the marine environment.

In the interest of addressing these concerns and assuring maintenance of existing environmental quality, a baseline assessment of the marine environment and potential impact analysis of the nearshore areas off the Olowalu Town property was conducted in 2010 and 2011. The rationale of this assessment was to evaluate the composition and condition of the existing marine environment, specifically in terms of both water chemistry and coral reef community structure. As the existing condition of the marine environment is the result of factors occurring both in the past and present, particularly groundwater and stream input, the characterization involves evaluating the effects this input has on water quality at the present time, prior to the commencement of any new construction activities. Combining this information with estimates of changes in groundwater and surface water flow rates and chemical composition that could result from the proposed Olowalu Town Master Plan project provides a basis from which to evaluate potential future effects to the marine and anchialine pool environments. Predicted changes in groundwater composition and flow rates have been supplied by Tom Nance Water Resource Engineering (TNWRE 2011). Results of the combined evaluations indicate if, and to what degree, there is potential for negative effects to the marine and aquatic environments from the proposed Olowalu Town project. In addition, these results can provide a basis for implementing mitigation measures to pre-emptively avoid any predicted impacts.

II. CHARACTERIZATION OF WATER CHEMISTRY

A. METHODS

Five water sampling survey sites were established spanning the shoreline boundaries of the Olowalu Town Master Plan (Figure 1). Transect Site 1was located near the northwestern boundary of the project; Transect Site 2 was located directly off the mouth of Olowalu Stream; Sites 3-5 bisected the wide reef flat off Olowalu Point (Figure 1).

Water quality was evaluated at each site on transects that were oriented approximately perpendicular to the shoreline and depth contours. Water samples were collected at nine locations on each transect from just seaward of the shoreline to approximately 400-600 meters (m) offshore. Such a sampling scheme is designed to span the greatest range of salinity with respect to potential freshwater efflux at the shoreline. Sampling was more concentrated in the nearshore zone because this area is most likely to show the effects of shoreline modification. At sample locations where water depth exceeded one meter, two samples were collected: a surface sample collected within approximately 10 centimeters (cm) of the sea surface and a bottom sample collected within 50 cm of the sea floor. At sampling sites where water depth was less than one meter, a single sample from within 10 cm of the surface wos collected at each station. In addition, samples were also collected from two wells located upslope of the Olowalu Town shoreline.

Water quality parameters that were evaluated include the 11 specific constituents for open coastal waters (Chapter11-54, Section 06 (b) of the State of Hawaii Department of Health (DOH) Water Quality Standards). These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium nitrogen (NH_4^+), total phosphorus (TP), Chlorophyll a (Chl a), turbidity, temperature, pH and salinity. In addition, silica (Si) and orthophosphate phosphorus (PO_4^{-3}) were also reported because these constituents are indicators of groundwater input and mixing, as well as biotic activity.

Fieldwork was conducted on June 10, 2010 by swimmers working from the shoreline and with the use of a 22-foot boat for offshore sampling. Deep (near bottom) samples were collected using a 1.8 liter Niskin sampling bottle. The bottle was lowered to the desired sampling depth with spring-loaded endcaps held open so water could pass freely through the bottle. At the desired sampling depth, a weighted messenger released from the surface triggered closure of the endcaps, isolating a volume of water.

All water samples were collected in triple-rinsed, one-liter, linear polyethylene bottles. Subsamples for nutrient analyses were immediately placed in 125-milliliter (ml) acid-washed, triple rinsed, polyethylene bottles and stored on ice. Analyses for Si, NH_4^+, PO_4^{3-}, and NO_3^- were performed on filtered samples with a Technicon Autoanalyzer using standard methods for seawater analysis (Strickland and Parsons 1968, Grasshoff 1983). TN and TP were analyzed in a similar fashion following digestion of unfiltered samples. Total organic nitrogen (TON) and total organic phosphorus (TOP) were calculated as the difference between TN and dissolved inorganic N (NO_3^- + NH_4^+), and TP and dissolved inorganic P (PO_4^{3-}), respectively.

Water for other analyses was subsampled from one-liter polyethylene bottles and kept chilled until analysis. Chl a was measured by filtering enough water through glass-fiber filters to detect color; pigments on filters were extracted in 90% acetone in the dark at -20° C for 12-24 hours. Fluorescence before and after acidification of the extract was measured with a Turner Designs fluorometer. Salinity was determined using an AGE Model 2100 laboratory salinometer with a readability of 0.0001‰ (ppt). Turbidity was determined using a 90-degree nephelometer and reported in nephelometric turbidity units (NTU) (precision of 0.01 NTU).

In-situ field measurements of continuous vertical profiles of water temperature, salinity, dissolved oxygen and pH were acquired at each sampling station using a RBR Model XR-62 CTD calibrated to factory standards (precision of 0.01°C, 0.001‰, 0.001% O_2 saturation, and 0.001 pH units).

All fieldwork was conducted by Dr. Steven Dollar and Tom Nance. All laboratory analyses were conducted by Marine Analytical Specialists located in Honolulu, HI (Labcode: HI 00009). This analytical laboratory possesses acceptable ratings from EPA-compliant proficiency and quality cantrol testing.

B. RESULTS

1. Horizontal Stratification

Tables 1 and 2 show results of all water chemistry analyses for samples collected off the Olowalu Town site on June 11, 2011. Table 1 shows concentrations of dissolved nutrients in micromolar (μM) units; Table 2 shows concentrations in micrograms per liter (μg/L). Concentrations of eight dissolved nutrient constituents in surface and near bottom samples are plotted as functions of distance from the shoreline in Figure 2. Values of salinity, turbidity, temperature and Chl a as functions of distance from shore are shown in Figure 3.

Several patterns of distribution are evident in Tables 1 and 2 and Figures 2 and 3. It can be seen that, on all transects, the concentration of dissolved Si is elevated in samples near the shoreline, with progressively decreasing concentrations with distance from shore (Figure 2). This pattern is most pronounced on Transects 1 and 2 and progressively decreases in magnitude on Transects 3-5. On Transect 5, the value of dissolved Si at the shoreline (14-15 μM) is about seven times lower than on Transect 4, and 30 times lower than on Transect 2. Salinity displays the opposite trend, with sharply lower concentrations in the samples near the shoreline and increasing values with distance from shore (Figure 3).

Other dissolved nutrients, including NO_3^- and to a much lesser degree PO_4^{3-}, also display patterns of decreasing concentrations with distance from shore, although to a much smaller degree than Si. Of note is that the horizontal gradients of Si are greatest on Transect 2, located off the mouth of Olowalu Stream, while the gradient of NO_3^- on Transect 2 is the second lowest within the survey area. As Olowalu Stream was actively discharging to the ocean during and preceding sampling, it is apparent that stream water contains substantial

concentrations of Si, but not NO_3^-. It is also evident that on Transect 1, the concentration of NO_3^- is the highest recorded in the study area (~50 μM) and is about two orders of magnitude higher than the shoreline value at Transect 2 (~0.40 μM), although the salinities at both sites are nearly identical (~18‰). As the origin of Transect 1 is well-removed from the mouth of Olowalu Stream, the elevated NO_3^- at Transect 1 is a result of groundwater input at the shoreline.

On all transects the gradients of NO_3^- disappear beyond a distance of about 10-20 m from the shoreline and concentrations are uniformly low across the remainder of the transects. Similarly, there is near uniformity of salinity beyond a distance of 10-20 m from shore at all transect sites (Figures 2 and 3, Tables 1 and 2).

With the exception of Transect 2, located off Olowalu Stream, these patterns are the result of o concentrated input of groundwater to the ocean at or near the shoreline fronting some areas of the Olowalu Town project site. Low salinity groundwater, which typically contains high concentrations of Si, NO_3^-, and PO_4^{3-}, percolates to the ocean at the shoreline, resulting in a narrow nearshore zone of mixing. At the Olowalu survey sites, as with many areas of the Hawaiian Islands, such groundwater percolation results in steep horizontal gradients of increasing salinity and decreasing nutrients with distance from shore (Figure 2).

While groundwater discharge to the ocean is typical along much of the coastline of Maui, there is a high degree of variability in the effect of groundwater input to the ocean. The variability is a result of both the topographic and geologic structure of the shoreline area, as well as degree of mixing with marine waters by oceanographic processes in the nearshore zone. Such variability is evident in the differences between groundwater signatures at the five transect sites at Olowalu Town. Transect Site 1, located at the northern end of the property, displays values of NO_3^- that are three orders of magnitude higher than the shoreline value at Transect 5, located near the southern boundary of the property. However, on all transects, mixing of groundwater to background oceanic conditions occurs in a narrow zone within 10-20 m of the shoreline. Hence, this narrow zone is the only area that could potentially be affected by alteration of groundwater input.

Water chemistry parameters that are not associated with groundwater input (NH_4^+, TON, TOP) also show patterns of decreasing concentration with respect to distance from the shoreline in most transects. As with Si and NO_3^-, the steepest gradients occur in Transects 1 and 2, and the weakest grodient occurs in Transect 5 (Figures 2 and 3, Tables 1 and 2).

Similar to the patterns of dissolved inorganic nutrients, the distribution of Chl a on all transects also displays peaks near the shoreline with steeply decreasing gradients with distance from shore. Turbidity on all transects was also elevated in the nearshore samples at all five sampling sites. However, turbidity within five meters of the shoreline on Transect 2, located off the mouth of Olowalu Stream, was at least 10 times higher than the values at any other location. The substantial elevation in turbidity at the shoreline is likely a response of sediment-laden stream water discharging to the ocean. Turbidity of all samples at the offshore ends of the transects was consistently low, with values below 0.30 NTU (Table 1, Figure 3).

2. Vertical Stratification

Tables 1 and 2 and Figures 2 and 3 also show concentrations of water chemistry parameters as functions of distance from shore in samples collected from surface and deep water. It can be seen in Tables 1-2 and Figures 2-3 that, for the constituents that displayed distinct horizontal gradients, there is also variation between surface and near-bottom (deep) samples. Surface values of Si and NO_3^- were generally higher than deep values, while corresponding values of salinity were lower in surface samples relative to deep samples. While the difference between surface and deep samples was not as large as with Si and NO_3^-, there is also slight indication of a pattern of differences in surface and deep concentrations of PO_4^{3-}, but not for TOP and TON. Nearshore mixing of groundwater and ocean water creates a buoyant surface lens of low salinity, high nutrient water that is evident throughout the nearshore region fronting the project site (Tables 1 and 2). With the lack of physical mixing in terms of waves and currents (at least during the time of field sampling), the stratified water column persists along the entire length of some of the sampling transects off the Olowalu Town property.

Nutrient constituents not associated with groundwater input (NH_4^+, DON and DOP) do not exhibit any consistent discernible relationship with respect to vertical stratification. Likewise, turbidity and Chl a also showed no consistent trend, with surface values not consistently elevated relative to bottom values (Tables 1-2, Figure 3).

3. Conservative Mixing Analysis

A useful treatment of water chemistry data for interpreting the extent of material input from land is the application of a hydrographic mixing model. In the simplest form, such a model consists of plotting the concentration of a dissolved chemical species as a function of salinity (e.g., Officer 1979, Smith and Atkinson 1992, Dollar and Atkinson 1992). The concept of using such mixing models, which scale nutrient concentrations to salinity, has been adopted by the State of Hawaii Department of Health for establishing a unique set of water quality standards for the West Coast of the Island of Hawaii [Hawaii Administrative Rules, §11-54-06 (d)]. While such standards have not yet been mandated for the other islands, including Maui, application of the method provides a useful means to evaluate the fate of nutrients that reach the ocean from land.

Comparison of the curves produced by the distribution of data with conservative mixing lines provides an indication of the origin and fate of the material being considered. If the parameter in question displays purely conservative behavior (i.e., no input or removal from any process other than physical mixing), data points should fall on, or near, the conservative mixing line. If, however, material from external sources other than naturally occurring groundwater and ocean water is added to the system through processes such as leaching of fertilizer nutrients to groundwater, data points will fall above the mixing line. Conversely, if material is being removed from the system by processes such as biological uptake, data points will fall below the mixing line.

Figure 4 shows plots of the concentrations of Si, NO_3^-, PO_4^{3-}, and NH_4^+ as functions of salinity for the samples collected at each ocean transect station. Each graph also shows

conservative mixing lines constructed by connecting the end-member concentrations of open ocean water deemed to be beyond the influence of land (collected 600 m offshore at a depth of approximately 33 m) and groundwater in potable wells located upslope of the Olowalu Town property (Wells No. 4936-01 and 4937-01). While Well 4937-01 had nutrient concentrations indicative of basal groundwater, the concentrations in Well 4936-01 were closer to stream water (Tables 1 and 2).

Dissolved Si represents a check on the model as this material is present in high concentration in both groundwater and streamwater, but is not a major component of fertilizer or other man-made materials (note the similarity of all conservative mixing lines in Figure 4). In addition, Si is not utilized rapidly within the nearshore environment by biological processes.

It can be seen in Figure 4 that data points for all ocean transect sites fall in a linear array on, or very close to, the conservative mixing lines. Linear regression of the concentrations of Si as a function of salinity demonstrates that, for all six transects, there are significant values of R^2 (proportion of variation explained), indicating that the concentration of Si is dependant on salinity (R^2 = 0.96; F=0.00). The Y-intercept of the regression of Si as a function of salinity can be interpreted as the expected concentration at a salinity of zero. As groundwater has salinity close to zero (Table 1-2), the Y-intercept can be used to evaluate the relationship between upslope groundwater and groundwater that is entering the ocean at the shoreline. For the potable well sampled upslope of Olowalu Town, the concentration of Si was 843 μM at a salinity of 0.29‰, which would equal a Y-intercept of 850 μM. The upper and lower 95% confidence limits of the Y-intercepts of the regression lines of Si in ocean samples vs. salinity for the combined five transects are 724 and 796 μM, which are slightly lower than the intercept of the well and seawater concentrations. While the bounds of the confidence limits for the regression are slightly different than the value from a single well sample, this result still supports the assumption that Si is behaving as a conservative tracer and that well water sampled from the upslope well is similar in composition to groundwater entering the ocean and ponds at Olowalu Town.

The plots of concentrations of NO_3^- in ocean samples vs. salinity show a different distributian than the Si plots, particularly at Sites 1and 4. Most of the ocean data points for Transects 2, 3 and 5 fall below the well mixing line, and on the streamwater mixing line. Data points for Transects1 and 4 show a markedly different pattern. All data points at salinities below 30‰ lie far above all of the mixing lines. In addition, there is distinct upward concave curvilinearity in the distribution of ocean data points. The location of the points above the mixing line indicates additional subsidies of NO_3^- to groundwater reaching the ocean over that contained in naturally occurring groundwater. Such upward curvilinearity suggest biotic uptake within the nearshore areas. Curvilinearity is most pronounced at the nearshore area of Transect Site 1, which was located on the reef flat off the northern boundary of the Olowalu Town property. The upper and lower confidence limits of the Y-intercepts of the concentrations of NO_3^- from Transect Site 1 are 95-122 μM, while the concentration of NO_3^- in upslope potable water is 34 μM. Hence, at this location, there is about a three-fold increase in NO_3^- to the ocean shoreline from external subsidies compared to what would be expected from simple canservative mixing of natural groundwater and ocean water. On Transect 4, the confidence limits for the Y-intercept are 65-80 μM, indicating about a doubling of the concentration of NO_3^- in groundwater reaching the ocean.

PO_4^{3-} is also a major component of fertilizer and sewage; however, PO_4^{-3} is usually not found to in groundwater to the extent of NO_3^- owing to a high absorptive affinity of phosphorus in soils or rock. It can be seen in Figure 4, however, that the concentration of PO_4^{3-} in groundwater from Well 4937-01 is relatively high (3.30 μM) compared to stream water. Data points from Transects 1and 3 lie within the streamwater-groundwater envelope. However, data points from Transects 2 and 4 lie above the groundwater mixing line. This result presents a completely different scenario for PO_4^{3-} than for Si or NO_3^-. While there was a distinct subsidy of NO_3^- in Transect 1 and no subsidy in Transect 2, the opposite trend occurs for PO_4^{-3}. As streamwater is low in PO_4^{-3}, the substantial subsidy at Transect 2 is not a result of stream discharge. While this analysis identifies that a distinct subsidy of PO_4^{-3} is present in Transect 2, the origin of this material is not readily evident.

The other form of dissolved inorganic nitrogen, NH_4^+, shows a relationship that is different from all other nutrients. With the exception of a single data point from Transect 1, all data points fall above the conservative mixing lines. While plots of concentrations of NH_4^+ vs. salinity exhibit relatively weak linear trends with respect to salinity (Figure 4), there is an indication of upward curvilinearity of the data points. These results suggest there is a source of marine-generated NH_4^+ that is recycled within the nearshore reef areas.

4. Compliance with DOH Criteria

Tables 1 and 2 also show samples that exceed DOH water quality standards for open coastal waters under "wet" and "dry" conditions. The distinction between application of wet and dry criteria is based on whether the survey area receives less than ("dry") or greater than ("wet") three million gallons of freshwater input per mile per day. DOH standards include specific criteria for three situations: criteria that are not to be exceeded during either 10% or 2% of the time, and criteria that are not to be exceeded by the geometric mean of samples. All of these criteria are based on comparing replicate data sets collected as time-course series. So evaluation of the "10% or 2% of the time" and "geometric mean" criteria for the single data set presently acquired is not statistically meaningful. However, comparing sample concentrations to these criteria provides an indication of whether water quality is near the stated specific criteria.

Boxed values in Tables 1 and 2 indicate measurements that exceed the DOH 10% standards under "dry" conditions, while boxed and shaded values show measurements that exceed DOH 10% standards under "wet" conditions. In Transect 1, values of NO_3^-, NH_4^+, TN, TP, turbidity and Chl a exceeded the wet standards within 10 m of the shoreline. In Transect 2, however, no standards for NO_3^- were exceeded. Such a result is somewhat incongruous in that, at the location where streamwater is clearly affecting marine water chemistry, water quality standards are not exceeded for the constituent that occurs in highest concentration in naturally occurring groundwater. In Transects 3-6 some values of NO_3^-, NH_4^+, TN, TP and Chl a within 20 m of the shoreline also exceeded DOH standards

III. EVALUATION OF BIOTIC COMMUNITIES

A. METHODS

The nearshore marine environment at Olowalu consists of diverse assemblages of varied physical structures and biotic communities that represent a relatively unique Hawaiian coral reef habitat. The intent of this study is to describe the overall physical and biotic setting of these features of the marine environment. To obtain such an overview, we employed an approach that has become widely used in the field of coral reef science based on utilizing the optical properties of remote sensing imagery to generate habitat maps. As no detailed benthic habitat maps of the Olowalu region (or most of Maui) presently exist, a main objective of this assessment was to create such maps. In brief, this method involved obtaining commercially available remote sensing satellite imagery of the area of interest. Extensive ground-truth data were collected throughout the marine environment fronting the Olowalu Town Master Plan property. The ground-truth data were then used to develop a classification system that calibrated the spectral information contained in the remote sensing images. The resulting classification scheme was translated on a pixel-by-pixel basis into area coverage of categories of living benthos (e.g., coral, algae), as well as non-living bottom (e.g., sand, mud, rock). Bathymetry was also added to the maps using available LiDAR (Light Detection and Ranging) data.

The survey area encompassed approximately 2.9 miles [4.7 km] of linear coastline and extended from the shoreline to a water depth of approximately 33 feet (10 m), which encompasses an area of about 1,837,000 square meters (m^2) or 454 acres. While it is acknowledged that there are deeper reef areas, these reefs are not likely to be affected by activities on land and, hence, were not part of the present survey. The resulting map product provides a unique tool for quantification of components of the entire marine setting that is a valuable asset for understanding the effects of human inputs and subsequent impacts. It is important to note that the purpose of the study was not to generate an exhaustive species list of all biota occupying the area.

All methods utilized in this study to generate nearshore marine habitat maps followed standard procedures for processing coral reef remote sensing imagery (e.g., Andréfouët et al. 2003, Green et al. 2000, Mumby et al. 1998). The benthic habitat map was created based on a fully georeferenced, cloud-free WorldView-2 multispectral satellite image of Olowalu that was purchased from the Image Library at DigitalGlobe.com (image data acquired on February 22, 2010). The image had 2.0 m (6.6 ft) ground sample distance. The WorldView-2 image was processed to highlight submerged features, which revealed areas of different bottom composition.

Fieldwork was carried out on November 5, 2010, and February 27, April 2 and June 12, 2011 by divers working from either a 21-ft. boat or from the shoreline. Field operations consisted of assessing 200 "calibration-validation" (cal/val) sites placed strategically throughout the survey areas. Locations of cal/val sites were selected in the field based on investigator knowledge and visual interpretation of existing satellite "true-color" imagery, with the intent of maximizing coverage of all reef areas within the region of interest. Exact

locations of cal/val sites were recorded during the course of field work using a waterproofed GPS with a presumed accuracy of <1 m. Table 3 lists the GPS waypoints, which serve as labels for the cal/val sites, as well as the latitude and longitude of each site.

At each geo-located site, cal/val data were obtained by digitally recording the composition of the benthic surface using an underwater camera fitted with a 14 mm-wide angle lens. To ensure uniformity of the area of data collection, the camera was mounted on a platform centered over a PVC quadrat frame by four legs, similar to a tripod. The base of the frame forms a quadrat with dimensions of 1 m x 0.66 m, which is the same proportion as a photographic frame. Each cal/val site consists of five photo-quadrats arranged in a "cross" pattern ~5 m in diagonal, resulting in total reef surface area of 3.33 m^2, which encompasses an area of approximately four pixels of remote sensing imagery. For the present project, a substantial portion of the inner reef flat had water depths shallower than the height of the camera platform. In these areas oblique photographs of the bottom were taken and bottom cover data were extracted from these photographs.

Following fieldwork, the digital images were analyzed by projecting a grid dividing the frame into 100 equal-sized segments. Coral cover by species, as well as bottom cover of benthic algae, motile macro-benthos and non-living categories including sand, mud, bare limestone and rubble, were estimated by tabulating cover types within the segments. Zoom features of computer software and the high resolution of the digital photographs (~10 megapixels) generally allowed delineation of corals to the species level. Total cover of all five photographic frames constituted the cover estimates for each cal/val site. An advantage of using such a photo-quadrat method is that it allows for the collection of far more data per unit time than traditional *in-situ* transect techniques, with little or no loss of data quality or interpretation. Thus, the photo-quadrat technique provides far more extensive coverage of the subject area without any significant loss of information. In addition, the photographic survey method provides a permanent data record that can be utilized for future time-course surveys that are of value in determining changes to reef structure. All photo-quadrats evaluated by point counts are contained in Appendix A.

In the lab, map generation was accomplished by locating cal/val points on the geo-referenced satellite multispectral image that served as the basis for statistical image classification. "Training classes" (defined as the combination of geo-morphological zone and bottom cover) were created by assigning a class label to a survey point using the ground truth data for context. To spectrally define a "region of interest" for a training class, 20-30 adjoining pixels were isolated and included in the class. All training classes with the same spectral label were used to create a map showing the distribution of that particular bottom cover over the reef. The resultant analysis produced maps showing discrete classifications of coral, algal and mud/sediment cover. In addition to benthic habitat classifications, maps incorporate depth contours based on available LiDAR data (Figures 5 and 6). The data used to create the maps are compatible with ArcGIS.

Full cross-validation was utilized to evaluate accuracy of the habitat classification. In cross-validation, all but one data point are used to build a classifier, and the classifier is then tested on the withheld point. This process is repeated on every point in the data set. The result is a matrix of classification rates, with correct classifications on the diagonal and incorrect

classification off-diagonal (Table 4). Because each classifier is tested on a data point that was not used to build the classifier, the result is unbiased. Also, because the test classifiers use almost all the available data points, they more closely represent the classifier actually used to generate the image product (which used all data points).

To test the accuracy of the classifiers for the Olowalu data coral cover was divided into seven classes between zero cover and greater than 90% coral cover (Table 4). The overall accuracy of the classification (total correct classification divided by total number of data points) is 83%. The ">90% coral" class has the lowest correct classification rate at 70%; 17% of this class is misclassified as "70–90% coral," while 14% of this class is misclassified at one of the five other classes. All of other classes with coral cover between 30% and 90% have classification rates between 75-79%. Classes with coral cover less than 30% had correct rates between 88% and 90%. Thus, slightly greater confusion occurred between the classes describing highest coral cover. In addition, the highest rates of misclassification occur in the two highest cover classes. For example, a total of 30% of the coral in the ">90%) class is rated at lower values. While the overall accuracy of the map product is considered high, the cross-validation suggests that the image product provides a conservative estimate of coral cover in the study area.

Abundance of reef fish was estimated at selected cal/val sites using 10-minute stationary point counts. At these locations, an observer remained at the location of the boat anchor and recorded all fish visible within a 360° viewplane.

B. RESULTS

1. Descriptions of Reef Zones

The area of the nearshore marine environment included in the assessment for the Olowalu Town project extends from approximately the northwestern (Lahaina) end of the project boundary to the area known as "14-mile Marker" at the southeastern boundary of the project property. Within these boundaries there are a variety of zones composed of varied physical composition and biotic communities. Presented below is a descriptive view of these zones from the shoreline to a water depth of about 10 m (33 feet). Example areas of each zone are labeled in Figure 7.

It has been well-documented in the scientific literature that the major determining factor for reef coral community structure in open coastal areas in Hawaii is physical force from wave impacts (e.g., Dollar 1982, Dollar and Tribble, 1992, Grigg 1998, Fletcher et al. 2008). Results of the survey indicate that, while wave stress does play a role in shaping some of the coral communities in the area of study (particularly close to shore on the northwestern side of Olowalu Point), the reefs off Olowalu are largely an exception to this rule. This is the case owing to orientation to both northern and southern swells, and shelter from other islands that minimize the destructive effects from the typical seasonal wave climate. In area such as Olowalu where wave stress does not provide such a prevailing control, other physical or biotic factors provide dominant influence over the composition of coral communities. In the case of Olowalu, the predominant controlling factor appears to be effects from sediment,

originating both from terrestrial runoff and resuspension of naturally occurring marine sediment (note that the lack of wave energy may also result in less removal of sediment from coral surfaces than in areas of higher water velocity). The following descriptions of the reef zones focus on the interaction between sediment effects and reef community structure.

a. Northern Reef Platform – Zone A

The nearshore structure of the entirety of the Olowalu area consists of a wide, shallow inner reef flat with water depth less than 5 m (see the bathymetric contour maps shown in Figures 5 and 6). The shoreline area extending from the northern boundary of the Olowalu Town property to the mouth of Olowalu Stream (Zone A in Figure 7) consists of rounded boulder beaches extending from the vegetation line to the intertidal zone (Figure 8, top). The intertidal area consists of a berm of boulders and beachrock that grades into a subtidal platform composed of fossil limestone. From the shoreline to a depth of approximately 2 m (within the wave impact zone), the reef platform is essentially barren of macrofauna. Seaward of this depth, coral colonies occur on the bottom in increasing density with increasing depth. These colonies are interspersed over hard bottom that is covered with a layer of dark-colored terrigenous sediment (Figures 9 and 10). The predominant corals in this region consist of hemispherical branching colonies of *Pocillopora meandrina* and lobate growth forms of *Porites lobata*. Most of what can be considered individual coral colonies are small in size and separated by areas of the limestone platform that are covered with dark-colored sediment. The nearshore reef flat extends to a water depth of about 5-10 m, at which point bottom composition turns into a plain of gray sand.

b. Olowalu Stream Discharge - Zone B

Directly off the mouth of Olowalu Stream (Zone B in Figure 7), bottom composition is similar to Zone A, except that sediment deposition on the bottom is thicker and corals are less abundant (Figures 11 and 12). The substantially lower coral cover in the area off the stream mouth suggests that continual or episodic discharge of terrigenous material has a significant effect on coral community structure.

c. West Olowalu Outer Reef Platform – Zone C

Areas of sediment deposition on the reef platform are still evident south of the point of discharge of Olowalu Stream. However, coral cover is higher here than north of the stream mouth (Figure 13). Relief of the bottom is also greater compared to north of the stream, resulting in greater levels of coral colony amalgamation into "super-colonies" that are elevated above the reef platform. Possibly as a result of sediment cover on most non-coral substratum, both motile invertebrates (e.g., sea urchins) and fleshy benthic macroalgae are nearly absent from Zones A-C.

d. West Olowalu Inner Reef Platform - Zone D

The shallow subtidal area fronting most of the northwestern side of Olowalu Point is composed of a limestone bench interspersed with pockets of sand and rubble (Zone D in Figure 7). Living corals in this zone are sparse and restricted to heads of *Pocillopora meandrina*. Encrusting coralline algae are common on dead coral heads and rubble fragments (Figure 14).

e. Reef Crest - Zone E

While the topographic compositions of Zones A-D are typical of most of the nearshore reef zones in West Maui, a unique feature of the Olowalu area is the wide semi-circular reef flat that extends from the old breakwater structure southward around Olowalu Point. The shoreline throughout the central section of the Olowalu project site differs from the boulder beach to the north and consists of white sand beaches that extend across the reef flat (Figure 8, center). The outer edge of the northwestern region of the reef flat consists of a reef crest composed of deposited coral rubble (Zone E in Figure 7). The reef crest is emergent at low tide and absorbs the full force of breaking wave, resulting in a lack of any biotic colonization (Figure 15).

f. Inner Reef Flat – Zone F

Inshore of the reef crest, the entire reef flat is shallow (less than 2 m in depth) and consists of sand channels that bisect the limestone platform (Zone F in Figure 7). Interspersed throughout the platform are bands and patches of coral, with upward growth limited by the surface of the water column (Figures 16 and 17). The most abundant coral species, *Porites lobata*, often occurs as "microatolls" where the upper surfaces of large round colonies consist of non-living areas owing to exposure to the atmosphere at low tide. Like large-scale atolls, growth of these colonies continues laterally rather than vertically, increasing the diameter of the colony (Figure 18). The upper surfaces of many of the microatolls, as well as wide areas of the reef surface, are covered with the invasive species of brown algae *Acanthophora specifera* (Figure 18 and 19). With distance southward over the inner flat, the reef surface becomes progressively more covered with algal turfs that trap sediment and less with living coral (Figures 20 and 21).

g. Outer Reef Flat - Zone G

The outer region of the reef platform is substantially different from the inner flat in that water depth is slightly greater and topographical structure grades into a series of spurs and grooves oriented perpendicular to the shoreline. While coral cover on the outer flat is greater than on the inner flat, much of the bottom still shows evidence of effects from sediment deposition (Figure 22).

h. Fore Reef – Zone H

The outer fore reef flat platform off Olowalu Point provides an ideal habitat for optimal coral growth, as is reflected in the expansive reef structures that typify the area shown as Zone H in Figure 7. These reefs consist primarily of expansive mounds of interconnected colonies of finger coral (*Porites compressa*) (Figures 23 and 24) and large (up to several meters in diameter) helmet-shaped colonies of *Porites lobata* (Figures 25-26). The coral-covered knolls extend seaward to abrupt vertical faces at the edge of sand flats (Figure 24). As virtually all of the limestone structure of the reef surface is colonized with living coral, these reefs can be considered "climax" communities. Owing to the expansive growth of branching finger coral, and little indication of breakage or fracturing of the reef structure, this area does not appear to have been affected by damaging wave impacts for a period of at least many decades (if ever). In addition, there is little or no evidence of any effects of sediment deposition, as in the more inshore areas. As noted above, the existence of actively accreting reefs in an open coastal environment is a relatively unique situation for Hawaii.

i. Southeast Reefs (Mile Marker 14) – Zone I

The north and the south ends of the project area differ in that the broad spur-and-groove fringing reef absent from the northern area continues from Olowalu Point to the southern property boundary. Near the southern end of the project site, an area known as "14-Mile Marker" is a high-use recreational area for snorkelers and kayakers. Part of the attraction of this area is the presence of an elevated section of reef close to the beach (Zone I in Figure 7). While coral cover and species diversity are higher in this particular area than on the surrounding reefs, a somewhat surprising observation was the extent of dead coral patches throughout the zone (Figure 27-28). While the appearance of the dead coral areas seems to be the result of sediment deposition, there are no streams in the area, as on the northern side of the study area. While the observed mortality may be a result of past episodic events of surface runoff following torrential rains, examination of the surface of many of the corals indicates settlement of sand, rather than mud (Figure 29). In any event, while the structure of the reefs to the south of Olowalu Point are distinctly different than those to the north of the Point, coral community structure in both areas is affected by sediment deposition that impacts coral settlement and growth. These sediment control factors do not control reef structure off the central area of the Olowalu region beyond the reef flat.

2. *Quantification of Benthic Cover*

Combining the percent cover data for all 200 cal/points provides an estimate of the overall reef structure for the 454 acres of reef surveyed. Total coral coverage of the survey area was 43%. The most abundant coral, *Porites lobata*, comprised 17% of bottom cover and 40% of coral cover. The second most abundant coral was *Porites compressa* (12% bottom cover, 29% coral cover), followed by *Montipora capitata* and *M. patula* with combined bottom cover of 10% and 23% coral cover). *Pocillopora meandrina* accounted for about 2% of bottom cover and 4% of coral cover. Seven other coral species were observed at cal/val sites and accounted for less than 2% bottom cover and 4% bottom cover. Hence, five species of coral

accounted for 96% of coral cover throughout the survey area.

Considering non-coral substratum, sand accounted for about 21% of bottom cover, while algal turf (including turf covered with mud) covered about 26% of the bottom. Macroalgae comprised about 3.4% of bottom cover, while bare limestone was encountered on 6% of the bottom. Mud comprised about 1.2% of benthic cover.

3. Habitat Mapping

Figures 30-32 show satellite images of the Olowalu region overlayed with color coded circles that represent percent bottom cover of coral, algae and mud (including turf-bound sediment) at each of the 200 cal/val sampling points. In addition, these figures also include maps of coral, algae and mud (including turf-bound sediment) generated by classification schemes produced from the cal/val points. Overall, the maps provide a good representation of the spatial distribution of the zonal composition described in the previous section. The densest coral cover can be seen along the outer reef crest off Olowalu Point (Figure 30); algae is most dense on the nearshore reef platform (Figure 31); mud and turf-bound sediment are clearly most abundant off the area where Olowalu Stream discharges (Figure 32). These maps show the composition of the area in its entirety, with all areas given equal significance. Such comprehensive consideration provides views of the spatial relationships between areas of high algal and/or coral cover with respect to the physical composition of the system and proximity of point source material input from land.

An important attribute of remote sensing mapping is the ability to evaluate the total area of study with equal weight. Table 5 shows coverage estimates of seven abundance classes of the main types of benthic cover within the mapped area (coral, algae, sand and mud). For coral, the highest area cover is the 10-30% class, accounting for about 476 x 10^3 m^2, while the lowest abundance is seen in the class where coral covers greater than 90% of the bottom (51x10^3 m^2). Over the entire mapped area, coral cover accounts for about 38% of map area. This value is slightly lower than the 43% coral cover calculated as the mean value from cal/val points. Such a difference is not unexpected as investigator selection of the cal/val locations in the field is likely to be somewhat biased toward areas of higher coral cover.

With respect to algae, the highest cover (by a factor of almost three) is the class with no algae, with the two highest cover classes of algae (>70%) accounting for the smallest areas of coverage (total of 16x10^3 m^2). Over the entire reef, macroalgae comprised about 8% of bottom cover.

Of the non-coral/algae bottom types, sand comprised about 21% of bottom cover, while mud and turf-bound sediment covered about 33% of the bottom. Hence, about 54% of the bottom of the entire mapped area consists of sand, mud and turf-bound sediment, while 46% consists of coral and macroalgae.

It is worth noting that around 1881, the channel of Olowalu Stream was diverted from a flowpath that intersected the shoreline south of Olowalu Point to the present location north of the point. Based on the habitat mapping performed for this assessment, any effects to marine

communities from discharge of sediment at the former region of discharge have been eliminated in the ensuing 130 years. As the average projected time for Hawaiian reef communities to reach a "climax" state is on the order of 50 years for wave-sheltered coastal areas (Dollar 1982, Grigg and Maragos 1974), the 130 period since stream diversion appears to be more than twice the period required for coral community recovery, assuming that the original stream discharge exerted a similar impact as the present stream discharge.

4. Other Benthic Invertebrates

The major taxa of benthic organisms, other than corals, occurring on the reef off Olowalu are sea urchins (Echinoidea) and sea cucumbers (Holothuroidea). The most abundant urchins are the two species that bore into limestone surfaces, *Echinometra matheai* and *Echinostrephus aciculatus*. These urchins are most common on the outer fore reef although densities of these urchins are not as high as an other reefs throughout Hawaii owing to the near complete coverage of the bottom by living coral. Less abundant, but ubiquitous, across the reef front are the larger species of urchins, *Tripneustes gratilla*, *Echinothrix diadema* and *Heterocentrotus mammilatus*. Urchins of any species are rare or absent from the reef platform on the north side of the project site where much of bottom was covered with terrigenous sediment. The most common sea cucumbers are the species *Holothuria atra* and *H. mauritiana*, which occur mainly on the sandy regions of the inner reef flats. Sea stars, predominantly *Linckia* spp., are observed in low numbers over the entire nearshore region. No crown-of-thorns starfish (*Acanthaster planci*) were observed during the course of the present survey.

Marine flora on the outer reef front are dominated by encrusting calcareous algae that covers bared limestone surfaces and the non-living parts of coral skeletons. The most common forms of encrusting algae are *Parolithon* spp. and *Peysonellia rubra*, which grows on the bases of *Porites compressa* branches. On the shallow reef flat, most of the solid structure of the reef surface is covered with a thin layer of algal turf, which affectively binds sediment. Frondose benthic algae consists primarily of the invasive species *Acanthophora specifera*, which comprises a high percentage of bottom cover in the nearshore areas of the reef flat to the south of Olowalu Point. Other species of macroalgae (particularly *Ulva* spp. and *Hypnea musciformis*) that dominate bottom cover in other nearshore areas of Maui were not observed in high abundance on the Olowalu reefs. The areas where these two species are abundant (i,e., Maalaea, Kihei) are characterized by nearshore reef flats that are subjected to substantial wave action and water motion. The inner reef flats at Olowalu are not subjected to such water motion and are normally very calm. Hence, the environmental setting is not suitable for colonization by these two species, although it is well suited for *Acanthophora*.

The design of the reef survey was such that no cryptic organisms or species living within interstitial spaces of the reef surface were enumerated. However, no dominant communities of these classes of biota were observed during surveys at any of the study stations.

5. *Reef Fish Community Structure*

Results of stationary count fish surveys are shown for the northern reef (Zone A, Table 6-a), the reef flat (Zone F, Table 6-b) and the outer reef front (Zone H, Table 6-c). Overall, abundance af reef fish was lowest on the reef flat, with a total of 29 species observed. The number of species observed at five survey sites ranged from 5 to 18, and the number of individuals ranged from 33 to 103 (Table 6-a). Dominant fish species on the reef flat include a variety of wrasses (Labridae), damselfish (Pomocentridae) and small parrotfish (Scaridae). At one site on the inner reef flat a large school of *Mulloidichthys flavolineatus* (yellow-striped goatfish) was encountered.

Abundance of fish on the northern reef platform (Zone A) was intermediate between the lower abundance on the inner reef flat (Zone F) and the outer reef face (Zone H). A total of 33 species were observed at three sites, with the number of species per site ranging from 13 to 20, and the number of individuals per site ranging from 45 to 113 (Table 6-b). As on the reef flat, the most abundant families were the wrasses (Labridae), damselfish (Pomocentridae) and surgeonfish (Acanthuridae). Of note were the comparatively low numbers of butterfly fish (Family Chaetodontidae) on both the inner reef flat and the northern reef platform.

Fish abundance was highest on the outer reef front with a total of 53 species observed. Number of species observed at eight survey sites ranged from 11 to 30, with the number of individuals per site ranging from 54 to 471 (Table 6-c). The most abundant species on the outer reefs included 11 species of wrasses, with the saddleback wrasse (*Thalassoma duperrey*) the most common. Thirteen species of surgeonfish (Acanthuridae) were encountered, with the brown surgeonfish (*Acanthurus nigrofuscus*) occurring at every survey site. Damselfish (Pomocentridae) were also abundant, particularly the species *Chromis vanderbilti*. The triggerfishes *Melanichthys* spp. were commonly seen congregating in the water column. Juvenile reef fishes were most abundant at the deeper reef habitats within the matrix created by branching stands of *Porites compressa*. The lattice structure formed by this coral provides a sheltered refuge for small fish. Juveniles belonged mostly to the family Acanthuridae (surgeonfishes), with representatives from the families Labridae (wrasses), Mullidae (goat fishes), and Chaetodontidae (butterfly fishes). While not part of the stationary point surveys, numerous small black-tip reef sharks (*Carcharhinus limbatus*) were observed on the inner reef flat south of Olowalu Point.

Although the reefs along the project area (particularly on the outer reef face) harbor an abundant and diverse fish fauna, it is also apparent that the area is subjected to a high degree of fishing pressure. A near-complete lack of fishes considered good "food fish" clearly indicated heavy fishing pressure. No carangids (e.g., jacks, papio) were sighted, although several small omilu (*Caranx melamphygus*) were sighted in inshore areas of the reef flat. Similarly, the scarcity of larger goatfishes and parrotfishes suggests that these species are impacted by fishing pressure. Inspection under ledges and large coral heads revealed fair numbers of squirrelfish (Family Holocentridae), but fewer than would be expected in an unfished area. No spiny lobsters were observed.

6. *Threatened or Endangered Species*

Four species of marine animals that occur in Hawaiian waters and have been declared threatened or endangered by Federal jurisdiction may occur in the vicinity of the project site. The threatened green sea turtle (*Chelonia mydas*) occurs commonly throughout Hawaiian waters and is known to feed on selected species of macroalgae. Several green turtles were encountered during the course of fieldwork. The endangered hawksbill turtle (*Eretmochelys imbricata*) is found infrequently in waters off Maui, but regularly nest in South Maui.

Populations of the endangered humpback whale (*Megaptera novaeangliae*) spend the winter months in the Hawaiian Islands. While humpback whales are abundant in the waters offshore of Olowalu in the winter months, it is not common for whales to occupy the very shallow nearshore areas that are the focus of this survey. The Hawaiian Monk Seal (*Monachus schauinslandi*), is an endangered earless seal that is endemic to the Hawaiian Islands. While the majority of the population of Monk Seals occurs in the uninhabited Northwestern Hawaiian Islands, individuals are routinely observed resting on beaches around the main Islands and have the potential to occur at the project site.

IV. DISCUSSION and CONCLUSIONS

The purpose of this assessment is to assemble the information to make valid evaluations of the potential for impact to the marine environments from the proposed Olowalu Master Plan project. The information collected in this study provides the basis to understand the processes that are operating to affect reef processes in the nearshore ocean, so as to be able to address any concerns that might be raised in the planning process regarding these factors.

The proposed Olowalu Master Plan project does not include plans for any direct alteration of the shoreline or offshore areas. Therefore, potential impacts to the marine environment can only be considered from activities on land that may result in delivery of materials (primarily freshwater and nutrients) to the ocean through surface runoff or infiltration to groundwater on land with subsequent discharge to the ocean. To evaluate the possible magnitude of these processes, a report has been prepared by Tam Nance Water Resource Engineering (TNWRE) entitled *"Impact on Water Resources of the Olowalu Town Project"* (dated July 2011). Below is a summary of the information provided in the TNWRE report, along with conclusions regarding the potential effects of the project on the marine environment.

A basic assumption is that groundwater in the inland portion of the watershed moves toward and ultimately discharges at the shoreline. During transit through the aquifer to the shoreline, dissolved nutrients (nitrogen and phosphorus) may be supplemented by natural or anthropogenic inputs, or may be consumed by natural processes (not considering removal by pumping). There is an existing non-potable irrigation system which serves ongoing agricultural and landscape irrigation in the project area consisting of an upgradient diversion from Olowalu Stream at 502-foot elevation, a 1.1-mile long conveyance ditch and tunnel system, and an open storage reservoir at an elevation of about 360 feet.

A membrane bioreactor (MBR) treatment plant will be constructed onsite to treat project-generated wastewater to R-1 (tertiary) quality. Most of the treated effluent will be reused for irrigation. About 100 acres within the project have been identified for this irrigation reuse. Early in the project's development, and possibly on a continuous basis at full build out, the non-potable irrigation system will provide supplemental supply to these areas. In wet periods when there is an excess of R-1 treated effluent, the excess will pass through a two-acre "constructed" wetland and the effluent from the wetland will be disposed of in a large (4.7-acre) leach field.

The project site is crossed by Olowalu Stream and several other much smaller and unnamed normally dry gulches. As a result of the increase in impervious surfaces that will be created by the Olowalu Town project, peak rates of runoff and runoff volume have the potential to be higher when compared to the present (see TNWRE report). The intent of the drainage system designed for the project is to provide sufficient volume in onsite retention basins so that peak runoff rates and volumes for a 100-year, 24-hour design storm will not be increased over existing conditions. By providing these retention volumes, runoff rates and volumes for lesser storms would actually be less than for existing conditions. It is also likely that retention basins will reduce delivery of sediment to the ocean, as heavier particulate material should settle out.

Using the State Commission on Water Resource Management's methodology for establishing the sustainable yield of the Olowalu Aquifer System, groundwater discharging along the Olowalu Town project's shoreline is approximated as seven million gallons per day (MGD). As a first order approximation, it is assumed that existing surface runoff to the shoreline averages 2.3 MGD year-round and that 85% of this occurs at the point of shoreline discharge of Olowalu Stream. The remainder represents about one-third of the 20 inches of annual rainfall on the 635-acre project site.

The treated R-1 effluent available for irrigation reuse is generally estimated at 85% of the within-building potable water use. The remaining 15% would be lost in conveyance hardware, lost to evaporation and leakage at the wastewater treatment plant, or simply not be discharged into the wastewater system at the points of use.

About 100 acres in four land use categories (Public/Quasi Public, Park/Open Space, Agriculture, and the Highway) have been identified for the irrigation reuse of the R-1 treated wastewater. At full build out, it is estimated that about 0.24 MGD of the R-1 effluent would be used for this irrigation. The remainder, ultimately amounting to 0.14 MGD, would be directed into the two-acre constructed wetland and then disposed of in the 4.7-acre leach field.

Based on expected water use and wastewater generation amounts, estimates can be made regarding changes to groundwater flowrate and the loading of nitrogen and phosphorus as discharged along the project's shoreline. Based on flux rates, nutrient utilization rates and concentrations of nitrogen and phosphorus in groundwater, R-1 effluent, and fertilizers used in landscaping, TNWRE estimates that, with full project build-out, groundwater flowrate discharged into the marine environment will be reduced by 6%, nitrogen discharge to the ocean will be increased by about 10%, and phosphorus discharge will be decreased by about 1%.

Two factors affect changes to surface runoff resulting from project development: greater use of Olowalu Ditch and the changes to rainfall-runoff. It has been previously estimated that the project would use an average of 0.39 MGD from the ditch, an apparent increase over present use. The ditch flow is now measured at a location close to the system's storage reservoir and about 1.1 miles downstream from the point of stream diversion. Based on observations, it appears that the project's use of Olowalu Ditch can be supplied by appropriate repair and maintenance of the ditch and that this use will not create a difference in surface water discharge at the shoreline by Olowalu Stream.

Present surface runoff from the project's 635-acre area was estimated as one-third of its 20 inches of annual rainfall. This is equivalent to 0.31 MGD as a year-round average. The project's retention basins are to be designed to keep post-development peak rates and volumes of runoff at the same or less than existing conditions for a 100-year, 24-hour design storm. The installed retention volumes for this hypothetical design storm will have a more substantial impact on smaller rainfall events, meaning that the actual surface runoff from the project site will be less than under the existing, undeveloped condition. Since it is virtually impossible to estimate that reduction for the spectrum of actual rainfall-runoff events that will occur, it is simply assumed that there will be no increase in surface runoff discharge along the shoreline.

Water quality data of surface runoff from developed areas are scarce and widely varying. In general, these data indicate that nitrogen and phosphorus levels in stormwater runoff are lower than background levels in groundwater. On this basis, and as an order of magnitude estimate, it is assumed that increases of 30 μM of nitrogen and 2 μM of phosphorus will occur. For an average discharge of 0.31 MGD, the increased loading would amount to 1.08 pounds per day of nitrogen and 0.16 pounds per day of phosphorus. Thus, the total change in nutrient loading to the ocean from the project taking into account both groundwater discharge and surface water discharge would equal an increases in nitrogen by about 13% and phosphorus by abaut 1% over existing conditions (TNWRE 2011).

These results from TNWRE indicate there will be little change over existing conditions in the concentrations of nitrogen and phosphorus in groundwater discharging at the shoreline. The results of the analyses of nutrient concentrations in the nearshore regions presented in this report indicate that, at present, effects to nutrient concentrations from input from land can only be detected in the sub-tidal zone very close to the shoreline at selected locations. The extent of these effects does not reach the offshore areas that constitute viable "reef" habitats with accompanying biotic communities. In addition, nutrient subsidies from land are contained within a thin surface layer that does not come into contact with the reef surface. As a result, on both horizontal and vertical scales there is little contact between groundwater and biotic communities.

Because there is a predicted small (~6%) reduction in groundwater discharge over present conditions as a result of the project, the extent of offshore effects would be reduced even further owing to more rapid mixing of the smaller volume of discharged groundwater to background marine concentration. According to estimates produced by TNWRE, while there is an increase of groundwater nitrogen flux to the ocean of about 10% under full development, there is a corresponding decrease in phosphorus is about 1%. Combined with surface runoff,

the total flux of water from the project site to the ocean should result in an increase of 13% for nitrogen and 1% for phosphorus. However, as surface flow is restricted to only periods of heavy rainfall, groundwater discharge will constitute the major change to water and nutrient flux at the shoreline. Unless there is flux of phosphorus in groundwater to match the flux of nitrogen, there is no potential for the nitrogen subsidy to be utilized. At the location where groundwater flux was greatest within the Olowalu study area (Transect 1) the DIN:DIP ratio for the three samples collected nearest to the shoreline where groundwater input was most pronounced ranged from 65-104. The DIN:DIP of marine plants is about 30:1 (Smith and Atkinson 1983). Hence, the nearshore waters that are most influenced by groundwater input at Olowalu already have excess N in relation to P with respect to the required ratios for algal uptake. Hence, small additions of N without corresponding P do not have the potential to result in increased algal biomass.

Characterization of the benthic communities off Olowalu reveals significant effects from the deposition of terrigenous sediments entering the ocean through discharge from Olowalu Stream. As a result, any land management activity that could lessen the delivery of sediment to the ocean can be viewed as a positive action. Retention basins designed to capture storm runoff will offset the increased area of impervious surfaces of the Olowalu Town project such that there will be no change in volume of surface runoff relative to present conditions. However, while there should be no change in volume runoff, it might be expected that the retention basins could function as sediment traps, resulting in a decrease in sediment discharge, particularly during high intensity rainfall events. As it is not the volume of streamwater *per se* discharged to the ocean that affects biotic composition, but rather the sediment loads of streamwater, it is possible that the net effect of the project might result in an overall improvement of offshore reefs. Any future design considerations for the retention basins should focus on maximizing sediment trapping as well as runoff.

In summary, results of the baseline assessment of the marine environment off the proposed Olowalu Master Plan project site on west Maui reveal a diverse set of distinct reef habitats, some of which are essentially unaffected by input from land, and some of which are greatly influenced from input from land. Groundwater flow to the ocean is restricted in both magnitude and area extent (in terms of horizontal gradients from the shoreline and locations along the shoreline). In addition, groundwater input is retained within a buoyant surface lens that does not come in contact with the reef surface. Surface water discharge is evident along the northern boundary of the project site owing to input from Olowalu Stream.

Offshore coral reef communities consist of assemblages that are somewhat atypical of most Hawaiian reefs. Along the northern side of Olowalu Point, reef community structure is largely influenced by input of terrigenous sediment emanating from stream discharge. The southern side of Olowalu Point is characterized by a wide, shallow, wave-sheltered reef flat, which is not a common habitat found in Hawaii. The outer reefs consist of extensive actively accreting coral formations where growth and community composition are not controlled by wave forces, as is the typical situation on most Hawaiian open coastal areas. Along the southern side of the Olowalu survey area reefs exhibit effects of sediment, although of a different nature than along the northern perimeter.

An engineering evaluation of all water supply and use for the project reveals that, even at full buildout, there should be no substantial changes in either groundwater flow rate to the ocean

or composition of groundwater. As groundwater presently has essentially no effect on existing marine communities, the small changes to groundwater fluxes associated with the project will have no negative impacts to the ocean. Retention basins that will be an integral part of the proposed project should serve to trap terrestrial sediment prior to ocean discharge, which will hopefully mediate some of the stress associated with sediment discharge. A major focus of the Olowalu project will be on the recognition, appreciation and long-term stewardship and preservation of the natural and cultural resources of the land. Thus, all activities associated with the project should concentrate on maintenance of undisturbed areas and improvement of stressed areas. All of these considerations indicate that the proposed Olowalu project will not have any significant negative effects on the coastal ocean offshore of the property.

V. SUMMARY

1. Evaluation of the nearshore marine environment off the Olowalu Master Plan project site in West Maui was carried out in 2010-2011. Assessment of nearshore marine water chemistry was carried out by evaluating data from 60 water samples that were collected at five ocean sites spaced within the project boundaries. Water samples were collected on transects perpendicular to shore, extending from the shoreline to distances of approximately 500-600 m offshore. Analysis of fourteen water chemistry constituents included all specific constituents in DOH water quality standards.

2. Several dissolved nutrients (Si, NO_3^-, PO_4^{3-}, TN and TP) displayed strong horizontal gradients at several ocean transect sites with highest values closest to shore and lowest values at the most seaward sampling locations. Correspondingly, salinity was lowest closest to the shoreline and increased with distance from shore. These gradients were most pronounced at the northern boundary of the project site and weakest at the southern region of the project area southwest of Olowalu Point. These patterns are indicative of groundwater efflux at the shoreline, producing a zone of mixing where nearshore waters are a combination of ocean water and groundwater. In all cases, the nearshore zone of mixing was restricted to a narrow zone that extended a maximum of only tens of meters from the shoreline. Beyond this distance, water chemistry at all sites was representative of pristine open coastal waters.

3. Water chemistry constituents that are not major components of groundwater also displayed distinct gradients with respect to distance from the shoreline. In particular, Chl a and turbidity were generally elevated in nearshore samples with decreasing values moving seaward.

4. Application of a hydrographic mixing model to the water chemistry data was used to indicate if increased nutrient concentrations in nearshore waters are the result of mixing of natural groundwater with oceanic water, or are the result of inputs from activities on land. The model indicates that, at the time of sampling, there was a distinct subsidy of nitrate nitrogen (NO_3^-) to the ocean at survey sites located near the northern boundary of the property (Site 1) and off the eastern side of Olowalu Point (Site 4). There was no external supply of nitrate at Site 2, located directly off Olowalu Stream. However, there was a subsidy of phosphate phosphorus (PO_4^{3-}) off Olowalu Stream, which did not occur at any other

location.

5. Evaluating water chemistry from the single sampling in 2010 using DOH specific criteria for Open Coastal Waters indicates that many of the measurements in the nearshore areas (within 10-20 m of the shoreline) exceed standards, particularly for various forms of nitrogen. As these standards do not take into consideration of mixing of high-nutrient, naturally-occurring groundwater with ocean water in the nearshore zone, such exceedances are expected.

6. Characterization of the marine habitat and biotic community structure was carried out using a fully georeferenced WorldView-2 multispectral satellite image of the Olowalu area purchased from the Image Library at DigitalGlobe.com (image data originally acquired on February 10, 2010). Ground-truth data derived from georeferenced digital photographs collected at 200 representative points provided the input to create benthic habitat maps of the Olowalu reefs. Ground-truth data and resulting computer generated maps provided estimates of occurrence of living coral cover, as well as cover of algae, sand and mud throughout the various zones of the reef environment.

7. Analysis of spectral data within the satellite image was classified using georeferenced ground-truth data and covered an area of about 1.8 million square meters, or 454 acres. Overall coral cover in the mapped area was about 37% of bottom cover, while living coral cover within the calibration photo-quadrats equaled about 40% of bottom cover. The difference in cover values using the two estimates is a result of selection of calibration-validation points that are likely biased toward areas of higher coral cover. Macroalgae accounted for about 8% of bottom cover, 21% of the bottom was covered with sand, and 33% of the bottom consisted of mud and sediment bound in algal turf.

8. In most open coastal areas of Hawaii the dominant factor responsible for the physical structure of reefs and species assemblages is stress from wave energy. The reefs at Olowalu are somewhat unique in that sediment depositian (or lack thereof), rather than wave forces, appears to be the major determinant of physical and biotic reef structure. Along the northern side of Olowalu Point, deposition of terrigenous sediment emanating from Olowalu Stream creates a habitat where coral communities are limited to species and growth forms that can withstand the sub-optimal conditions created by sediment deposition. South of Olowalu Point, a shallow, wide, triangular-shaped reef flat, formed from deposition of alluvial material from Olowalu Stream, terminates in a fore-reef composed of actively accreting corals assemblages that show little or no effect of sediment stress. Reefs at that southeastern end of the project site (14-Mile Marker) also showed distinct indications of sediment stress, although no major streams discharge regularly in this area.

9. Motile macro-invertebrates on the reef consist primarily of several species of sea urchins. These species include the bio-eroding burrowing urchins *Echinometra matheai* and *Echinostrephus aciculatus*, and the larger slate pencil urchin (*Heteracentrotus mammilatus*), the collector urchin (*Tripneustes gratilla*) and the long-spined urchin (*Echinothrix diadema*). Urchins were rare in the zones covered by sediment. Other macrobenthos observed consist of sea cucumbers, primarily on the sandy areas of the reef flats, and starfish. The coral-eating crown-of-thorns starfish (*Acanthaster planci*) was not observed in the study area.

10. Populations of reef fish in the area were typical of Hawaii reefs, although numbers of larger fish were low, likely as a result of fishing pressure. The most abundant families consist of wrasses, damselfish and surgeonfish. As is generally the case, density of fish was a function of vertical complexity of the benthic surface, with the highest abundance on the outer fore-reef. Reef fish were rarest in the areas with heaviest deposition of mud. Numerous small sharks were observed on the inner reef flat south of Olowalu Point.

11. Overall, results of this study indicate that the existing episodic discharge to the ocean of land-derived sediment is the most pervasive stress to the reefs off Olowalu. However, the area extent of such deposition is limited and does not affect all areas of the reef. Reef communities on the outer reef flat and fore reef represent essentially pristine ecological settings unaffected by most activities of man (with the exception of fishing).

12. Engineering analysis indicates that, with full build-out of the planned project, there will be changes in groundwater that include a small reduction in flow rate and phosphorus discharge and an increase in nitrogen discharge to the nearshare ocean compared to present conditions. The changes with combined groundwater and surface runoff from episode storm events, is predicted to increase both phosphorus and nitrogen flux to the ocean by small amounts. Depiction of the existing marine environment indicates that, at present, groundwater is so restricted in distribution that there is essentially no effect on marine community structure. Thus, the small changes in groundwater dynamics projected to result from the project do not present a mechanism for future negative effects to offshore marine communities.

13. A planned component of the Olowalu Tawn Master Plan is a series of retention basins within the project site for the purpose of retaining starm water runoff prior to discharge to the ocean. While the project will increase the area of impervious surfaces, the inclusion of retention basins is predicted to result in no change to discharge of water ta the ocean compared ta the present scenario. However, with respect to impacts to coral communities, the most important aspect of the retention basins is a potential reduction in discharge of terrigenous sediment.

14. Planning of the Olowalu Town Master Plan focuses on continued maintenance and stewardship of the unique natural resources of the area. As a result, as long as best management practices are utilized to avoid any unforeseen impacts during the construction and operational phases of the project, and engineering considerations in the design of the retention basins focus on maximizing sediment trapping, there is no rationale to indicate the potential for negative impacts to the marine environment.

15. The studies conducted for this report, particularly the water quality onalyses and coral reef habitat maps, can serve as an initial baseline for any monitoring programs that may be required for the project.

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FIGURE 1. Satellite image of Olowalu, Maui, Hawaii showing locations of five water sampling transects that extend from the shoreline to 400-600 meters offshore. Nine sampling stations were located on each transect.

TABLE 1. Water chemistry measurements (nutrient concentrations in micromolar units) from five ocean water transects, two streams and two groundwater wells collected in the vicinity of the Olowalu Town project on June 11, 2010. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) 'not to exceed more than 10% of the time' and 'not to exceed more than 2% of the time' water quality standards for open coastal waters under 'dry' and 'wet' conditions. Boxed values exceed DOH 10% 'dry' standards; boxed and shaded values exceed DOH 10% 'wet' standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO_4^{3-} (µM)	NO_3^- (µM)	NH_4^+ (µM)	Si (µM)	TOP (µM)	TON (µM)	TP (µM)	TN (µM)	TURB (NTU)	SALINITY (ppt)	pH (pH units)	CHL a (µg/L)	TEMP (deg.C)	O2 % Sat
Olowalu 1	0S	0.56	50.12	8.46	310.16	1.08	14.72	1.64	73.30	0.79	18.942	7.55	2.48	24.79	101.0
	1S	1.08	57.76	13.12	354.32	1.32	10.96	2.40	81.84	1.54	17.389	7.81	5.12	24.72	101.1
	2S	0.24	19.48	0.24	178.92	1.24	6.40	1.48	26.12	0.56	25.669	8.04	1.13	24.59	101.4
	5S	0.16	2.20	0.68	84.80	1.08	9.48	1.24	12.72	0.45	30.874	8.07	0.51	24.76	100.8
	10S	0.09	0.14	0.82	25.98	0.46	8.29	0.55	9.05	0.63	33.551	8.06	2.01	24.90	101.7
	20S	0.05	0.10	0.02	12.83	0.33	8.11	0.38	8.23	0.36	34.238	8.07	0.61	24.92	104.2
	50S	0.07	BDL	0.08	5.73	0.32	5.91	0.39	5.99	0.28	34.616	8.14	0.14	26.16	105.2
	50D	0.04	0.02	0.10	5.35	0.30	7.08	0.34	7.20	0.29	34.620	8.14	0.36	26.10	105.7
	150S	0.04	0.02	0.12	6.55	0.29	6.84	0.33	6.98	0.42	34.600	8.16	0.07	25.95	103.6
	150D	0.01	0.03	0.10	2.45	0.33	7.13	0.34	7.26	0.17	34.787	8.18	0.05	25.97	101.3
	400S	0.07	0.04	0.80	2.69	0.42	7.04	0.49	7.88	0.14	34.811	8.18	0.07	26.01	102.9
	400D	0.02	0.05	0.43	2.05	0.33	6.87	0.35	7.35	0.18	34.787	8.19	0.06	25.88	102.2
Olowalu 2	0S	0.52	0.36	5.68	427.84	0.80	9.40	1.32	15.44	16.90	18.198	7.21	1.74	25.58	109.3
	1S	2.28	0.40	2.73	322.60	0.60	22.48	2.88	24.60	5.91	21.315	7.59	1.25	25.57	109.7
	2S	1.04	0.68	5.68	181.88	1.24	21.84	2.28	28.20	2.79	28.616	7.74	0.35	25.58	109.9
	5S	0.55	0.64	2.38	107.85	0.35	8.91	0.90	11.93	3.88	32.228	7.74	0.29	25.57	110.4
	10S	0.15	0.11	1.48	4.89	0.47	8.76	0.62	10.35	0.53	34.707	8.10	0.99	25.56	109.0
	20S	0.05	0.07	0.07	4.27	0.36	7.66	0.41	7.80	0.29	34.690	8.13	0.38	25.56	108.4
	50S	0.20	0.19	0.21	2.55	0.42	7.25	0.62	7.65	0.13	34.801	8.14	0.05	26.02	101.4
	50D	0.13	0.11	0.48	2.32	0.40	7.18	0.53	7.77	0.16	34.814	8.14	0.13	26.07	99.8
	200S	0.04	0.05	0.18	1.99	0.33	7.49	0.37	7.72	0.14	34.800	8.17	0.04	25.99	101.1
	200D	0.04	0.08	0.34	1.78	0.35	6.92	0.39	7.34	0.13	34.813	8.16	0.04	25.87	100.5
	500S	0.03	0.01	0.03	1.82	0.36	7.13	0.39	7.17	0.11	34.778	8.19	0.03	25.98	104.5
	500D	0.16	0.02	0.28	1.58	0.42	7.61	0.60	7.91	0.16	34.780	8.20	0.02	25.49	107.0
Olowalu 3	0S	0.68	1.08	3.80	148.52	0.96	10.20	1.64	15.08	0.55	26.230	7.90	0.74	25.80	113.3
	1S	0.52	0.92	1.96	129.24	0.96	13.04	1.48	15.92	0.55	28.411	8.06	0.92	25.83	113.7
	10S	0.14	0.07	0.29	25.73	0.38	7.61	0.52	7.97	0.42	33.883	8.11	0.64	25.79	110.1
	20S	0.06	0.04	0.17	24.06	0.29	7.92	0.35	8.13	0.29	33.797	8.08	0.19	25.81	113.3
	40S	0.05	0.05	0.07	6.99	0.29	6.78	0.34	6.90	0.18	34.663	8.15	0.18	25.81	110.7
	60S	0.06	0.08	0.11	3.54	0.30	6.42	0.36	6.61	0.22	34.813	8.12	0.07	25.89	105.5
	100S	0.08	0.23	0.07	1.60	0.30	6.08	0.38	6.38	0.12	34.855	8.14	0.05	26.12	101.4
	100D	0.13	0.12	BDL	1.54	0.40	6.54	0.53	6.66	0.11	34.853	8.14	0.06	26.17	100.5
	300S	0.02	0.17	0.01	1.67	0.33	6.18	0.35	6.36	0.12	34.823	8.18	0.05	26.00	104.1
	300D	0.06	0.12	0.04	1.54	0.33	6.10	0.39	6.26	0.09	34.828	8.18	0.03	26.01	103.4
	600S	0.02	0.09	0.07	1.42	0.33	6.51	0.35	6.67	0.10	34.818	8.19	0.08	25.91	104.0
	600D	0.08	0.06	0.06	1.28	0.42	6.29	0.50	6.41	0.07	34.800	8.20	0.04	25.51	105.8
Olowalu 4	0S	0.27	5.11	0.65	104.30	0.31	7.26	0.58	13.02	0.70	32.679	8.01	1.45	26.31	103.3
	1S	0.37	2.14	0.77	58.45	0.35	7.48	0.52	10.41	0.94	33.920	8.20	0.37	26.29	101.0
	10S	0.06	0.46	2.35	16.41	0.30	7.83	0.36	10.64	0.73	34.905	8.30	0.39	26.28	98.3
	20S	0.04	0.03	0.34	8.45	0.29	8.29	0.33	8.66	0.53	35.142	8.27	0.24	26.23	96.4
	40S	0.04	BDL	0.07	12.05	0.30	8.54	0.34	8.61	0.49	34.829	8.08	0.20	26.20	93.3
	60S	0.06	0.02	0.30	4.67	0.30	7.26	0.36	7.58	0.37	35.059	8.03	0.09	26.19	92.4
	100s	0.14	0.41	0.43	2.69	0.36	6.39	0.50	7.23	0.17	34.906	8.06	0.85	26.02	101.2
	100d	0.03	0.35	0.09	2.21	0.30	6.02	0.33	6.46	0.14	34.910	8.06	0.09	26.02	92.2
	300S	0.04	0.47	0.09	2.00	0.36	5.34	0.40	5.90	0.17	34.930	8.03	0.05	25.56	94.5
	300D	0.24	0.51	0.11	2.20	0.30	6.01	0.54	6.63	0.19	34.890	8.07	0.10	26.06	92.8
	600S	0.15	0.30	0.10	2.22	0.38	5.62	0.53	6.02	0.30	34.844	8.15	0.09	25.13	103.6
	600D	0.06	0.30	0.11	1.26	0.37	5.48	0.43	5.89	0.10	34.827	8.18	0.06	25.90	104.1
Olowalu 5	0S	0.10	0.09	0.41	14.03	0.28	6.49	0.38	6.99	0.40	34.262	8.02	0.19	26.03	103.8
	1S	0.04	0.03	0.23	15.47	0.26	6.82	0.30	7.08	0.45	34.193	8.03	0.62	25.93	101.3
	2S	0.03	0.04	0.39	7.51	0.30	6.93	0.33	7.36	0.38	34.600	8.04	1.01	25.97	102.5
	5S	0.08	0.06	0.39	3.79	0.30	6.40	0.38	6.85	0.30	34.835	8.06	0.13	25.97	101.5
	10S	0.14	0.03	0.08	3.86	0.26	5.81	0.40	5.92	0.22	34.818	8.06	0.18	26.01	100.9
	20S	0.09	0.08	0.69	3.71	0.46	5.94	0.55	6.65	0.28	34.832	8.05	0.51	25.93	94.7
	50S	0.05	0.32	0.13	1.75	0.39	7.05	0.44	7.50	0.17	34.858	8.10	0.09	25.85	98.7
	50D	0.12	0.31	0.19	2.13	0.36	5.19	0.48	5.69	0.23	34.847	8.10	0.15	25.95	96.1
	200S	0.08	0.35	0.11	1.69	0.39	5.87	0.47	6.33	0.18	34.840	8.12	0.06	25.93	100.5
	200D	0.14	0.39	0.21	1.75	0.37	5.34	0.51	5.94	0.16	34.841	8.13	0.05	25.92	95.0
	500S	0.22	0.29	0.30	1.43	0.22	6.28	0.44	6.87	0.16	34.830	8.15	0.04	25.89	102.8
	500D	0.07	0.21	0.15	1.41	0.33	5.62	0.40	5.98	0.11	34.826	8.16	0.03	25.94	100.1
Streams	210	0.40	0.20	0.80	697.50	1.50	22.40	1.90	23.40		0.177				
	520	0.60	0.40	0.80	720.80	1.70	20.20	2.30	21.40		0.160				
Wells	4936-01	0.70	4.00	0.90	759.70	1.60	16.70	2.30	21.60		0.175				
	4937-01	3.30	34.40	2.10	843.50	1.70	2.80	5.00	39.30		0.294				
DOH WQS	DRY	10%	0.71	0.36				0.96	12.86	0.50	*	***	0.50	**	****
		2%	1.43	0.64				1.45	17.86	1.00			1.00		
	WET	10%	1.00	0.61				1.29	17.85	1.25	*	***	0.90	**	****
		2%	1.78	1.07				1.93	25.00	2.00			1.75		

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
*** pH shall not deviate more than 0.5 units from a value of 8.1.
**** Dissolved Oxygen not to be below 75% saturation.

TABLE 2. Water chemistry measurements (nutrient concentrations in µg/L) from five ocean water transects, two streams and two groundwater wells collected in the vicinity of the Olowalu Town project on June 11, 2010. Abbreviations as follows: DFS=distance from shore; S=surface; D=deep; BDL=below detection limit. Also shown are the State of Hawaii, Department of Health (DOH) 'not to exceed more than 10% of the time' and 'not to exceed more than 2% of the time' water quality standards for open coastal waters under 'dry' and 'wet' conditions. Boxed values exceed DOH 10% 'dry' standards; boxed and shaded values exceed DOH 10% 'wet' standards. For sampling site locations, see Figure 1.

TRANSECT SITE	DFS (m)	PO_4^{3-} (µg/L)	NO_3^- (µg/L)	NH_4^+ (µg/L)	Si (µg/L)	TOP (µg/L)	TON (µg/L)	TP (µg/L)	TN (µg/L)	TURB (NTU)	SALINITY (ppt)	pH (pH units)	CHL a (µg/L)	TEMP (deg.C)	O2 % Sat
Olowalu 1	0S	17.36	701.7	118.77	8715	33.48	206.1	50.84	1028	0.79	18.942	7.55	2.48	24.79	101.0
	1S	33.48	808.6	183.76	9956	40.92	153.4	74.40	1146	1.54	17.389	7.81	5.12	24.72	101.1
	2S	7.44	272.7	3.36	5028	38.44	89.60	45.88	365.7	0.56	25.669	8.04	1.13	24.59	101.4
	5S	4.96	23.04	12.33	2383	33.48	132.7	38.44	176.1	0.45	30.874	8.07	0.51	24.76	100.8
	10S	2.79	1.96	8.68	730.0	14.26	116.1	17.05	126.7	0.63	33.551	8.06	2.01	24.90	101.7
	20S	1.55	1.40	0.28	360.5	10.23	113.5	11.78	115.2	0.36	34.238	8.07	0.61	24.92	104.2
	50S	2.17	BDL	1.12	161.0	9.92	82.74	12.09	83.9	0.28	34.616	8.14	0.14	26.16	105.2
	50D	1.24	0.28	1.40	150.3	9.30	99.12	10.54	100.8	0.29	34.620	8.14	0.36	26.10	105.7
	150S	1.24	0.28	1.68	184.1	8.99	95.76	10.23	97.7	0.42	34.600	8.16	0.07	25.95	103.6
	150D	0.31	0.42	1.40	68.8	10.23	99.82	10.54	101.6	0.17	34.787	8.18	0.05	25.97	101.3
	400S	2.17	0.56	11.20	75.6	13.02	98.56	15.19	110.3	0.14	34.811	8.18	0.07	26.01	102.9
	400D	0.62	0.70	6.02	57.6	10.23	96.18	10.85	102.9	0.18	34.787	8.19	0.06	25.88	102.2
Olowalu 2	0S	16.12	5.04	79.55	12022	24.80	131.6	40.92	216.2	16.90	18.198	7.21	1.74	25.58	109.3
	1S	70.68	5.60	52.10	9065	18.60	314.7	89.28	372.4	5.91	21.315	7.59	1.25	25.57	109.7
	2S	32.24	9.52	79.55	5111	38.44	305.8	70.56	394.8	2.79	28.616	7.74	0.35	25.58	109.9
	5S	17.05	8.96	33.32	3031	10.85	124.7	27.90	167.0	3.88	32.228	7.74	0.29	25.57	110.4
	10S	4.65	1.54	20.75	137.4	14.57	122.6	19.22	144.9	0.53	34.707	8.10	0.99	25.56	109.0
	20S	1.55	0.98	0.98	120.0	11.16	107.2	12.71	109.2	0.29	34.690	8.13	0.38	25.56	108.4
	50S	6.20	2.66	2.94	71.7	13.02	101.5	19.22	107.1	0.13	34.801	8.14	0.05	26.02	101.4
	50D	4.03	1.54	6.72	65.2	12.40	100.5	16.43	108.8	0.16	34.814	8.14	0.13	26.07	99.8
	200S	1.24	0.70	2.52	55.9	10.23	104.9	11.47	108.1	0.14	34.800	8.17	0.04	25.99	101.1
	200D	1.24	1.12	4.76	50.0	10.85	96.88	12.09	102.8	0.13	34.813	8.16	0.04	25.87	100.5
	500S	0.93	0.14	0.42	51.1	11.16	99.82	12.09	100.4	0.11	34.778	8.19	0.03	25.98	104.5
	500D	5.58	0.28	3.92	44.4	13.02	106.5	18.60	110.7	0.16	34.780	8.20	0.02	25.49	107.0
Olowalu 3	0S	21.08	15.12	53.22	4173	29.76	142.8	50.84	211.1	0.55	26.230	7.90	0.74	25.80	113.3
	1S	16.12	12.88	27.45	3632	29.76	182.6	45.88	222.9	0.55	28.411	8.06	0.92	25.83	113.7
	10S	4.34	0.98	4.06	723.0	11.78	106.5	16.12	111.6	0.42	33.883	8.11	0.64	25.79	110.1
	20S	1.86	0.56	2.38	676.1	8.99	110.9	10.85	113.8	0.29	33.797	8.08	0.19	25.81	113.3
	40S	1.55	0.70	0.98	196.4	8.99	94.92	10.54	96.6	0.18	34.663	8.15	0.18	25.81	110.7
	60S	1.86	1.12	1.54	99.5	9.30	89.88	11.16	92.5	0.22	34.813	8.12	0.07	25.89	105.5
	100S	2.48	3.22	0.98	45.0	9.30	85.12	11.78	89.3	0.12	34.855	8.14	0.05	26.12	101.4
	100D	4.03	1.68	BDL	43.3	12.40	91.56	16.43	93.2	0.11	34.853	8.14	0.06	26.17	100.5
	300S	0.62	2.38	0.14	46.9	10.23	86.52	10.85	89.0	0.12	34.823	8.18	0.05	26.00	104.1
	300D	1.86	1.68	0.56	43.3	10.23	85.40	12.09	87.6	0.09	34.828	8.18	0.03	26.01	103.4
	600S	0.62	1.26	0.98	39.9	10.23	91.14	10.85	93.4	0.10	34.818	8.19	0.08	25.91	104.0
	600D	2.48	0.84	0.84	36.0	13.02	88.06	15.50	89.7	0.07	34.800	8.20	0.04	25.51	105.8
Olowalu 4	0S	8.37	71.54	9.10	2931	9.61	101.6	17.98	182.3	0.70	32.679	8.01	1.45	26.31	103.3
	1S	5.27	30.24	10.78	1642	10.85	104.7	16.12	145.7	0.94	33.920	8.20	0.37	26.29	101.0
	10S	1.86	6.44	32.91	461.1	9.30	109.6	11.16	149.0	0.73	34.905	8.30	0.39	26.28	98.3
	20S	1.24	0.42	4.76	237.4	8.99	116.1	10.23	121.2	0.53	35.142	8.27	0.24	26.23	96.4
	40S	1.24	BDL	0.98	338.6	9.30	119.6	10.54	120.5	0.49	34.829	8.08	0.20	26.20	93.3
	60S	1.86	0.28	4.20	131.2	9.30	101.6	11.16	106.1	0.37	35.059	8.03	0.09	26.19	92.4
	100s	4.34	5.74	6.02	75.6	11.16	89.46	15.50	101.2	0.17	34.906	8.06	0.85	26.02	101.2
	100d	0.93	4.90	1.26	62.1	9.30	84.28	10.23	90.4	0.14	34.910	8.06	0.09	26.02	92.2
	300S	1.24	6.58	1.26	56.2	11.16	74.76	12.40	82.6	0.17	34.930	8.03	0.05	25.56	94.5
	300D	7.44	7.14	1.54	61.8	9.30	84.14	16.74	92.8	0.19	34.890	8.07	0.10	26.06	92.8
	600S	4.65	4.20	1.40	62.4	11.78	78.68	16.43	84.3	0.30	34.844	8.15	0.09	25.13	103.6
	600D	1.86	4.20	1.54	35.4	11.47	76.72	13.33	82.5	0.10	34.827	8.18	0.06	25.90	104.1
Olowalu 5	0S	3.10	1.26	5.74	394.2	8.68	90.86	11.78	97.9	0.40	34.262	8.02	0.19	26.03	103.8
	1S	1.24	0.42	3.22	434.7	8.06	95.48	9.30	99.1	0.45	34.193	8.03	0.62	25.93	101.3
	2S	0.93	0.56	5.46	211.0	9.30	97.02	10.23	103.0	0.38	34.600	8.04	1.01	25.97	102.5
	5S	2.48	0.84	5.46	106.5	9.30	89.60	11.78	95.9	0.30	34.835	8.06	0.13	25.97	101.5
	10S	4.34	0.42	1.12	108.5	8.06	81.34	12.40	82.9	0.22	34.818	8.06	0.18	26.01	100.9
	20S	2.79	1.12	9.82	104.3	14.26	83.16	17.05	93.1	0.28	34.832	8.05	0.51	25.93	94.7
	50S	1.55	4.48	1.82	49.2	12.09	98.70	13.64	105.0	0.17	34.858	8.10	0.09	25.85	98.7
	50D	3.72	4.34	2.66	59.9	11.16	72.66	14.88	79.7	0.23	34.847	8.10	0.15	25.95	96.1
	200S	2.48	4.90	1.54	47.5	12.09	82.18	14.57	88.6	0.18	34.840	8.12	0.06	25.93	100.5
	200D	4.34	5.46	2.94	49.2	11.47	74.76	15.81	83.2	0.16	34.841	8.13	0.05	25.92	95.0
	500S	6.82	4.06	4.20	40.2	6.82	87.92	13.64	96.2	0.16	34.830	8.15	0.04	25.89	102.8
	500D	2.17	2.94	2.10	39.6	10.23	78.68	12.40	83.7	0.11	34.826	8.16	0.03	25.94	100.1
Streams	210	12.40	2.80	11.20	19600	46.50	313.6	58.90	327.6		0.177				
	520	18.60	5.60	11.20	20254	52.70	282.8	71.30	299.6		0.160				
Wells	4936-01	21.70	56.00	12.60	21348	49.60	233.8	71.30	302.4		0.175				
	4937-01	102.3	481.6	29.40	23702	52.70	39.20	155.0	550.2		0.294				
DOH WQS	DRY	10%	10.00	5.00				30.00	180.00	0.50	*	***	0.50	**	****
		2%	20.00	9.00				45.00	250.00	1.00			1.00		
	WET	10%	14.00	8.50				40.00	250.00	1.25	*	***	0.90	**	****
		2%	25.00	15.00				60.00	350.00	2.00			1.75		

* Salinity shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic conditions.
** Temperature shall not vary by more than one degree C. from ambient conditions.
*** pH shall not deviate more than 0.5 units from a value of 8.1.
**** Dissolved Oxygen not to be below 75% saturation.

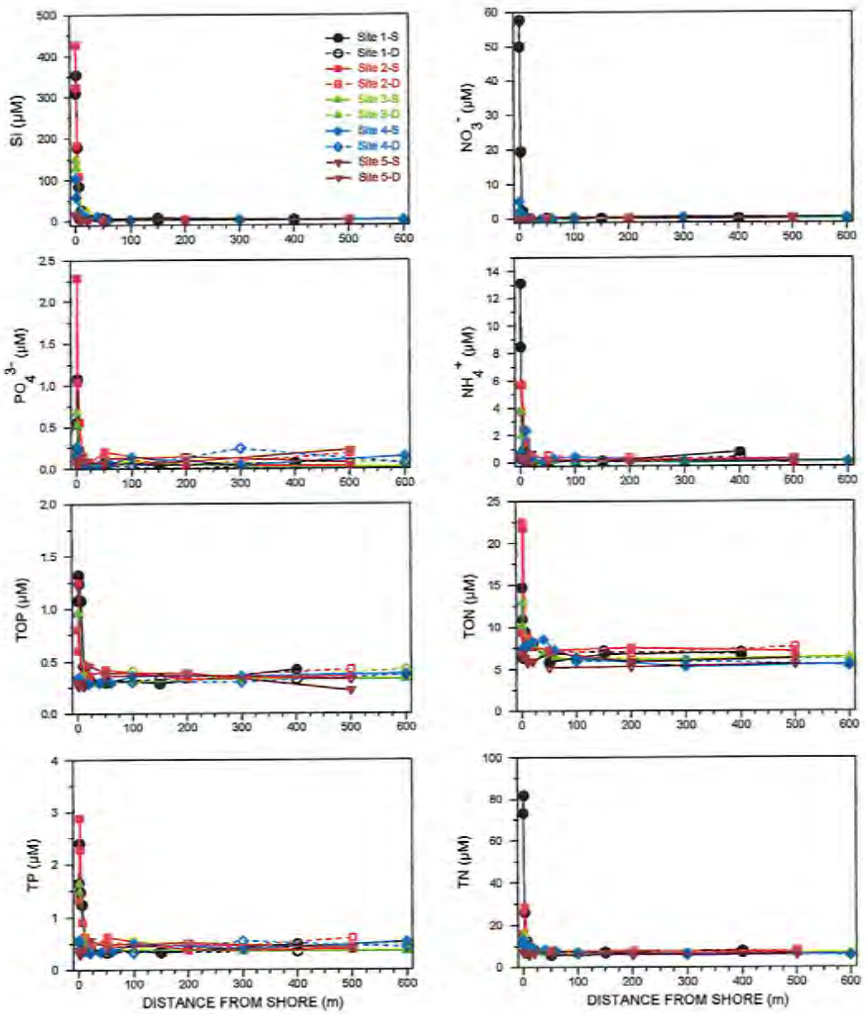


FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on June 11, 2010 as a function of distance from the shoreline in the vicinity of Olowalu Town project. For site locations, see Figure 1.

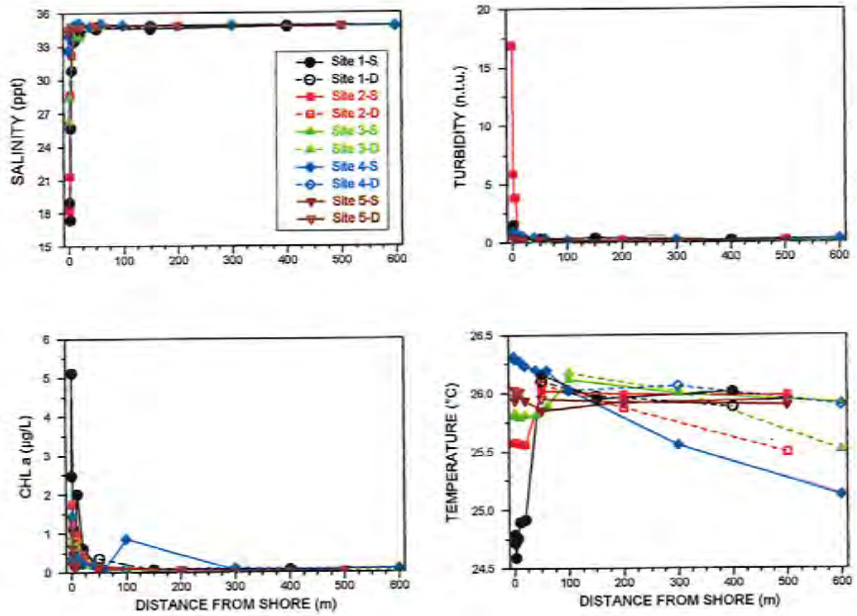


FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on June 11, 2010 as a function of distance from the shoreline in the vicinity of Olowalu Town project. For site locations, see Figure 1.

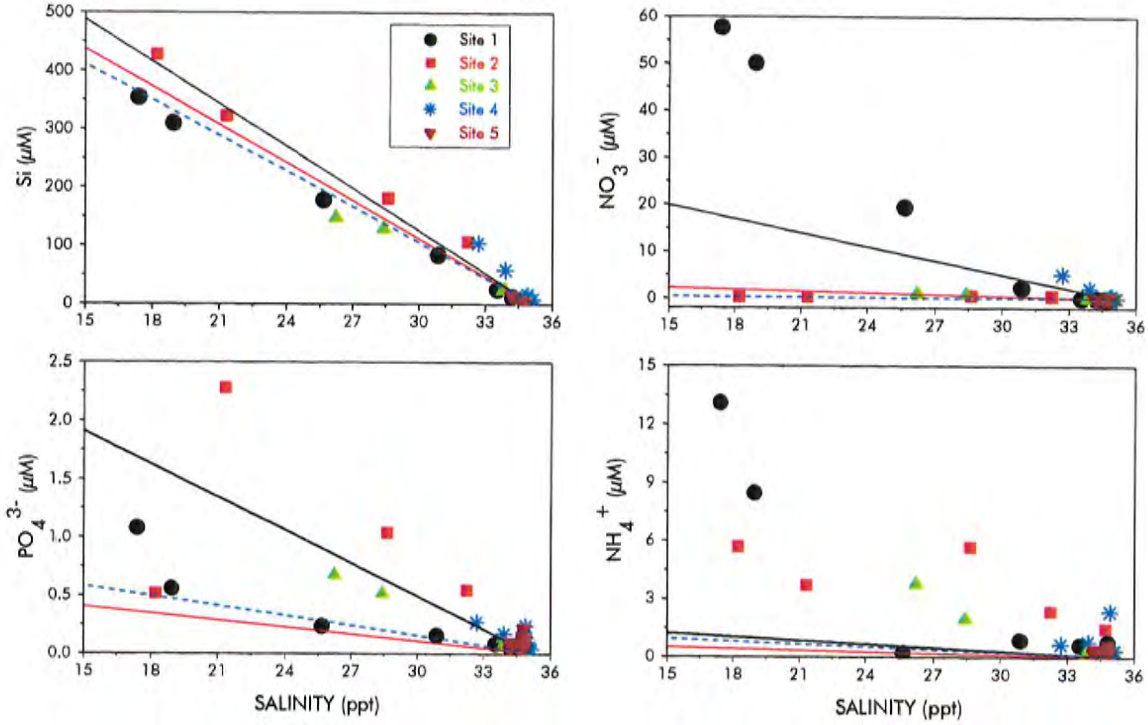


FIGURE 4. Mixing diagram showing concentration of dissolved nutrients from samples collected offshore of the Olowalu Town project on June 11, 2010 as functions of salinity. Conservative mixing lines, constructed by connecting the concentrations in open coastal water with water from two groundwater wells located upslope of the project site are also shown (red line=well #4936-01; black line=well#4937-01); blue dashed line is average Olowalu Stream water. For sampling site locations, see Figure 1.

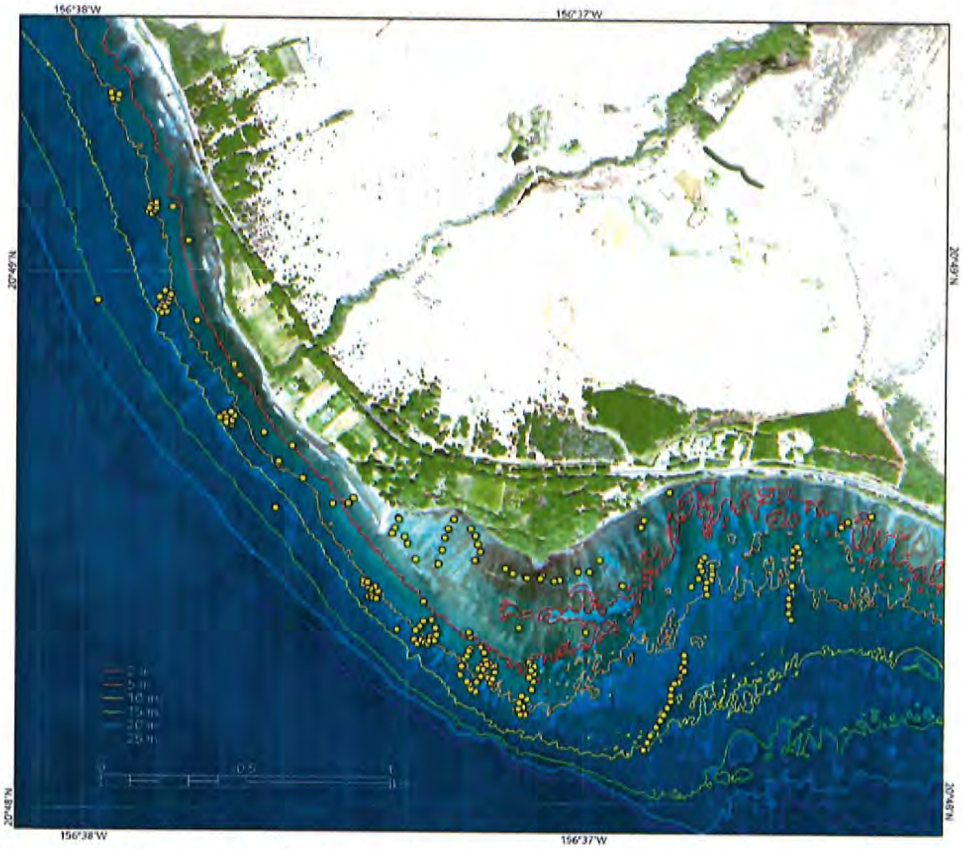


FIGURE 5. Satellite image of study area off Olowalu, Maui, Hawaii showing depth contours and locations of 200 reef survey calibration/validation sites (yellow circles).

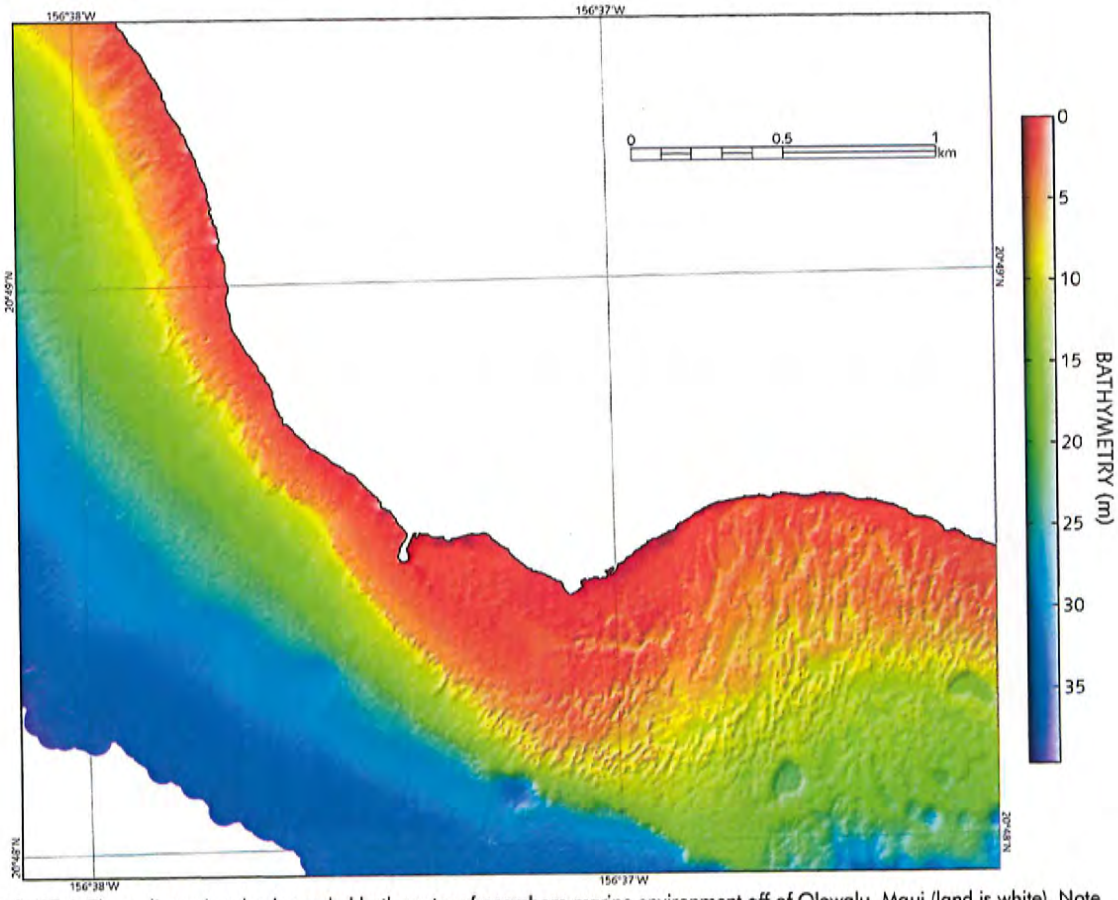


FIGURE 6. Three-dimensional color-coded bathymetry of nearshore marine environment off of Olowalu, Maui (land is white). Note significantly greater rugosity of reef structure on east side of Olowalu Point relative to west side. Data provided by SHOALS (Scanning Hydrographic Operational Airbourne Lidar Survey).

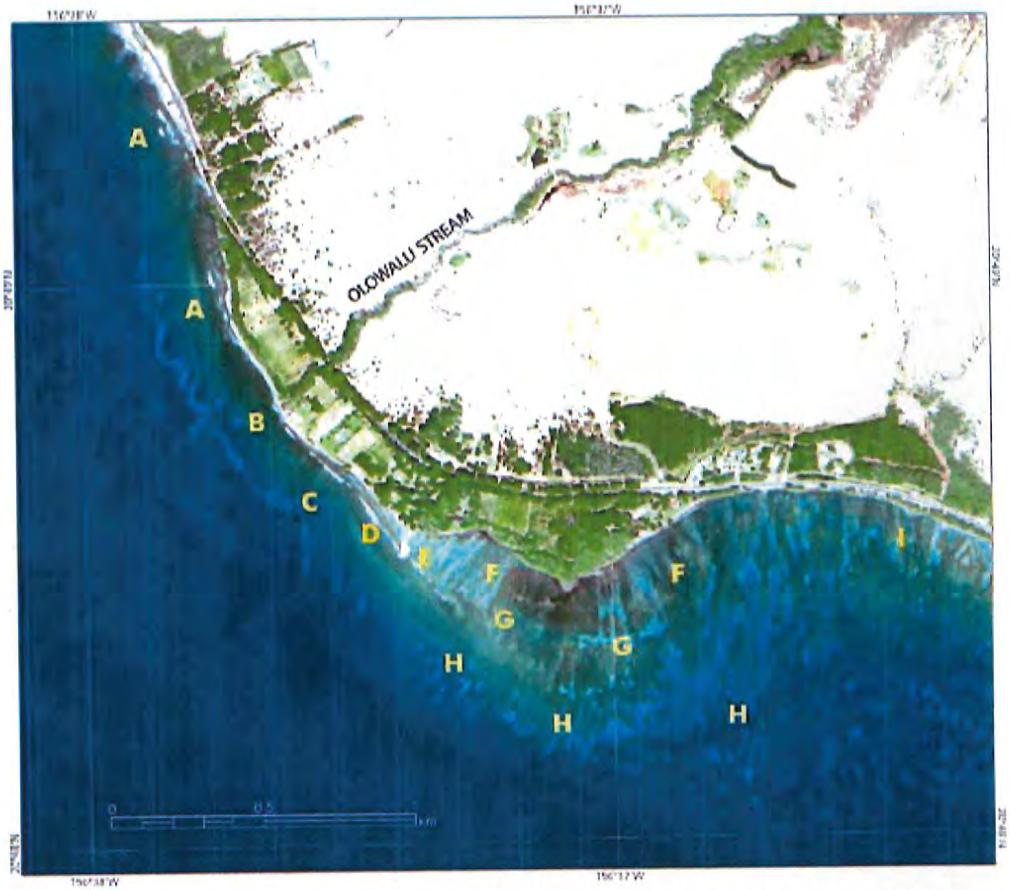


FIGURE 7. Satellite image of coastal and reef area of Olowalu, Maui, Hawaii . Letters designate regions of various reef zones described in text.

FIGURE 8. Views of shoreline at northern end (top) central (middle) and southern end (bottom) of Olowalu Town project site.

FIGURE 9. Reef platform typifying Zone A (see Figure 7) near northern boundary of Olowalu Town project site, and north of the discharge area of Olowalu Stream. Predominant species of coral in both photos is *Porites lobata*. Note layer of mud on reef surface between coral colonies.

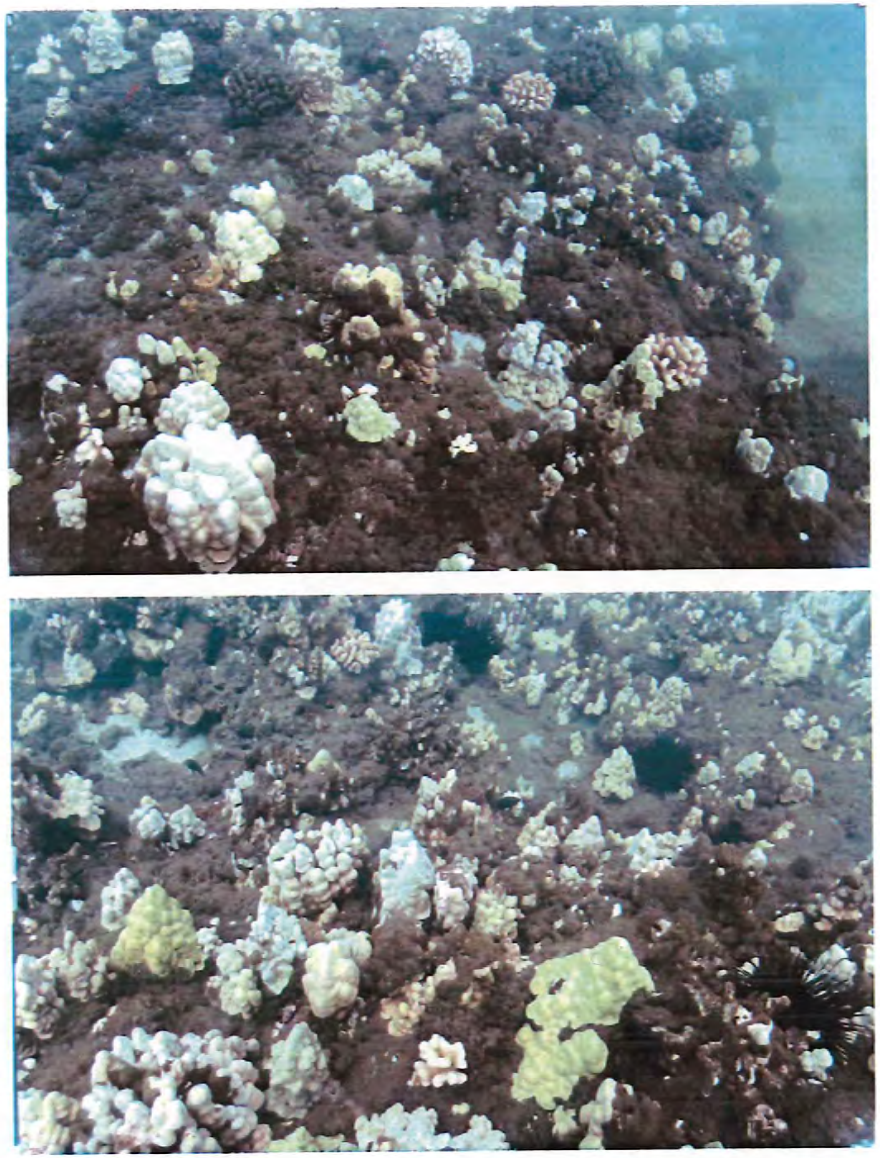


FIGURE 10. Two examples of the reef platform in Zone A north of Olowalu Point. Predominant corals in both photos are *Porites lobata* (tan and green knobby colonies) and *Pocillopora meandrina* (round branching colonies). Not bottom cover of dark colored sediment between corals.

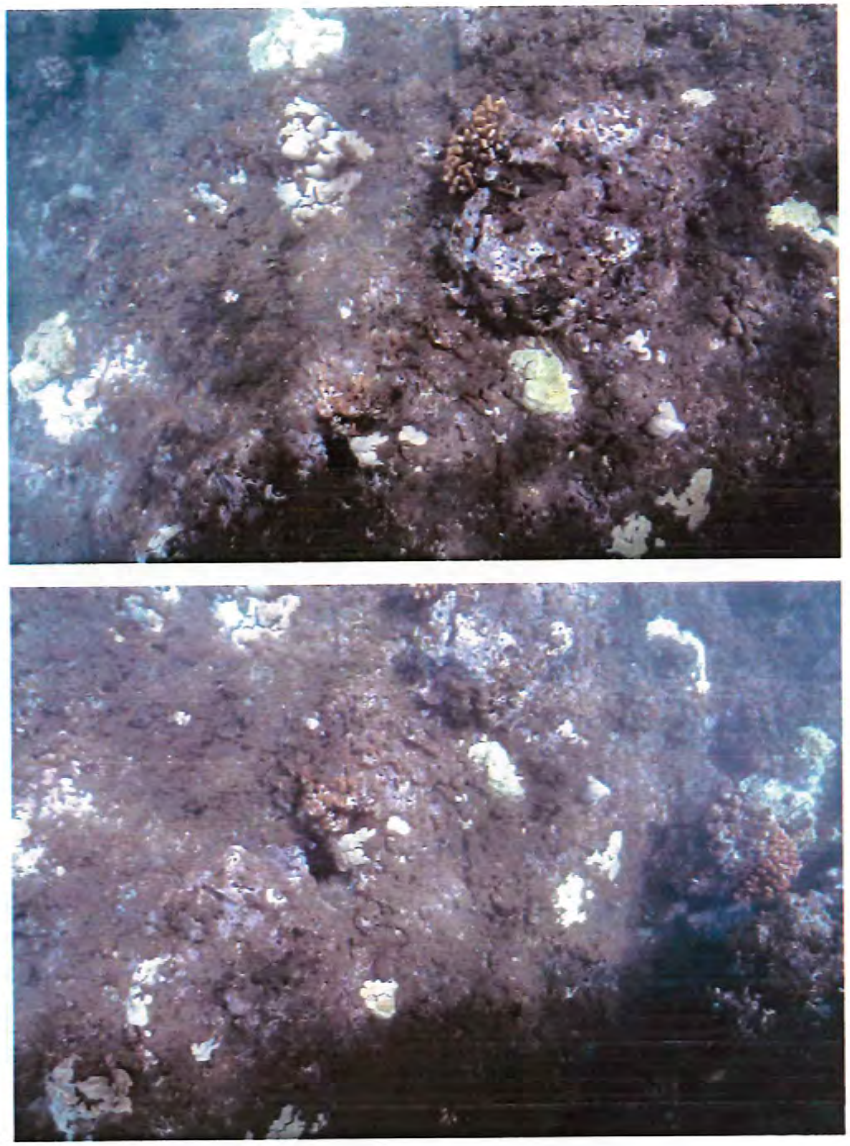


FIGURE 11. Two views of reef surface near point of discharge of Olowalu Stream (see Zone B in Figure 7).

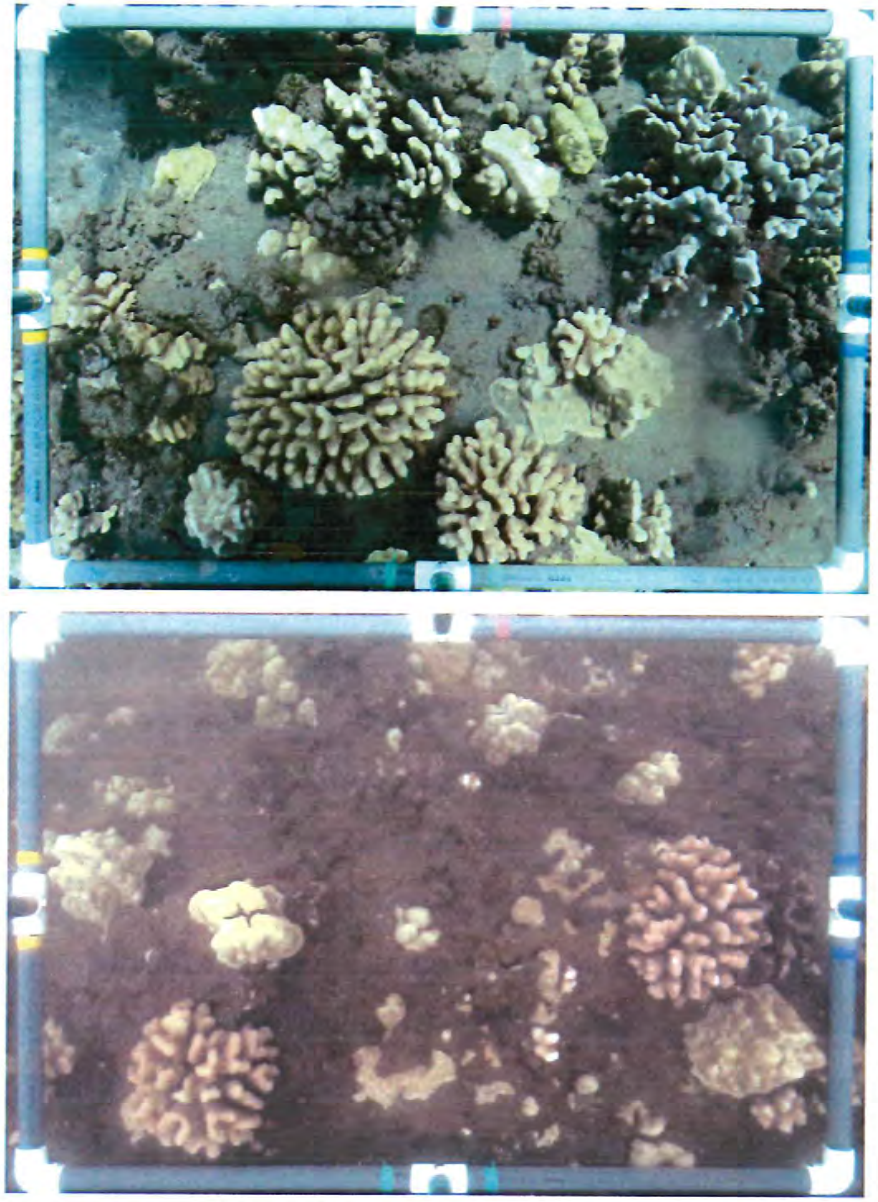


FIGURE 12. Two examples of photoquadrats taken in Zone B (see Figure 7) near the point where Olowalu Stream discharges to the ocean. Note significant deposition of muddy sediment between corals.

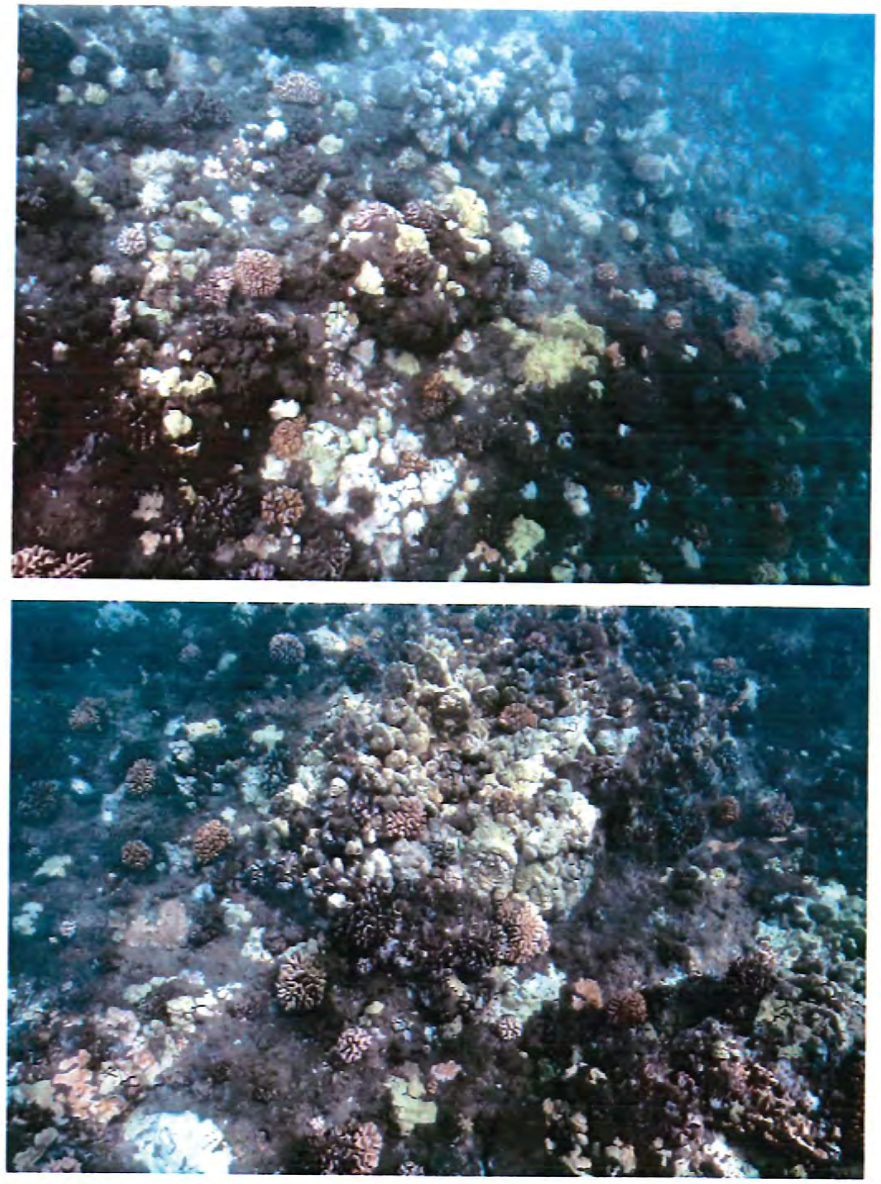


FIGURE 13. Two examples of coral communities on southwest reef platform (Zone C in Figure 7) located between Olowalu Stream Discharge and Olowalu Point. Note higher density of corals and lower levels of deposited mud on bottom compared to Zones A and B.

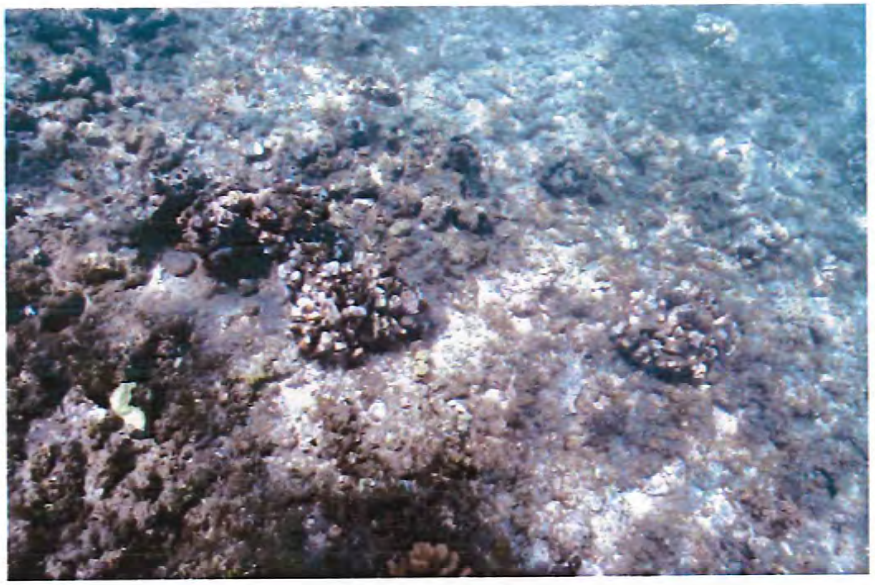


FIGURE 14. Two views of shallow inner reef platform on the north side of Olowalu Point (see Zone D in Figure 7).

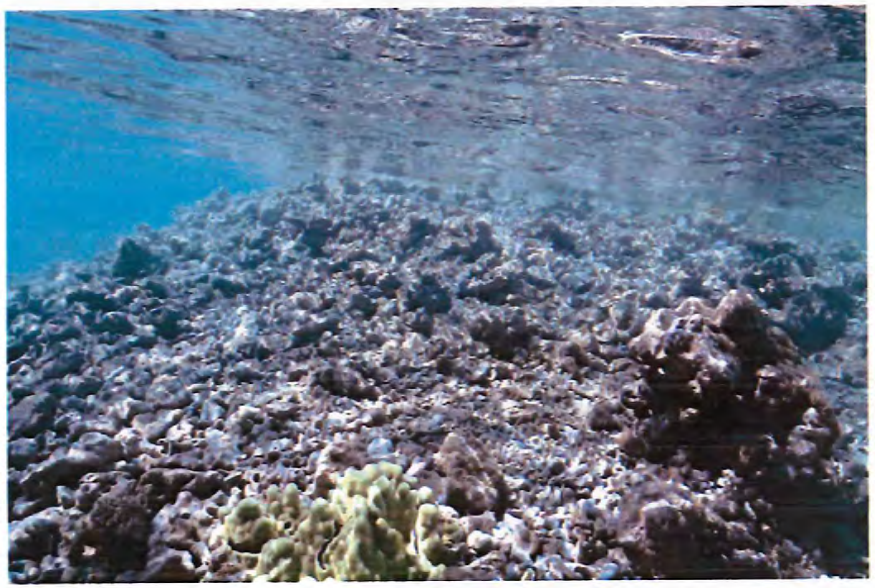
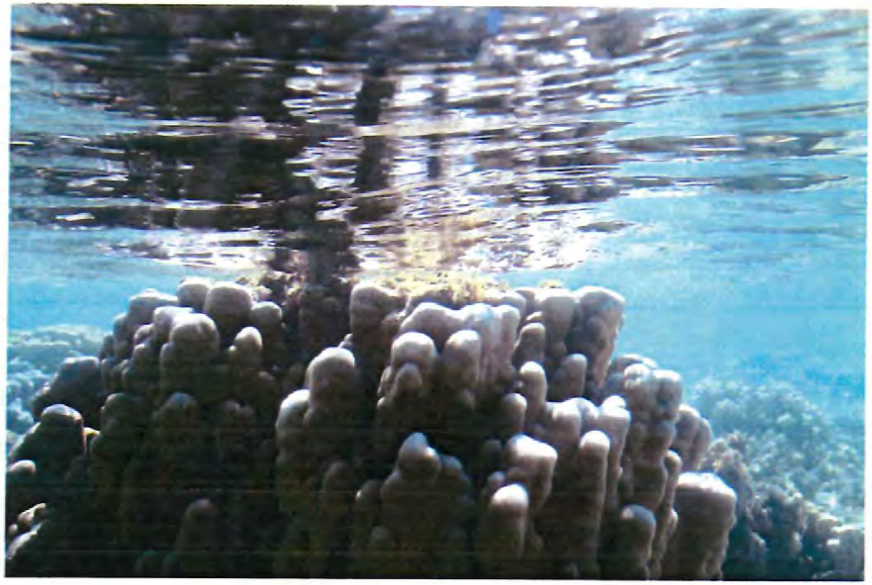


FIGURE 15. Reef crest (Zone E in Figure 7) off the south side of old pier off Olowalu Point. Reef crest is emergent at low tide and absorbs the force of breaking waves (top photo). Not the lack of living coral on the upper surface of the crest in both photos.



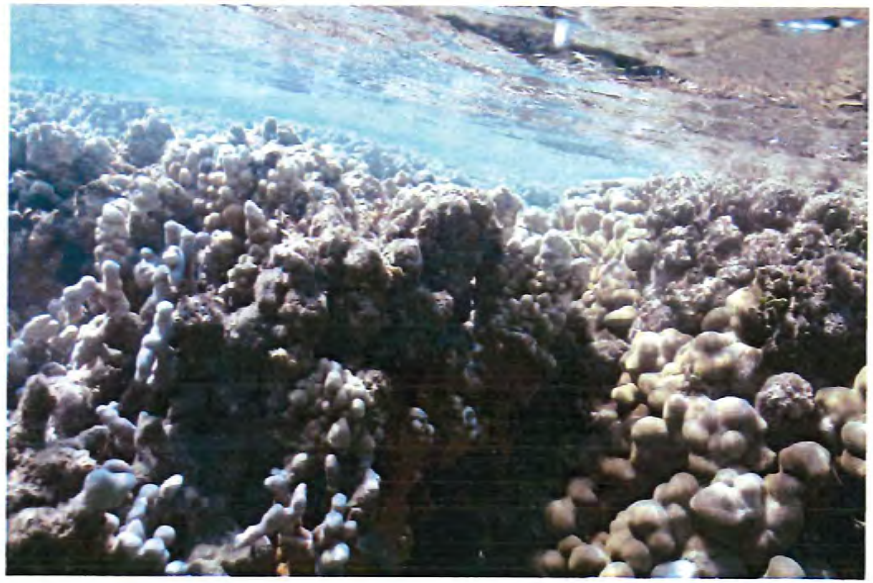
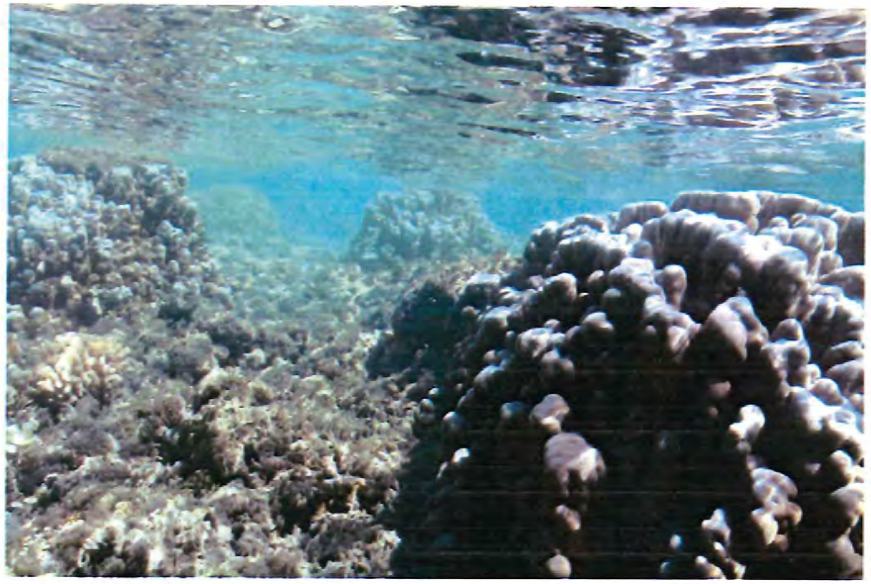


FIGURE 16. Two examples of coral growth to the surface of the water column on inner reef flat off Olowalu Point (Zone F in Figure 7). Predominant coral in both photos is *Porites compressa*.



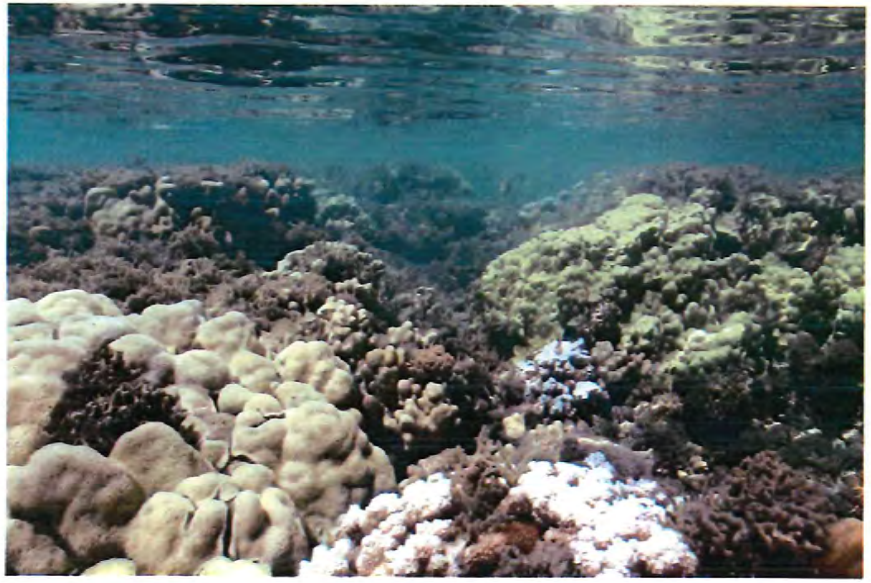


FIGURE 17. Two views of inner reef flat landward of reef crest off Olowalu Point. Predominant corals in both photos are *Porites lobata*.

FIGURE 18. Two examples of "microatolls" on inner reef flat (Zone F in Figure 7) off southern side of Olowalu Point. Upward growth of colonies is limited by surface of water, resulting in lateral growth, thus increasing the diameter of the coral. Live coral cover on the upper surface is limited, and in most cases is replaced by the alien algae *Acanthophora specifera*.

FIGURE 19. Patches of the invasive algae *Acanthophora specifera* covers much of the reef surface (top), as well sandy bottom (bottom) on the nearshore inner reef flat at Olowalu (Zone F in Figure 7).

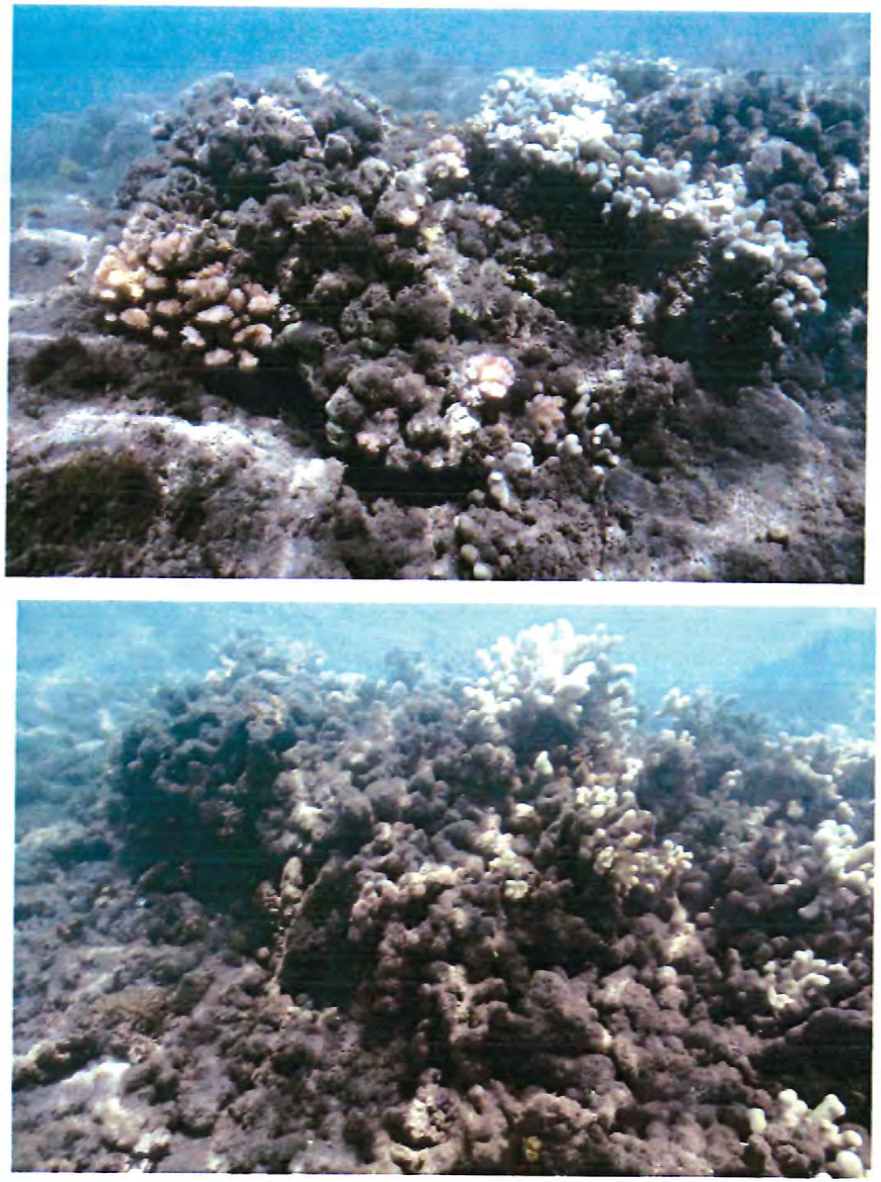


FIGURE 20. Partially dead coral colonies covered with algal turf in southern region of the reef flat off Olowalu (Zone F in Figure 7).

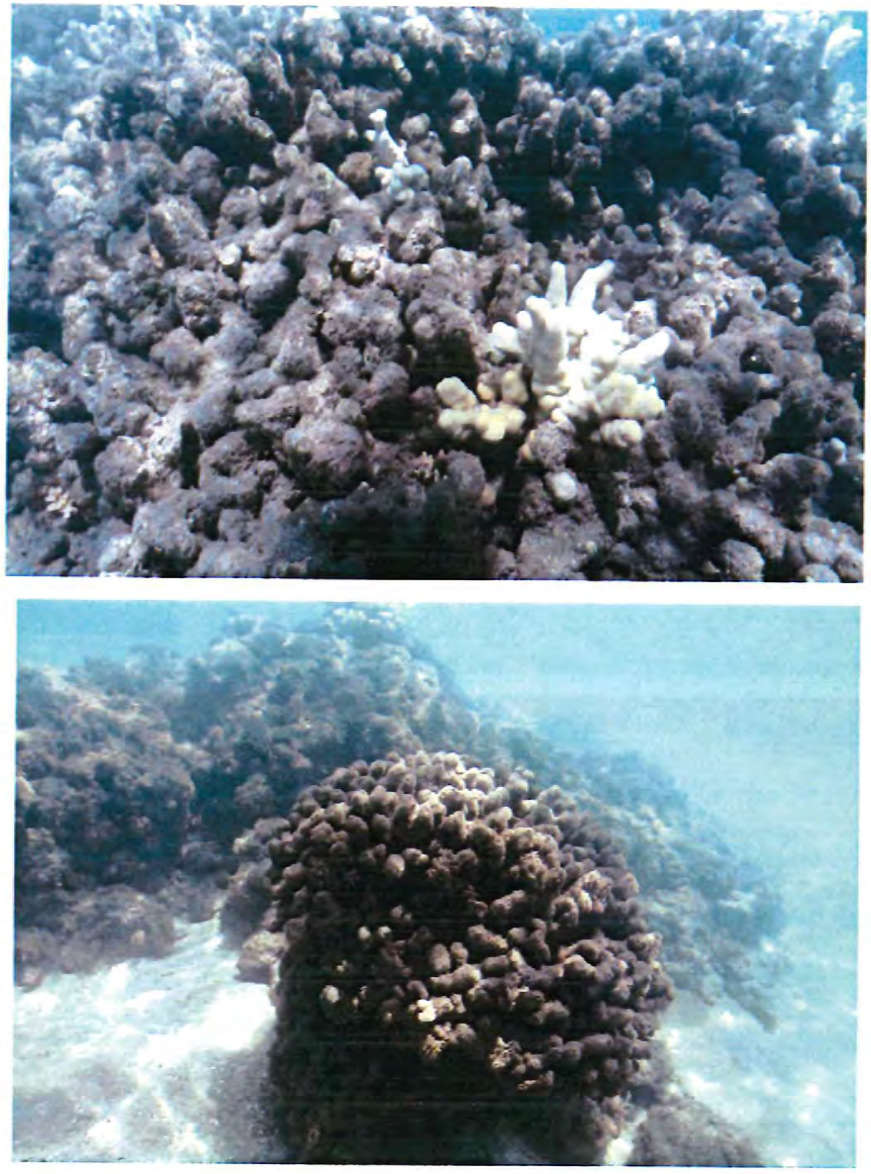


FIGURE 21. Partially dead coral colonies covered with algal turf in southern region of the reef flat off Olowalu (Zone F in Figure 7).

FIGURE 22. Two views of outer reef flat (Zone G in Figure 7). Coral cover is higher than on inner reef flat, although evidence of sediment effects are still visible.

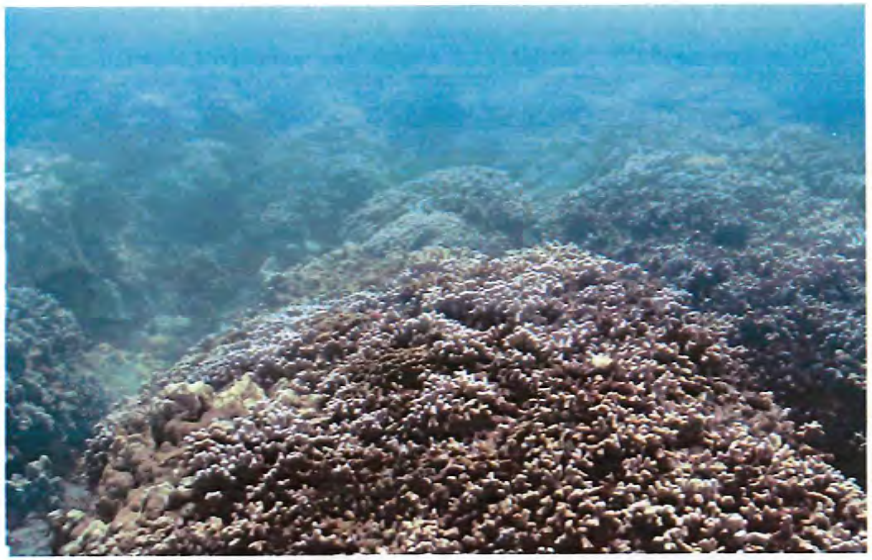


FIGURE 23. Expanses of interconnected mats of finger coral (*Porites compressa*) on the outer reef face at Olowalu (Zone H in Figure 7). Without disturbance from episodic wave stress, these colonies have amalgated over time to form true reefs in the sense that they are accreting limestone. Such accretion is relatively rare in exposed coastal areas of Hawaii.

FIGURE 24. Two areas of expansive growth of interconnected mats of finger coral (*Porites compressa*) at the outer edge of the reef face off Olowalu Point (Zone H in Figure 7). The seaward edge of the reef in the top photo drops to a bed of sand that extends seaward.

FIGURE 25. Two views of *Porites lobata* community structure in outer reef face zone at Olowalu (Zone H in Figure 7). Upper photo shows area where numerous colonies have essentially fused into a massive "super-colony." Lower photo shows a solitary colony approximately 2 meters in height.

FIGURE 26. Outer reef face coral communities off Olowalu Point. Elevated accreting formations above the level of sand channels. Extensive coral growth covers essentially all of the hard substratum in the area.

FIGURE 27. Reef surface off southern end of Olowalu Town project site, at dive site known as 14-Mile Marker (Zone I in Figure 7). Note substantial areas of the reef surface where coral is dead and covered with a layer of sediment.

FIGURE 28. Partially dead and sediment covered corals at 14-Mile dive site at southern end of Olowalu (Zone I in Figure 7).

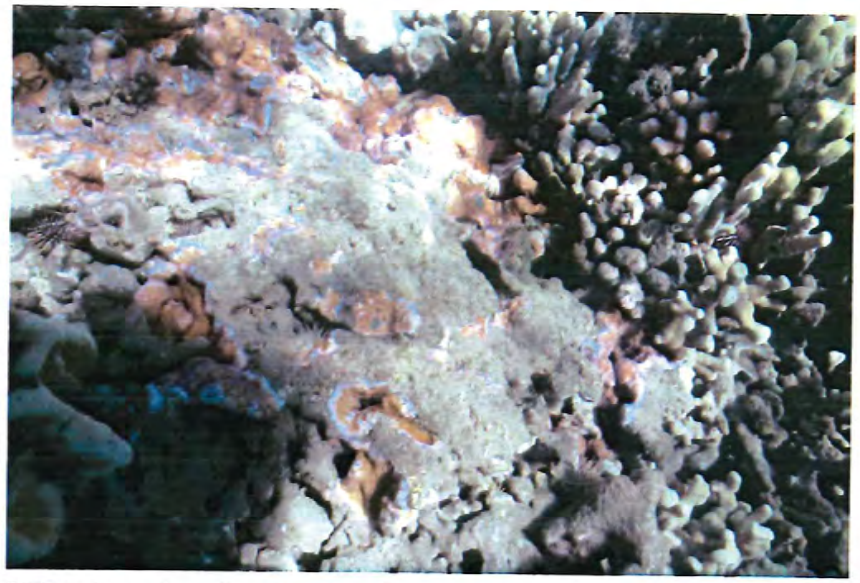


FIGURE 29. Upper photos shows deposition of marine sand on living surface of colony of *Porites* sp. at 14-Mile Marker area. Inspection of the areas under the sand revealed areas of stressed tissue. Lower photo shows colony of *Montipora* sp. with significant portions of the colony dead, likely from sediment stress.

TABLE 3-1. Locations of cal/val sites and percent cover of each bottom type at Olowalu, Mau collected on February 27, 2010. Abbreviations for bottom cover categories are: TURF=algal turf; SP=sponge; LS=limestone; DC=dead coral; CCA=crustose calcareous algae; TBS=turb-bound marine sediment; TBM=turf bound mud; INV=motile invertebrates; RUB=rubble.

27-Feb-2010

CAL/VAL SITE	LONGITUDE	LATITUDE	CORAL	ALGAE	TURF	SP	SAND	LS	DC	CCA	TBS	TBM	MUD	INV	RUB
001	-156.61303	20.80673	73	0	0	0	0	0	1	0	26	0	0	0	0
002	-156.61279	20.80698	60	0	0	0	0	0	13	0	27	0	0	0	0
003	-156.61267	20.80723	78	0	0	0	0	0	15	0	7	0	0	0	0
004	-156.61273	20.80738	46	7	0	0	3	0	2	0	0	42	0	0	0
005	-156.61266	20.80756	63	2	0	0	0	0	6	0	8	21	0	0	0
006	-156.61257	20.80765	0	0	0	0	100	0	0	0	0	0	0	0	0
072	-156.61233	20.80736	67	4	0	0	0	0	1	0	0	28	0	0	0
073	-156.61232	20.80722	66	1	0	0	0	0	8	0	25	0	0	0	0
074	-156.61232	20.80712	34	0	0	0	3	0	54	0	9	0	0	0	0
075	-156.61236	20.80695	0	0	0	0	100	0	0	0	0	0	0	0	0
076	-156.61250	20.80686	92	0	0	0	0	0	0	0	8	0	0	0	0
077	-156.61253	20.80668	86	0	0	0	0	0	6	0	8	0	0	0	0
078	-156.61250	20.80648	93	0	0	0	0	0	5	0	2	0	0	0	0
079	-156.61329	20.80459	50	0	0	0	1	0	0	0	0	49	0	0	0
080	-156.61328	20.80438	77	0	0	0	0	0	0	0	0	23	0	0	0
081	-156.61339	20.80419	77	0	0	0	0	0	0	0	0	23	0	0	0
082	-156.61329	20.80410	0	0	0	0	100	0	0	0	0	0	0	0	0
083	-156.61341	20.80393	75	0	0	0	0	0	0	0	0	25	0	0	0
084	-156.61342	20.80381	72	1	0	0	0	0	3	0	0	24	0	0	0
085	-156.61348	20.80375	0	0	0	0	100	0	0	0	0	0	0	0	0
086	-156.61363	20.80371	85	0	0	0	0	0	0	0	15	0	0	0	0
087	-156.61373	20.80355	75	0	0	0	0	0	10	0	15	0	0	0	0
088	-156.61376	20.80335	73	0	0	0	0	0	3	0	0	24	0	0	0
089	-156.61375	20.80316	80	0	0	0	0	0	1	0	19	0	0	0	0
090	-156.61388	20.80296	73	0	0	0	0	0	3	0	24	0	0	0	0
091	-156.61400	20.80275	62	0	0	0	0	0	34	0	4	0	0	0	0
092	-156.61411	20.80257	98	0	0	0	0	0	2	0	0	0	0	0	0
093	-156.61425	20.80237	96	0	0	0	0	0	3	0	1	0	0	0	0
094	-156.61445	20.80211	79	0	0	0	0	0	18	0	3	0	0	0	0
095	-156.61456	20.80189	87	0	0	0	0	0	6	0	7	0	0	0	0
096	-156.61468	20.80166	73	0	0	0	0	0	27	0	0	0	0	0	0
097	-156.63218	20.82222	22	0	0	0	4	0	0	0	0	74	0	0	0
098	-156.63215	20.82204	34	0	0	0	7	0	1	0	0	58	0	0	0
099	-156.63195	20.82202	29	0	0	0	0	0	0	0	0	71	0	0	0
100	-156.63192	20.82216	23	0	0	0	0	0	0	0	0	77	0	0	0
168	-156.60966	20.80760	55	0	0	0	0	0	39	0	6	0	0	0	0
169	-156.60964	20.80785	72	0	0	0	0	0	12	0	16	0	0	0	0
170	-156.60951	20.80796	48	0	0	0	0	0	3	0	49	0	0	0	0
171	-156.60942	20.80777	0	0	0	0	100	0	0	0	0	0	0	0	0

TABLE 3-1. continued

CAL/VAL SITE	LONGITUDE	LATITUDE	CORAL	ALGAE	TURF	SP	SAND	LS	DC	CCA	TBS	TBM	MUD	INV	RUB
172	-156.60968	20.80735	67	0	0	0	0	0	18	0	15	0	0	0	0
173	-156.60968	20.80674	84	0	0	0	1	0	14	0	1	0	0	0	0
174	-156.60979	20.80635	58	0	0	0	2	0	40	0	0	0	0	0	0
175	-156.60975	20.80604	84	0	0	0	0	0	3	0	13	0	0	0	0
176	-156.60980	20.80614	88	0	0	0	0	0	3	0	9	0	0	0	0
177	-156.60972	20.80568	0	0	0	0	100	0	0	0	0	0	0	0	0
178	-156.60981	20.80589	90	0	0	0	0	0	1	0	9	0	0	0	0
964	-156.62044	20.80471	83	0	0	0	0	0	0	0	0	17	0	0	0
965	-156.62041	20.80485	32	0	0	0	1	0	2	0	0	65	0	0	0
966	-156.62042	20.80522	42	0	0	0	0	0	2	0	0	56	0	0	0
967	-156.62046	20.80532	44	0	0	0	0	0	2	0	0	54	0	0	0
968	-156.62046	20.80535	83	0	0	0	0	0	3	0	14	0	0	0	0
969	-156.62007	20.80488	69	0	0	0	0	0	0	0	0	31	0	0	0
970	-156.61996	20.80471	57	0	0	0	0	0	3	3	0	37	0	0	0
971	-156.61990	20.80448	5	0	0	0	92	0	0	0	3	0	0	0	0
972	-156.61988	20.80434	0	0	0	0	79	0	0	0	21	0	0	0	0
973	-156.61999	20.80420	60	0	0	0	2	0	4	0	34	0	0	0	0
974	-156.62007	20.80398	94	0	0	0	0	0	2	0	4	0	0	0	0
975	-156.62021	20.80380	0	0	0	0	93	0	0	0	7	0	0	0	0
976	-156.62026	20.80351	98	0	0	0	0	0	2	0	0	0	0	0	0
977	-156.62041	20.80360	95	0	0	0	0	0	5	0	0	0	0	0	0
978	-156.62045	20.80374	0	0	0	0	100	0	0	0	0	0	0	0	0
979	-156.62054	20.80382	98	0	0	0	0	0	1	0	1	0	0	0	0
980	-156.62075	20.80404	88	0	0	0	0	0	12	0	0	0	0	0	0
981	-156.62070	20.80430	83	0	0	0	0	0	9	0	0	8	0	0	0
982	-156.62062	20.80451	80	0	0	0	5	0	3	0	12	0	0	0	0
983	-156.62052	20.80461	27	0	0	0	29	0	0	0	44	0	0	0	0
984	-156.62046	20.80477	65	0	0	0	0	0	0	0	0	35	0	0	0
985	-156.61847	20.80439	0	0	0	0	46	0	0	0	54	0	0	0	0
986	-156.61838	20.80430	47	0	0	0	2	0	16	0	35	0	0	0	0
987	-156.61830	20.80426	28	0	0	0	0	0	17	0	55	0	0	0	0
988	-156.61832	20.80404	2	0	0	0	8	0	0	0	90	0	0	0	0
989	-156.61834	20.80381	24	0	0	0	0	0	29	0	0	47	0	0	0
990	-156.61839	20.80355	62	0	0	0	0	0	9	0	0	29	0	0	0
991	-156.61856	20.80327	75	0	0	0	0	0	6	0	19	0	0	0	0
992	-156.61867	20.80302	72	0	0	0	1	0	7	0	20	0	0	0	0
993	-156.61862	20.80279	84	0	0	0	0	0	8	0	8	0	0	0	0
994	-156.61877	20.80279	0	0	0	0	100	0	0	0	0	0	0	0	0
995	-156.61883	20.80297	84	0	0	0	0	0	6	0	10	0	0	0	0
996	-156.61880	20.80315	66	0	0	0	0	0	14	0	0	20	0	0	0
997	-156.61872	20.80336	49	0	0	0	0	0	21	0	0	30	0	0	0
998	-156.61847	20.80393	65	0	0	0	0	0	2	0	0	33	0	0	0
999	-156.61841	20.80416	46	0	0	0	0	0	11	0	43	0	0	0	0

TABLE 3-2. Locations of cal/val sites and percent cover of each bottom type at Olowalu, Mau collected on November 5, 2010. Abbreviations for bottom cover categories are: TURF=algal turf; SP=sponge; LS=limestone; DC=dead coral; CCA=crustose calcareous algae; TBS=turb-bound marine sediment; TBM=turf bound mud; INV=motile invertebrates; RUB=rubble.

5-Nov-2010

CAL/VAL SITE	DATE	LONGITUDE	LATITUDE	CORAL	ALGAE	TURF	SP	SAND	LS	DC	CCA	TBS	TBM	MUD	INV	RUB
560	20101105	-156.63098	20.81851	22	1	16	0	34	0	3	0	24	0	0	0	0
561	20101105	-156.63088	20.81845	0	0	0	0	100	0	0	0	0	0	0	0	0
562	20101105	-156.63077	20.81856	17	1	20	0	16	0	1	0	45	0	0	0	0
563	20101105	-156.63072	20.81864	0	0	0	0	100	0	0	0	0	0	0	0	0
564	20101105	-156.63072	20.81879	30	1	16	0	17	1	4	0	31	0	0	0	0
565	20101105	-156.63091	20.81873	38	2	9	0	8	0	14	0	29	0	0	0	0
566	20101105	-156.63095	20.81863	0	0	0	0	100	0	0	0	0	0	0	0	0
567	20101105	-156.63055	20.81564	33	0	0	0	3	0	3	0	0	61	0	0	0
568	20101105	-156.63062	20.81555	0	0	0	0	99	0	0	0	1	0	0	0	0
569	20101105	-156.63067	20.81544	0	0	0	0	100	0	0	0	0	0	0	0	0
570	20101105	-156.63056	20.81536	39	2	1	0	3	0	4	1	50	0	0	0	0
571	20101105	-156.63040	20.81539	37	5	0	0	2	0	6	0	0	50	0	0	0
572	20101105	-156.63046	20.81555	53	0	0	0	3	0	13	0	0	31	0	0	0
573	20101105	-156.63035	20.81568	52	0	0	0	1	0	9	0	0	38	0	0	0
574	20101105	-156.63031	20.81581	58	0	0	0	1	0	13	0	0	28	0	0	0
575	20101105	-156.63027	20.81592	29	5	0	0	14	0	4	0	48	0	0	0	0
576	20101105	-156.63045	20.81605	25	2	0	0	8	0	2	0	63	0	0	0	0
577	20101105	-156.63063	20.81585	44	1	0	0	2	0	8	0	45	0	0	0	0
578	20101105	-156.62830	20.81189	8	0	0	0	9	0	0	0	0	83	0	0	0
579	20101105	-156.62828	20.81200	18	0	0	0	1	0	0	0	0	81	0	0	0
580	20101105	-156.62820	20.81215	17	0	0	0	0	0	8	0	0	75	0	0	0
581	20101105	-156.62832	20.81226	24	0	0	0	0	0	3	0	0	73	0	0	0
582	20101105	-156.62854	20.81220	24	1	0	0	2	0	2	0	0	71	0	0	0
583	20101105	-156.62869	20.81210	0	1	0	0	16	0	0	0	0	73	10	0	0
584	20101105	-156.62847	20.81209	27	0	0	0	2	0	4	0	0	67	0	0	0
585	20101105	-156.62848	20.81195	33	1	0	0	4	0	6	0	0	56	0	0	0
587	20101105	-156.62674	20.81066	23	0	0	0	1	0	0	0	0	0	76	0	0
588	20101105	-156.62674	20.81077	27	0	0	0	1	0	7	0	0	0	65	0	0
589	20101105	-156.62673	20.81075	29	0	0	0	0	0	7	0	0	0	64	0	0
590	20101105	-156.62379	20.80650	2	0	67	0	31	0	0	0	0	0	0	0	0
591	20101105	-156.62369	20.80653	62	0	3	0	0	0	10	4	0	21	0	0	0
592	20101105	-156.62365	20.80646	0	0	39	0	61	0	0	0	0	0	0	0	0
593	20101105	-156.62353	20.80643	67	0	7	0	0	0	7	0	0	19	0	0	0
594	20101105	-156.62347	20.80666	48	0	40	0	0	4	7	0	0	0	0	1	0
595	20101105	-156.62355	20.80680	67	0	0	0	0	1	3	0	0	28	0	1	0
596	20101105	-156.62371	20.80674	57	0	2	0	2	1	5	0	0	33	0	0	0
597	20101105	-156.62383	20.80681	58	0	0	0	1	0	7	0	0	34	0	0	0
598	20101105	-156.62395	20.80689	76	0	0	0	0	0	2	0	0	21	0	1	0

TABLE 3-2. continued.

CAL/VAL SITE	DATE	LONGITUDE	LATITUDE	CORAL	ALGAE	TURF	SP	SAND	LS	DC	CCA	TBS	TBM	MUD	INV	RUB
599	20101105	-156.62394	20.80701	63	0	0	0	0	0	3	0	0	34	0	0	0
600	20101105	-156.62381	20.80695	10	0	0	0	20	0	0	0	13	57	0	0	0
601	20101105	-156.62174	20.80521	60	0	9	0	0	0	8	0	0	23	0	0	0
602	20101105	-156.62158	20.80521	60	0	15	0	0	0	10	0	0	15	0	0	0
603	20101105	-156.62149	20.80534	73	0	8	0	5	0	4	0	0	10	0	0	0
604	20101105	-156.62156	20.80549	68	0	16	0	3	0	9	0	4	0	0	0	0
605	20101105	-156.62169	20.80575	61	0	0	0	0	0	2	0	0	37	0	0	0
606	20101105	-156.62196	20.80571	64	0	3	0	0	0	9	0	0	24	0	0	0
607	20101105	-156.62208	20.80555	68	0	4	0	0	0	0	0	0	28	0	0	0
608	20101105	-156.62222	20.80542	0	0	14	0	85	0	1	0	0	0	0	0	0
609	20101105	-156.62228	20.80514	0	0	6	0	94	0	0	0	0	0	0	0	0
610	20101105	-156.62217	20.80502	74	0	0	0	0	0	11	0	0	15	0	0	0
611	20101105	-156.62204	20.80512	73	0	0	0	0	0	13	0	0	14	0	0	0
612	20101105	-156.62193	20.80506	0	1	1	0	88	0	0	0	10	0	0	0	0
613	20101105	-156.62183	20.80501	53	2	31	0	0	0	14	0	0	0	0	0	0
614	20101105	-156.62177	20.80510	63	0	0	0	0	0	3	0	2	32	0	0	0
615	20101105	-156.62160	20.80510	0	0	0	0	100	0	0	0	0	0	0	0	0
616	20101105	-156.62153	20.80528	71	0	0	0	0	0	3	0	0	26	0	0	0
617	20101105	-156.61990	20.80406	58	6	0	0	0	0	0	0	36	0	0	0	0
618	20101105	-156.61984	20.80395	67	3	4	0	0	0	8	0	18	0	0	0	0
619	20101105	-156.61975	20.80378	69	8	15	0	0	0	8	0	0	0	0	0	0
620	20101105	-156.61968	20.80390	1	0	0	0	98	0	0	0	1	0	0	0	0
621	20101105	-156.61960	20.80410	56	2	30	0	0	0	11	0	0	1	0	0	0
622	20101105	-156.61961	20.80430	55	3	35	0	1	0	6	0	0	0	0	0	0
623	20101105	-156.61972	20.80430	0	0	0	0	55	0	0	0	45	0	0	0	0
624	20101105	-156.61980	20.80439	0	0	0	0	82	0	0	0	18	0	0	0	0
625	20101105	-156.62003	20.80431	60	2	28	0	0	0	10	0	0	0	0	0	0
626	20101105	-156.62016	20.80422	73	0	17	0	2	0	3	0	5	0	0	0	0

TABLE 3-3. Locations of cal/val sites and percent cover of each bottom type at Olowalu, Mau collected on April 2, 2011. Abbreviations for bottom cover categories are: TURF=algal turf; SP=sponge; LS=limestone; DC=dead coral; CCA=crustose calcareous algae; TBS=turb-bound marine sediment; TBM=turf bound mud; INV=motile invertebrates; RUB=rubble.

2-Apr-2011

CAL/VAL SITE	DATE	LONGITUDE	LATITUDE	CORAL	ALGAE	TURF	SP	SAND	LS	DC	CCA	TBS	TBM	MUD	INV	RUB
063	20110402	-156.62277	20.80894	63	0	0	0	22	8	0	0	7	0	0	0	0
064	20110402	-156.62274	20.80890	65	0	0	0	0	15	0	0	20	0	0	0	0
066	20110402	-156.62288	20.80863	23	0	0	0	0	33	0	0	17	0	0	0	27
067	20110402	-156.62298	20.80846	38	0	0	0	7	13	0	0	2	0	0	0	40
068	20110402	-156.62256	20.80836	72	0	0	0	3	23	0	0	2	0	0	0	0
069	20110402	-156.62247	20.80814	47	10	0	0	15	25	0	0	0	0	0	0	3
070	20110402	-156.62220	20.80765	58	2	0	0	2	31	0	0	7	0	0	0	0
072	20110402	-156.62145	20.80750	30	2	0	0	33	17	0	0	1	0	0	0	17
073	20110402	-156.62132	20.80793	44	8	0	0	10	22	0	0	13	0	0	0	3
074	20110402	-156.62123	20.80831	66	9	0	0	2	16	0	0	7	0	0	0	0
075	20110402	-156.62111	20.80859	0	10	0	0	57	0	0	0	0	0	0	0	33
076	20110402	-156.62092	20.80889	0	3	0	0	47	0	0	0	0	0	0	0	50
077	20110402	-156.62036	20.80859	36	40	0	0	9	7	0	0	8	0	0	0	0
078	20110402	-156.62021	20.80836	53	42	0	0	0	2	0	0	3	0	0	0	0
079	20110402	-156.62013	20.80810	8	92	0	0	0	0	0	0	0	0	0	0	0
080	20110402	-156.62005	20.80787	36	47	0	0	1	0	0	0	16	0	0	0	0
081	20110402	-156.62021	20.80761	55	13	0	0	7	0	0	0	25	0	0	0	0
083	20110402	-156.62024	20.80760	59	9	0	0	3	0	0	0	29	0	0	0	0
084	20110402	-156.61375	20.80969	0	0	0	0	72	0	0	0	0	0	0	0	28
085	20110402	-156.61460	20.80881	30	0	0	0	70	0	0	0	0	0	0	0	0
086	20110402	-156.61610	20.80758	25	0	0	0	47	0	0	0	8	0	0	0	20
087	20110402	-156.61644	20.80721	11	0	0	0	35	13	0	0	36	0	0	0	5
088	20110402	-156.61744	20.80696	11	29	0	0	8	8	0	0	44	0	0	0	0
089	20110402	-156.61802	20.80710	29	18	0	0	0	0	0	0	53	0	0	0	0
090	20110402	-156.61922	20.80734	23	31	0	0	26	2	0	0	18	0	0	0	0
091	20110402	-156.61898	20.80718	16	27	0	0	37	0	0	0	12	0	0	0	8
092	20110402	-156.61852	20.80704	0	70	0	0	26	0	0	0	0	0	0	0	4
093	20110402	-156.61808	20.80701	63	0	0	0	0	0	0	0	37	0	0	0	0
094	20110402	-156.61763	20.80694	16	0	0	0	4	0	0	0	80	0	0	0	0
095	20110402	-156.61684	20.80722	1	71	0	0	9	0	0	0	19	0	0	0	0
096	20110402	-156.61471	20.80859	16	2	0	0	0	0	0	0	82	0	0	0	0
098	20110402	-156.60805	20.80857	67	0	0	0	0	0	0	0	33	0	0	0	0
099	20110402	-156.60783	20.80872	60	8	0	0	0	0	0	0	32	0	0	0	0
100	20110402	-156.60707	20.80889	44	3	0	0	0	0	0	0	53	0	0	0	0

TABLE 3-4. Locations of cal/val sites and percent cover of each bottom type at Olowalu, Mau collected on June 12, 2011. Abbreviations for bottom cover categories are: TURF=algal turf; SP=sponge; LS=limestone; DC=dead coral; CCA=crustose calcareous algae; TBS=turb-bound marine sediment; TBM=turf bound mud; INV=motile invertebrates; RUB=rubble.

12-Jun-2011

CAL/VAL SITE	DATE	LONGITUDE	LATITUDE	CORAL	ALGAE	TURF	SP	SAND	LS	DC	CCA	TBS	TBM	MUD	INV	RUB
180	20110612	-156.63019	20.81866	30	0	0	0	0	13	0	0	50	0	0	0	7
181	20110612	-156.62969	20.81761	3	9	0	0	6	2	0	0	80	0	0	0	0
183	20110612	-156.62942	20.81511	46	0	0	0	0	10	0	0	44	0	0	0	0
184	20110612	-156.62820	20.81373	3	0	0	0	2	0	0	0	95	0	0	0	0
185	20110612	-156.62801	20.81339	16	0	0	0	0	6	0	0	78	0	0	0	0
186	20110612	-156.62721	20.81164	47	0	0	0	0	5	0	0	48	0	0	0	0
187	20110612	-156.62627	20.81123	27	0	0	0	0	5	0	0	58	0	0	0	10
188	20110612	-156.62592	20.81021	6	0	0	0	50	10	0	0	34	0	0	0	0
190	20110612	-156.62685	20.80929	10	0	0	0	50	0	0	0	0	0	0	0	40
191	20110612	-156.62442	20.80942	6	6	0	0	0	15	0	0	23	0	0	0	50
192	20110612	-156.62424	20.80957	0	60	0	0	0	15	0	0	5	0	0	0	20
193	20110612	-156.62494	20.80941	46	0	0	0	0	15	0	0	39	0	0	0	0
194	20110612	-156.62284	20.80546	40	0	0	0	40	0	0	0	0	0	0	0	20
196	20110612	-156.62195	20.80633	27	0	0	0	0	0	0	0	48	0	0	0	25
197	20110612	-156.61879	20.80548	35	0	0	0	0	5	0	0	60	0	0	0	0
198	20110612	-156.61658	20.80532	57	0	0	0	0	25	0	0	18	0	0	0	0
199	20110612	-156.61534	20.80677	65	6	0	0	0	5	0	0	24	0	0	0	0
200	20110612	-156.63267	20.81577	0	0	0	0	60	0	0	0	40	0	0	0	0

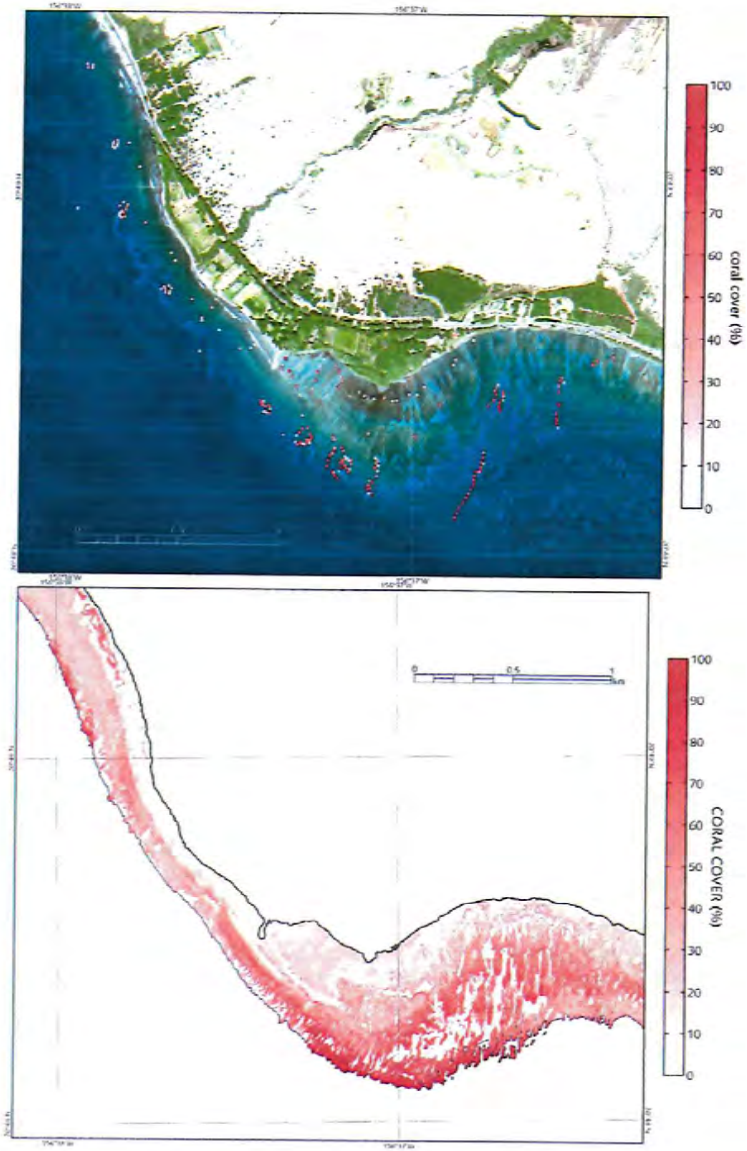


FIGURE 30. Satellite image showing coral cover at Olowalu with cal/val sites color-coded to indicate intensity of cover (top). Map of coral cover created from cal/val data (bottom).

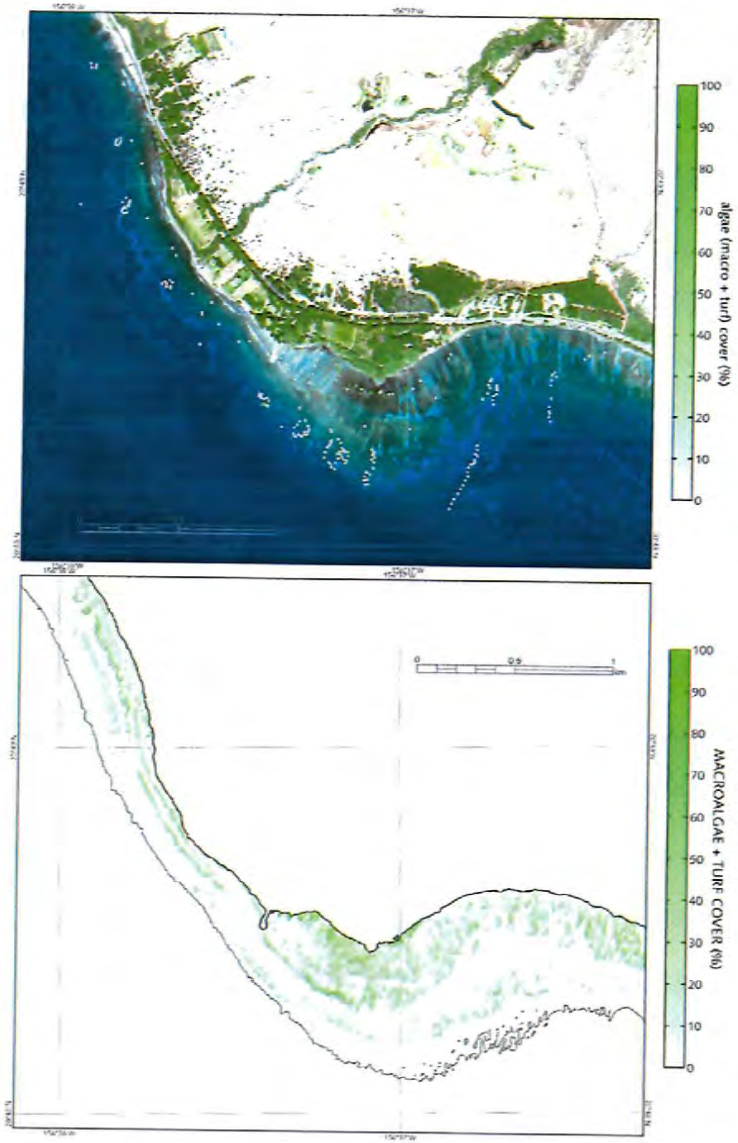


FIGURE 31. Satellite image showing algal cover at Olowalu with cal/val sites color-coded to indicate intensity of cover (top). Map of algal cover created from cal/val data (bottom).

FIGURE 32. Satellite image showing mud and sediment cover at Olowalu with cal/val sites color-coded to indicate intensity of cover (top). Map of mud and sediment cover created from cal/val data (bottom).

TABLE 4. Cross-validation accuracy assessment matrix for coral covel in map product produced for Olowalu survey sites. In cross-validation, all but one data point are used to build a classifier, and the classifier is tested on the withheld point. This process is repeated on every point in the data set. The result is a matrix of classification rates, comparing the actual classes with classes predicted from the classifer. Correct classifications on the diagonal and incorrect classification off-diagonal. The highest accuracy (98%) occurred in the class with no coral, indicating that only 2% of the time pixels were classified as containing coral when none was present. The lowest accuracy (70%) occurred in the class with the highest coral cover (>90%), where 30% of the pixels expressed coral coverage below 90%.

		ACTUAL CLASSES						
		coral = 0	0 < coral ≤ 10	10 < coral ≤ 30	30 < coral ≤ 50	50 < coral ≤ 70	70 < coral ≤ 90	coral > 90
PREDICTED CLASSES	coral = 0	98.0	1.6	1.1	0.8	0.4	0.9	2.9
	0 < coral ≤ 10	0.3	91.0	3.5	1.5	1.4	0.5	2.0
	10 < coral ≤ 30	1.1	3.6	88.2	8.0	3.7	0.9	0.6
	30 < coral ≤ 50	0.1	1.3	2.9	77.8	4.4	3.0	1.5
	50 < coral ≤ 70	0.1	1.2	2.9	7.0	74.6	11.7	6.4
	70 < coral ≤ 90	0.3	0.8	1.1	4.8	13.1	78.6	16.6
	coral > 90	0.1	0.4	0.3	0.2	2.4	4.5	70.0

TABLE 5. Total area cover (in $10^3 m^2$) of classes of coral, algae, sand and mud (including turf-bound sediment) in Olowalu map area.

COVER CLASS	CORAL	ALGAE	SAND	MUD/SEDIMENT
x = 0	317	1,107	845	348
0 < x ≤ 10	235	390	400	250
10 < x ≤ 30	476	153	136	449
30 < x ≤ 50	234	53	159	385
50 < x ≤ 70	257	78	36	160
70 < x ≤ 90	226	7	50	183
x > 90	51	9	171	23
TOTAL % COVER	37.6	8.3	21.2	32.9

TABLE 6-a. Reef fish abundance in Zone A (See Figure 7) off Olowalu. Site ID corresponds to cal/val site designation shown in Table 3.

ZONE A

Site ID	564	576	100
Depth (ft)	16	18	21
Sample Date:			
FAMILY			
Species			
CIRRHITIDAE			
Paracirrhites arcatus	2	2	1
P. forsteri		1	
Cirrhitus pinnulatus	1		
MULLIDAE			
Parupeneus multifasciatus		3	1
Mulloidichthys flavolineatus			
CHAETODONTIDAE			
Chaetodon ornitissimus	1	2	
C. lunula			1
POMACENTRIDAE			
Chromis vanderbilti	76	33	5
C. hanui			
C. agilis			
Stegastes fasciolatus		5	2
Plectroglyphidodon johnstonianus	3	5	1
P. imparipennis			
LABRIDAE			
Gomphosus varius		4	
Thalassoma duperrey	9	35	8
Halichoeres ornatissimus	4	2	
Stethojulis balteata	4	5	2
Pseudocheilinus octotaenia	2		
P. evanidus		1	
ACANTHURIDAE			
Acanthurus olivaceus	4	3	
A. nigrofuscus	3	27	9
A. dussumieri		1	
Naso lituratus			1
BALISTIDAE			
Sufflamen bursa			
S. psittacus		10	
Melichthys niger		3	2
M. vidua			3
Rhinecanthus rectangulus		3	4
TETRADONTIDAE			
Canthigaster jactator	3	2	5
SERRANIDAE			
Cephalopholis argus	1		
MONCANTHIDAE			
Cantherhines dumerilii		1	
AULOSTOMIDAE			
Aulostomus chinensis			1
NUMBER SPECIES	13	20	15
NUMBER INDIVIDUALS	113	148	45

TABLE 6-b. Reef fish abundance in Zone F (See Figure 7) off Olowalu. Site ID corresponds to cal/val site designation shown in Table 3.

ZONE F

Transect Site ID	73	80	87	99	100
Depth	3	3	12	15	18
Sample Date:	4/2/11	4/2/11	4/2/11	4/2/11	4/2/11
FAMILY					
Species					
CIRRHITIDAE					
Cirrhitichthys fasciatus		1			
MULLIDAE					
Parupeneus multifasciatus			4		1
Mulloidichthys flavolineatus	60				
CHAETODONTIDAE					
Chaetodon ornitissimus					2
C. auriga			1		1
C. lunula			1		
POMACENTRIDAE					
Abudefduf abdominalis	2	7		61	11
Stegastes fasciolatus	1	1			1
P. imparipennis					1
LABRIDAE					
Gomphosus varius		1		2	4
Thalassoma duperrey	2	6	2	8	4
Halichoeres ornatissimus		3		2	
Labroides phthirophagus					3
Stethojulis balteata	1	2		4	1
ACANTHURIDAE					
Acanthurus nigrofuscus			10	13	13
A. triostegus			1		
Naso lituratus					4
Naso unicornis					3
Ctenochaetus strigosus					1
BALISTIDAE					
Melichthys niger					4
Rhinecanthus rectangulus				1	
TETRADONTIDAE					
Canthigaster jactator		1			
C. amboinensis				2	
Ostracion meleagris				1	
Arothron meleagris				1	
SCARIDAE					
Scarus psittacus		31	13	8	2
Chlorurus sordidus		4			3
ZANCLIDAE					
Zanclus cornutus			1		
BLENNIIDAE					
Cirripectes vanderbilti					1
NUMBER SPECIES	**5**	**10**	**8**	**11**	**18**
NUMBER INDIVIDUALS	**66**	**57**	**33**	**103**	**60**

TABLE 6-c. Reef fish abundance in Zone H (See Figure 7) off Olowalu. Site ID corresponds to cal/val site designation shown in Table 3.

ZONE H

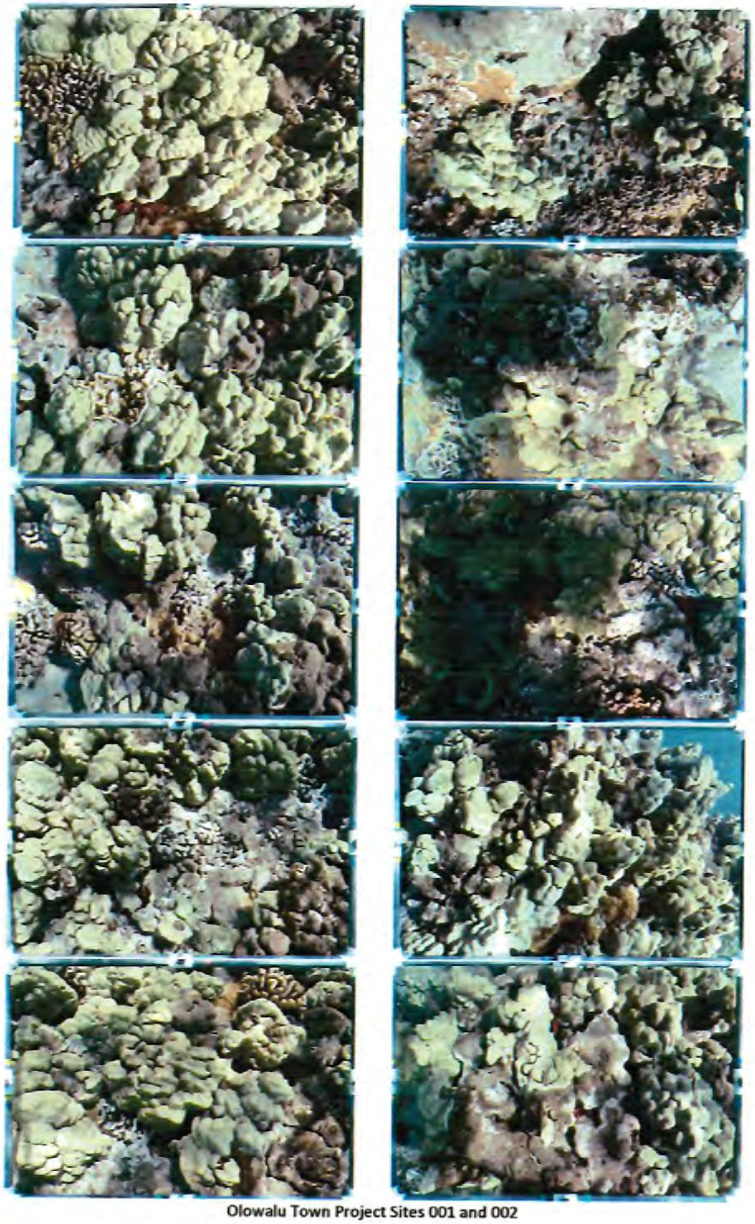
Transect Site ID	590	610	615	964	980	991	84	95
Depth (feet)	30	25	27	24	29	27	25	30
Sample Date:	11/15/10	11/15/10	11/15/10	2/27/11	2/27/11	2/27/11	2/27/11	2/27/11
FAMILY								
Species								
CIRRHITIDAE								
Paracirrhites arcatus	8	3	2	1		2		1
P. forsteri				2				
MULLIDAE								
Parupeneus multifasciatus	3	2	2		1	1	1	
Mulloidichthys flavolineatus							30	
CHAETODONTIDAE								
Chaetodon ornitissimus		1				1	1	1
C. auriga		1				2	2	
C. lunula		2		1		1	1	
C. unimaculatus							4	2
C. quadrimaculatus							1	
Forcipiger flavissimus				1				
POMACENTRIDAE								
Chromis vanderbilti		300		60		40	25	10
C. hanui		4	3					
C. agilis		2						
Stegastes fascialatus	1	17	11	3	2	1		2
Plectroglyphidodon johnstonianus	2	7	2			1		2
P. imparipennis	2							
LABRIDAE								
Coris gaimard		2						
Gomphosus varius		6	3	6	5	3		2
Thalassoma duperrey	25	30	22	3	7	4	10	5
T. ballieui						1		
Halichoeres ornatissimus		3		2		1	1	
Labroides phthirophagus				2		1		
Stethojulis balteata	18	5	1	2	7		5	
Pseudocheilinus octotaenia	1	4						
P. evanidus	3							
Macropharyngodon geoffroy		2						
Anampses chrysocephalus			1					
ACANTHURIDAE								
Acanthurus olivaceus		12						
A. achilles					3			
A. nigrofuscus	1	28	25	61	17	18	30	25
A. leucopareius				1		1		
A. blochii				10		3	4	1
A. dussumieri				1				
A. triostegus				1			3	15
A. olivaceus				9		22	1	
Naso lituratus						6	2	
N. unicornis			1					
N. brevirostris			1				9	1
Ctenochaetus strigosus		7	25					
Zebrasoma flavescens	1	5	1					
BALISTIDAE								
Sufflamen bursa	2	4				2	3	2
S. psittacus	5	8	1					
Melichthys niger	3	4		3	2	7	5	43
M. vidua	1	1		3	2		1	3
Rhinecanthus rectangulus	6			1	2			
TETRADONTIDAE								
Canthigaster jactator	16	3		2		1		1
Arothron hispidus								1
SCARIDAE								
Scarus rubroviolaceus		1	1					1
S. psittacus				9	6	20	1	
Chlorurus sordidus	1	5	10	4		12	5	5
C. perspicillatus						1		
BLENNIIDAE								
Cirripectes vanderbilti		1						
HOLOCENTRIDAE								
Sargocentron esifer		1						
NUMBER SPECIES	**18**	**30**	**17**	**23**	**11**	**24**	**22**	**19**
NUMBER INDIVIDUALS	**99**	**471**	**112**	**188**	**54**	**152**	**145**	**123**

APPENDIX A.

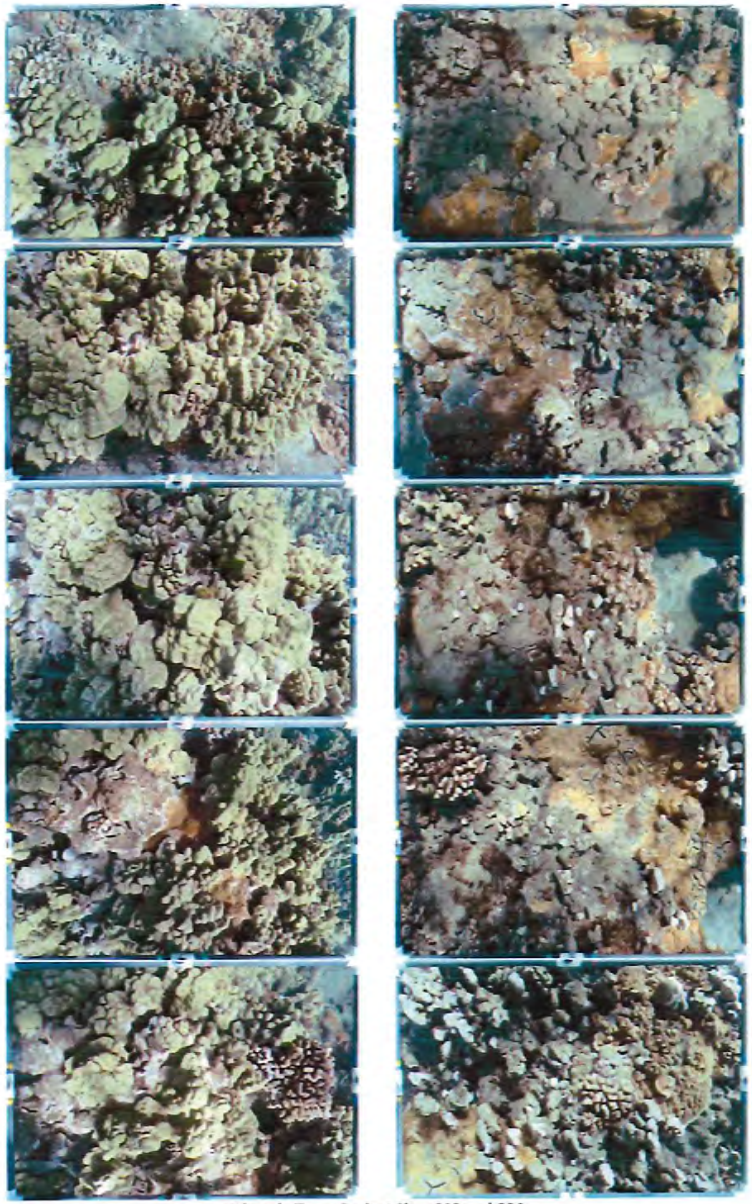
Photoquadrats

ASSESSMENT OF MARINE WATER CHEMISTRY AND BIOTIC COMMUNITY STRUCTURE IN THE VICINITY OF THE OLOWALU TOWN MASTER PLAN, OLOWALU, MAUI, HAWAII

July 2011



Olowalu Town Project Sites 001 and 002



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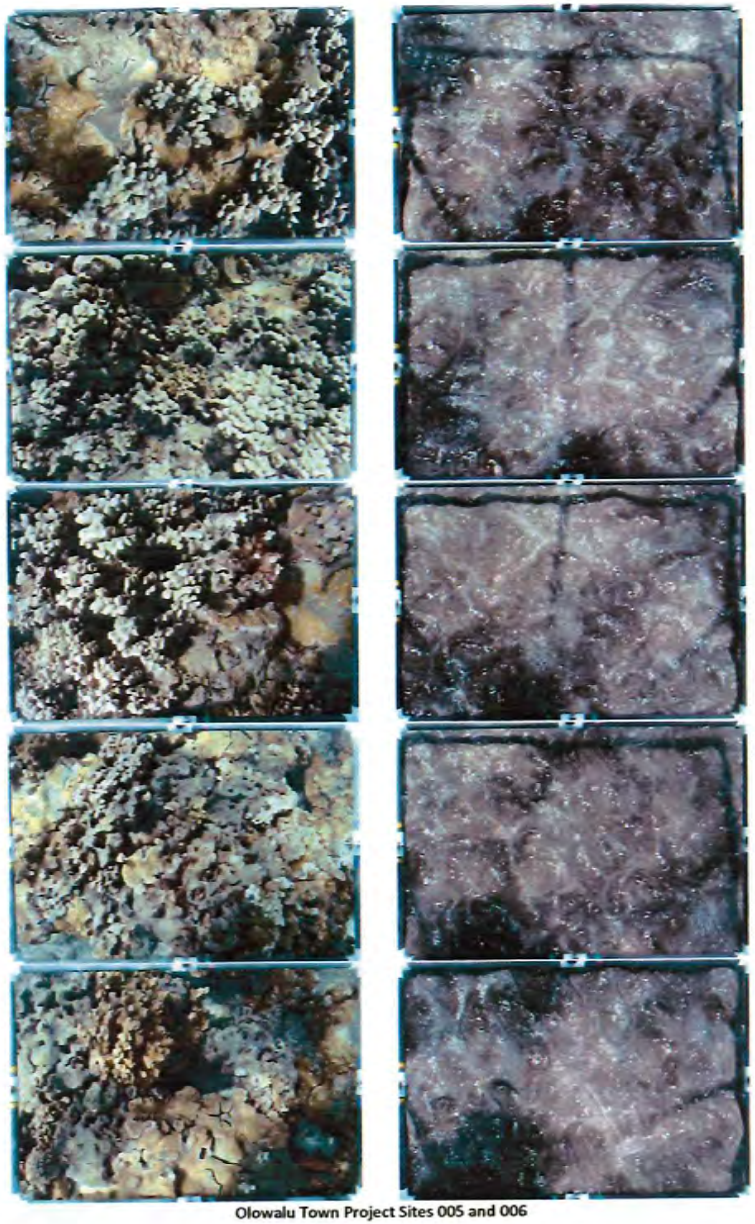

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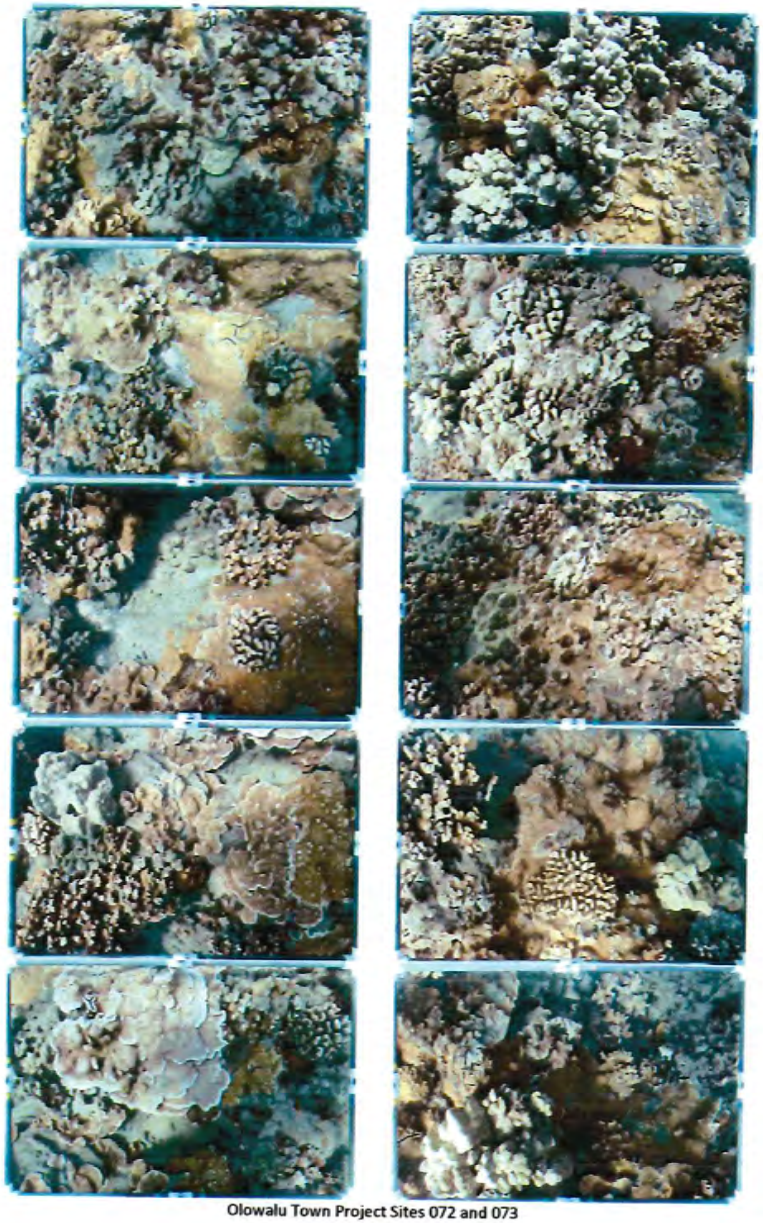

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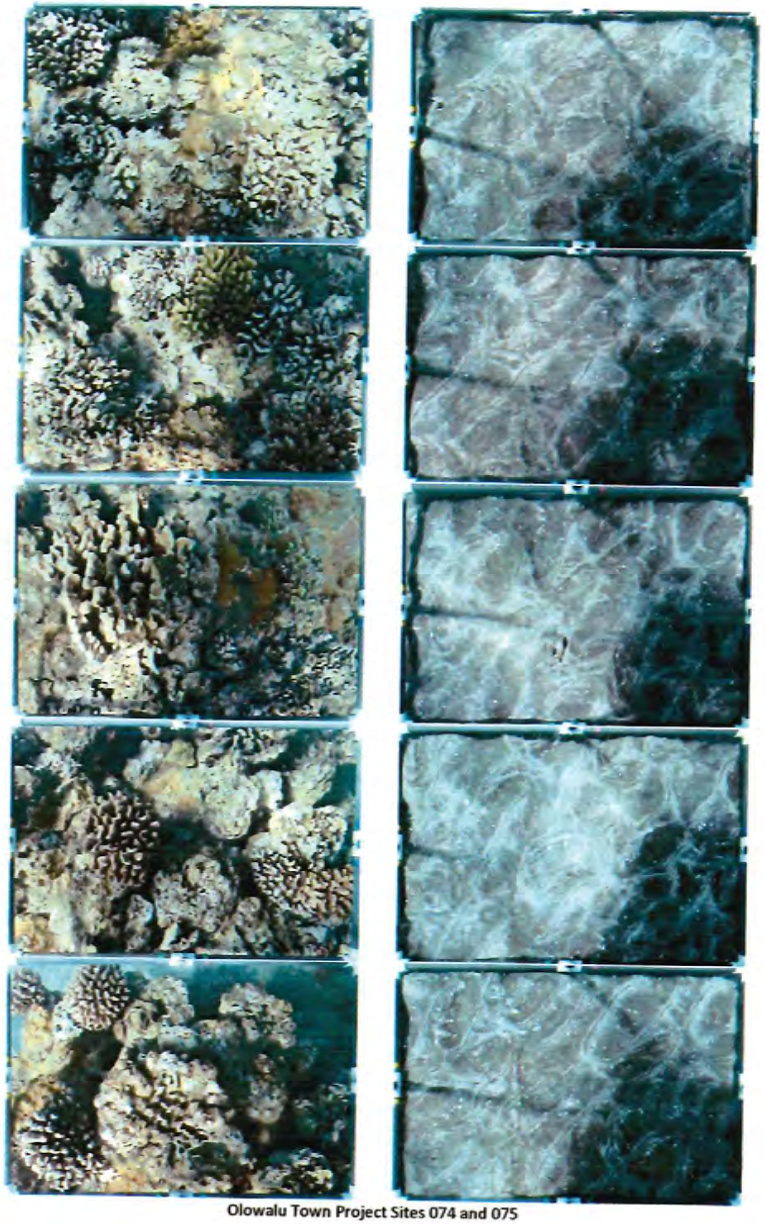

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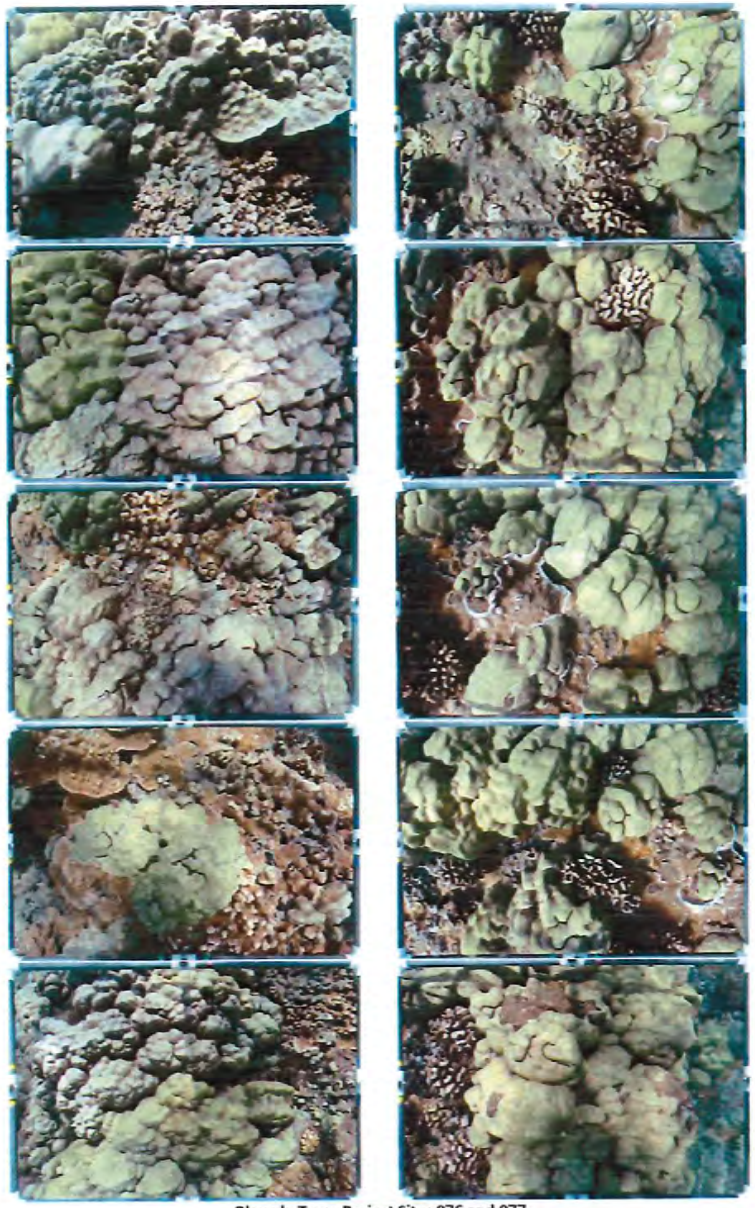

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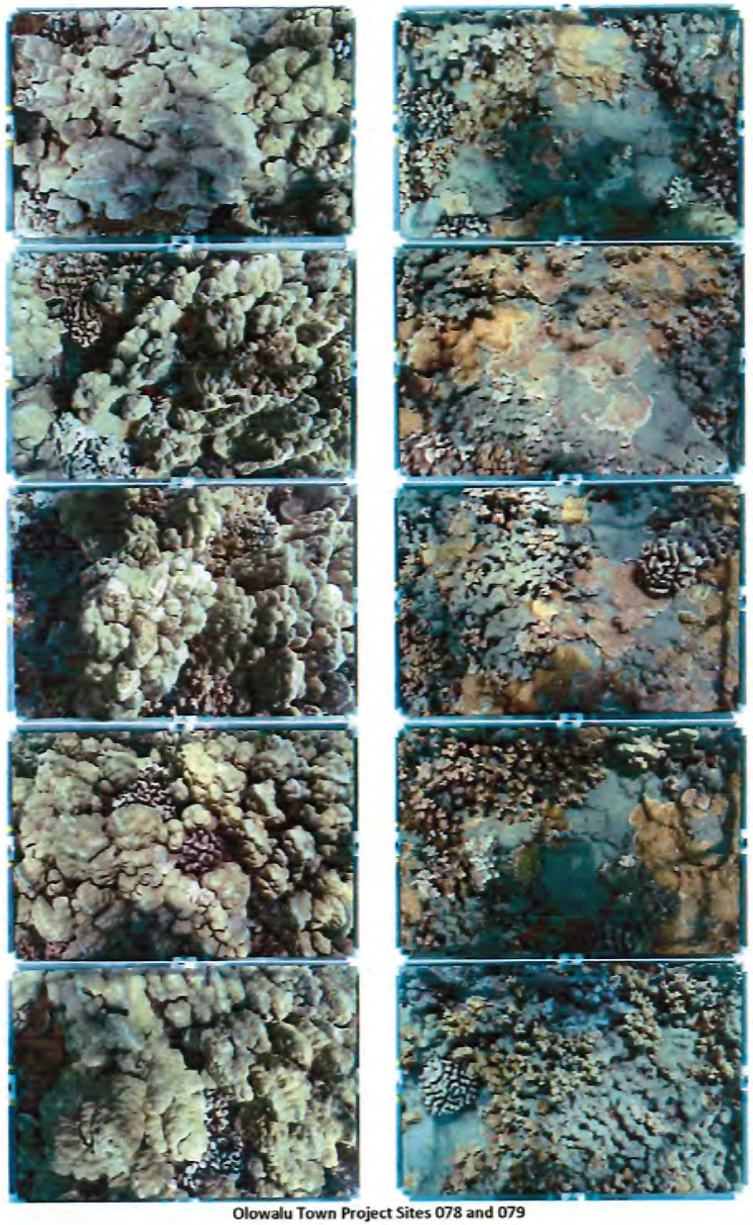

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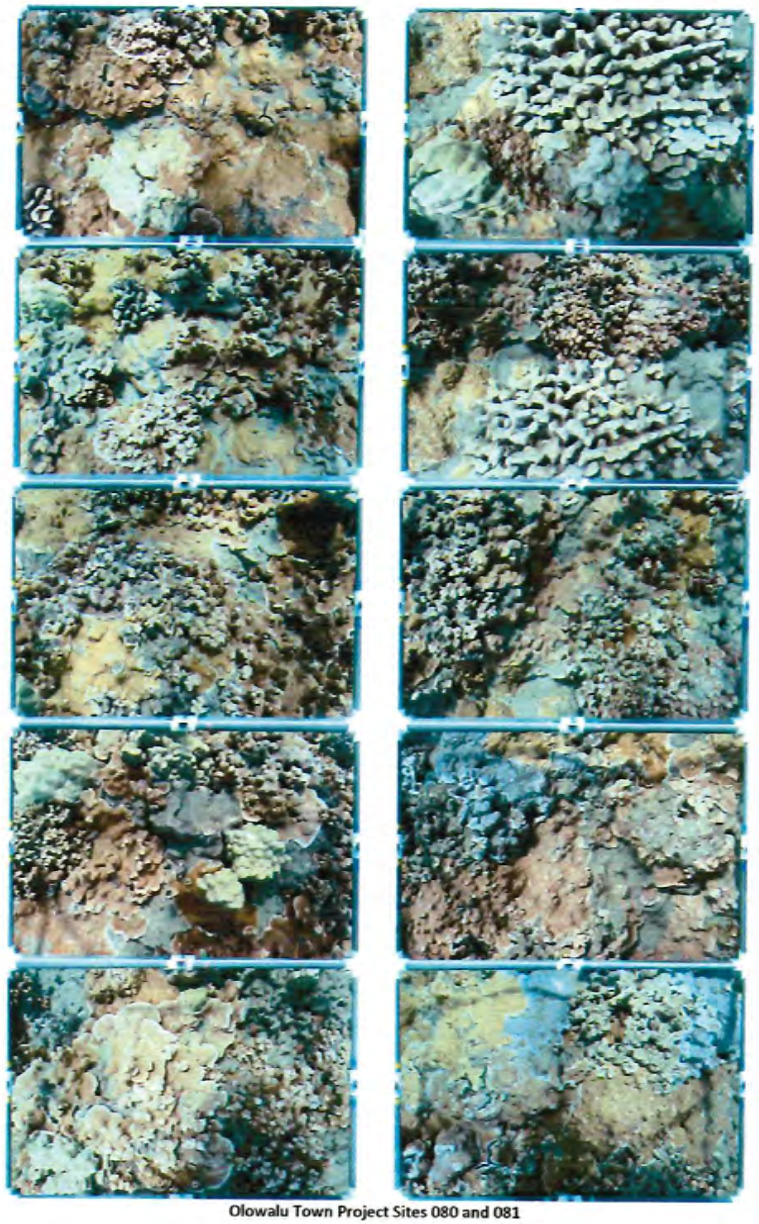

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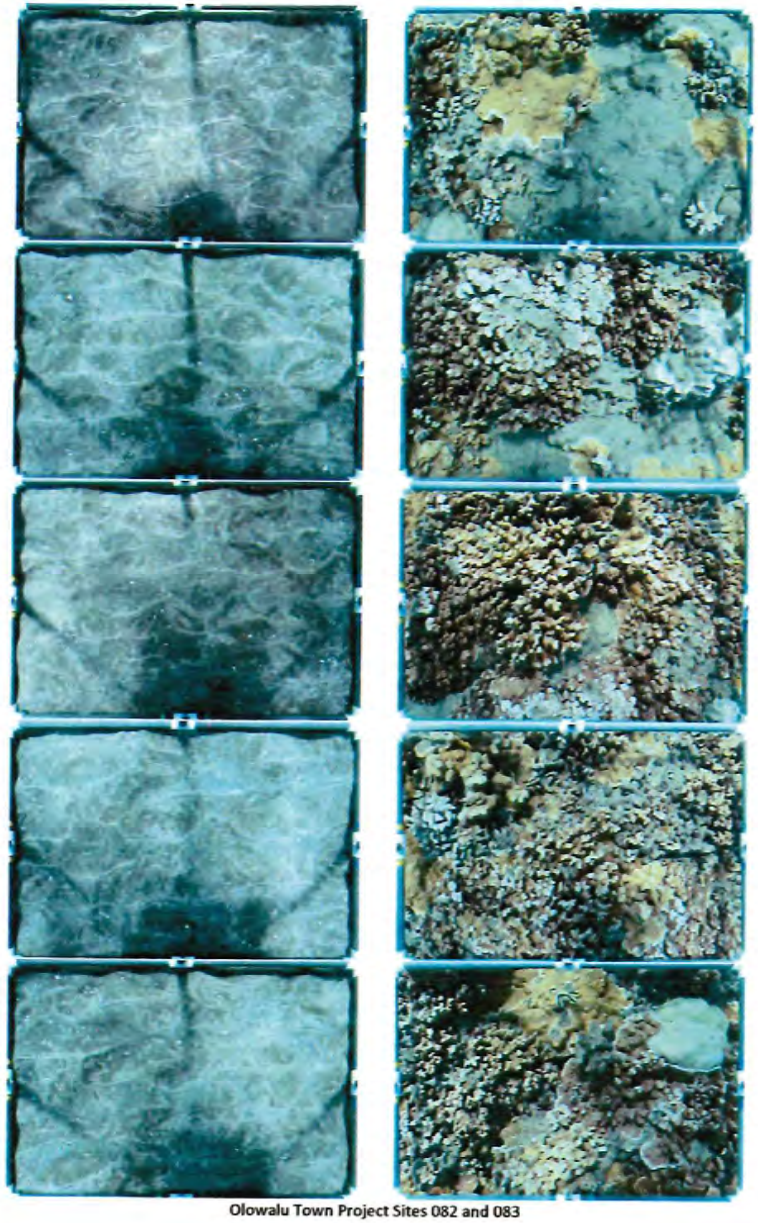

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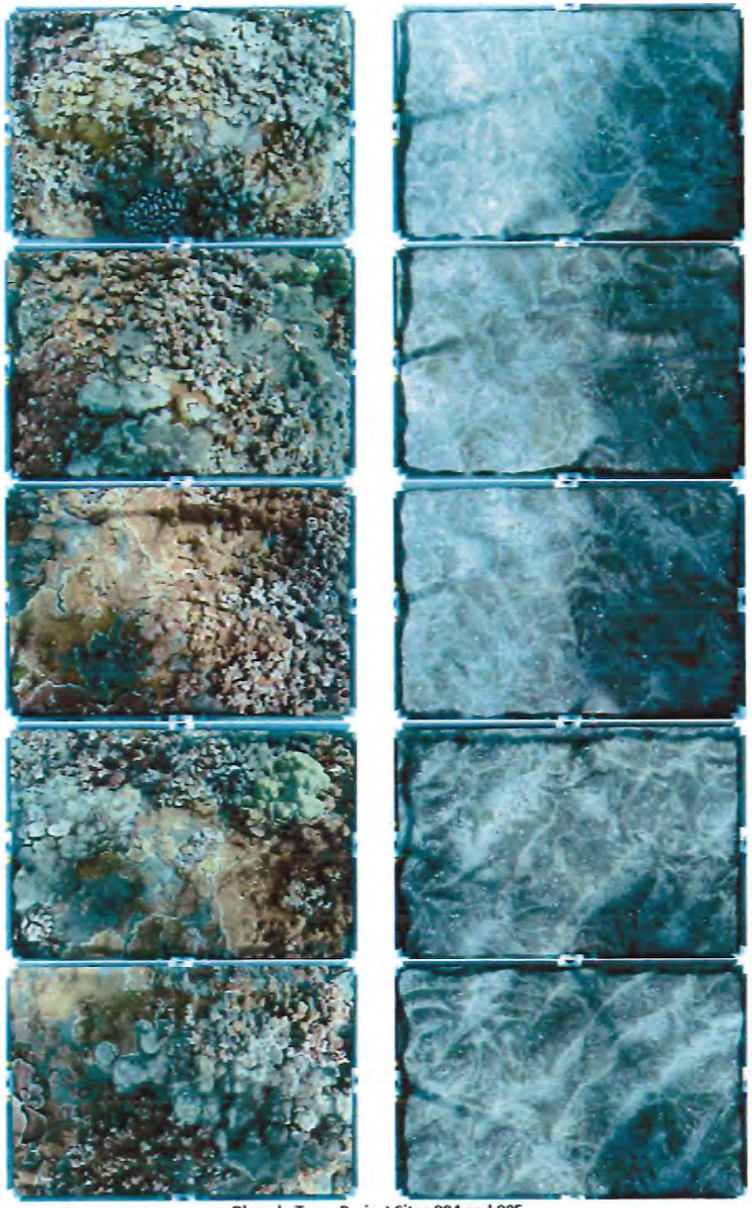

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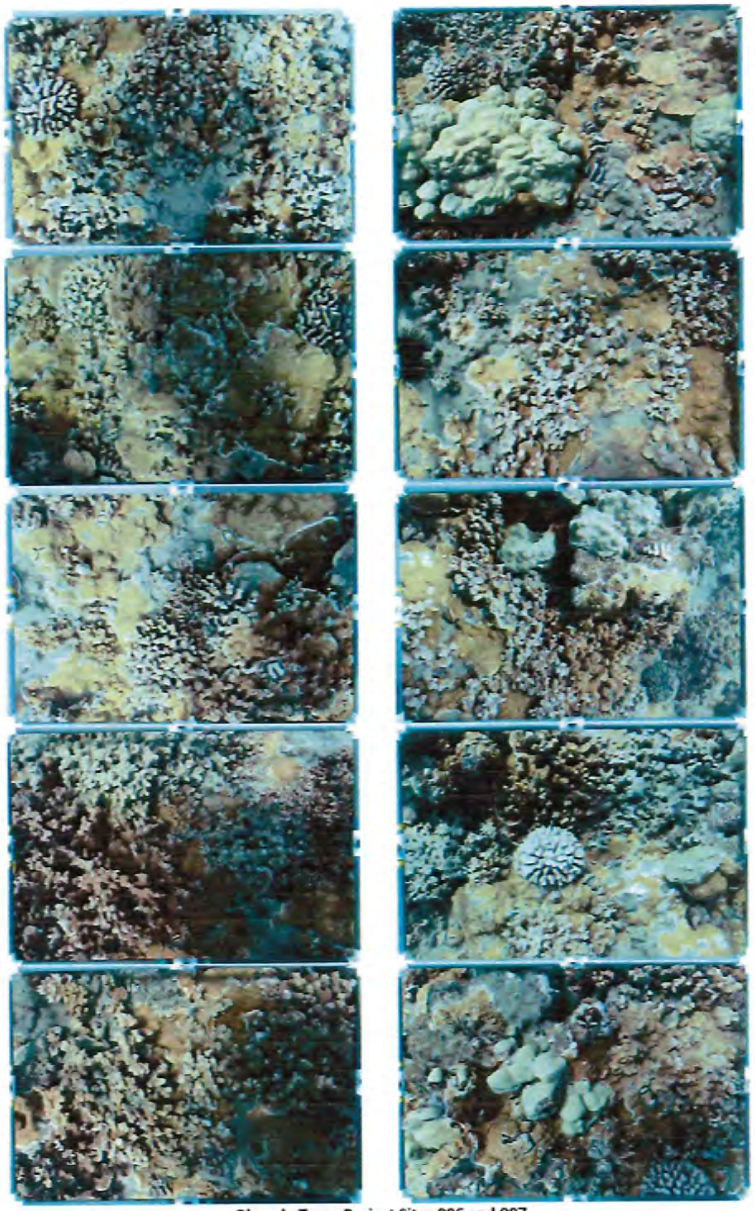

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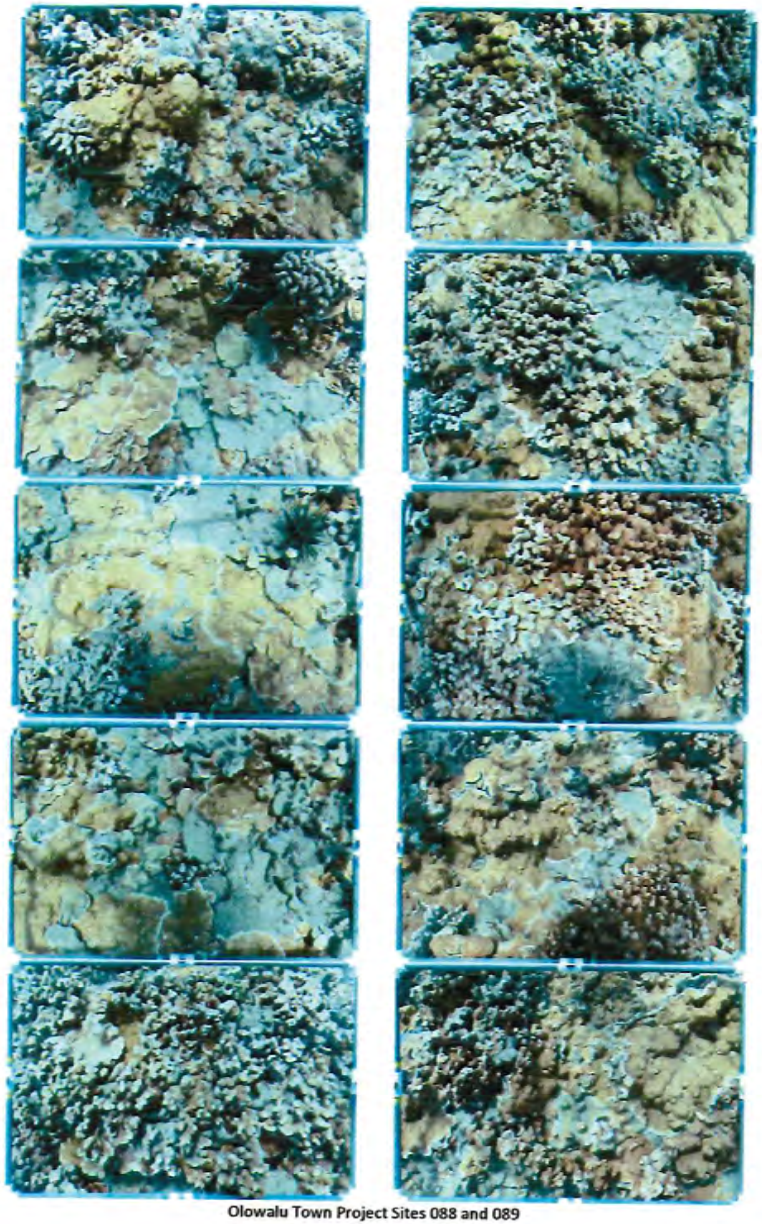

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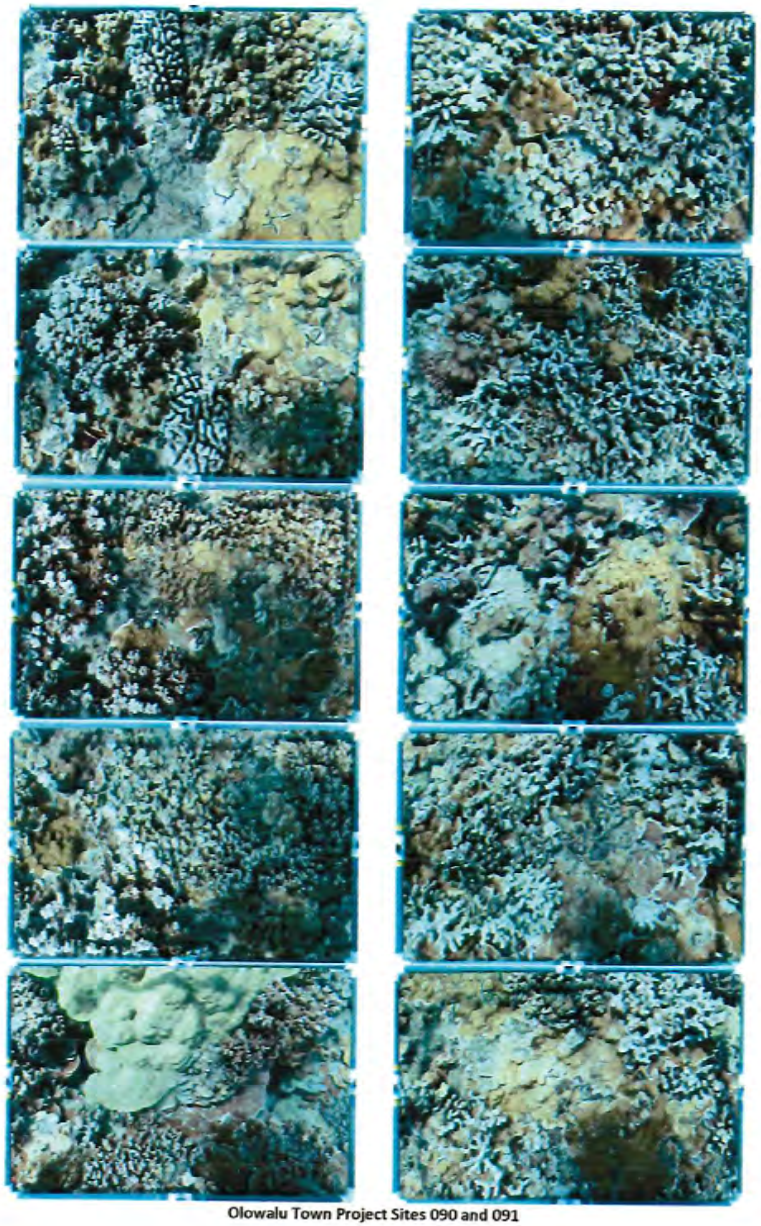

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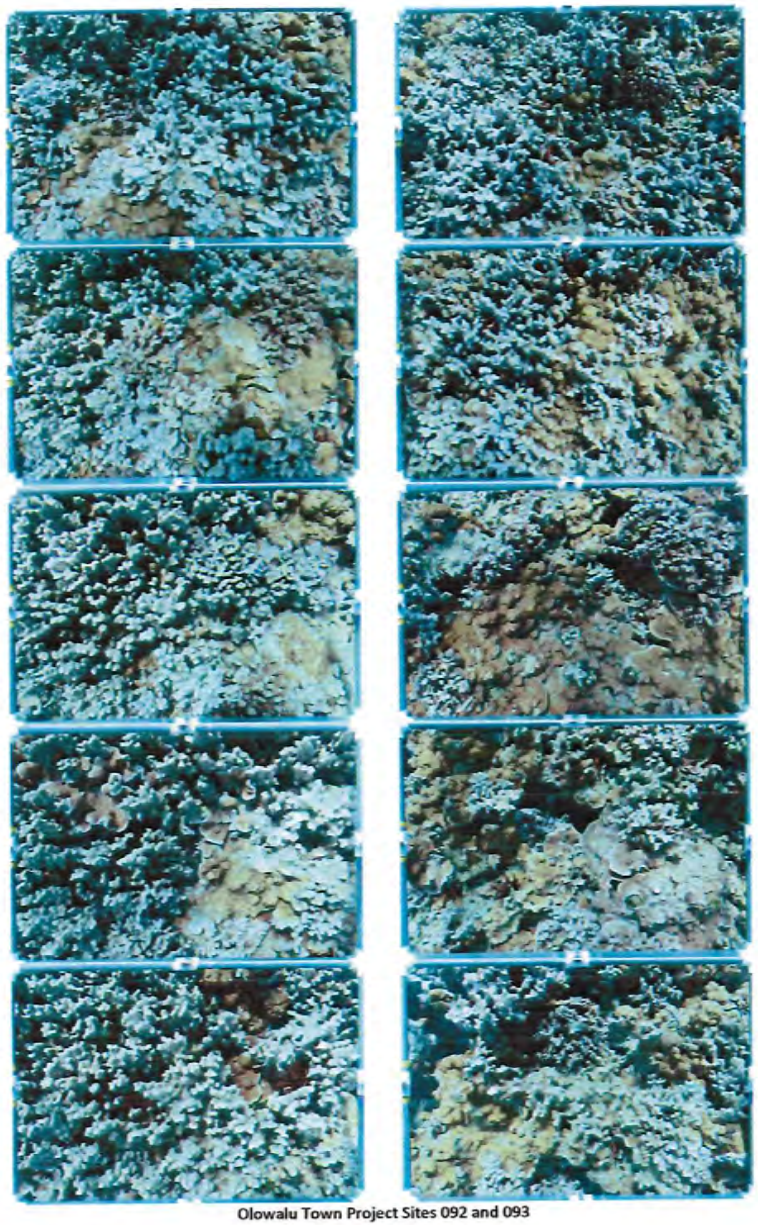

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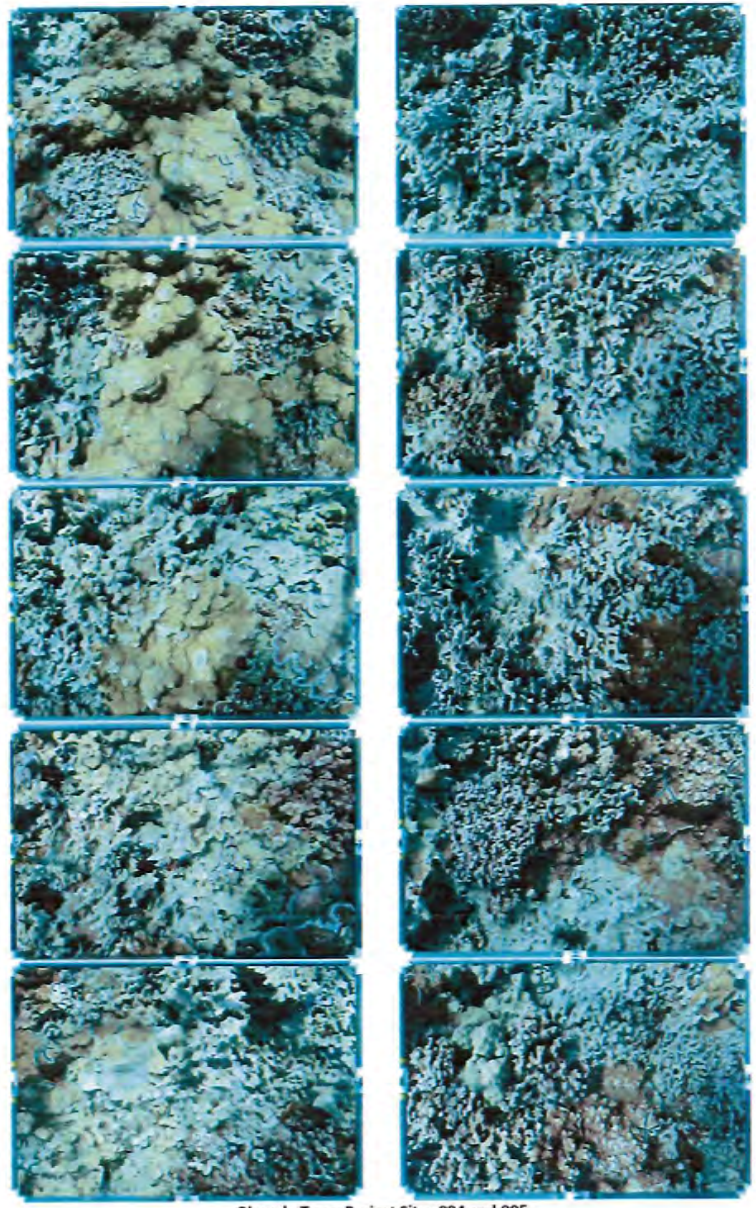

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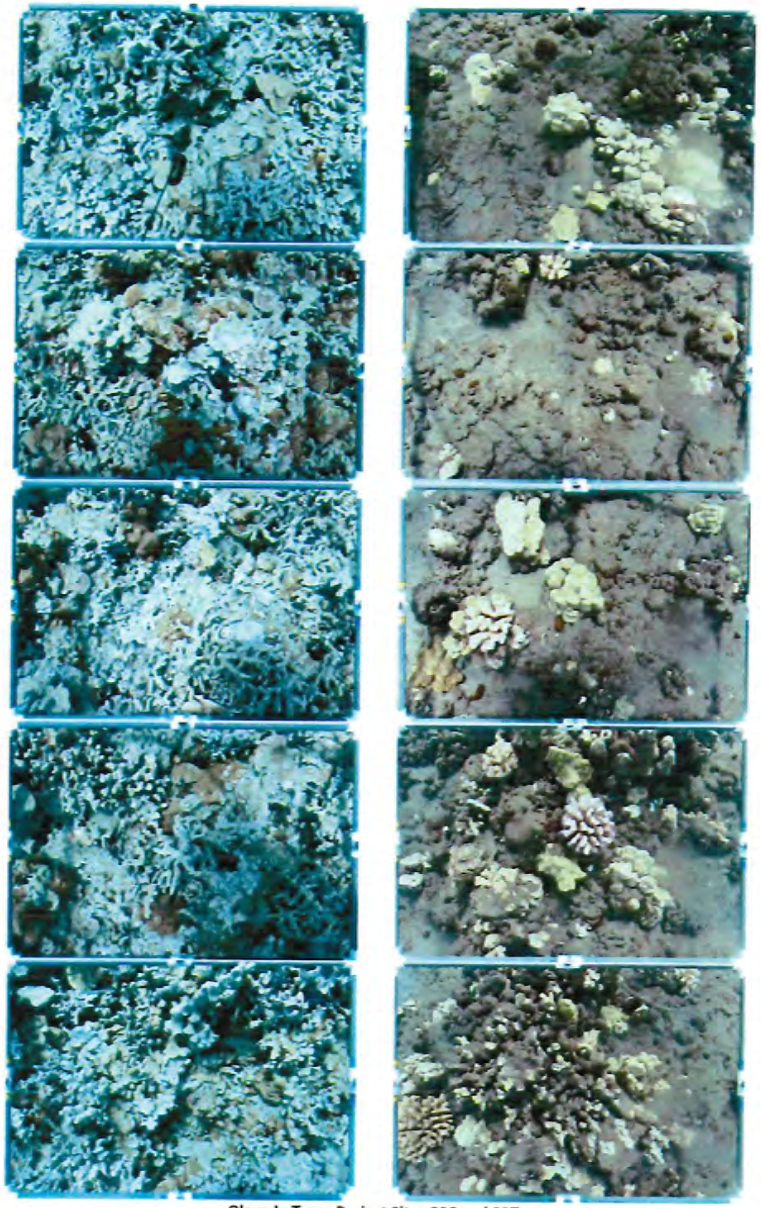

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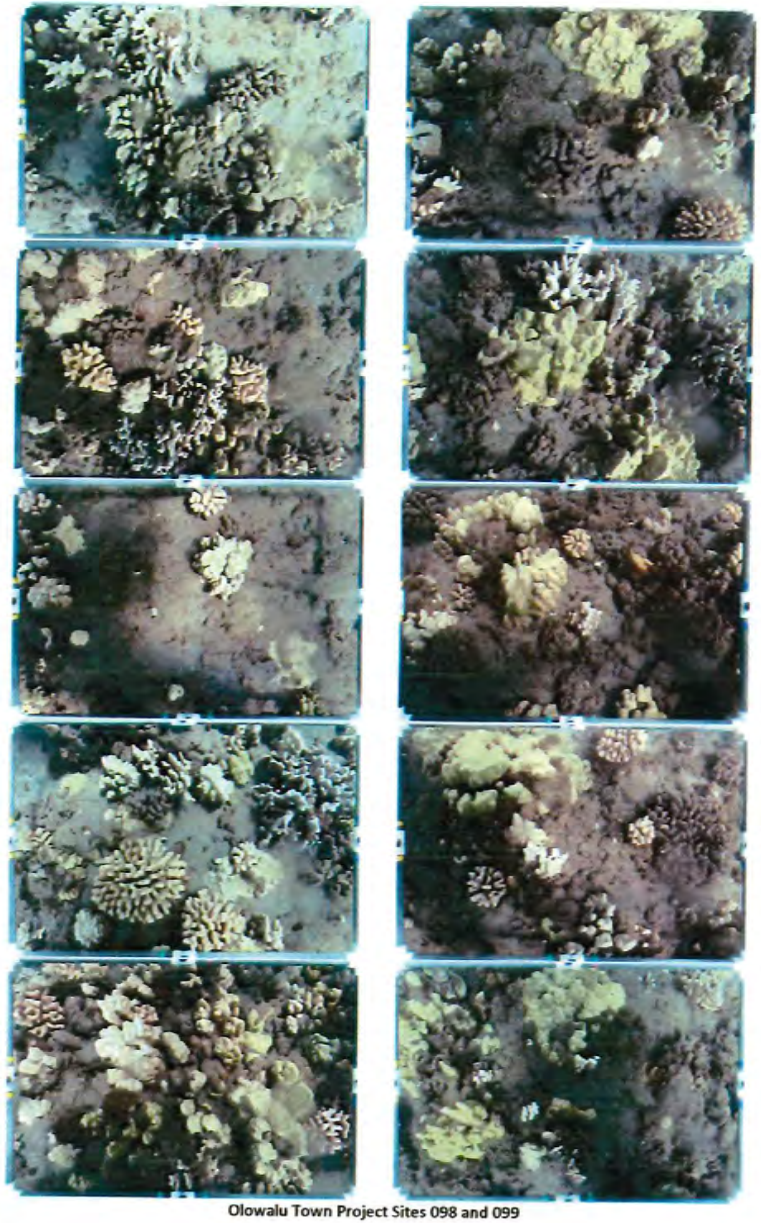

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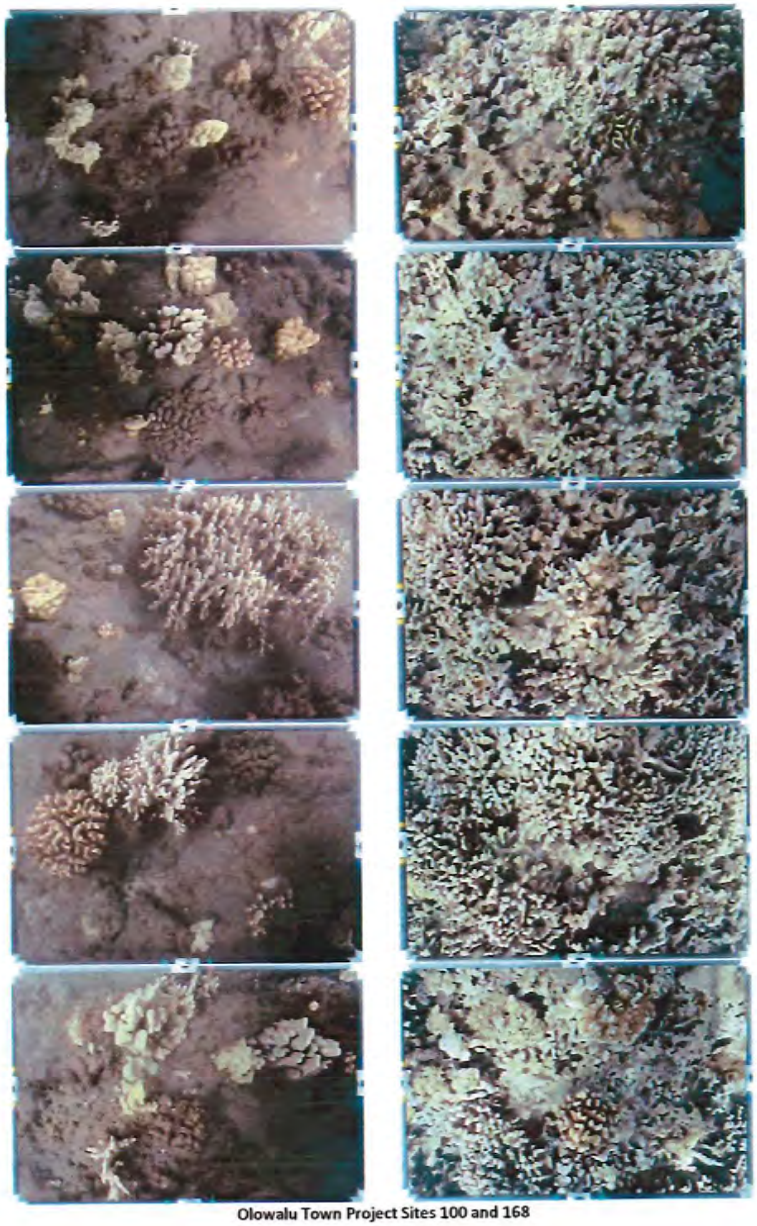
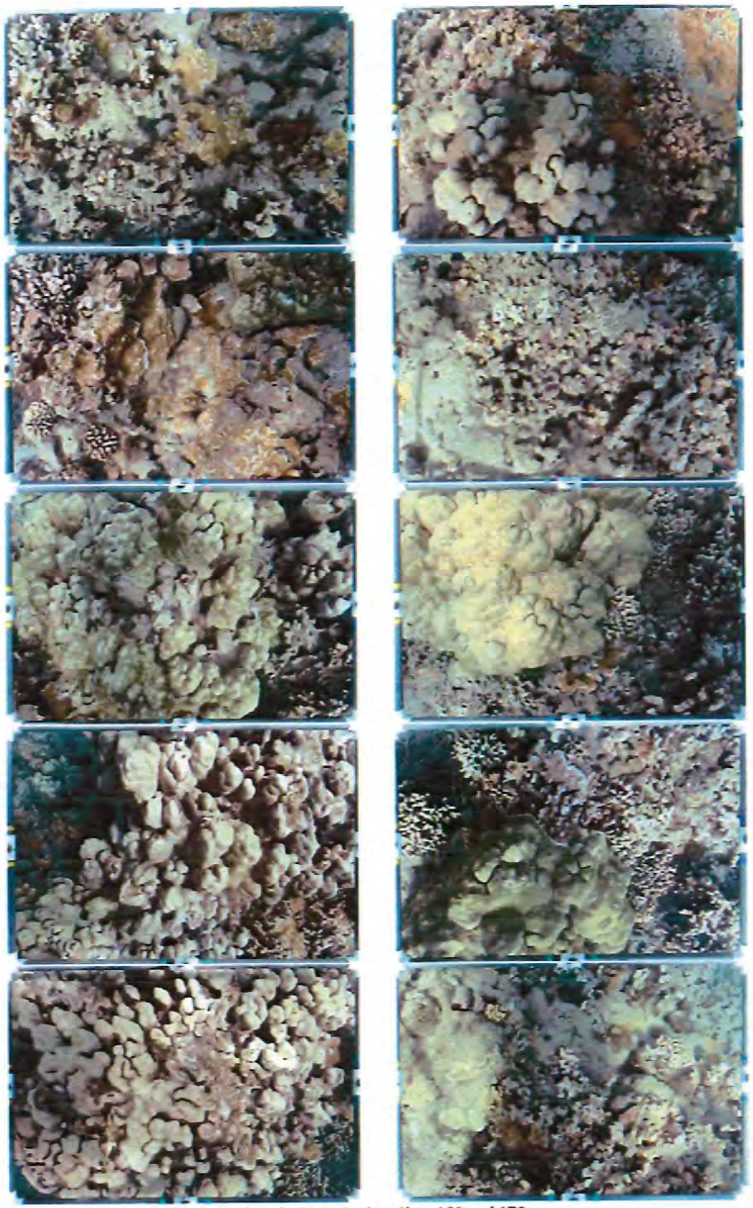
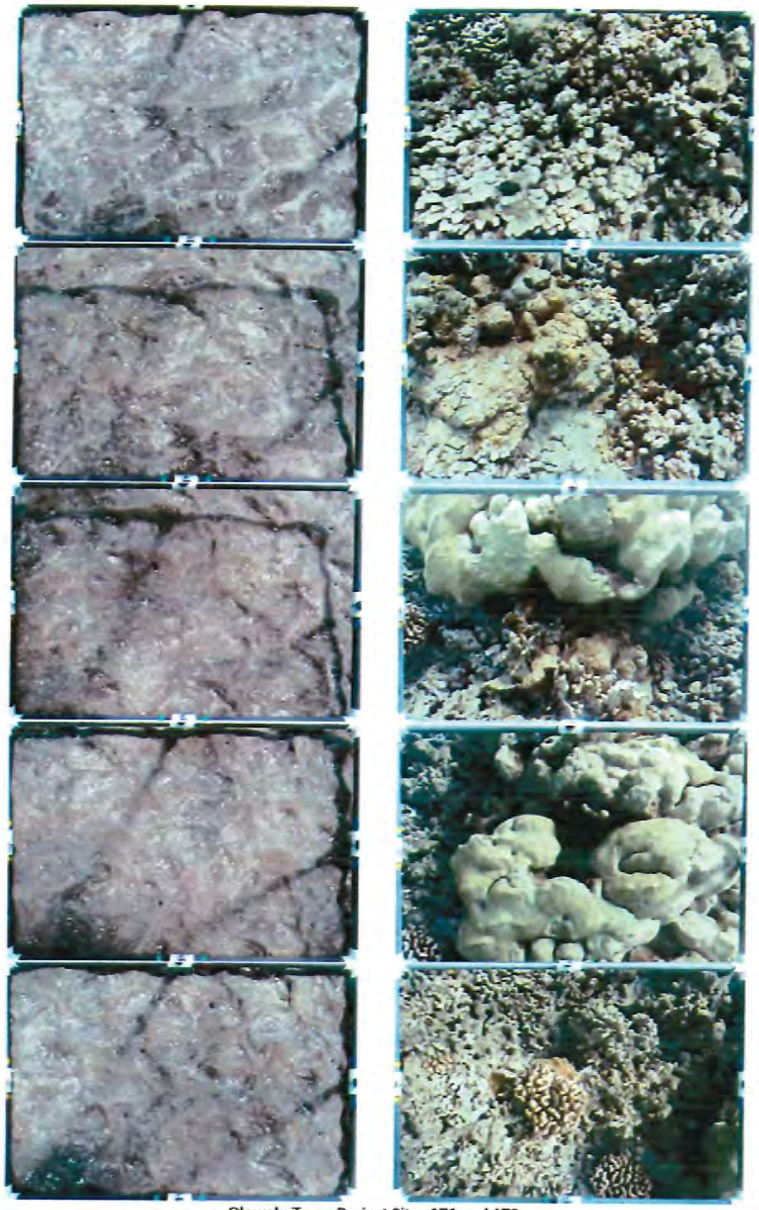


Olowalu Town Project Sites 100 and 168



Olowalu Town Project Sites 169 and 170



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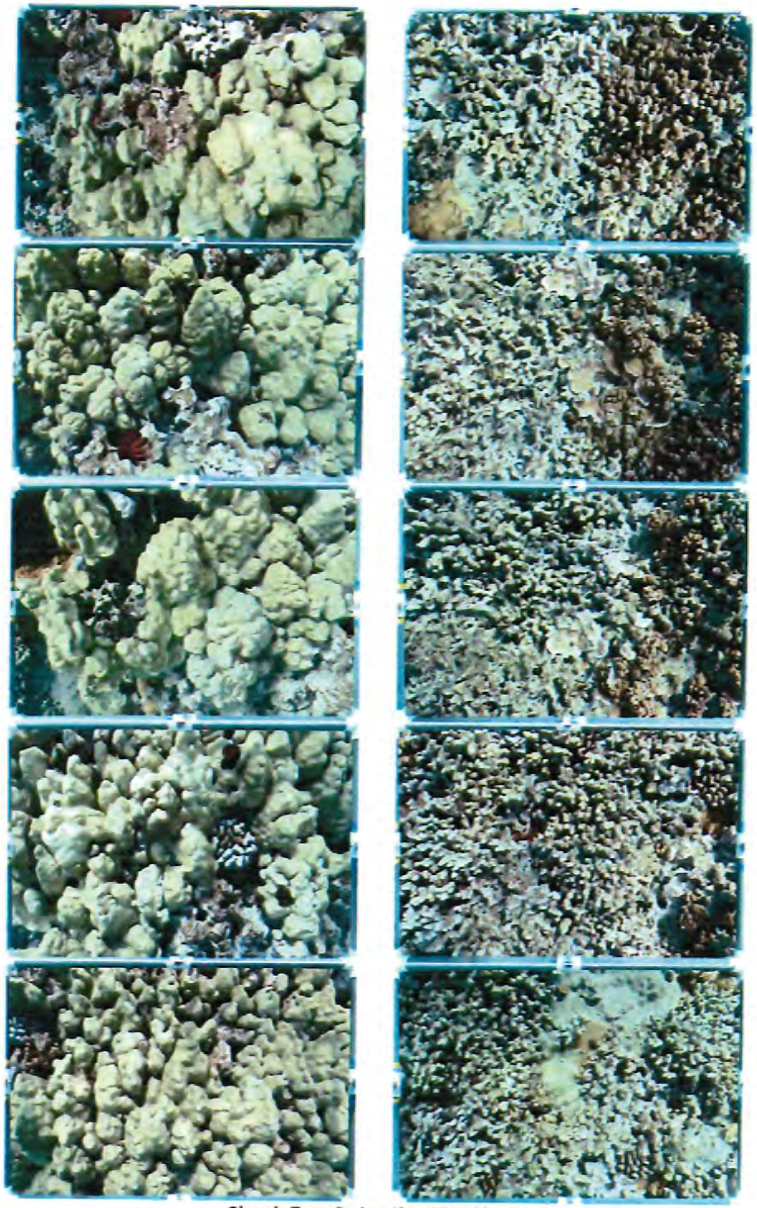

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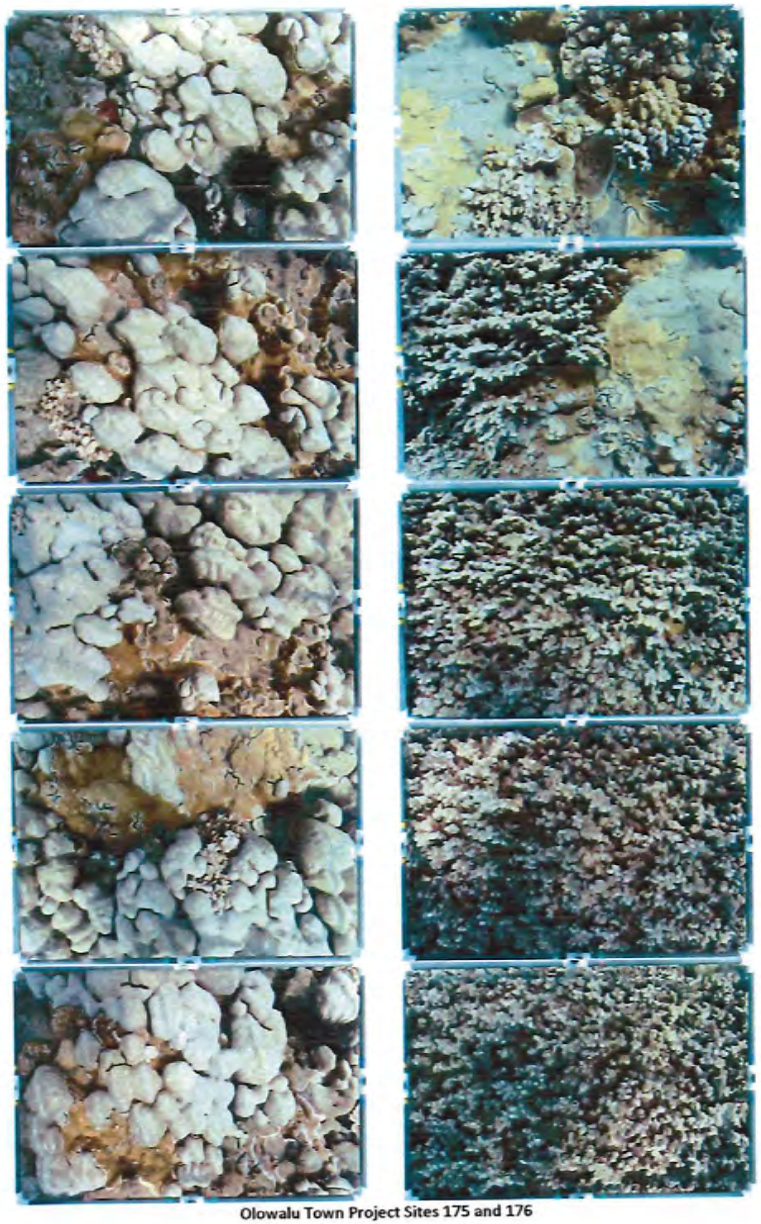
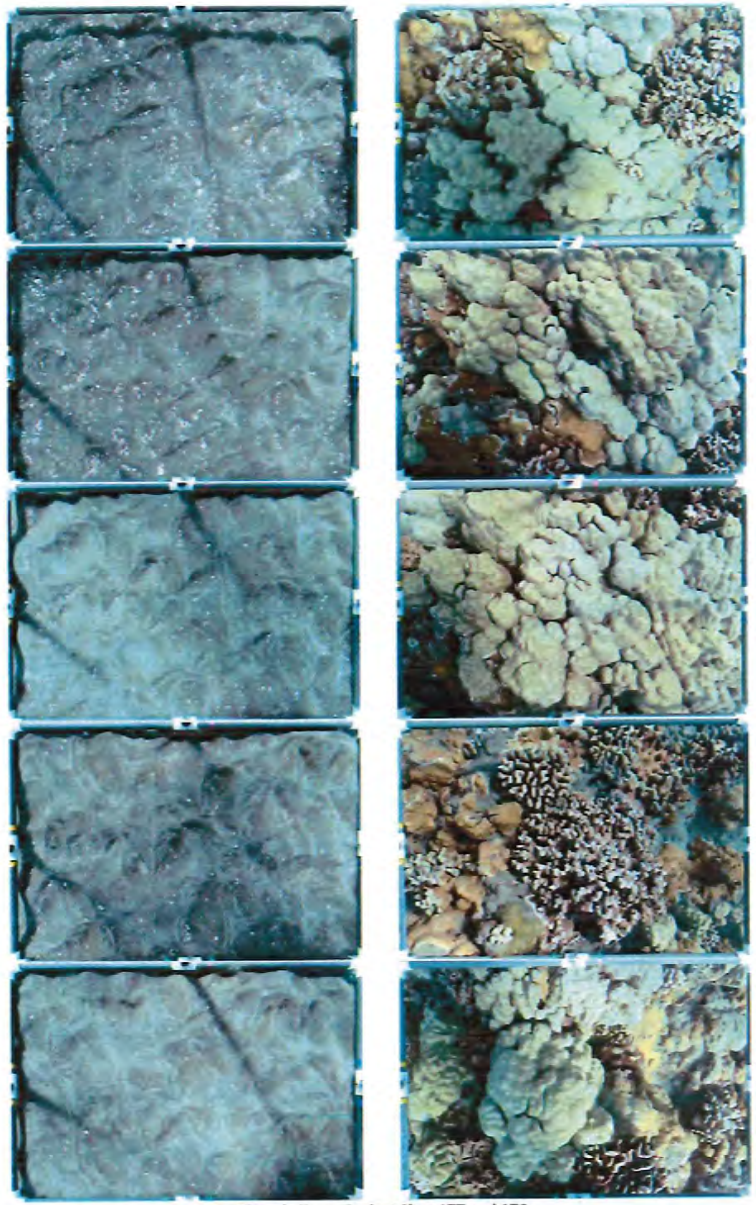
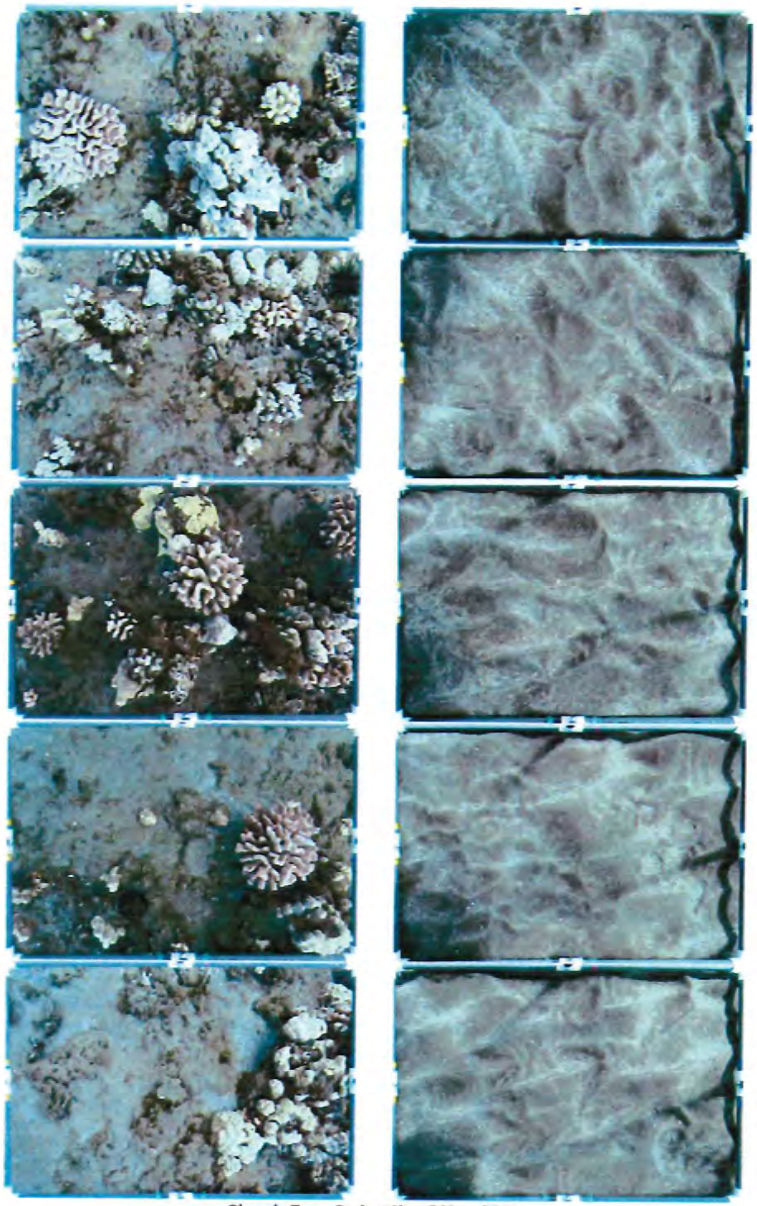


Olowalu Town Project Sites 175 and 176



Olowalu Town Project Sites 177 and 178



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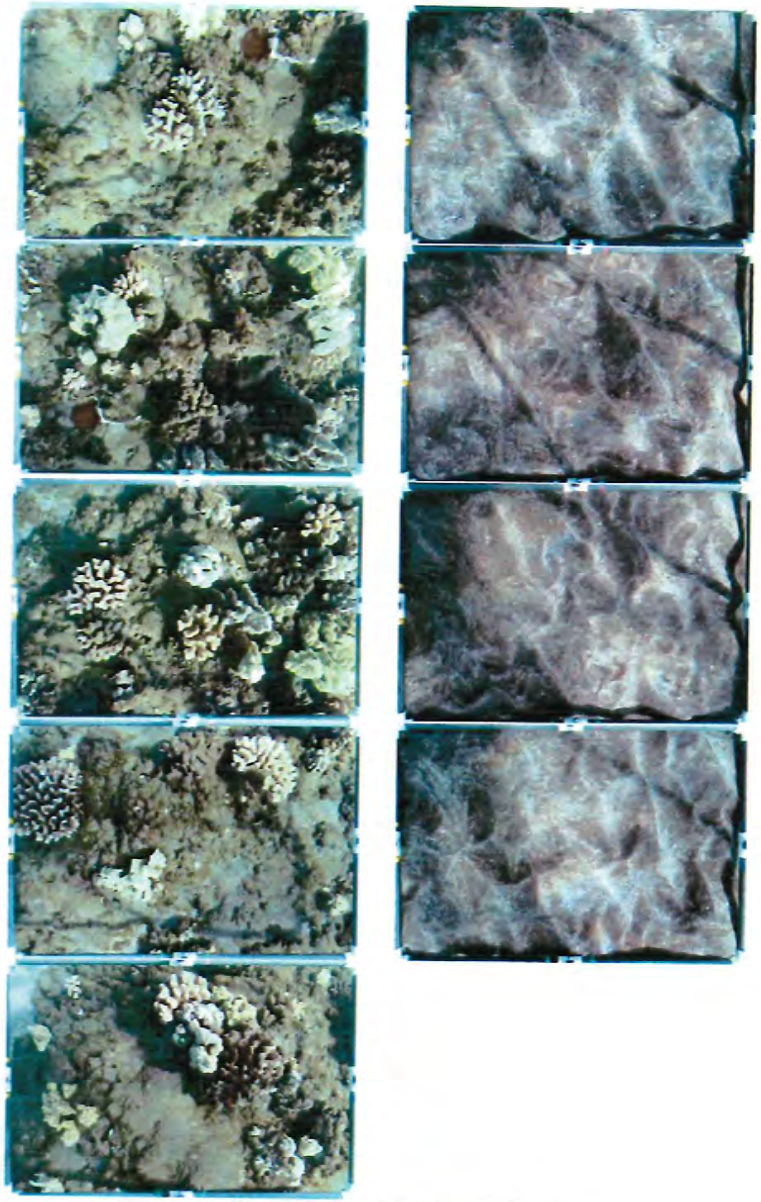
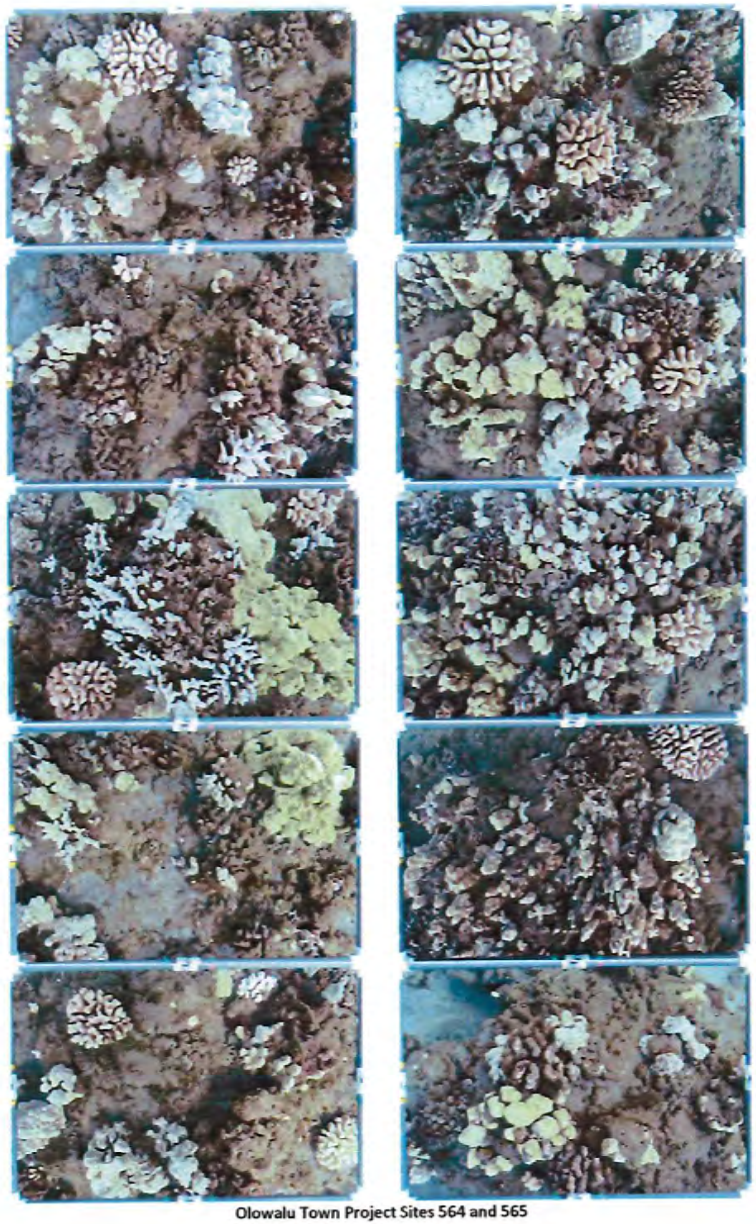


Olowalu Town Project Sites 562 and 563



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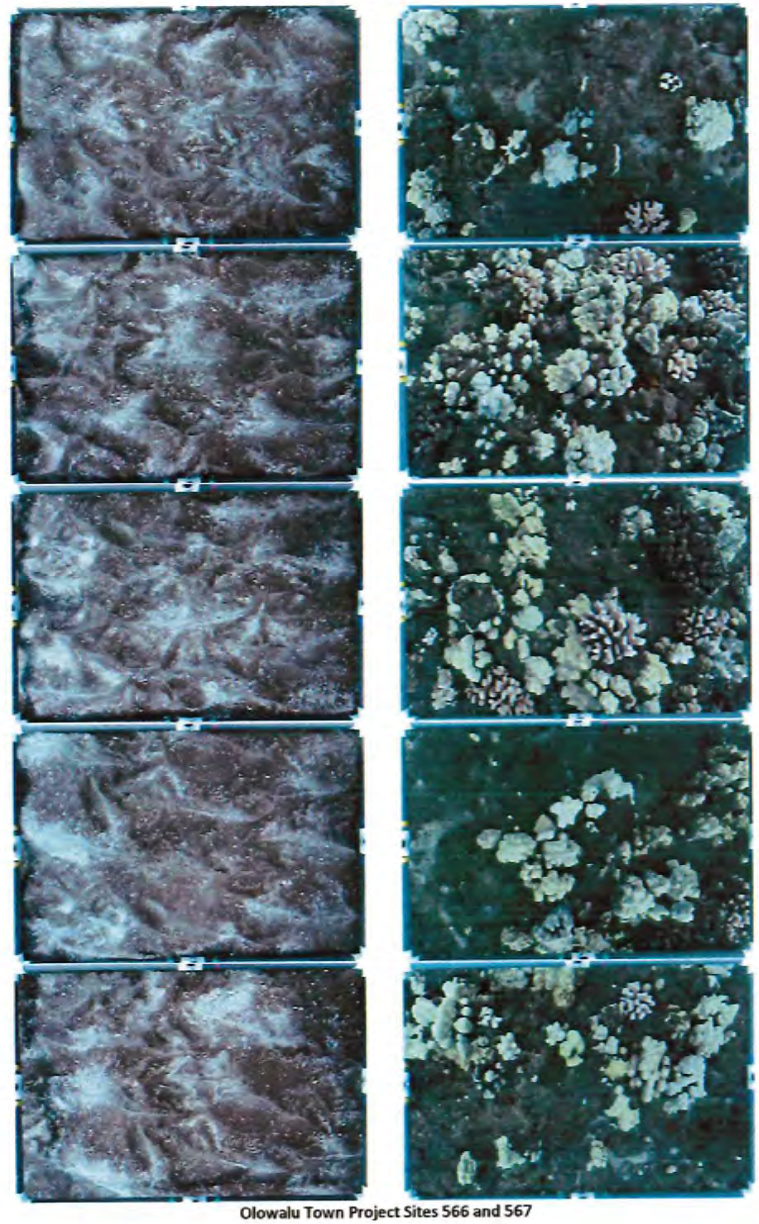

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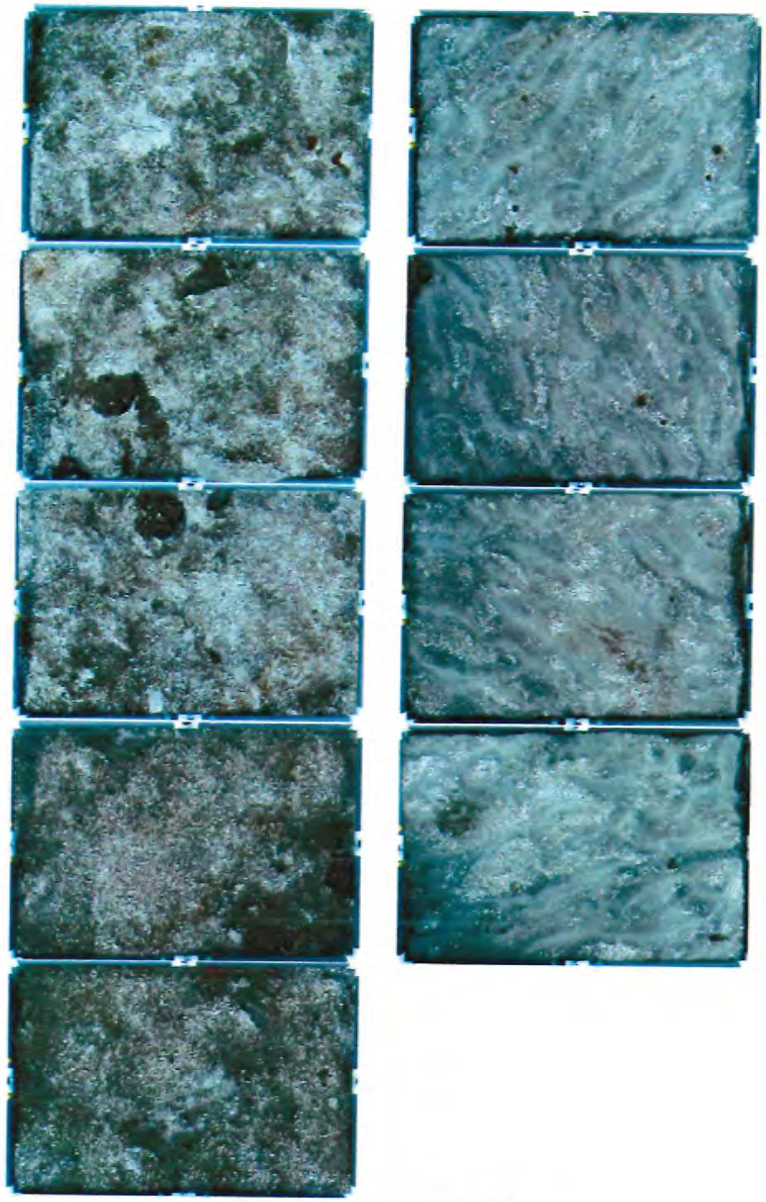

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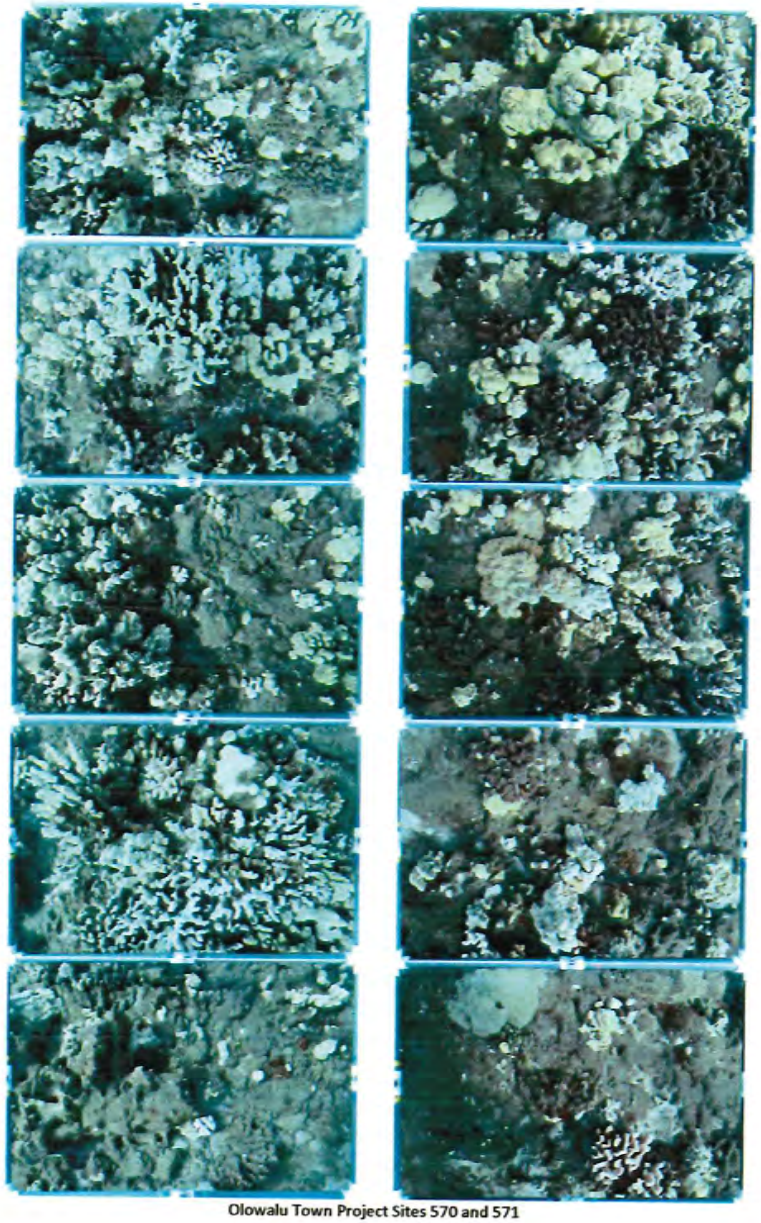

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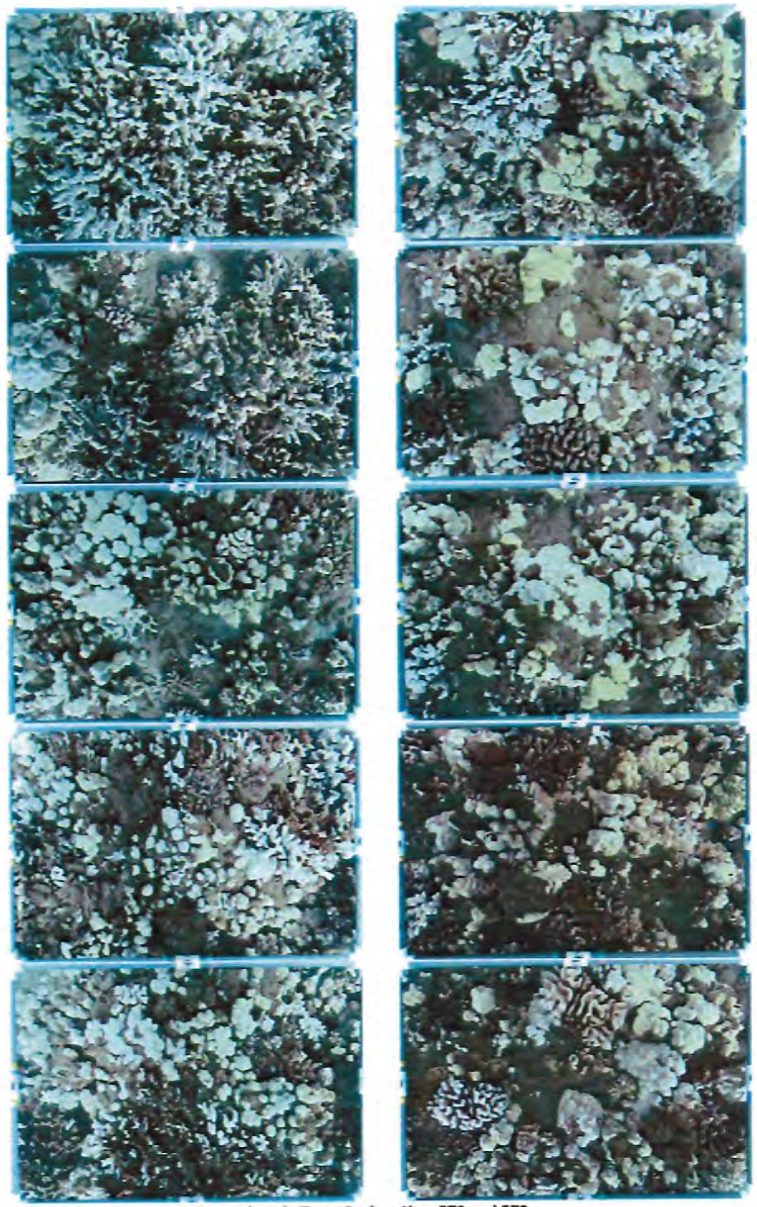

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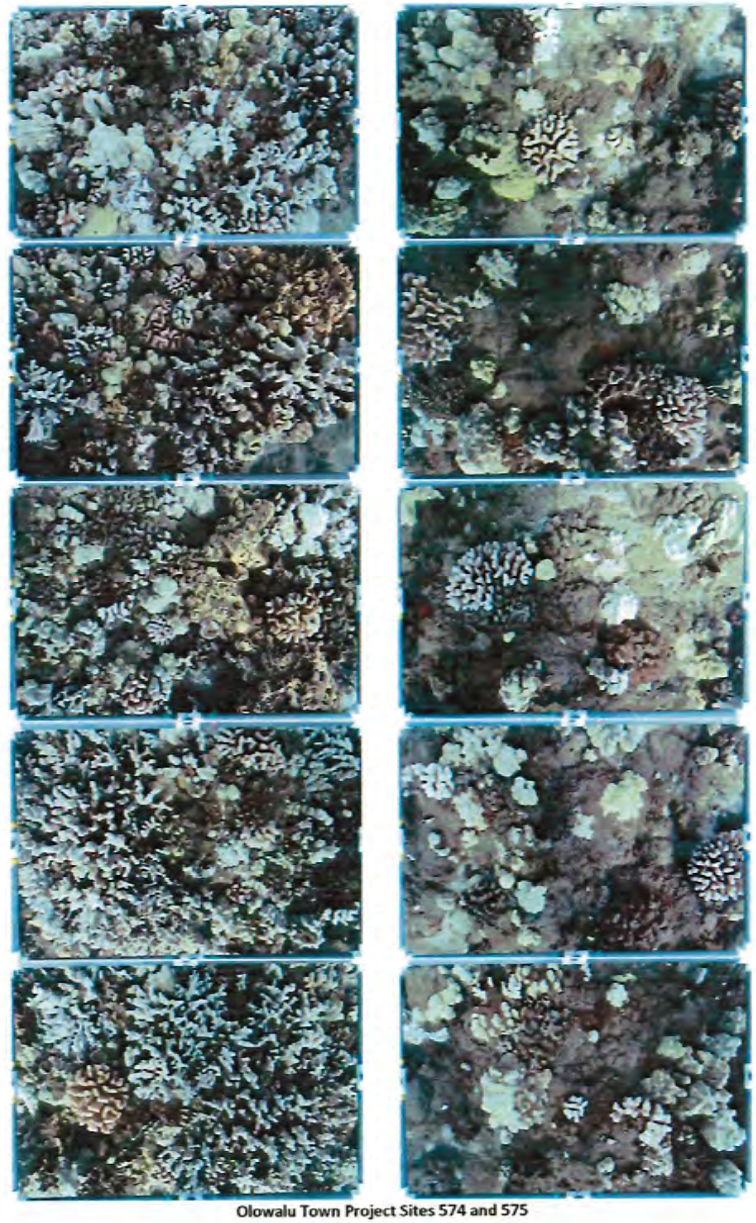

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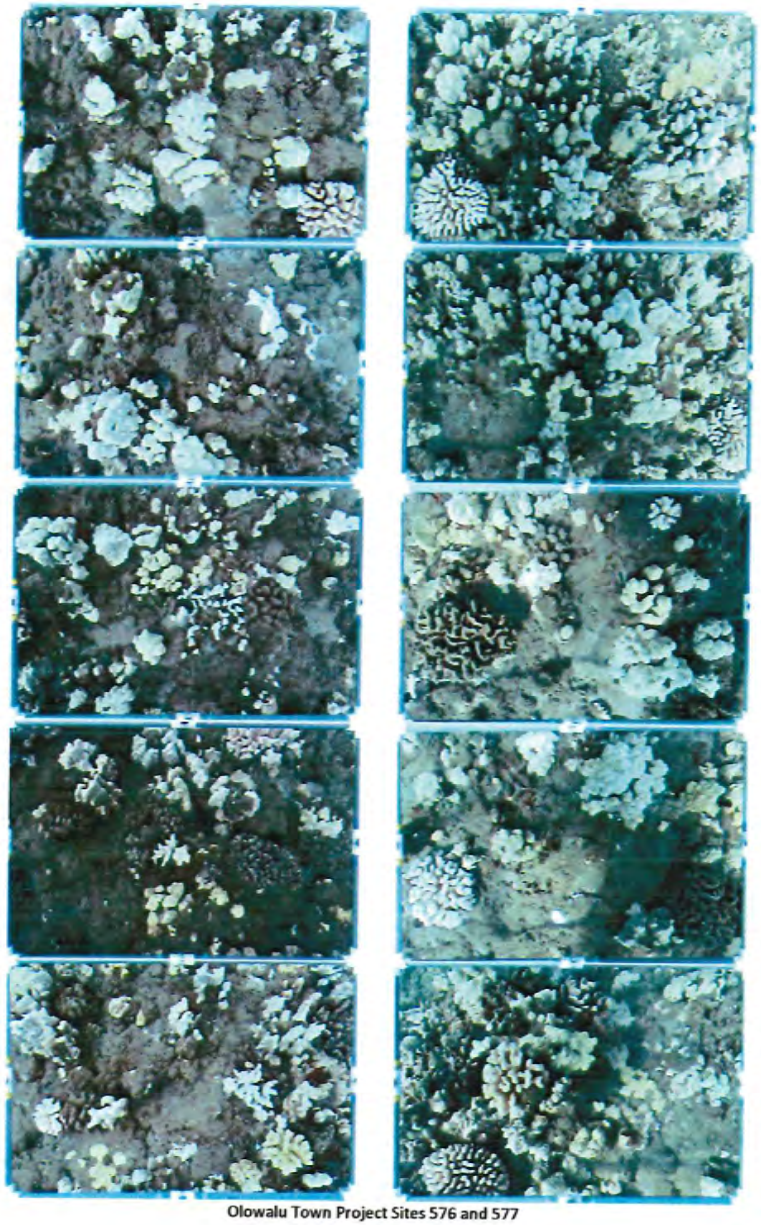

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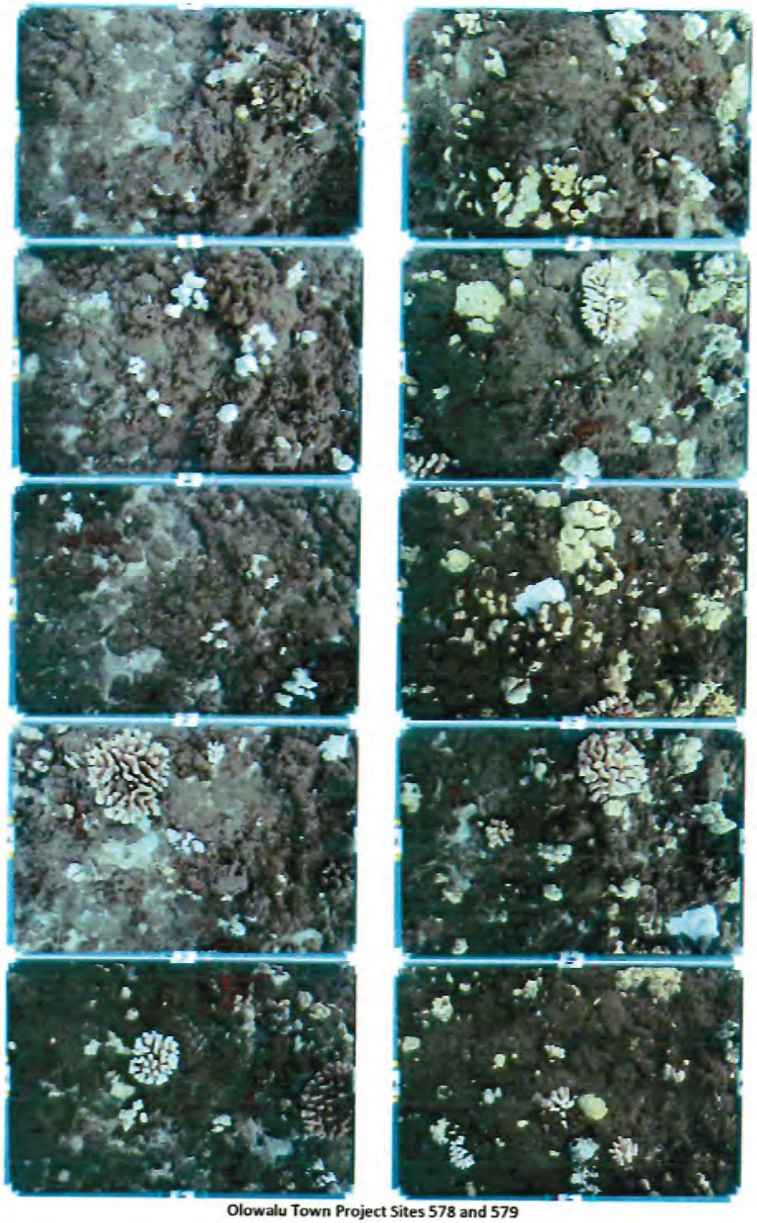

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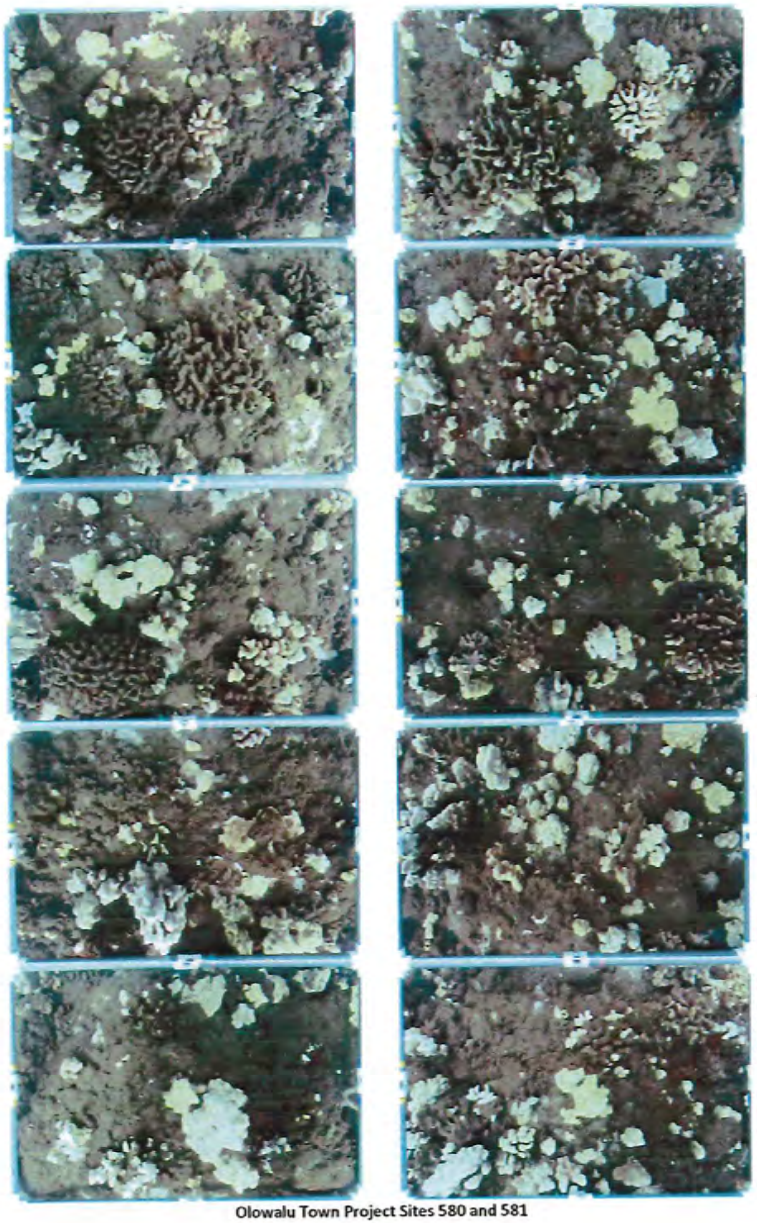

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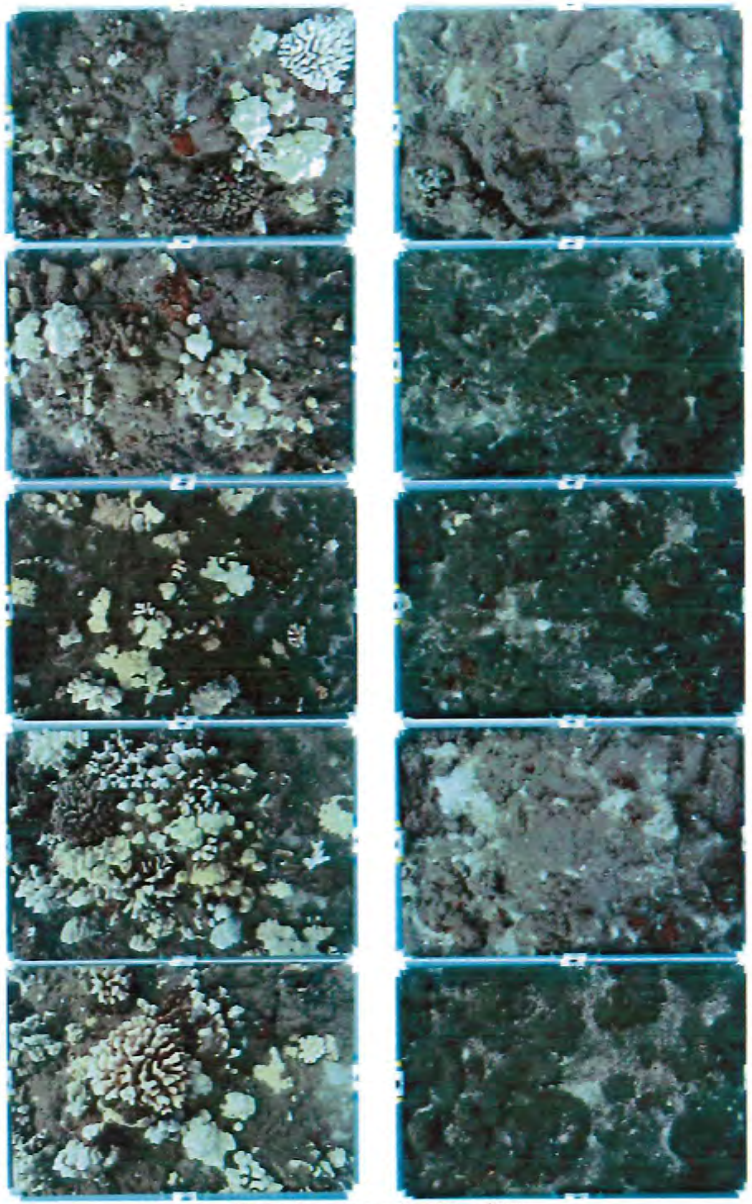

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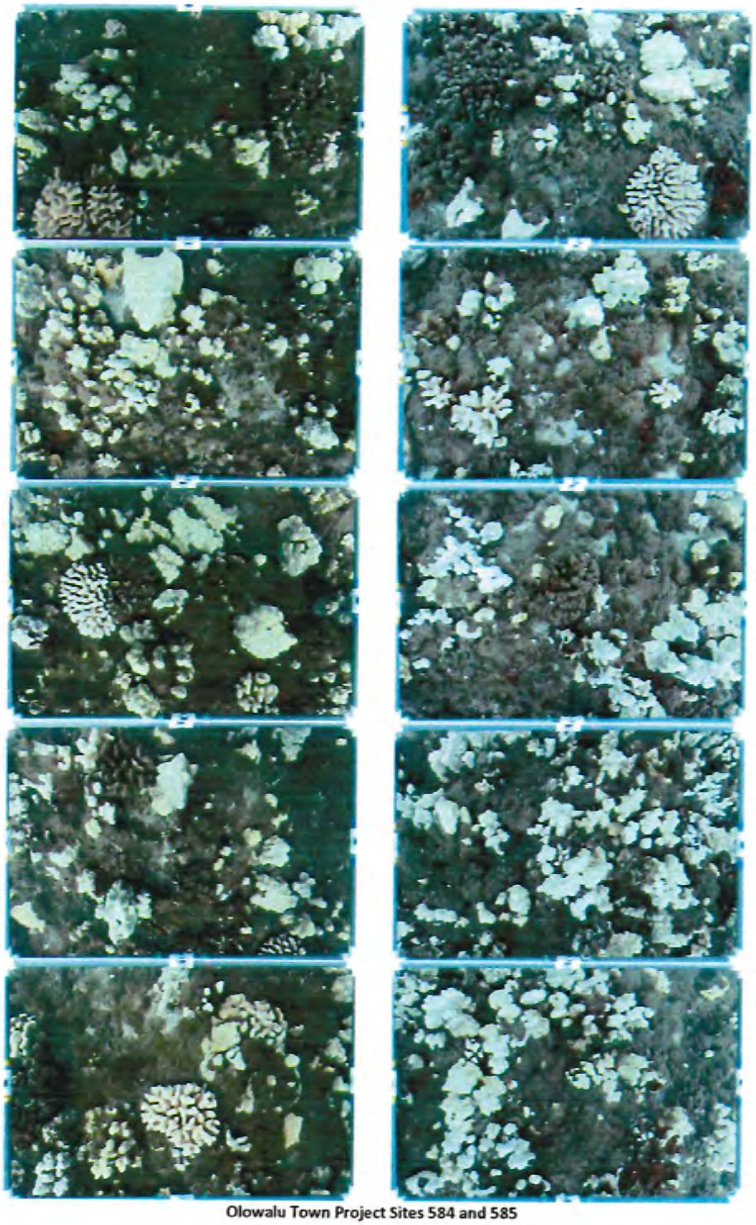

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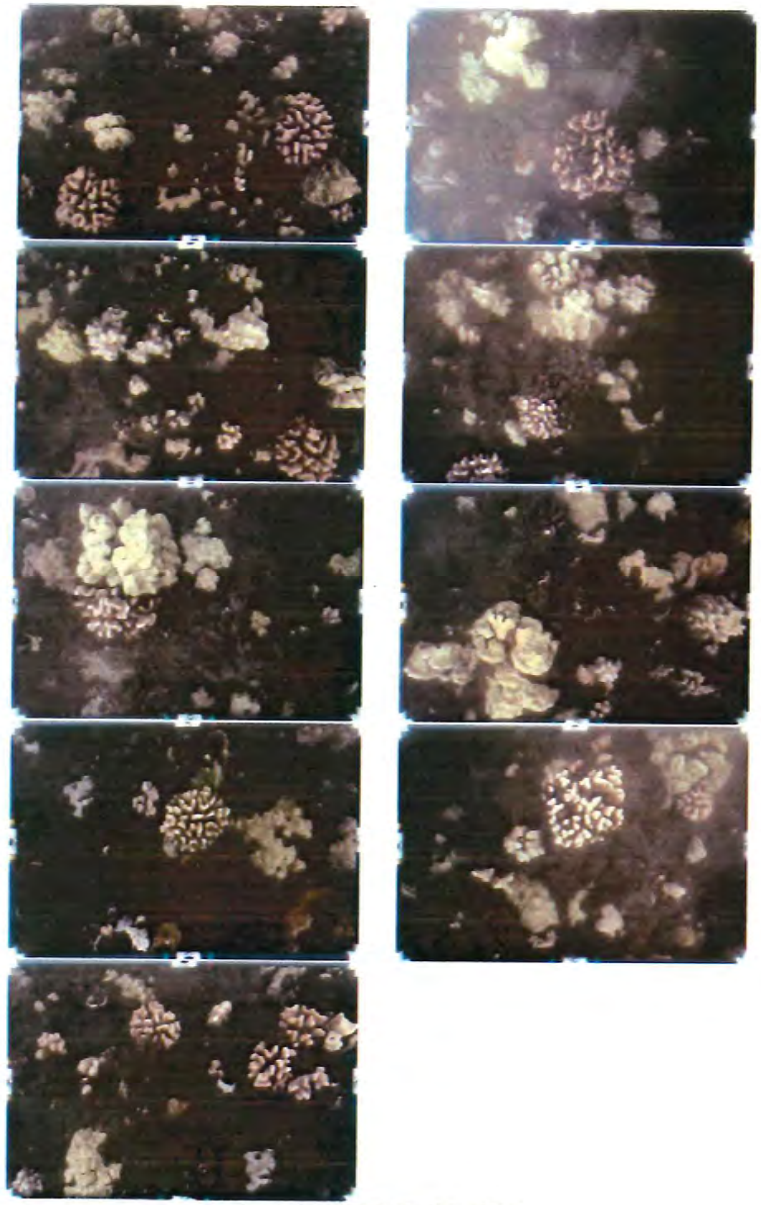

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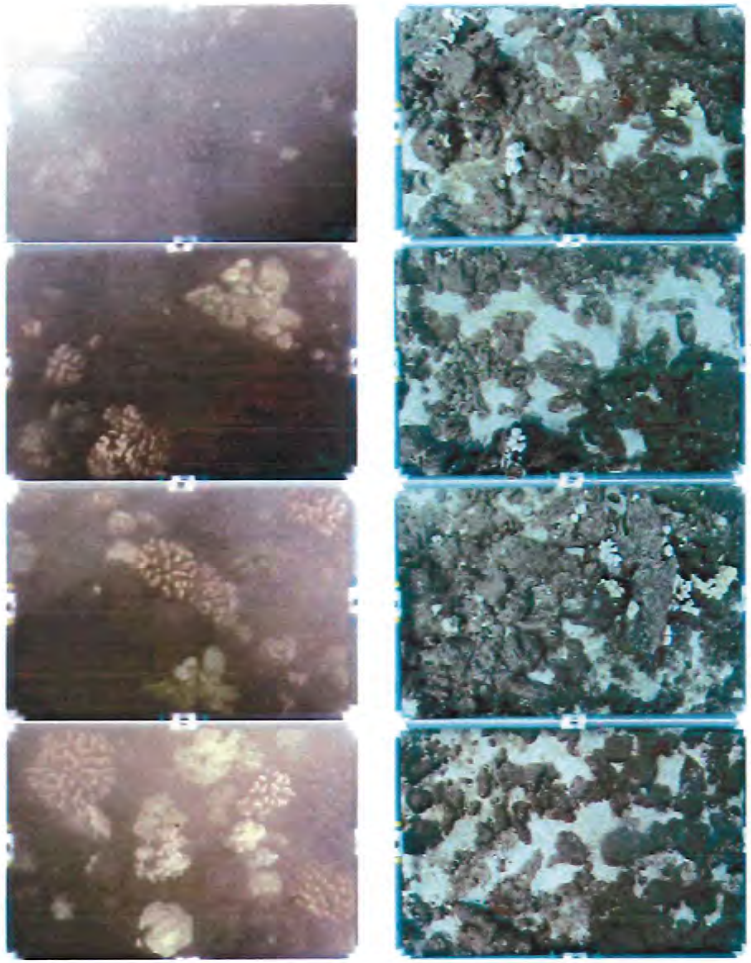

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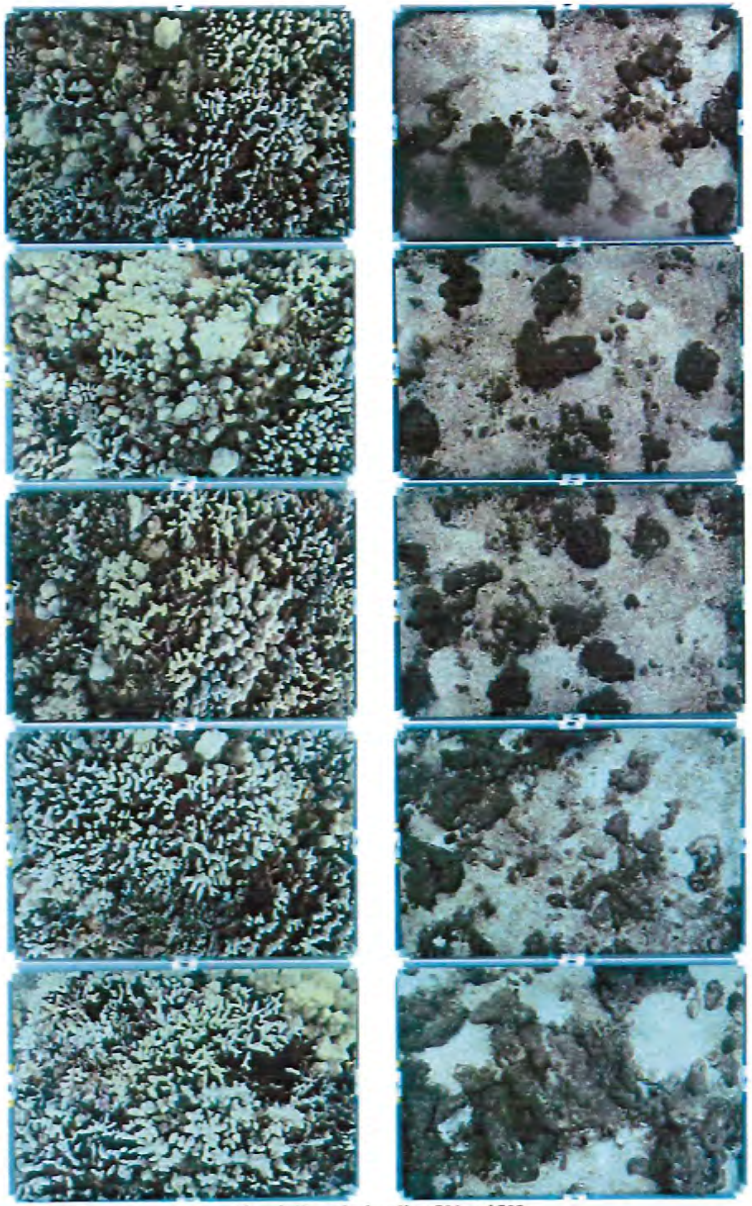

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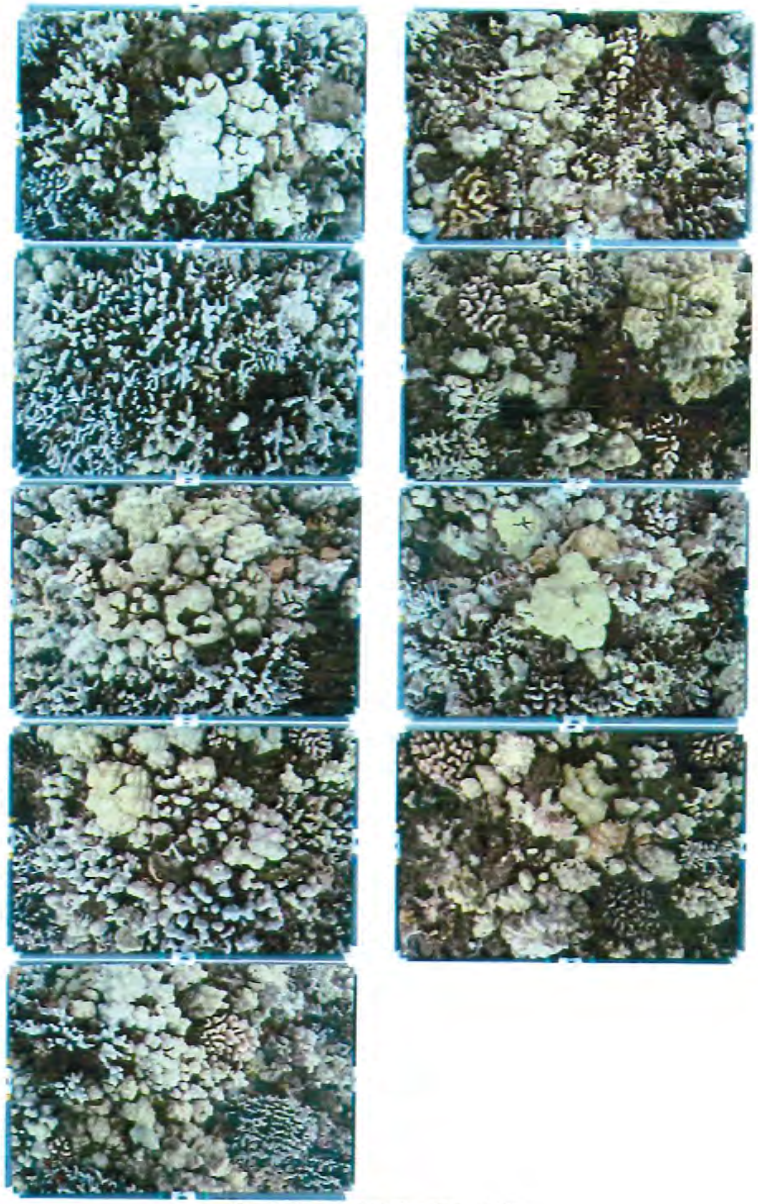

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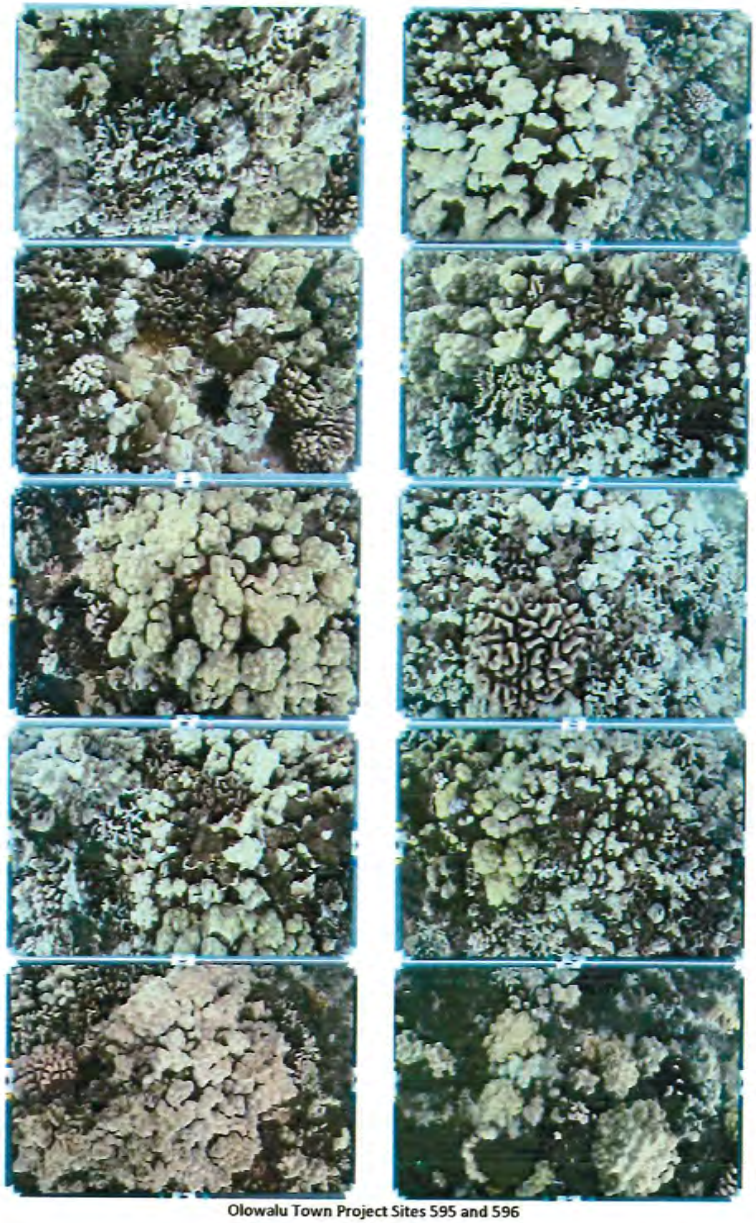

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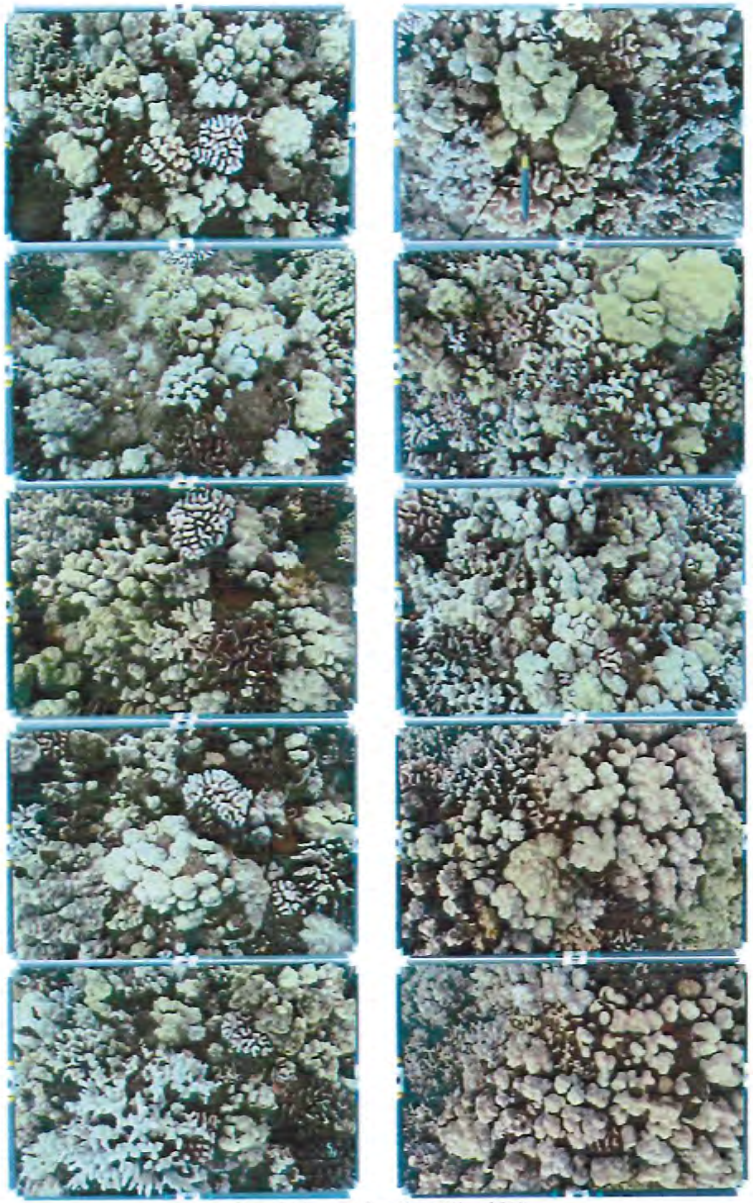

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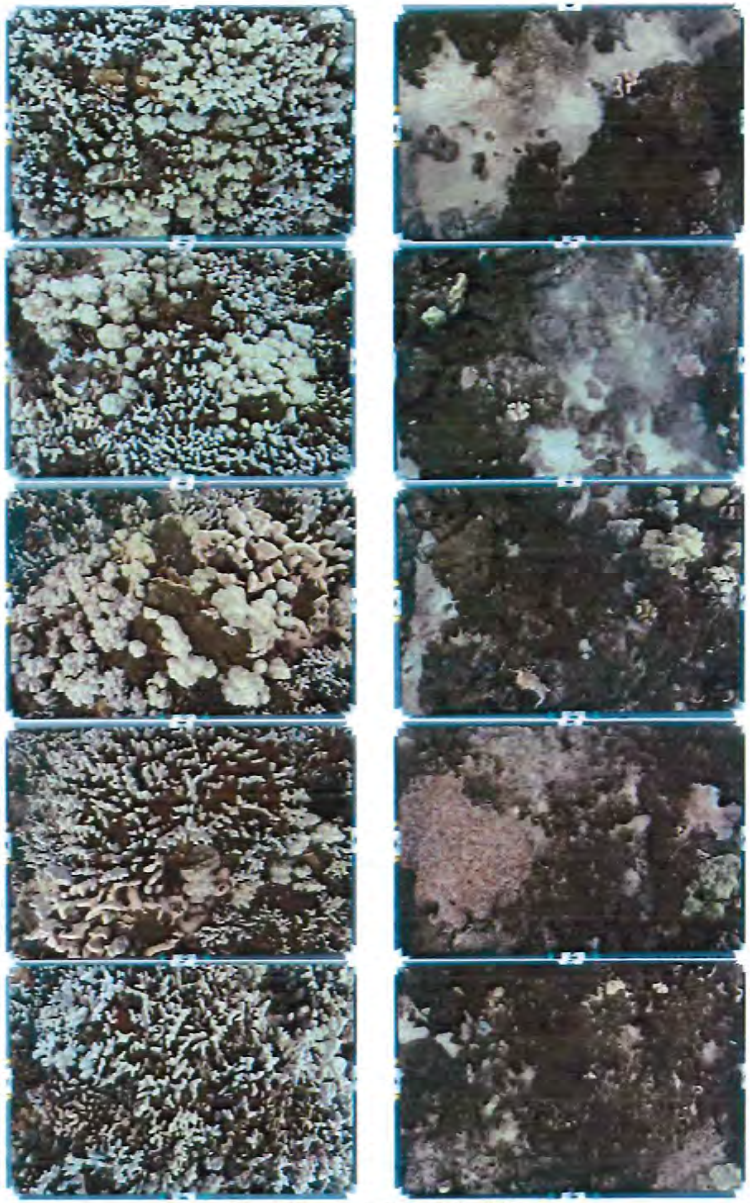

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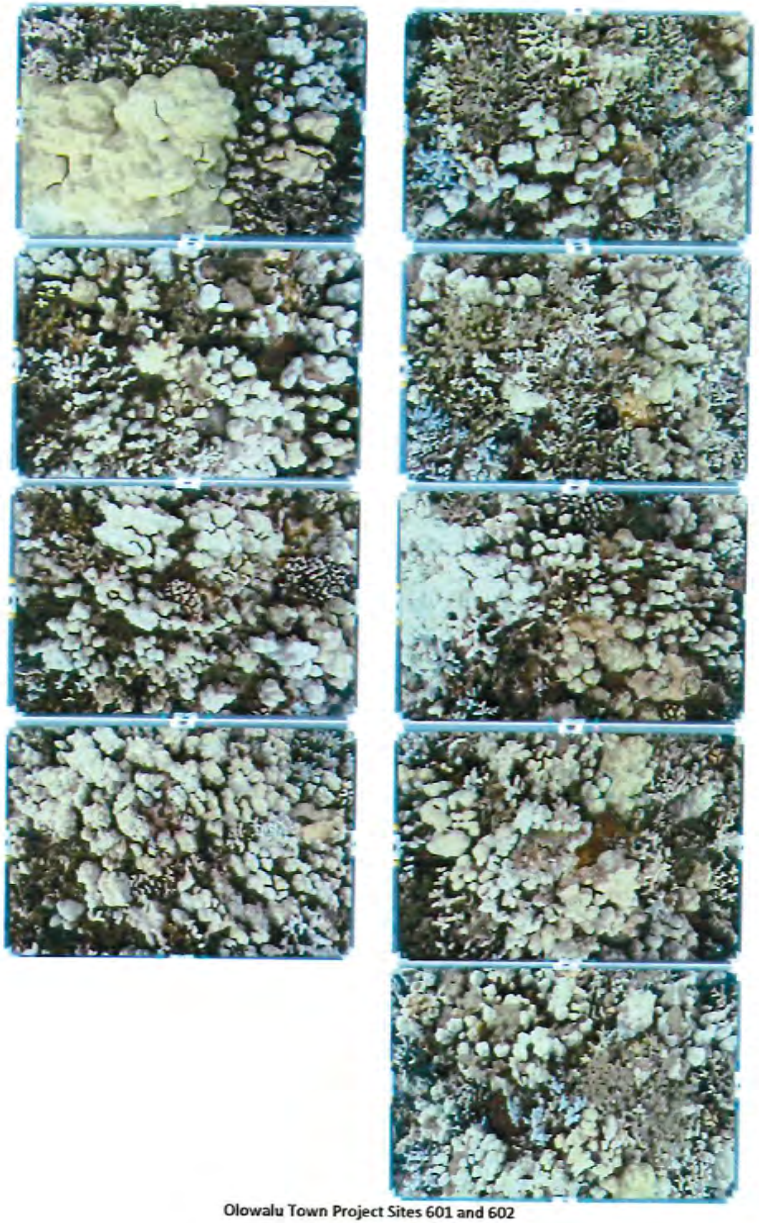

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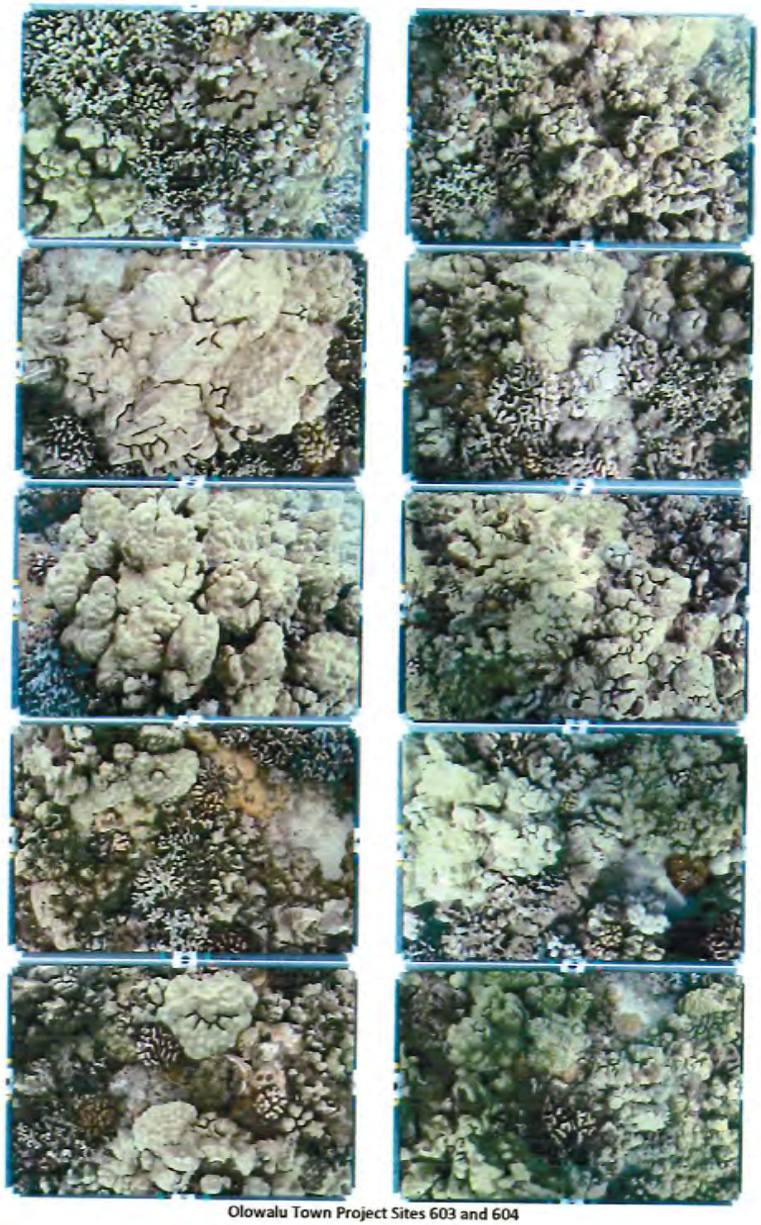

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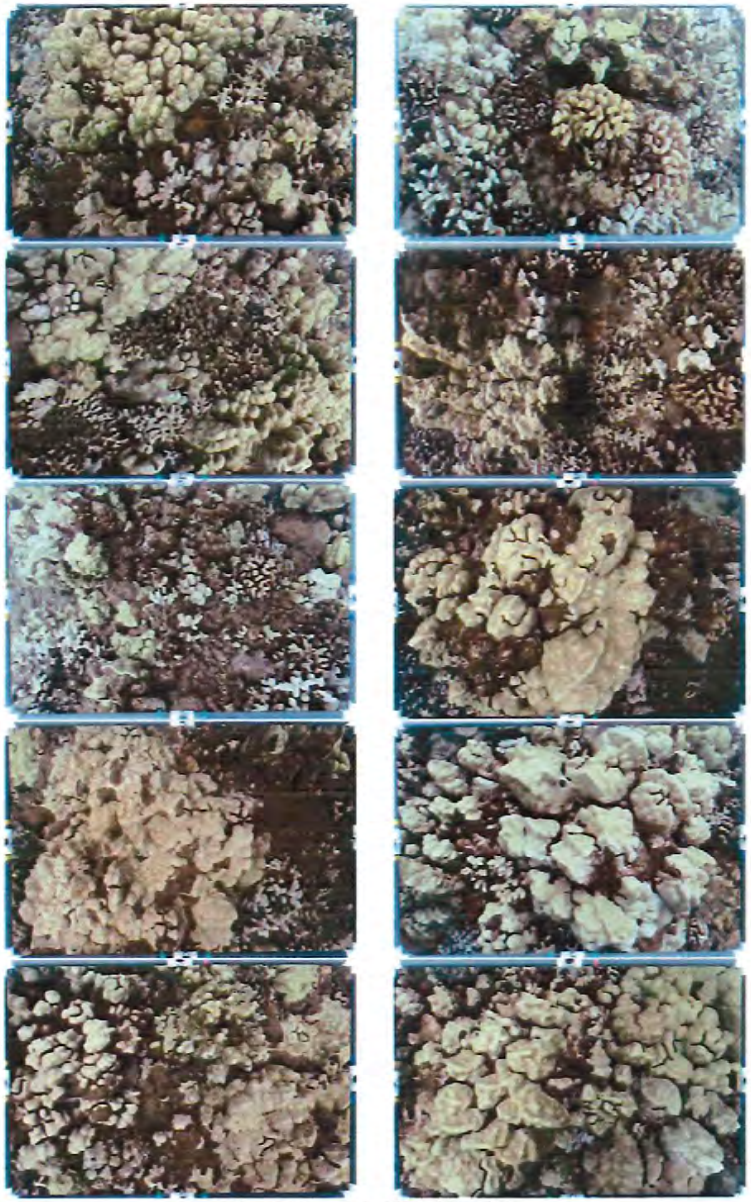

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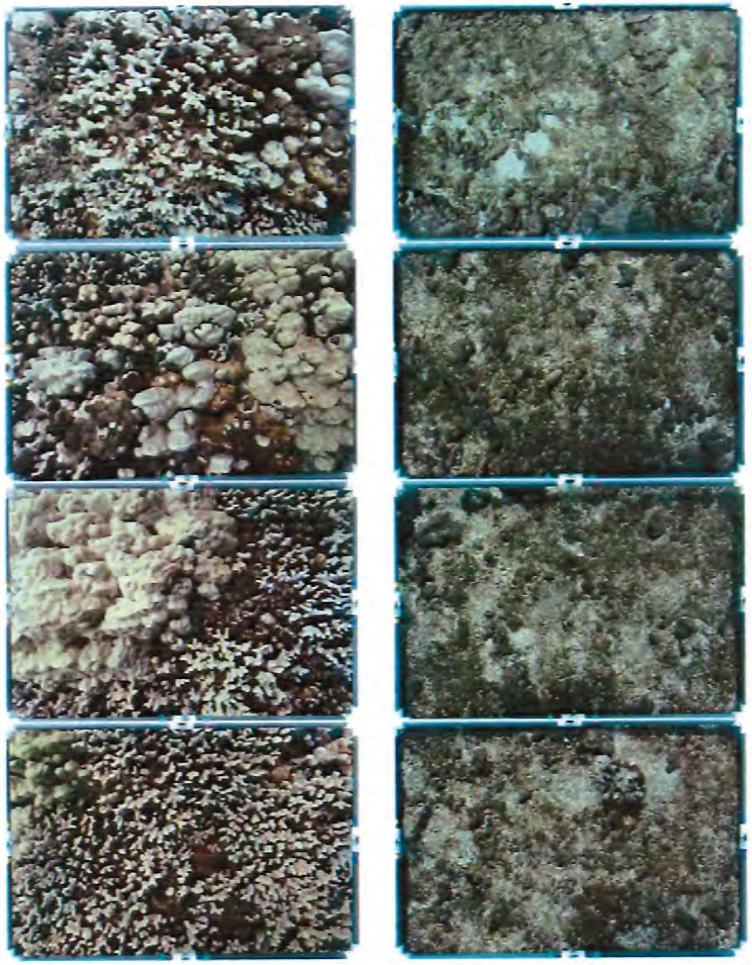

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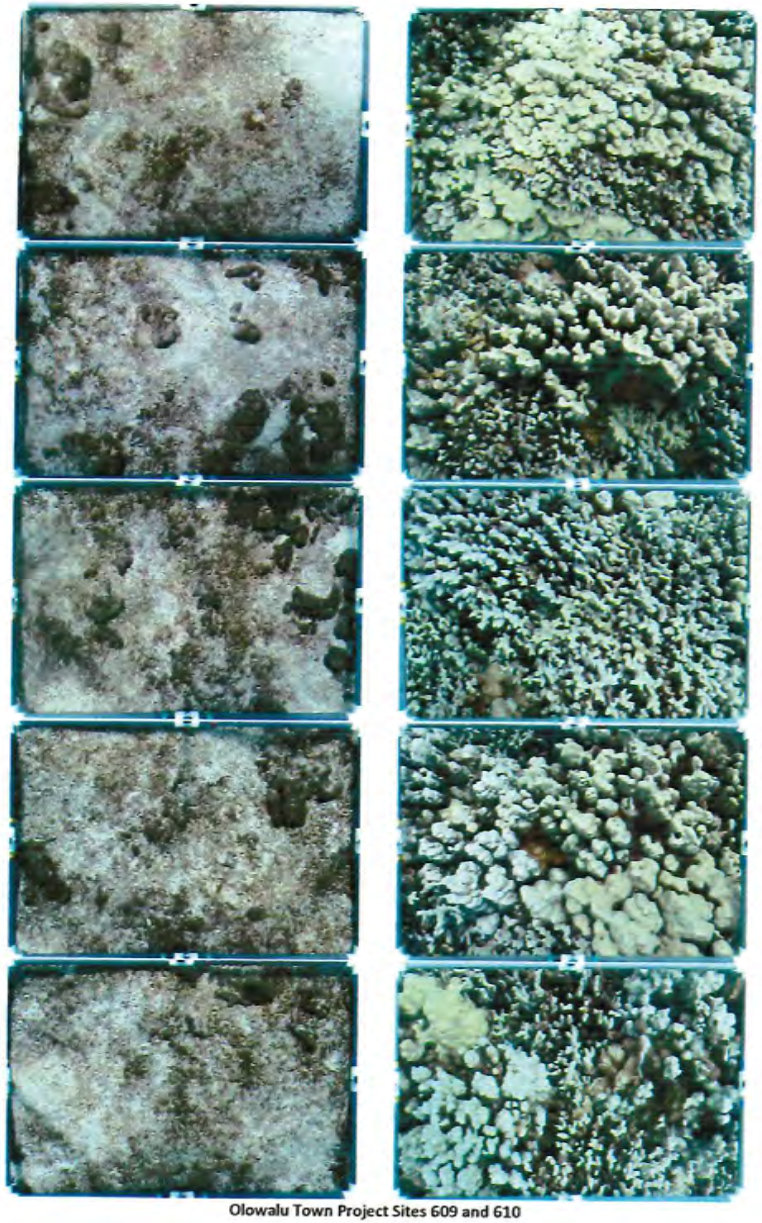

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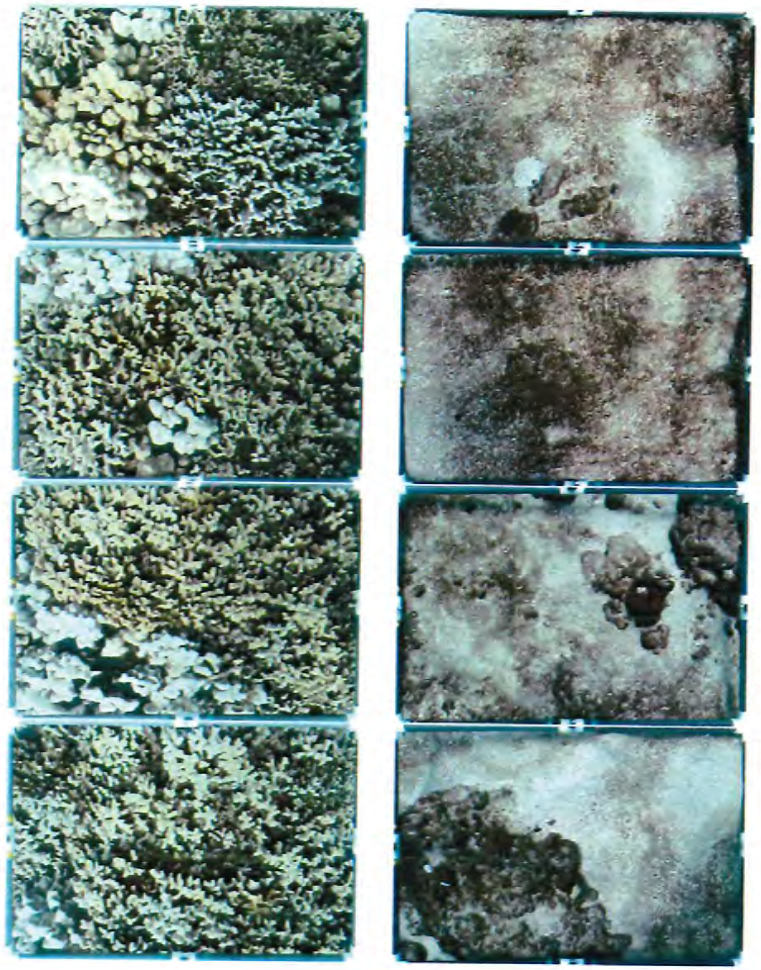

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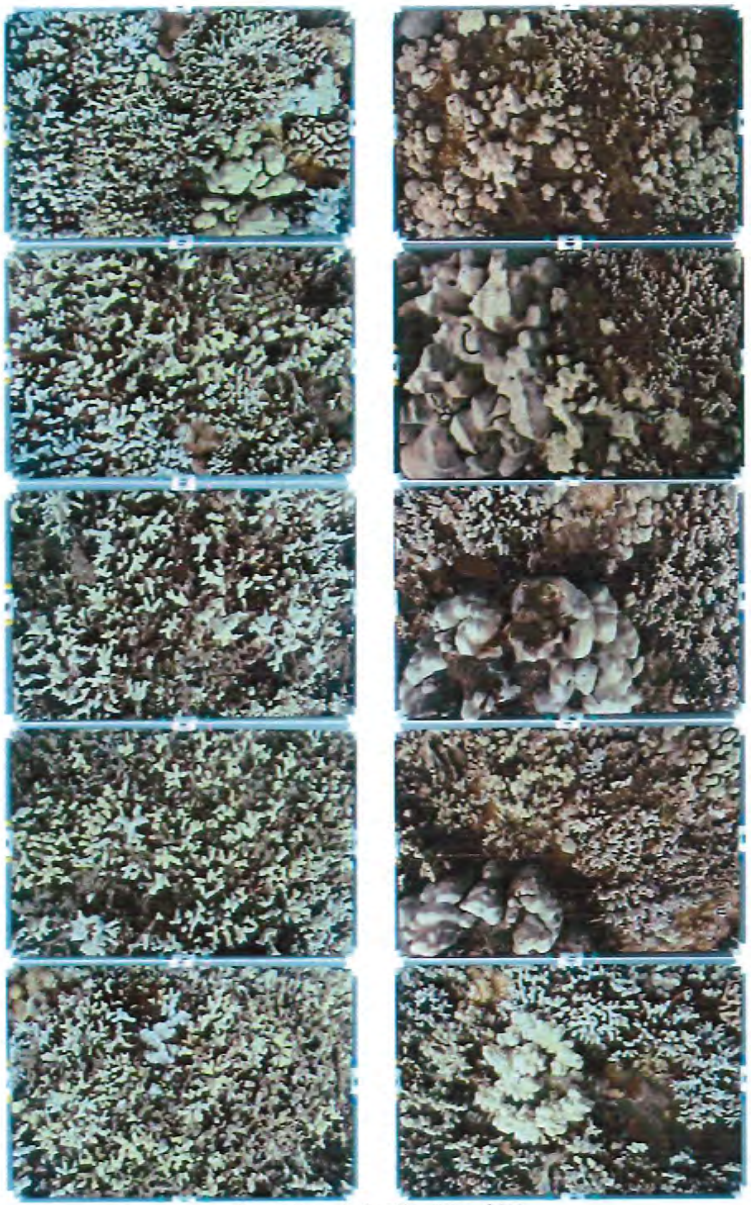

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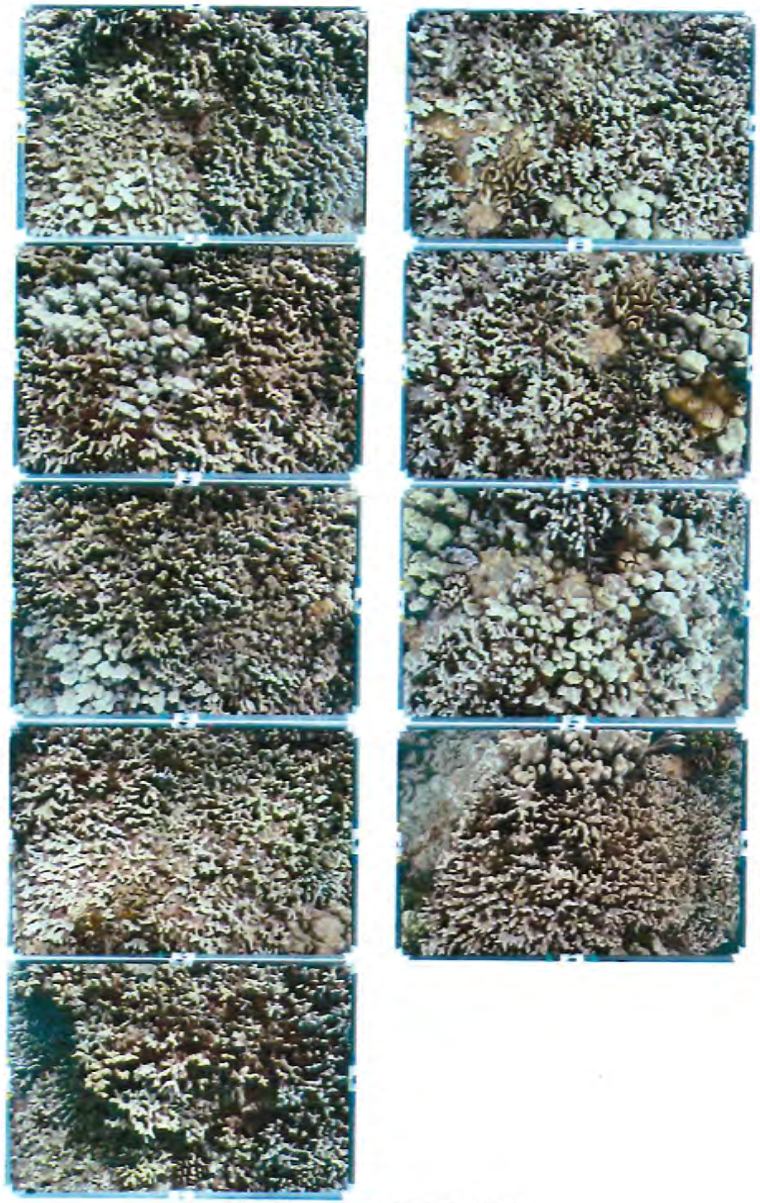

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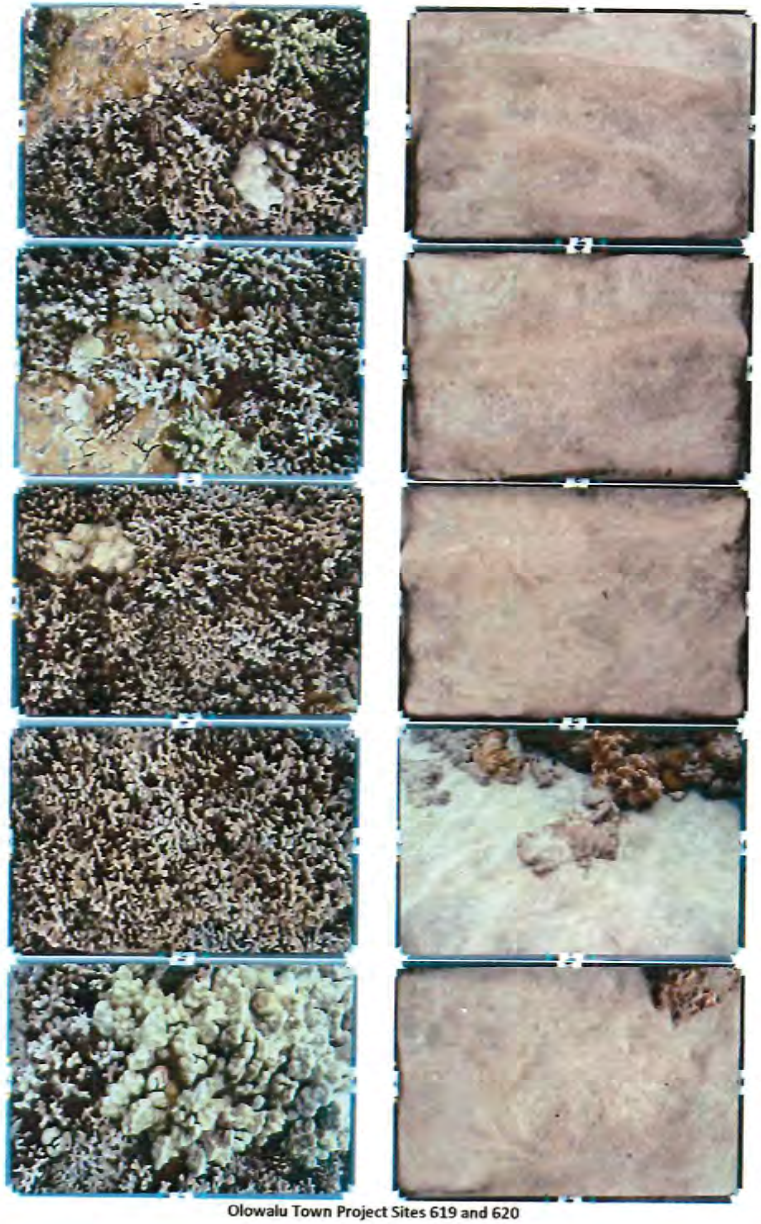

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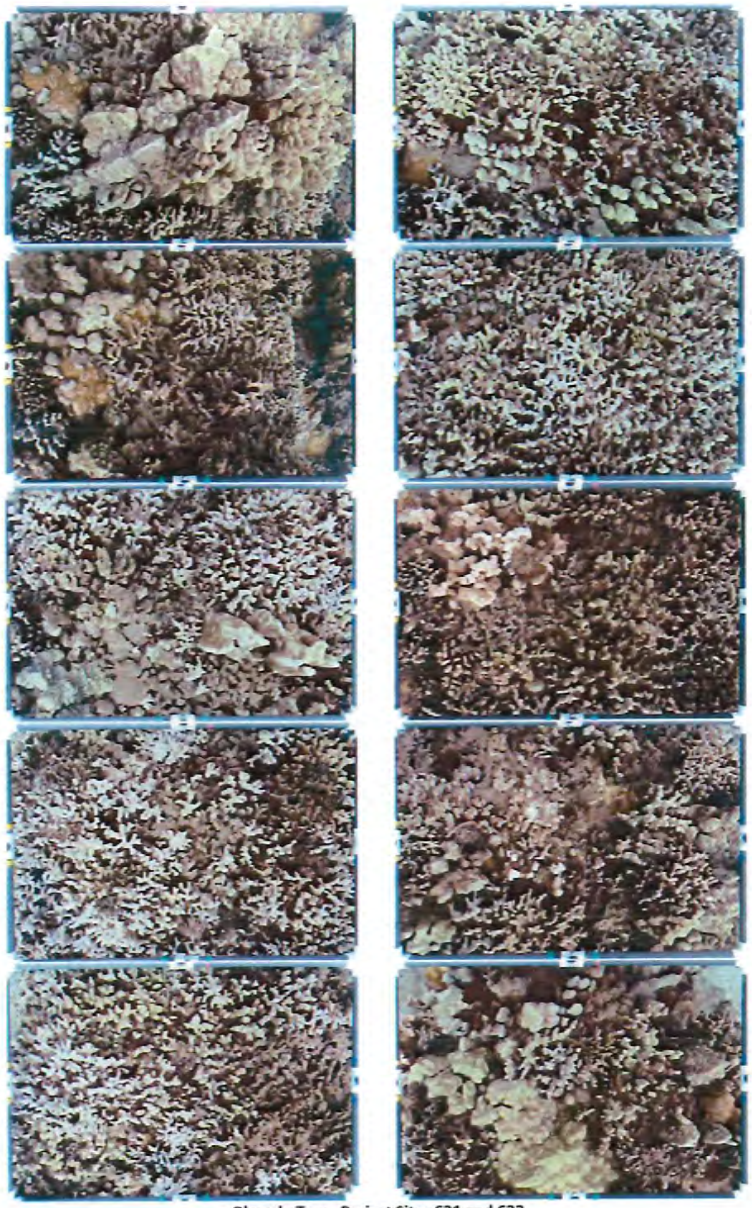

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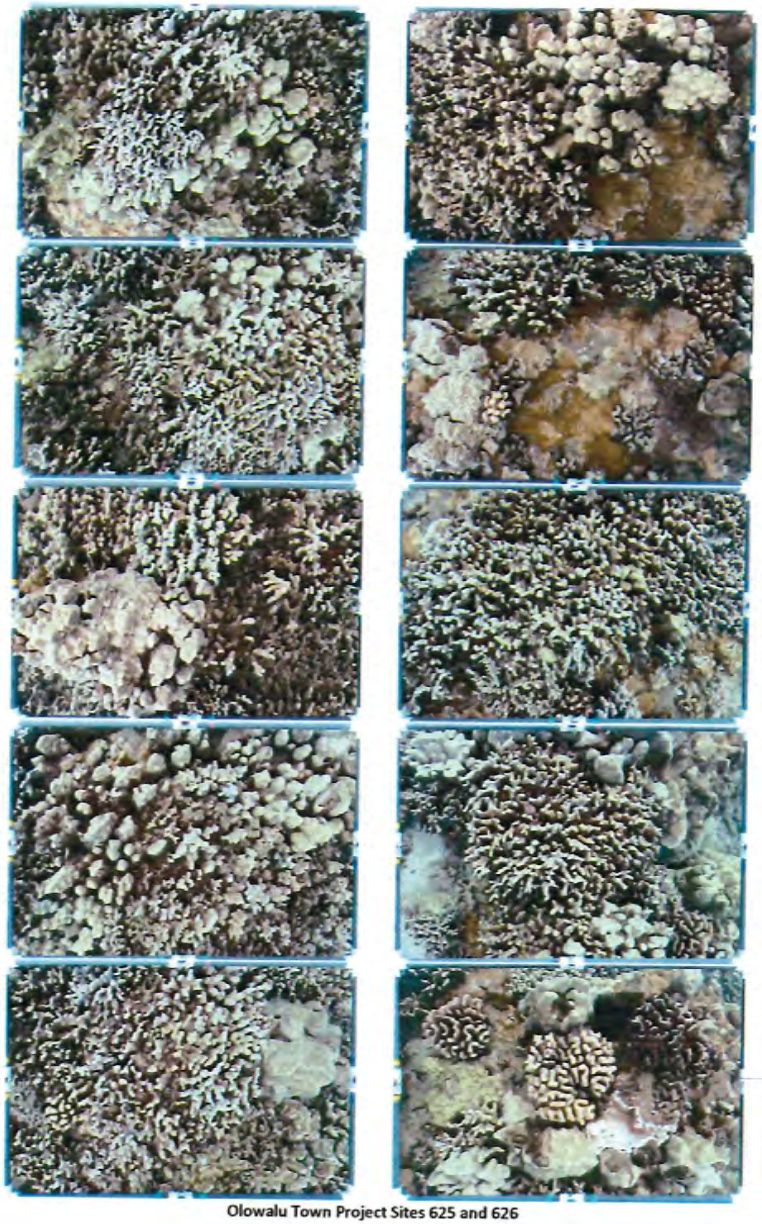

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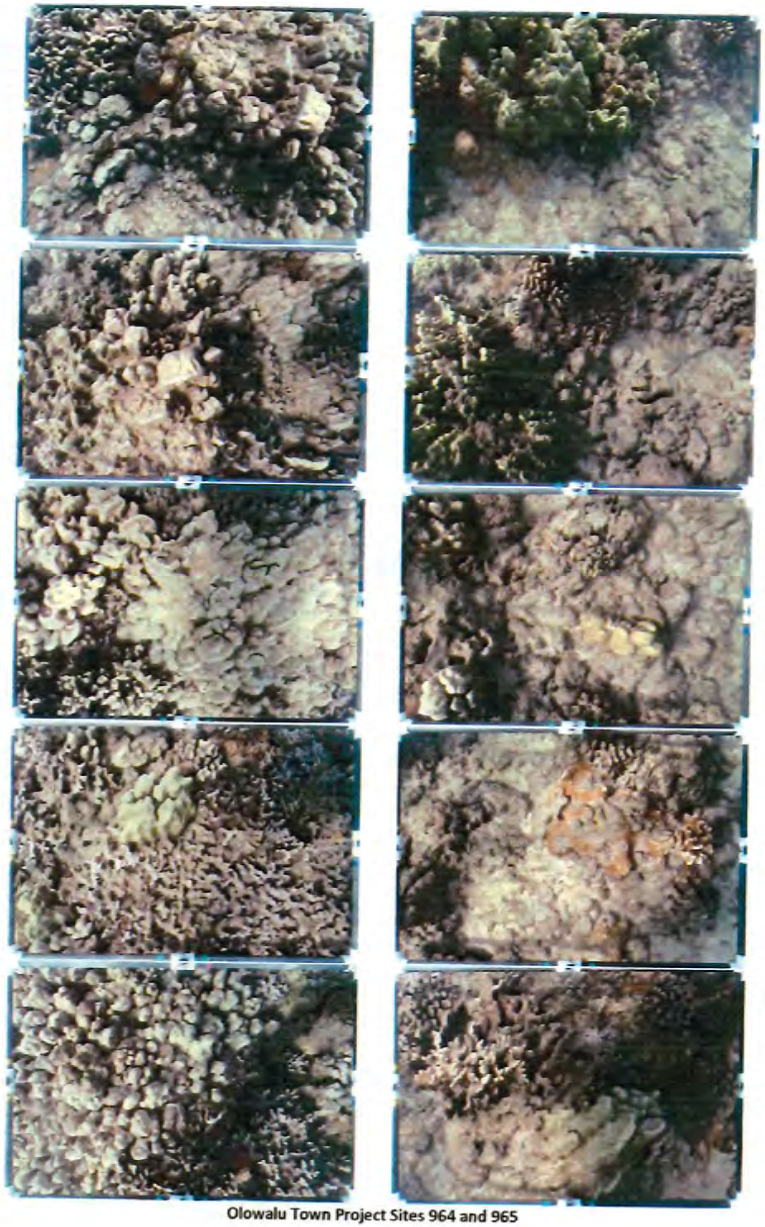

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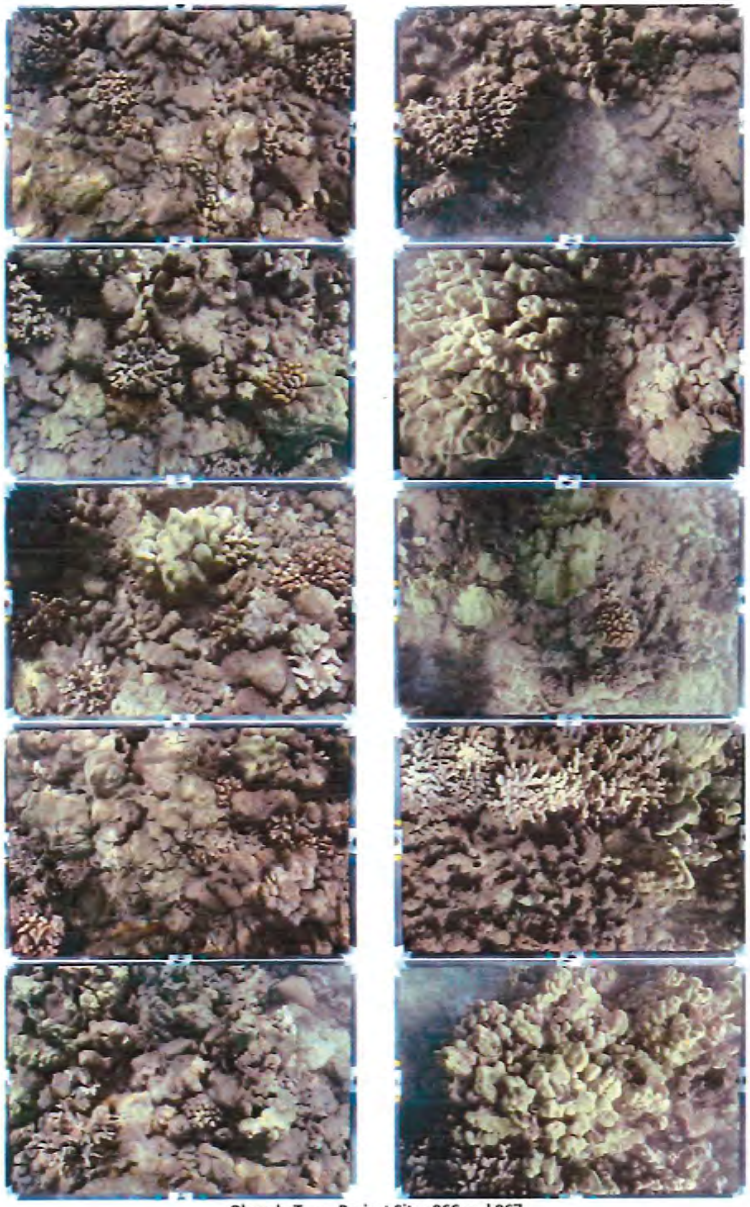

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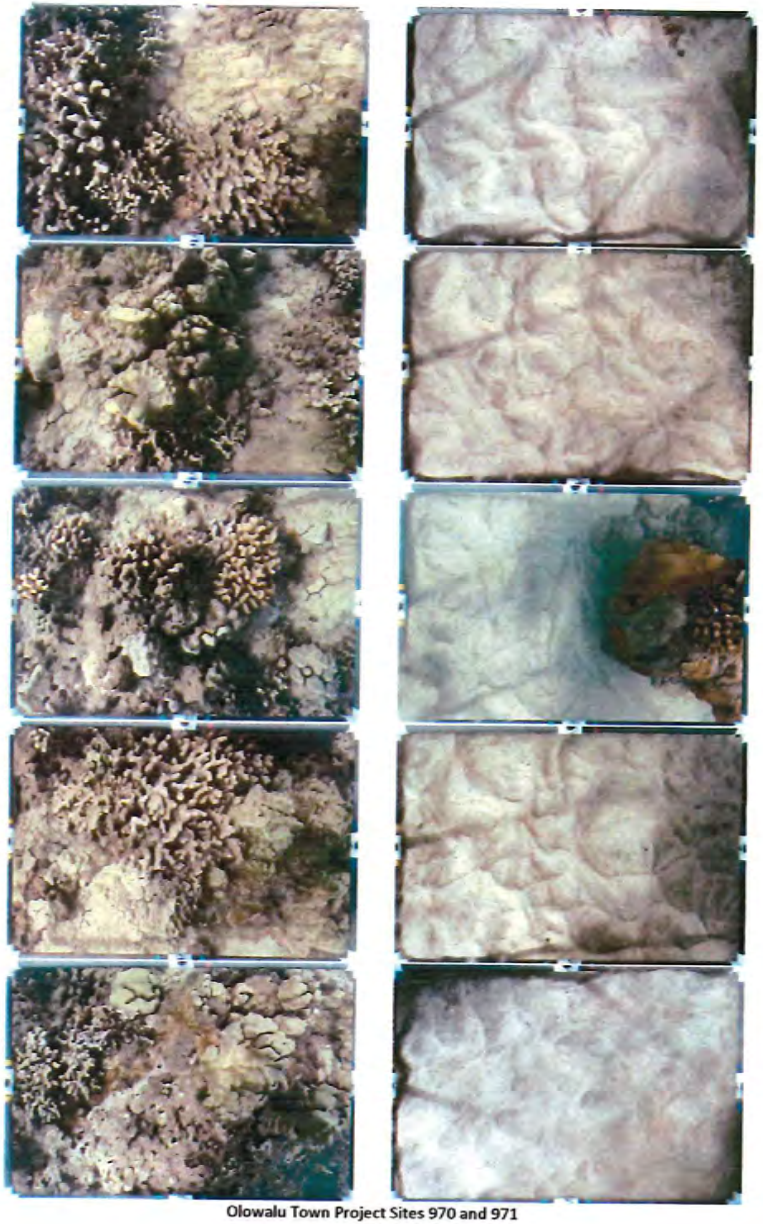

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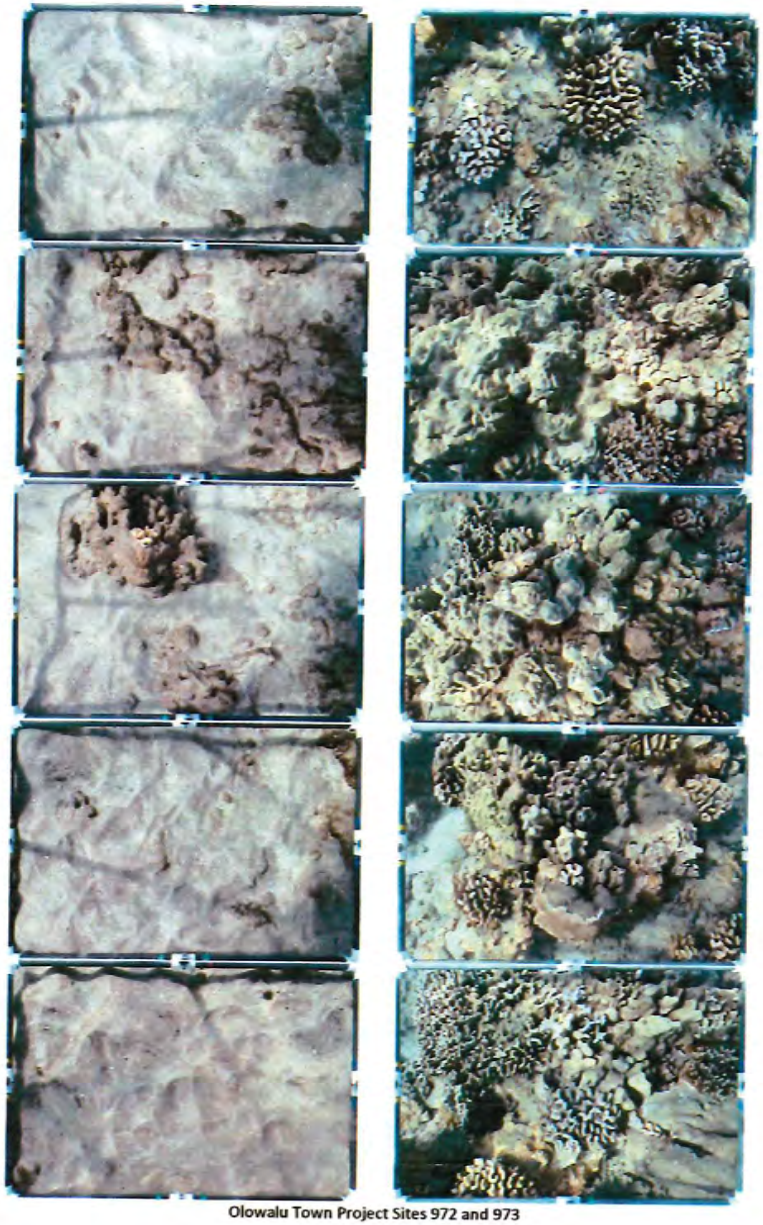

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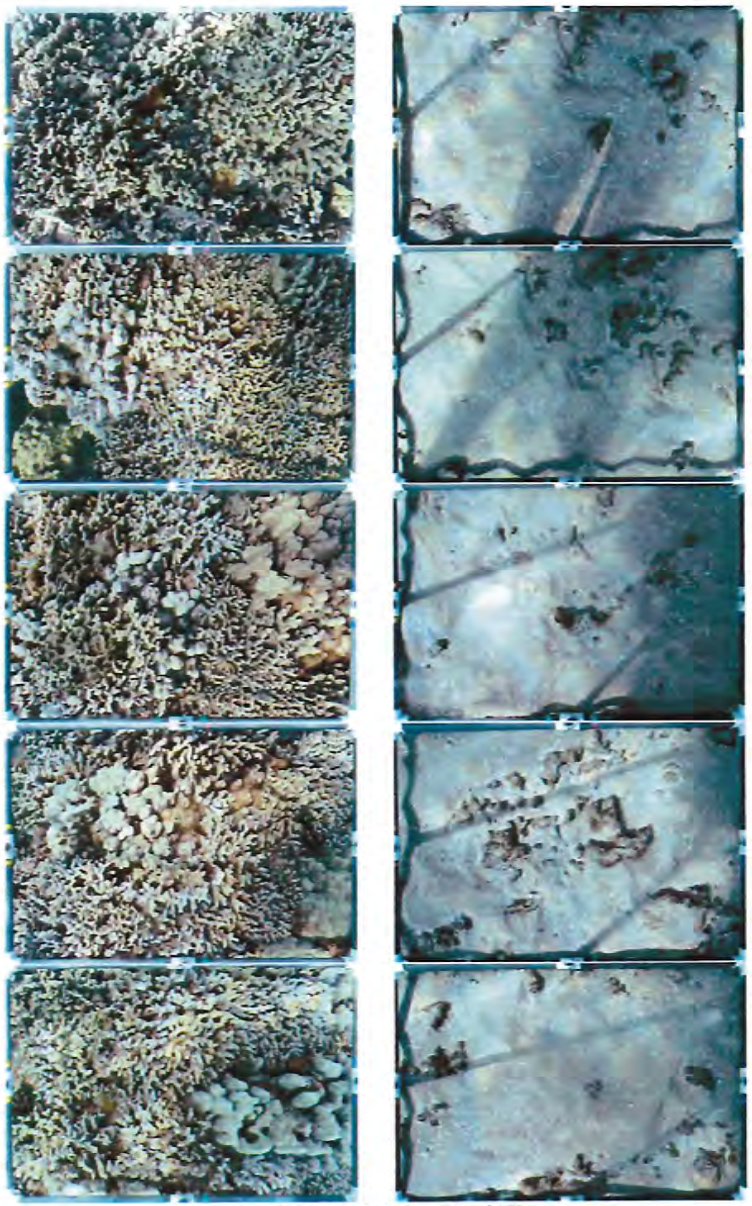

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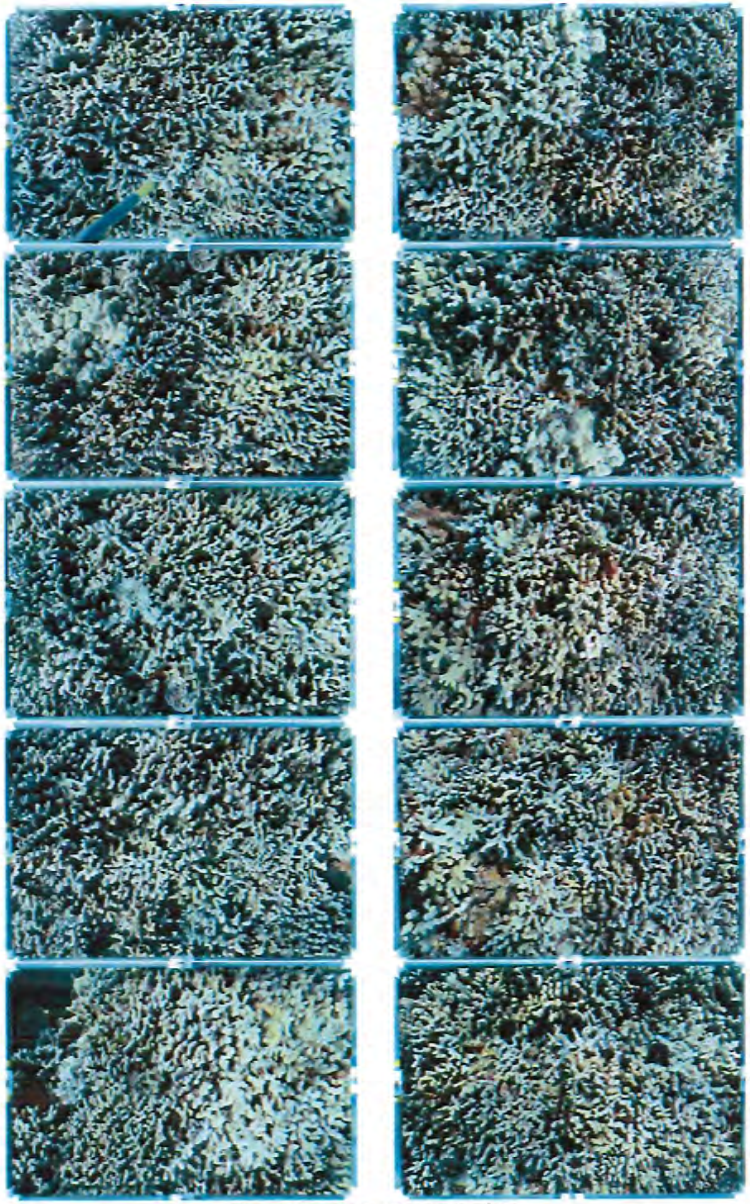

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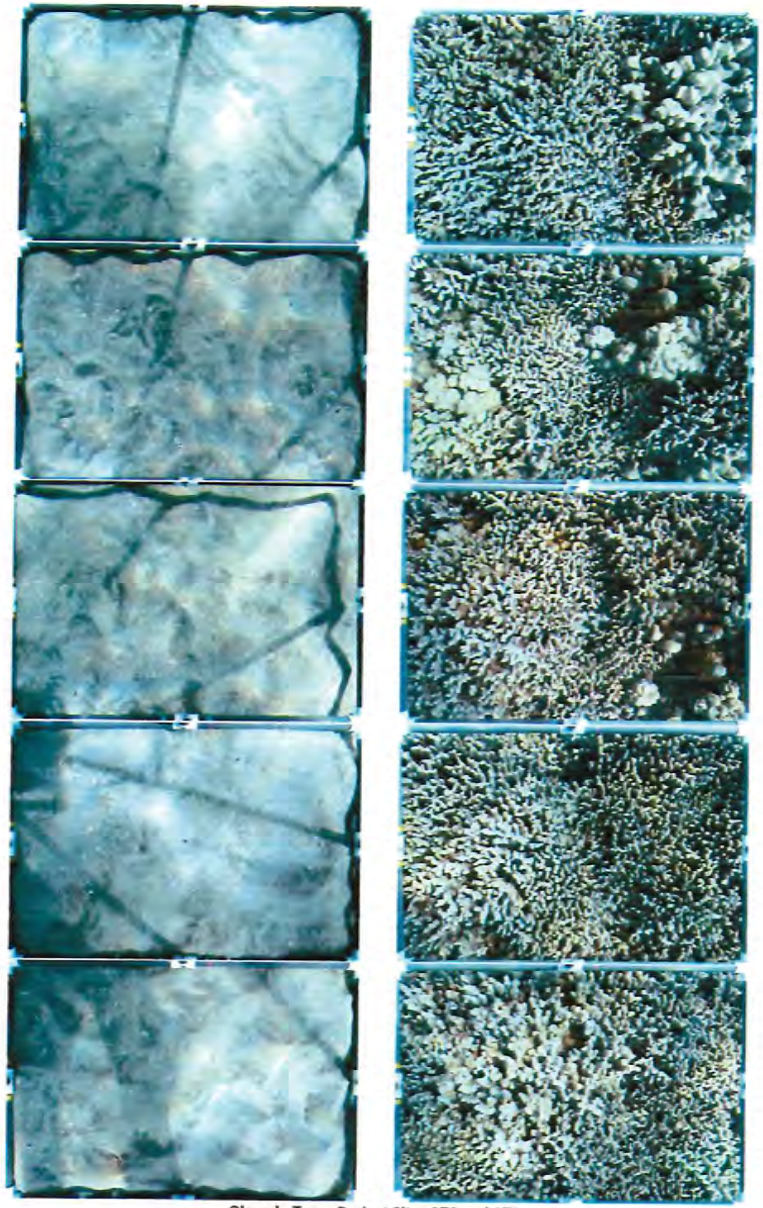

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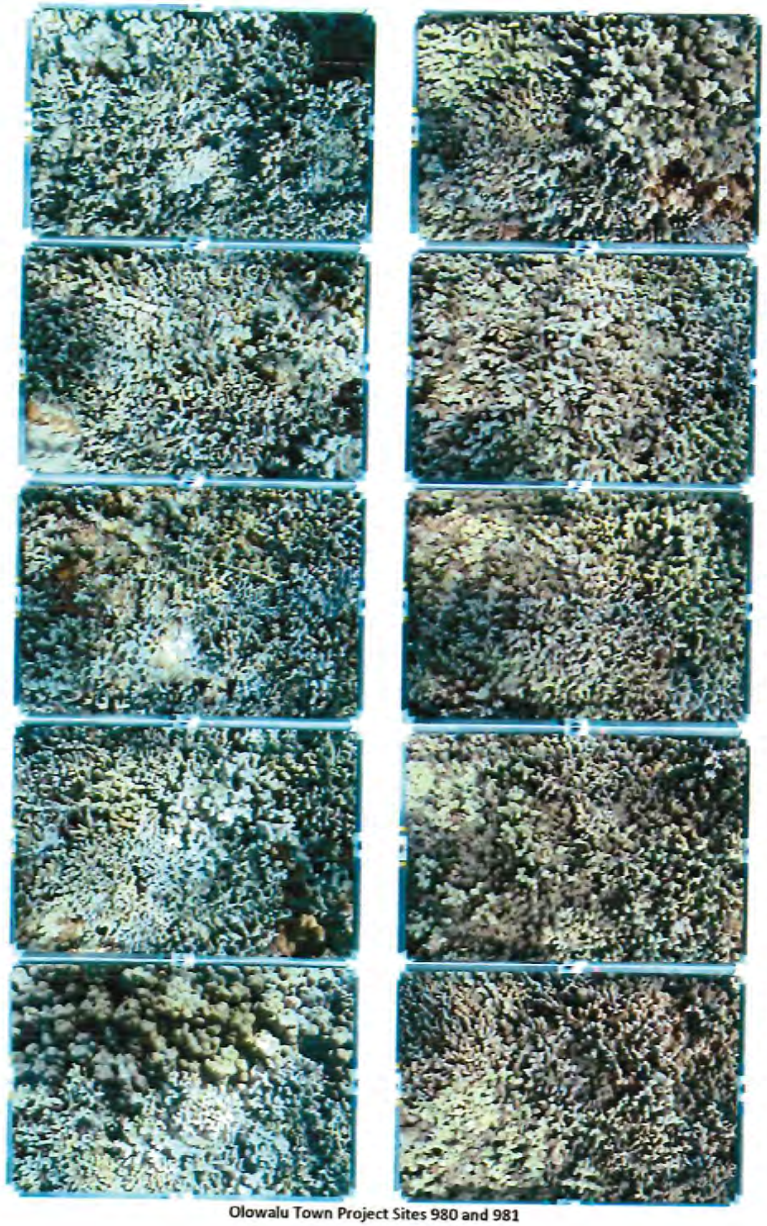

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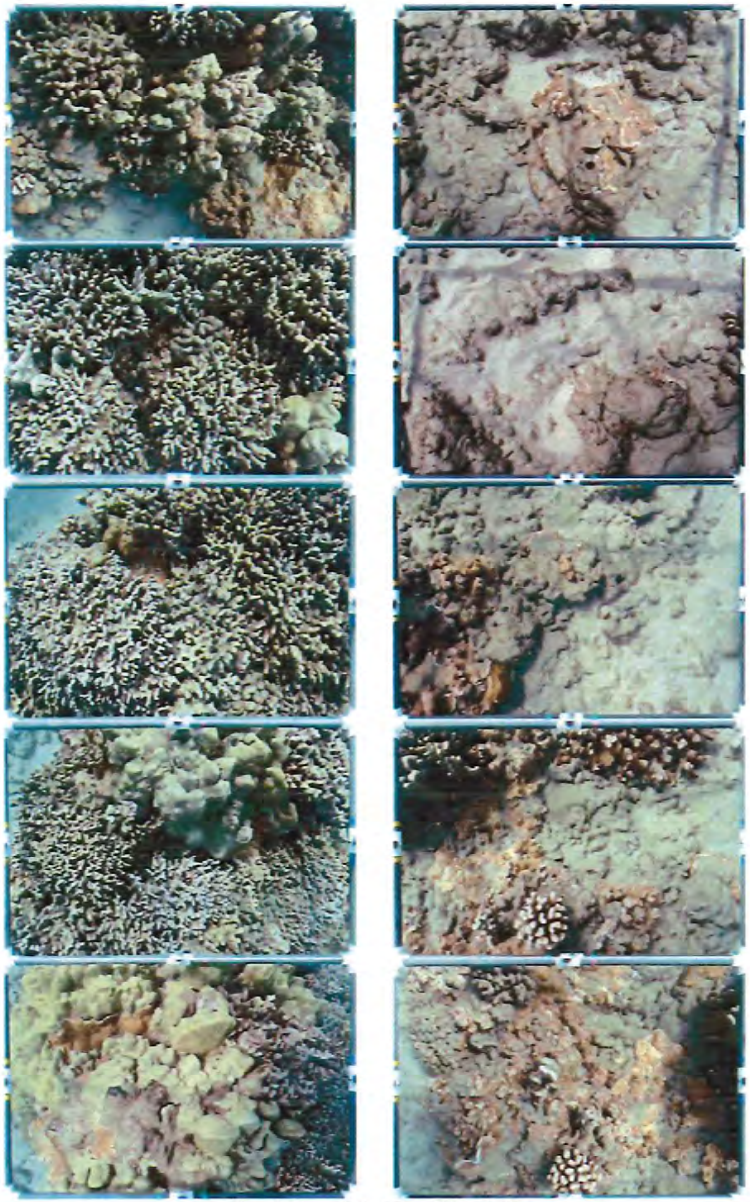

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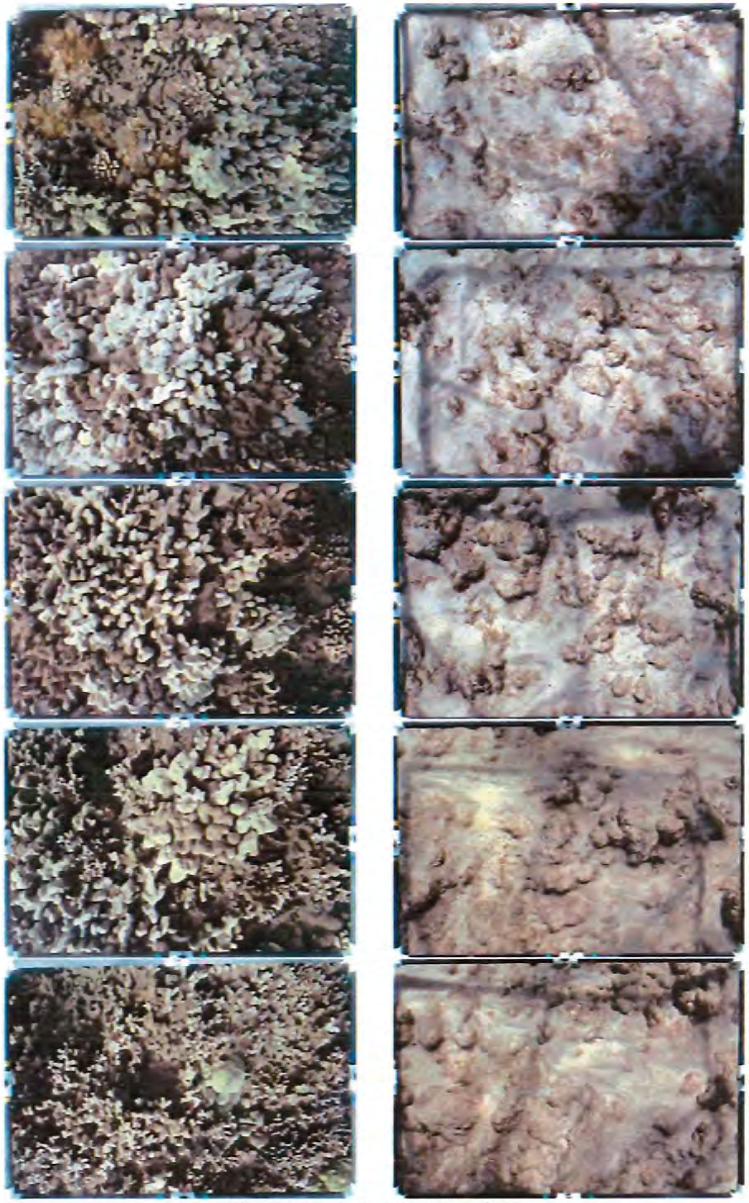

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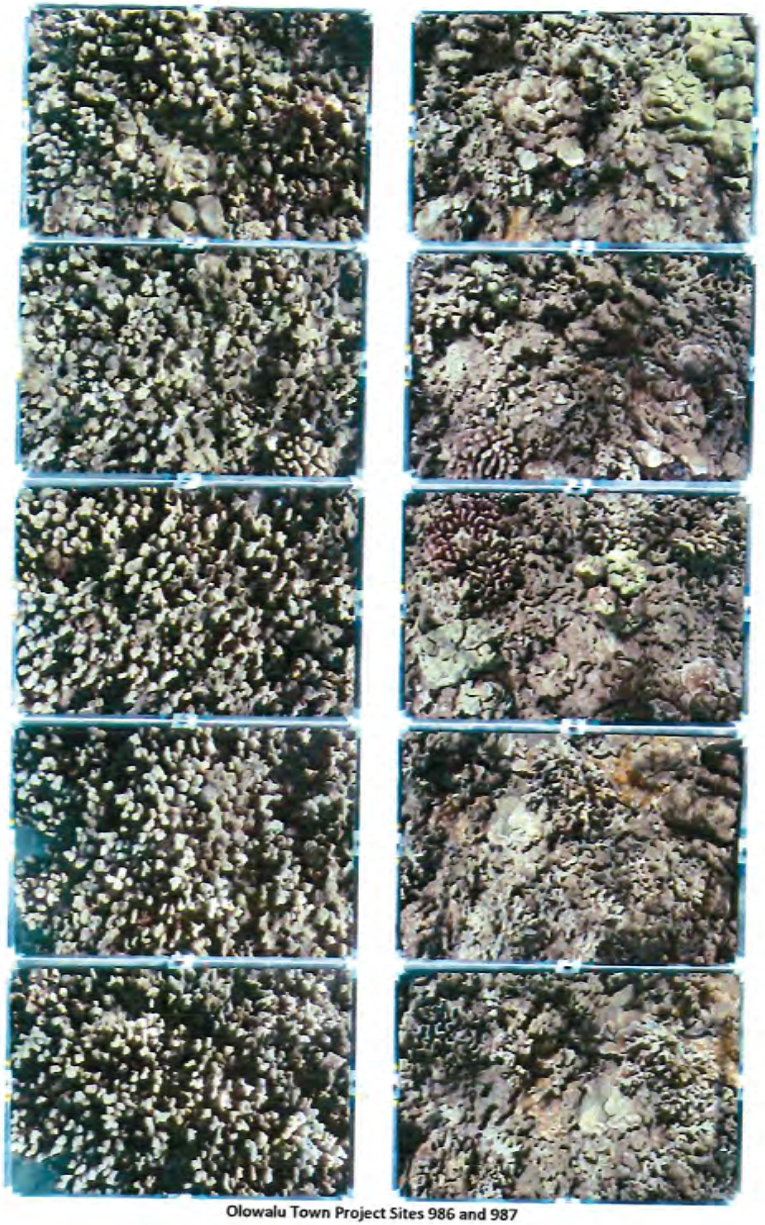

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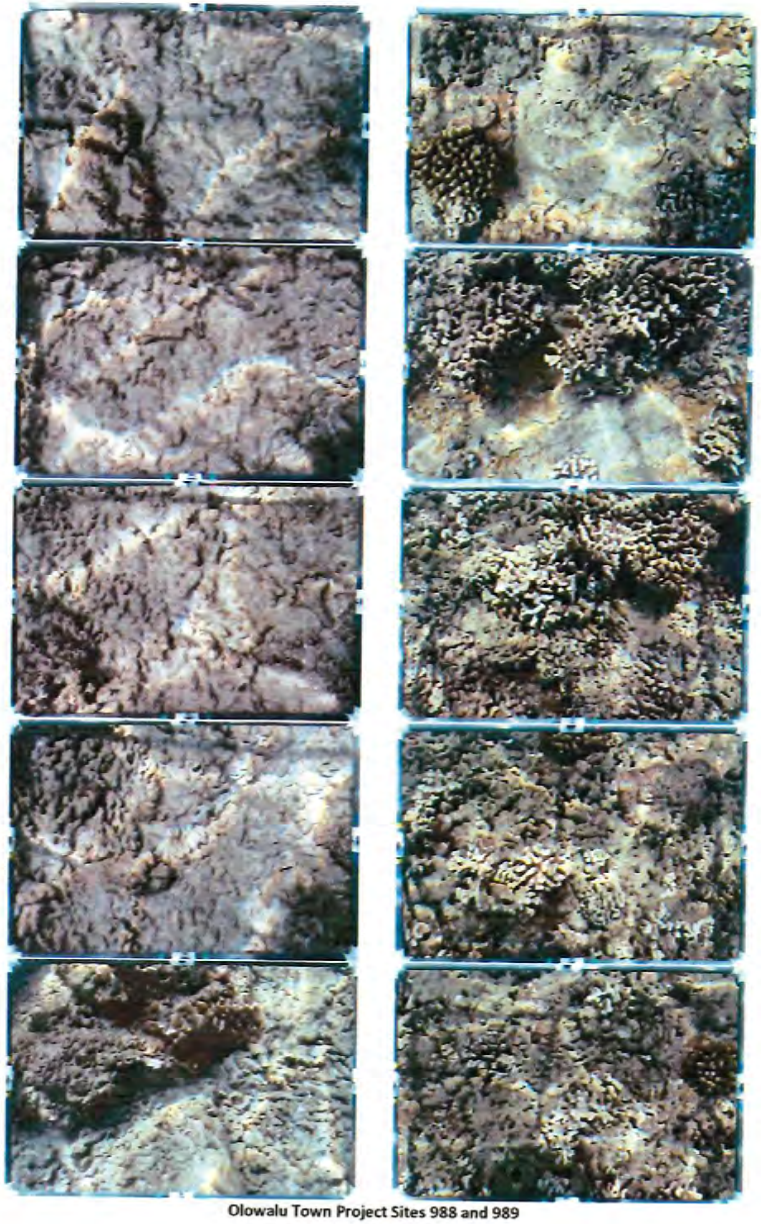

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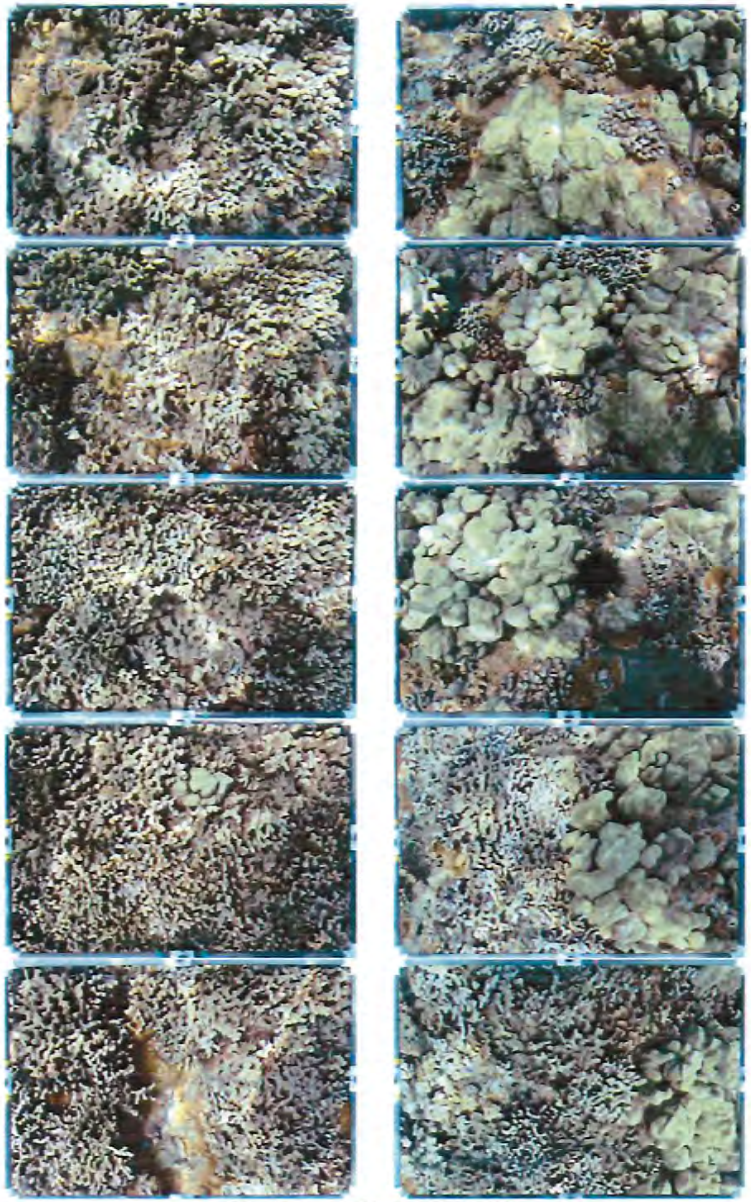

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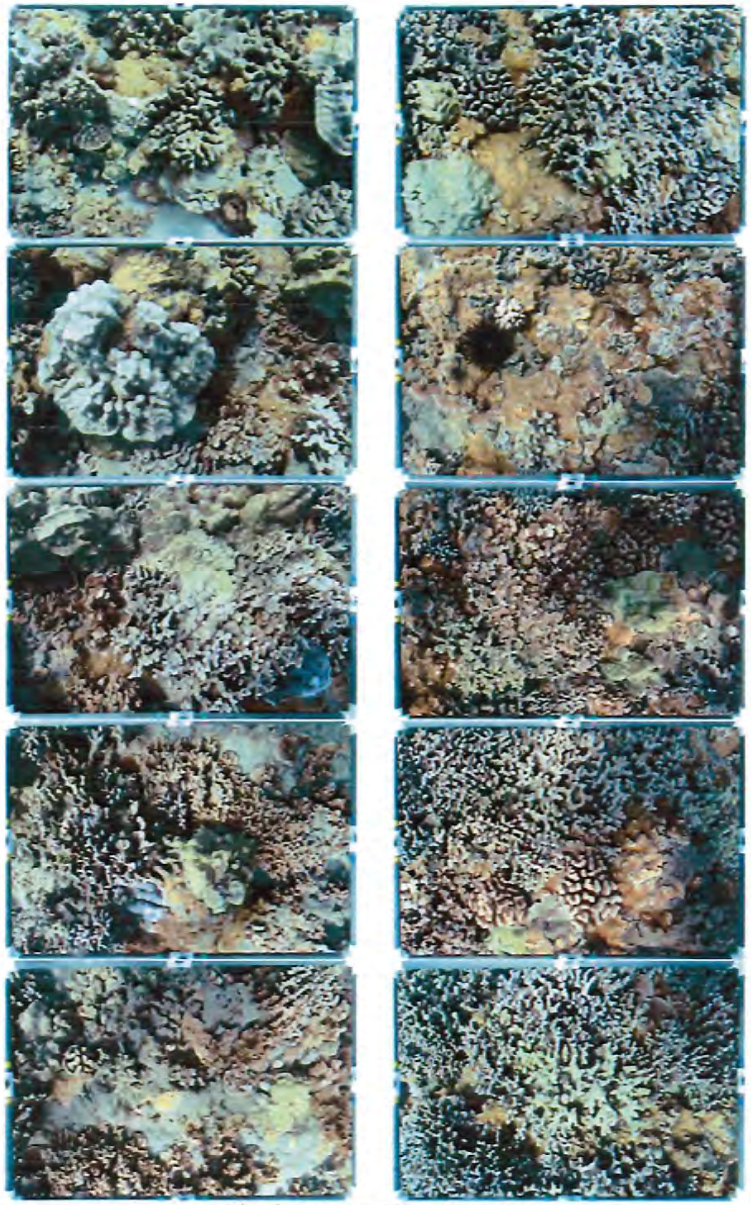

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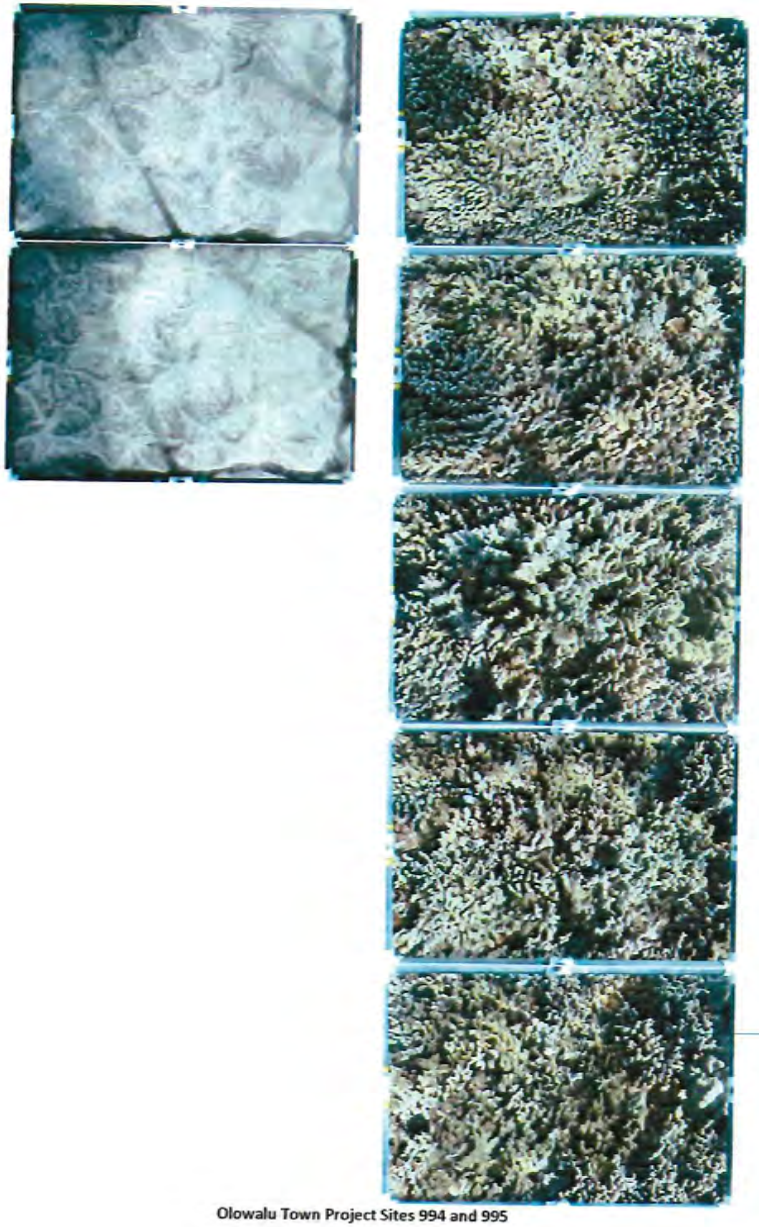

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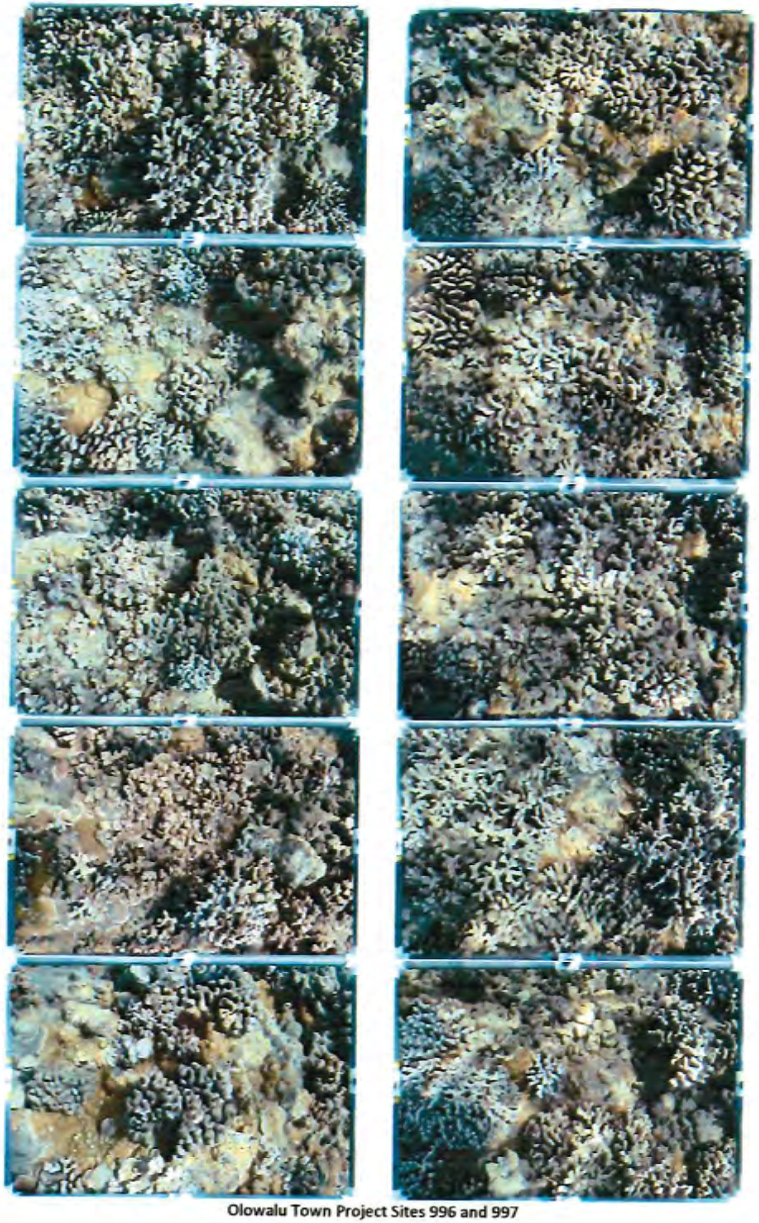

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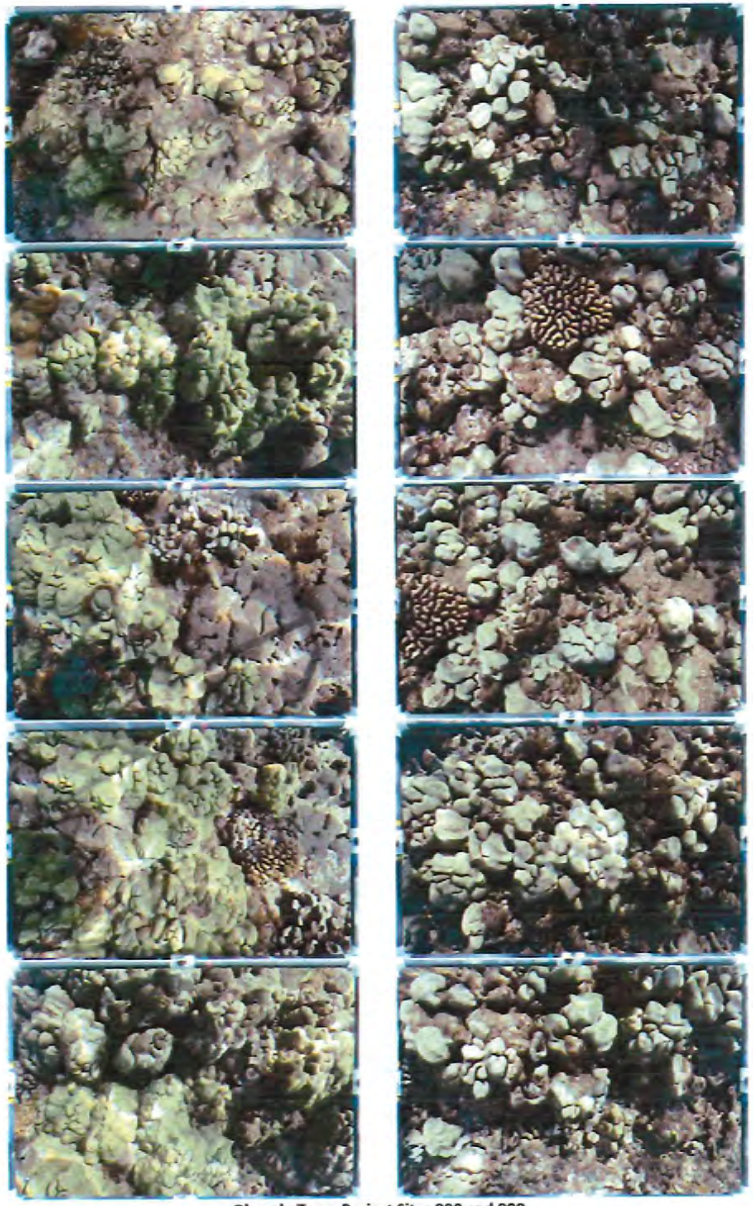

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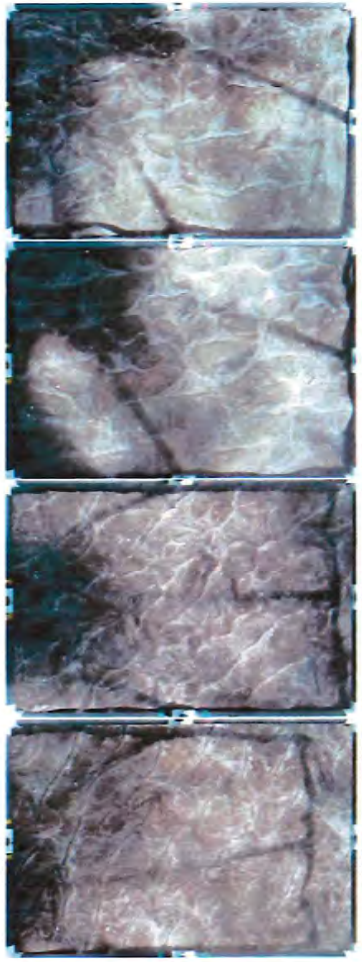

Olowalu Town Project Site 1000

APPENDIX E-1.

September 28, 2015 Letter from Marine Research Consultants, Inc.

MARINE RESEARCH CONSULTANTS, INC.
1039 Waakaua Pl. Honolulu, Hawaii 96822

September 28, 2015

Dave Ward and Bill Frampton
Olowalu Town, LLC
2035 Main Street, Suite No. 1
Wailuku, Hawaii 96793

SUBJECT: Report Entitled *Assessment of Marine Water Chemistry and Biotic Community Structure in the Vicinity of the Olowalu Town Master Plan, Olowalu, Maui, Hawaii* (Dated July, 2011)

Dear Mr. Ward and Mr. Frampton:

The subject report evaluated the nearshore marine environment off of the Olowalu Town Master Plan project site. I understand that there are two (2) alternatives addressed in the Final Environmental Impact Statement: Alternative 1, the Preferred Alternative; and Alternative 2, the Maui Island Plan (MIP) alternative, which excludes lands makai of Honoapiilani Highway. Moreover, I understand that both Alternatives 1 and 2 call for the development of up to 1,500 residential units and between 300,000 to 375,000 square feet of commercial space.

My study methodology and outcomes should not be affected by the alternative land use configurations offered by Alternative 1 and Alternative 2. The research methodology, analysis, findings and recommendations are focused on the marine environment only. Recommendation no. 14 discussed in the summary section of my report applies to both Alternatives:

> *Planning of the Olowalu Town Master Plan focuses on continued maintenance and stewardship of the unique natural resources of the area. As a result, as long as best management practices are utilized to avoid any unforeseen impacts during the construction and operational phases of the project, and engineering considerations in the design of the retention basins focus on maximizing sediment trapping, there is no rationale to indicate the potential for negative impacts to the marine environment. In fact, my work revealed that there is presently some localized impacts to coral reef communities as a result of sediment discharge from Olowalu Stream, The implementation of BMP's through construction of retention*

> *basins may result in an overall improvement to the condition of offshore marine life.*

Since the evaluation of the nearshore environment in 2010 and 2011, and the 2011 preparation of our report, I have become aware of new circumstances that have altered the results of my previous surveys. Recent elevated ocean temperatures around the State of Hawaii have resulted in bleaching of corals in at least some nearshore settings. Visual inspection of the reef at Olowalu that I conducted on September 24, 2015 indicated that such bleaching has occurred at my study sites, resulting in a reduction of live corals. As the bleaching event has not likely reached its conclusion, it is not yet possible to evaluate the permanent overall effect of this event.

However, even with this change in character of the Olowalu reef by natural phenomenon that are not directly related to activities on land, there is no reason to suggest the possibility of different or likely increased environmental impacts not previously dealt with in the 2011 report. Rather, decreasing sediment delivery to the ocean over the existing situation will likely provide an enhancement to recover of the reef that survives the bleaching event. I confirm that the report's research and data collection, compilation and analysis are still valid as to conditions that existed at the time of the surveys. These previous surveys also provide a valid baseline to which future surveys may be compared to accurately document changes in the local environment.

Sincerely,

Steven Dollar, Ph.D.
Marine Research Consultants, Inc.

cc: Colleen Suyama, Munekiyo Hiraga
K:\DATA\OlowaluTown\MasterPl\Final EIS\Marine Research Letter.doc

APPENDIX ~~E~~F.

Flora and Fauna Survey

FLORA AND FAUNA SURVEY

FOR THE

OLOWALU TOWN MASTER PLAN

OLOWALU, MAUI, HAWAII

by

ROBERT W. HOBDY
ENVIRONMENTAL CONSULTANT
Kokomo, Maui
May 2010

Prepared for:
Olowalu Town, LLC

FLORA AND FAUNA SURVEY FOR THE OLOWALU TOWN MASTER PLAN

INTRODUCTION

The Olowalu Town Master Plan project lies on approximately 636 acres of land TMK (2) 4-8-003:84, 98 through 118, and 124 in Olowalu and Ukumehame in southwestern West Maui (see Figure 1). The property borders the ocean on its southwest side and grades into rough mountainous land on the northeast side. This study, evaluating the flora and fauna resources, was initiated by the owners in compliance with environmental requirements of the planning process.

SITE DESCRIPTION

This project area encompasses, in its entirety, a large alluvial fan that was created over several millenium by the deposition of soil and rocks washed down by Olowalu Stream from the upper valley. This alluvial fan has a slope of about 10% in its upper portion but the slope becomes gentler as it approaches the coast line where it is only 1 to 3%. The elevation ranges from about 500 feet on the lower slopes of the mountain down to sea level. Olowalu Stream cuts through the alluvial slopes to form a riparian corridor.

Nearly the entire area was formerly farmed in sugar cane agriculture and had a network of access roads, reservoirs and irrigation ditches. Today the fields are fallow and are overgrown with dry grasslands and fast-growing trees. Soils vary considerably. The coastal strip is made up mostly of rough cobble beaches in the northern portion and fine gray sands in the southern portion. The fallow fields are deep, alluvial, silty-loams with abundant loose rock. The lower mountain slopes are rough, broken and stony land (Foote et al, 1972). Rainfall varies from about 13 inches per year near the coast up to about 20 inches per year on the lower slopes of the mountain with the bulk falling during the winter months (Armstrong, 1983).

BIOLOGICAL HISTORY

In pre-contact times this area would have been a dry native shrubland with a few scattered trees. A good diversity of species would have been present, but with a preponderance of grasses such as pili (*Heteropogon contortus*), kalamälö (*Eragrostis deflexa*) and käkonakona (*Panicum torridum*), shrubs such as 'a'ali'i (*Dodonaea viscosa*), (*Gouania hillebrandii*) no common name and ma'o hauhele (*Hibiscus brackenridgei*) and trees such as wiliwili (*Erythrina sandwicensis*) and 'ohe makai (*Reynoldsia sandwicensis*).

The Hawaiians had a substantial population in the Olowalu area and developed a complex irrigated agricultural system along the stream corridor. The area would have produced large amounts of kalo (*Colocasia esculenta*) as well as a variety of other food and fiber crops. The ocean was also productive of fish, he'e (octopus) and limu (seaweed species).

Sugar production began in the latter half of the 1800s and in time the entire area was converted to sugar cane agriculture. This began a continuous cycle of plowing, cultivating, burning and harvesting that lasted for over a century until sugar production ended with the last harvest in 1999. Today most of this land stands idle and has reverted to a dry grassland/shrubland that is dominated by hardy, non-native species.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the Olowalu Town Master Plan which was conducted in May 2010.

The objectives of the survey were to:

1. Document what plant, bird and mammal species occur on the property or may likely occur in the existing habitat.

2. Document the status and abundance of each species.

3. Determine the presence or likely occurrence of any native flora and fauna, particularly any that are Federally listed as Threatened or Endangered. If such occur, identify what features of the habitat may be essential for these species.

4. Determine if the project area contains any special habitats which if lost or altered might result in a significant negative impact on the flora and fauna in this part of the island.

5. Note which aspects of the proposed development pose significant concerns for plants or for wildlife and recommend measures that would mitigate or avoid these problems.

BOTANICAL SURVEY REPORT

SURVEY METHODS

A walk-through botanical survey method was used focusing on all of the diverse habitat types including the coastline, stream corridor, gulch sides, rocky outcrops, reservoirs, irrigation ditches, forests and open fields. Notes were made on plant species, distribution and abundance, as well as on terrain and substrate. Not recorded were those species on private parcel inclusions that were landscape ornamentals, fruit trees or other recent purposeful plantings.

DESCRIPTION OF THE VEGETATION

The great majority of this 630 acre property, which is made up of the former sugar cane fields, is presently an open grassland or a mixture of grass and aggressive dryland shrubs and trees. Two species truly dominate and are found in or around every habitat: buffelgrass (*Cenchrus ciliaris*) and ʻopiuma (*Pithecellobium dulce*). Also of common occurrence are koa haole (*Leucaena leucocephala*), Java plum (*Syzygium cumini*), ʻuhaloa (*Waltheria indica*), kiawe (*Prosopis pallida*), sourbush (*Pluchea carolinensis*) and Castor bean (*Ricinus communis*).

A total of 114 plant species were recorded during the course of the survey. Of these 3 were endemic to the Hawaiian Islands and nowhere else: nehe (*Melanthera lavarum*), alena (*Boerhavia herbstii*) and wiliwili. An additional 15 species were indigenous to Hawaii as well as to other places: (*Cyperus polystachyos*) no common name, pili grass (*Heteropogon contortus*), ʻäkulikuli (*Sesuvium potulacastrum*), kou (*Cordia subcordata*), kipukai (*Heliotropium curassavicum*), koali awahia (*Ipomoea indica*), pohuehue (*Ipomoea pes-caprae*), naupaka kahakai (*Scaevola taccada*), ʻilima (*Sida fallax*), hau (*Talipariti tiliaceum*), milo (*Thespesia populnea*), ʻuhaloa, ʻaʻaliʻi, ʻiliʻeʻe (*Plumbago zeylanica*) and pōpolo (*Solanum americanum*). Another 4 species were Polynesian introductions: kalo (*Colocasia esculenta*), niu (*Cocos nucifera*), Kō (*Saccharum officinarum*) and kukui (*Aleurites moluccana*). The remaining 92 species were non-native plants that are pasture grasses, escaped ornamentals or agricultural weeds.

DISCUSSION AND RECOMMENDATIONS

The vegetation throughout the project area is dominated by non-native plant species that have taken over the abandoned sugar cane fields during the last decade. Most prominent among these are buffelgrass and ʻopiuma. Buffelgrass has spread throughout the dry leeward districts of Maui where it serves as winter pasture for ranches in these areas. It dries out, however, during the long dry seasons and has proven to be a major fuel for wildfires. Recent fires have highlighted the need for creating and maintaining fuel breaks along key boundaries to protect valuable resources. It is recommended that fuel breaks be considered in project planning until such time as the buffelgrass can be replaced by less flammable landscaping.

ʻOpiuma too has spread dramatically in the former cane lands. It can be found in every habitat on the property, but grows most prolifically along Olowalu Stream and on the coastal plain where its deep roots can access ground water sources. It grows rapidly in these areas, outcompeting all other vegetation and forms dense thorny thickets. ʻOpiuma also carries wildfires and consideration should be given on the coastal flats to creating and maintaining fuel breaks.

Eighteen species of endemic and indigenous native plants were recorded during the survey. All but one of these were found only in areas that had not been cane fields. Six were found growing along the coast, ten were found growing on the steep slopes of upper Olowalu Gulch, and one along an irrigation ditch. Only the hardy 'uhaloa was found everywhere on the property. While all of the native plants except the 'uhaloa were of rare occurrence on the property, all are widespread in Hawaii in general.

No federally protected Threatened or Endangered plant species were found during the survey, nor were any found that are candidates for such status. No Critical Habitat for any protected species occurs on or adjacent to this project.

The main threat to federally protected species in this part of West Maui is fire. In 2007 a large fire swept up into the nearby West Maui Natural Area Reserve on the lower slopes of Lihau destroying populations of (*Gouania hillebrandii*) no common name, (*Spermolepis hawaiiensis*) no common name, and kio'ele (*Kadua coriacea*). Other Endangered species occur in wet forests at the summits of Lihau, wawae'iole (*Huperzia mannii*), and of Halepohaku, (*Tetramolopium capillare*) no common name, and (*Lysimachia lydgatei*) no common name about 2 miles mauka of the project area. Another fire earlier this year (May, 2010) burned the ridge below Halepohaku but spared the Endangered plants there. As long as the vegetation remains as it is in the project area it will represent a significant fuel hazard and a threat to human and natural resources both on-site and beyond. Both fuel breaks and certain grazing practices can greatly reduce fuel loading and help protect these resources.

Many of the dryland native plants that grow in leeward West Maui are ideally adapted to the soils and climate. It is recommended that a number of them that have proved successful in the Cultural Reserve plantings in Olowalu Valley be considered for use in landscaping schemes in the Olowalu Town Project.

With the above-mentioned considerations regarding fuel management and the use of fuel breaks, this project is not expected to have a significant negative impact on the botanical resources in this part of West Maui.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within three groups: Ferns, Monocots and Dicots. Taxonomy and nomenclature of these plants are in accordance with Palmer (2003), Wagner et al. (1999) and Staples & Herbst (2005).

For each species, the following information is provided:

1. Scientific name with author citation

2. Common English or Hawaiian name.

3. Bio-geographical status. The following symbols are used:
   endemic = native only to the Hawaiian Islands; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   polynesian introduction = plants introduced to Hawai'i in the course of Polynesian migrations and prior to western contact.
   non-native = all those plants brought to the islands intentionally or accidentally after western contact.

4. Abundance of each species within the project area:
   abundant = forming a major part of the vegetation within the project area.
   common = widely scattered throughout the area or locally abundant within a portion of it.
   uncommon = scattered sparsely throughout the area or occurring in a few small patches.
   rare = only a few isolated individuals within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
FERNS			
AZOLLACEAE (Mosquito Fern Family)			
Azolla filiculoides Lam.	mosquito fern	non-native	rare
NEPHROLEPIDACEAE (Sword Fern Family)			
Nephrolepis brownii (Desv.) Hovencamp & Miyam.	Asian sword fern	non-native	rare
PTERIDACEAE (Brake Fern Family)			
Adiantum raddianum C. Presl.	maidenhair fern	non-native	rare
THELYPTERIDACEAE (Marsh Fern Family)			
Christella parasitica (L.) H. Lev.	----------	non-native	rare
MONOCOTS			
ARACEAE (Aroid Family)			
Colocasia esculenta (L.) Schott	kalo, taro	Polynesian	rare
ARECACEAE (Palm Family)			
Cocos nucifera L.	niu, coconut	Polynesian	rare
Washingtonia filifera (Andre) S. Watson	California washingtonia	non-native	unc
Washingtonia robusta H. Wendland	Mexican washingtonia	non-native	rare
COMMELINACEAE (Spiderwort Family)			
Commelina diffusa N.L. Burm.	honohono	non-native	rare
CYPERACEAE (Sedge Family)			
Cyperus polystachyos Rottb.	----------	indigenous	rare
Cyperus rotundus L.	nut sedge	non-native	rare
Cyperus sp.	----------	non-native	rare
Kyllingia brevifolia Rottb.	kilio'opu	non-native	rare
POACEAE (Grass family)			
Brachiaria subquadripara (Trin.) Hitchc.	----------	non-native	rare
Cenchrus ciliaris L.	buffelgrass	non-native	abundant
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	uncommon
Chloris virgata Sw.	feather fingergrass	non-native	rare
Coix lacryma-jobi L.	Job's tears	non-native	rare
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	uncommon
Digitaria ciliaris (Retz.) Koeler	Henry's crabgrass	non-native	rare
Digitaria setigera Roth	kukae pua'a	non-native	rare
Eleusine indica (L.) Gaertn.	wiregrass	non-native	rare
Eragrostis pectinacea (Michx.) Nees	Carolina lovegrass	non-native	rare
Heteropogon contortus (L.) P.Beauv ex Roem & Schult.	pili	indigenous	rare
Melinis repens (Willd.) Zizka	Natal redtop	non-native	uncommon
Panicum maximum Jacq.	Guinea grass	non-native	uncommon
Paspalum conjugatum Bergius	Hilo grass	non-native	rare
Pennisetum purpureum Schumach.	Napier grass	non-native	rare
Polypogon monspeliensis (L.) Desf.	rabbitfoot grass	non-native	rare
Saccharum officinarum L.	kō, sugar cane	Polynesian	rare
Sacciolepis (L.) Chase	Glenwood grass	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Setaria parviflora (Poir.) Kerguelen	yellow foxtail	non-native	rare
Setaria verticillata (L.) P. Beauv.	bristly foxtail	non-native	rare
Stenotaphrum secundatum (Walter) Kuntze	St. Augustine grass	non-native	rare
Urochloa mutica (Forrsk.) T.Q. Nguyen	California grass	non-native	rare
DICOTS			
AIZOACAE (Fig-marigold Family)			
Sesuvium portulacastrum (L.) L.	ākulikuli	indigenous	rare
Trianthema portulacastrum L.	----------	non-native	rare
AMARANTHACEAE (Amaranth Family)			
Amaranthus spinosus L.	spiny amaranth	non-native	uncommon
Atriplex semibaccata R.Br.	Australian saltbush	non-native	rare
Atriplex suberecta Verd.	saltbush	non-native	rare
ANACARDIACEAE (Mango Family)			
Mangifera indica L.	mango	non-native	rare
ASTERACEAE (Sunflower Family)			
Ageratum conyzoides	maile hohono	non-native	rare
Bidens pilosa L.	Spanish needle	non-native	rare
Conyza bonariensis (L.) Cronq.	hairy horseweed	non-native	uncommon
Crassocephalum crepidioides (Benth.) S. Moore	redflower ragleaf	non-native	rare
Emilia fosbergii Nicolson	red pualele	non-native	rare
Lactuca sativa L.	prickly lettuce	non-native	rare
Melanthera lavarum (Gaud.) Wagner & Rob.	nehe	endemic	rare
Pluchea carolinensis (Jacq.) G. Don	sourbush	non-native	common
Pluchea indica (L.) Less.	Indian fleabane	non-native	rare
Senecio madagascariensis Poir.	fireweed	non-native	rare
Synedrella nodiflora (L.) Gaertn.	nodeweed	non-native	rare
Verbesina encelioides (Cav.) Benth. & Hook.	golden crown-beard	non-native	rare
BORAGINACEAE (Borage Family)			
Cordia subcordata Lam.	kou	indigenous	rare
Heliotropium curassavicum L.	kipukai	indigenous	rare
Heliotropium procumbens Mill.	fourspike heliotrope	non-native	rare
Tournefortia argentea L. fil.	tree heliotrope	non-native	rare
BRASSICACEAE (Mustard Family)			
Nasturtium microphyllum Boenn ex Rchb.	leko, watercress	non-native	rare
CARICACEAE (Papaya Family)			
Carica papaya L.	papaya	non-native	rare
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea alba L.	moonflower	non-native	rare
Ipomoea indica (J. Burm.) Merr.	koali awahia	indigenous	rare
Ipomoea pes-caprae (L.) R.Br.	pōhuehue	indigenous	rare
Ipomoea triloba L.	little bell	non-native	rare
Merremia aegyptia (L.) Urb.	hairy merremia	non-native	uncommon

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
CUCURBITACEAE (Gourd Family)			
Cucumis dipsaceus Ehrenb. ex Spach	hedgehog gourd	non-native	rare
Momordica charantia L.	bitter melon	non-native	uncommon
EUPHORBIACEAE (Spurge Family)			
Aleurites moluccana (L.) Willd.	kukui	Polynesian	rare
Chamaesyce hirta (L.) Millsp.	hairy spurge	non-native	uncommon
Chamaesyce hypericifolia (L.) Millsp.	graceful spurge	non-native	rare
Chamaesyce prostrata (Aiton) Small	prostrate spurge	non-native	rare
Ricinus communis L.	Castor bean	non-native	common
FABACEAE (Pea Family)			
Acacia farnesiana (L.) Willd.	klu	non-native	rare
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	rare
Crotalaria pallida Aiton	smooth rattlepod	non-native	uncommon
Desmanthus pernambucanus (L.) Thellung	slender mimosa	non-native	uncommon
Desmodium tortuosum (Sw.) DC.	Florida beggarweed	non-native	rare
Erythrina sandwicensis Degener	wiliwili	endemic	rare
Indigofera hendecaphylla Jacq.	creeping indigo	non-native	rare
Indigofera suffruticosa Mill.	inikö	non-native	rare
Leucaena leucocephala (Lam.) de Wit	koa haole	non-native	common
Macroptilium atropupureum (DC.) Urb.	siratro	non-native	rare
Macroptilium lathyroides (L.) Urb.	wild bean	non-native	rare
Peltophorum pterocarpum (A.P. de Candolle) K.Heyne	yellow poinciana	non-native	rare
Pithecellobium dulce (Roxb.) Bentham	'opiuma	non-native	abundant
Prosopis pallida (Willd.) Kunth	kiawe	non-native	common
Samanea saman (A.P. de Candolle) Merrill	monkeypod	non-native	uncommon
GOODENIACEAE (Goodenia Family)			
Scaevola taccada (Gaertn.) Roxb.	naupaka kahakai	indigenous	rare
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R.Br.	lion's ear	non-native	rare
Salvia occidentalis Sw.	West Indian sage	non-native	rare
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.) Sweet	hairy abutilon	non-native	rare
Malvastrum cormandelianum (L.) Garcke	false mallow	non-native	rare
Sida fallax Walp.	'ilima	indigenous	rare
Sida rhombifolia L.	Cuban jute	non-native	uncommon
Talipariti tileaceum (L.) Fryxell	hau	indigenous	rare
Thespesia populnea (L.) Sol. ex Correa	milo	indigenous	rare
Waltheria indica L.	'uhaloa	indigenous	common
MELIACEAE (Mahogany Family)			
Melia azedarach L.	pride of India	non-native	uncommon
MORACAE (Mulberry Family)			
Ficus macrophylla Desf. ex Pers.	Moreton Bay fig	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Ficus religiosa L.	Bo tree	non-native	rare
MYRTACEAE (Myrtle Family)			
Eucalyptus rudis Endl.	desert gum	non-native	rare
Psidium guajava L.	common guava	non-native	rare
Syzygium cumini (L.) Skeels	Java plum	non-native	common
NYCTAGINACEAE (Four-o'clock Family)			
Boerhavia coccinea Mill.	scarlet spiderling	non-native	uncommon
Boerhavia herbstii Fosb.	alena	endemic	rare
ONAGRACEAE (Evening Primrose Family)			
Ludwigia octovalvis (Jacq.) Raven	primrose willow	non-native	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora foetida L.	love-in-a-mist	non-native	uncommon
PLUMBAGINACEAE (Leadwort Family)			
Plumbago zeylanica L.	'ilie'e	indigenous	rare
PORTULACACEAE (Purslane Family)			
Portulaca oleracea L.	pigweed	non-native	rare
SAPINDACEAE (Soapberry Family)			
Dodonaea viscosa Jacq.	'a'ali'i	indigenous	rare
SCROPHULARIACEAE (Figwort Family)			
Buddleia asiatica Lour.	dog tail	non-native	rare
SOLANACEAE (Nightshade Family)			
Nicotiana glauca R.C. Graham	tree tobacco	non-native	rare
Solanum americanum Mill.	pöpolo	indigenous	rare
Solanum lycopersicum L.	cherry tomato	non-native	rare
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through survey method was conducted in conjunction with the botanical survey. All parts of the property were covered. Field observations were made with the aid of binoculars and by listening to vocalizations. Notes were made on species, abundance, activities and location as well as observations of trails, tracks, scat and signs of feeding. In addition an evening visit was made to the area to record crepuscular activities and vocalizations and to see if there was any evidence of occurrence of the öpe'ape'a or Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Five species of non-native mammals were recorded in the project during four site visits. Taxonomy and nomenclature follow Tomich (1986).

Domestic Cat (*Felis catus*) – One cat was seen hunting in the grasslands, but numerous tracks were seen along dirt roads.

Domestic dog (*Canis familiaris*) – Dogs and dog tracks were seen in the coastal area where people bring them to the beach or walk them along the coast.

Horse (*Equus caballus*) – Several horses were pastured in the middle of the property.

Cattle (*Bos Taurus*) – Several cattle were pastured in a separate area.

Axis deer (*Axis axis*) – A few deer tracks were seen in a pasture in the northern part of the property.

A dense cover of vegetation prevented good visibility of other ground dwelling mammals in much of the property, but one might expect to see rats (*Rattus* spp.) mice (*Mus domesticus*) and mongoose (*Herpestes auropunctatus*). Rats and mice feed on seeds, fruits and herbaceous vegetation while mongoose prey on these rodents and birds.

A special effort was made to look for the Hawaiian hoary bat by making an evening survey. Observations were made at two locations overlooking Olowalu Stream using both visual and electronic techniques. When present in an area these bats are clearly visible in the glow of twilight as they forage for insects that become active in the evening. No bats were seen. In addition a bat detection device (Batbox IIID) was employed, set to the frequency of 27,000 hertz that these bats are known to use for echo-location. No bat activity was detected at either location using this device.

BIRDS

There was good birdlife diversity in this dry area. Seventeen species of birds were recorded during four site visits, including fifteen non-native species, one migratory species and one native and Endangered species (USFWS, 2009), the Hawaiian goose or nēnē. Taxonomy and nomenclature follow American Ornithologists' Union (2005).

Common myna (*Acridotheres tristis*) - Mynas were common and were found throughout the property.

Zebra dove (*Geopelia striata*) – These small doves were seen in small groups feeding in clearings and along roadways.

Northern cardinal (*Cardinalis cardinalis*) – These bright red cardinals were seen and heard calling in trees throughout the property.

Japanese white-eye (*Zosterops japonicus*) – These small green birds were seen in trees and shrubs feeding on insects.

Gray francolin (*Fracnolinus pondicerianus*) – These beige francolins were heard calling throughout the grasslands and a few flushed from cover.

Chestnut mannikin (*Lonchura Malacca*) – Several flocks of these small reddish-brown birds were seen feeding on grass seeds in open country.

Chicken (*Gallus gallus*) – Flocks of chickens were seen scratching for bugs in the coastal kiawe forests and along Olowalu Stream.

House finch (*Carpodacus mexicanus*) – Small groups of these finches were seen feeding in trees in the lower and middle parts of the property.

Spotted dove (*Streptopelia chinensis*) – Several individuals of these large doves were seen in trees and in flight over the property.

Black francolin (*Francolinus francolinus*) – A few of these black francolins were seen and others heard making their buzzing calls from the grasslands.

Nutmeg mannikin (*Lonchura punctulata*) – A few small flocks of these brown mannikins were seen in brush and feeding in the grasslands.

Northern mockingbird (*Mimus polyglottos*) – Several individuals were seen in the topmost branches of trees calling incessantly.

African silverbill (*Lonchura cantans*) – A couple flocks of these small beige birds were seen in the grasslands and heard making their quiet high-pitched calls.

House sparrow (*Passer domesticus*) – A few of these sparrows were seen in the lower part of the property near human habitations.

Wandering tattler 'Ulili *(Heteroscelus incanus)* - One of these migrant waterbirds was seen on the banks of a reservoir near the top of the property.

Red-crested cardinal *(Paroaria coronata)* – One red-crested cardinal was observed in kiawe forest in the southern part of the property.

Nēnē, Hawaiian goose *(Branta sanvicensis)* – Tracks of nēnē were seen in mud in an irrigated pasture. These Endangered geese are multiplying in West Maui and are frequently sighted by the water management crew and people at the Olowalu Cultural Reserve. They are attracted to the fringes of water features or temporarily irrigated areas. They are extremely wide-ranging in their daily activities, flying 10 miles or more between stops.

A few other non-native birds might be expected to use this habitat but the area is unsuitable for Maui's native forest birds which now only occupy native forests at higher elevations beyond the range of mosquitoes and the avian diseases they carry. Also the two reservoirs that are still functional have steep, artificial banks and deep water that greatly reduce their usefulness as habitat for Hawaii's native waterbirds.

No ae'o or Hawaiian stilt (*Himantopus mexicanus knudseni*), 'alae ke'oke'o or Hawaiian coot (*Fulica alai)* or koloa or Hawaiian duck (*Anas wyvilliana*) were seen in these reservoirs or were reported as being seen by the water management crew in the area.

INSECTS

While insects in general were not recorded, they were observed and their status noted. No native insects were seen. This habitat is not suitable for most native species. One Endangered native moth, Blackburn's sphinx moth (*Manduca blackburni*)(USFWS,2000), could occur in this type of habitat. Its host plants are native 'aiea species (*Nothocestrum* spp.) and non-native species of tree tobacco (*Nicotiana glauca*), tobacco (*Nicotiana tabacum*) and tomato (*Solanum lycopersicum*). Of these only a few young tree tobacco plants were found within the property. Each of the tree tobacco plants found were carefully examined and no Blackburn's sphinx moths or their larvae were detected.

Also a number of damselflies were seen along the open ditch and the upper reservoir, but these proved to be the non-native Familiar bluet (*Enallagma civile*) and not one of our native species.

DISCUSSION AND RECOMMENDATIONS

Most of the environment within the project area is heavily disturbed from over 100 years of intensive agricultural activity that involved land clearing, plowing the soil, cultivation, burning and harvesting in continuous cycles. Much of the steeper ground that was not in cane production has also periodically been burned in wildfire events. Little remains of native habitats and species except along the coastline and on steep rocky gulch sides. No native mammals or insects were found and sign of only one native bird, the nēnē, was detected.

Nēnē, as mentioned above, are wide-ranging, opportunistic birds that are attracted to certain types of water features and other types of irrigated and open landscapes where lush grasses grow. They like to spend some time feeding and resting in such places, but then move on to other sites during the course of

each day. These sites are widespread and diverse in character. Individually, each of these sites could be considered important habitat for these Endangered geese but would not fall into the category of being considered critical to their survival. The irrigated pasture on this property is a type of temporary habitat that is useful to nēnē in the broad scheme of things in West Maui.

Perhaps a more attractive and permanent shallow-sided water feature could be created within the upper portion of the proposed cultural reserve area that would attract nēnē as well as the ae'o, 'alae ke'oke'o and koloa. This could provide good habitat for these Endangered birds and serve as an educational and cultural component of this project. At any rate both developers and residents should be educated about the Endangered status of the nēnē and encouraged to support and delight in the resurgence in the numbers of these beautiful birds. In addition there are two abandoned plantation reservoirs on the property that could be restored to use that would serve as additional waterbird habitat as well as attractive and educational water features for the project.

While the Endangered ōpe'ape'a was not found during the survey, there is no reason not to expect its presence during the winter months when insect populations spike, attracting these bats to the lowlands and along the shoreline. Ope'ape'a roost individually in trees and shrubs, under ledges in gulches during the day and are active in the evening and throughout the night. Assuring that such vegetation and habitat is retained will allow these bats to thrive here when they are present.

This property is not suitable habitat for two protected seabird species, the Endangered 'ua'u or Hawaiian petrel (*Pterodroma sanwichensis*) and the Threatened 'a'o or Newell's shearwater (*Puffinus newelli*), which are known to nest high in the West Maui Mountains during the summer and fall months. These birds, however, must fly over the lowlands during the evening and early mornings hours to get to their burrows and then to return to the open ocean. During the late fall when the young birds are fledging they are inexperienced and uncertain fliers. These young birds are often confused by bright lights, whereupon they crash into the light source, injuring themselves and becoming vulnerable to being struck by vehicles or being attacked by dogs or cats. It is recommended that all major outdoor light sources within the project area such as street lights and flood lights be shielded so that the light is directed downward to avoid this situation.

The lower reaches of Olowalu Stream flows to the ocean only about 5-15 days out of the year. The stream was dry at the time of the survey. Thus no aquatic fauna were observed. The stream has a long history of diversion for agricultural purposes and this use continues today. The owners are considering returning a portion of the water to the stream to restore a perennial flow. In anticipation of this action it is recommended that any vehicular or pedestrian bridges across the stream be constructed as single spans so that no support piers are placed within the stream corridor to obstruct natural flow of the waters.

Other than the above considerations and recommendations, no other wildlife concerns are anticipated and the proposed project is not expected to have a significant negative impact on the fauna resources in this part of West Maui.

ANIMAL SPECIES LIST

Following is a checklist of the animal species inventoried during the field work. Animal species are arranged in descending abundance within two groups: Mammals and Birds. For each species the following information is provided:

1. Common name
2. Scientific name
3. Bio-geographical status. The following symbols are used:

   endemic = native only to Hawaii; not naturally occurring anywhere else in the world.
   indigenous = native to the Hawaiian Islands and also to one or more other geographic area(s).
   non-native = all those animals brought to Hawaii intentionally or accidentally after western contact.
   migratory = spending a portion of the year in Hawaii and a portion elsewhere. In Hawaii the migratory birds are usually in the overwintering/non-breeding phase of their life cycle.

4. Abundance of each species within the project area:

   abundant = many flocks or individuals seen throughout the area at all times of day.
   common = a few flocks or well scattered individuals throughout the area.
   uncommon = only one flock or several individuals seen within the project area.
   rare = only one or two seen within the project area.

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
MAMMALS			
Feral cat	*Felis catus*	non-native	uncommon
Domestic dog	*Canis familiaris*	non-native	rare
Horse	*Equus caballus*	non-native	rare
Cattle	*Bos taurus*	non-native	rare
Axis deer	*Axis axis*	non-native	rare
BIRDS			
Common myna	*Acridotheres tristis*	non-native	common
Zebra dove	*Geopelia striata*	non-native	common
Northern cardinal	*Cardinalis cardinalis*	non-native	common
Japanese white-eye	*Zosterops japonicus*	non-native	common
Gray francolin	*Francolinus podicerianus*	non-native	uncommon
Chestnut mannikin	*Lonchura malacca*	non-native	uncommon
Chicken	*Gallus gallus*	non-native	uncommon
House finch	*Carpodcaus mexicanus*	non-native	uncommon
Spotted dove	*Streptopelia chinensis*	non-native	rare
Black francolin	*Francolinus francolinus*	non-native	rare
Nutmeg mannikin	*Lonchura punctulata*	non-native	rare
Northern mockingbird	*Mimus polyglottos*	non-native	rare
African silverbill	*Lonchura cantans*	non-native	rare
House sparrow	*Passer domesticus*	non-native	rare
Wandering tattler	*Heteroscelus incanus*	migratory	rare
Red-crested cardinal	*Paroaria coronata*	non-native	rare
Nēnē, Hawaiian goose	*Branta sanvicensis*	endemic	rare

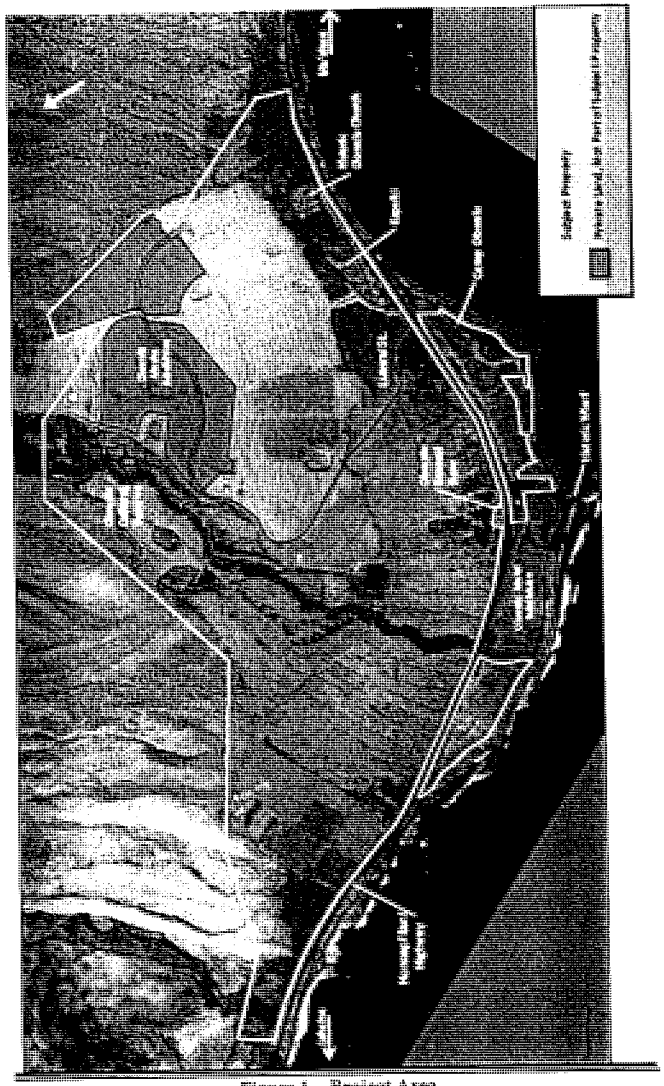

Figure 1 – Project Area

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APPENDIX ~~E-1~~F-1.

Aquatic Resource Survey

AQUATIC RESOURCE SURVEY

For the

OLOWALU TOWN PROJECT

OLOWALU, WEST MAUI, HAWAII

By:

Robert W. Hobdy
Environmental Consultant
Kokomo, Maui
May, 2011

Prepared for:
Olowalu Town, LLC

INTRODUCTION

The Olowalu Town Project lies on approximately 636 acres of land, TMK (2) 4-8-003:84, 98, 118, and 124 in Olowalu and a small corner of Ukumehame in southwestern West Maui (see Figures 1 & 2). The property borders the shoreline setback and Honoapiilani Highway on the southwest side and rough mountainous lands on the north, east and south sides. This Aquatic Resources Survey was initiated at the recommendation of the U.S. Army Corps of Engineers to determine whether any wetlands, drainage ditches, gulches, gullies or streams in the project area might qualify as jurisdictional Waters of the U.S. under provisions of the Rivers and Harbors Act (1899) or the Clean Water Act (1973).

SITE DESCRIPTION

This project area encompasses, in its entirety, a large alluvial fan two miles in width which was created over several millennia by the deposition of soil and rocks washed down the narrow 5.5 miles long Olowalu Canyon from the upper valley. On either side of Olowalu Stream several smaller rocky gulches drain the steep, dry forehills of the West Maui Mountains. At the toe of the alluvial fan a narrow coastal plain fringes the coastline.

Nearly the entire area was formerly farmed in sugar cane agriculture and had a network of access roads, reservoirs and irrigation ditches. Today the fields are fallow and are overgrown with dry grasslands and fast-growing trees. Soils vary considerably. The coastal strip is made up mostly of rough cobble beaches in the northern portion and fine gray sands in the southern portion. The fallow fields are deep, alluvial, silty-loams with abundant loose rock. The lower mountain slopes are rough, broken and stony land (Foote et al, 1972). Rainfall varies from about 13 inches per year near the coast up to about 20 inches per year on the lower slopes of the mountain with the bulk falling during the winter months (Armstrong, 1983).

During nearly 100 years of sugar cane agricultural development and management in Olowalu, many alterations were made to the physical landscape including clearing, access road development, plowing, planting and harvesting. No activity, however, had a greater impact than the diversion, storage and distribution of water resources for the irrigation of crops. An intake and ditch diverted water from Olowalu Stream, turning this perennial stream into a defacto intermittent stream that now only flows to the sea following significant rainfall events. Also a 4 – 6 foot high berm was created along the edges of Olowalu stream where it passes through the gentler slopes of the alluvial fan and the coastal plain. This berm was built to contain the flood waters generated by unusually large storms within the stream channel so that field crops would not be damaged. These berms also prevented sheet flow from gently sloping lands adjacent to the river from flowing into it in a natural way.

Ditch systems moved water across slopes in four elevational tiers to optimize crop coverage. These ditches captured water from small ephemeral stream gullies flowing into the project area from above as well as from the continuation of these gullies moving it laterally for irrigation purposes. This diversion of natural flow in combination with frequent plowing of the fields greatly obscured these ephemeral gullies or obliterated them entirely. While most of these ditches no longer carry irrigation water, they continue to divert ephemeral flow laterally in an unnatural way.

Finally, at two places on the nearly level coastal plain, drainage channels were excavated to move flood waters quickly off the fields and through culverts under the highway to the sea. One of these, situated alongside Kapä'iki village at Möpua near the southern end of the project, was also deeply excavated to lower a shallow water table under the village.

ANALYSIS AND RESULTS

Six aquatic features were identified within the project area. Each of these was analyzed according to U.S. Army Corps of Engineers guidelines to determine whether these aquatic features were jurisdictional waters of the U.S. The analysis follow the Corps' Approved Jurisdictional Determination Form. These six proposed determinations are here presented for Corps inspection and disposition.

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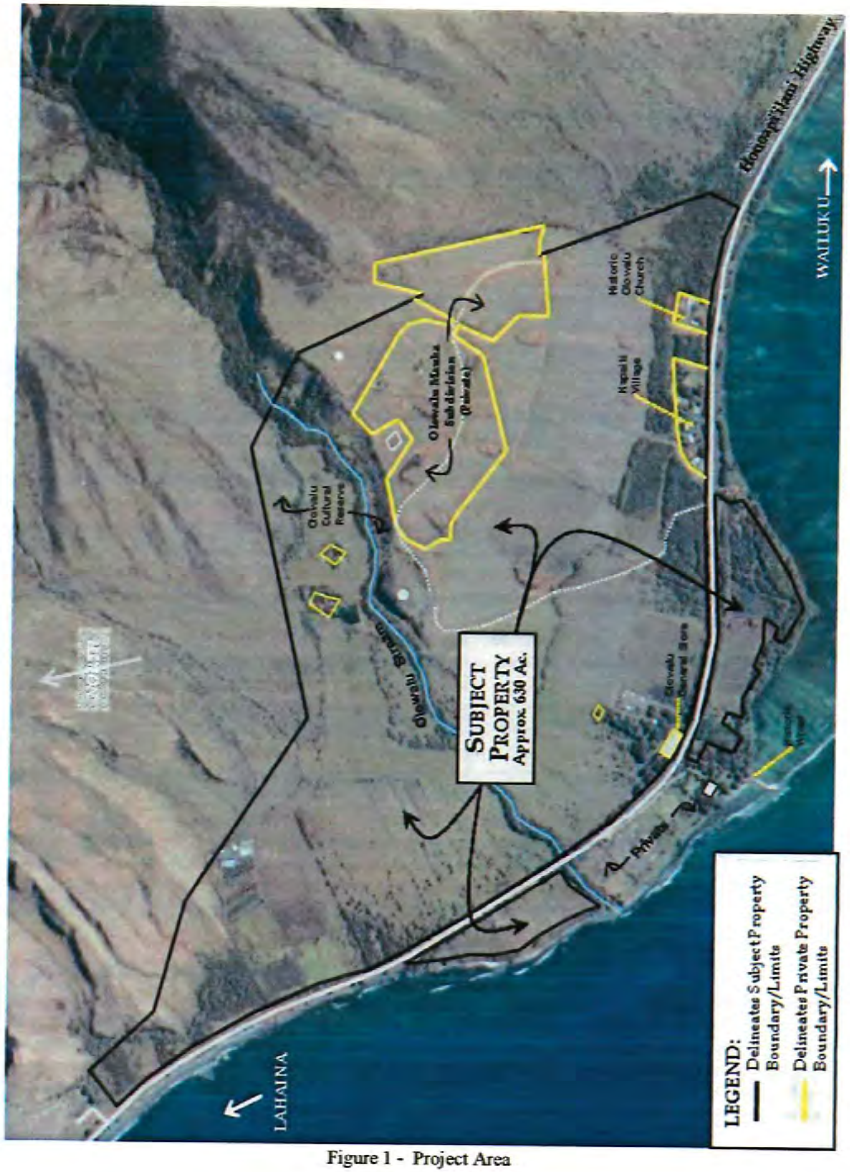


Figure 1 - Project Area

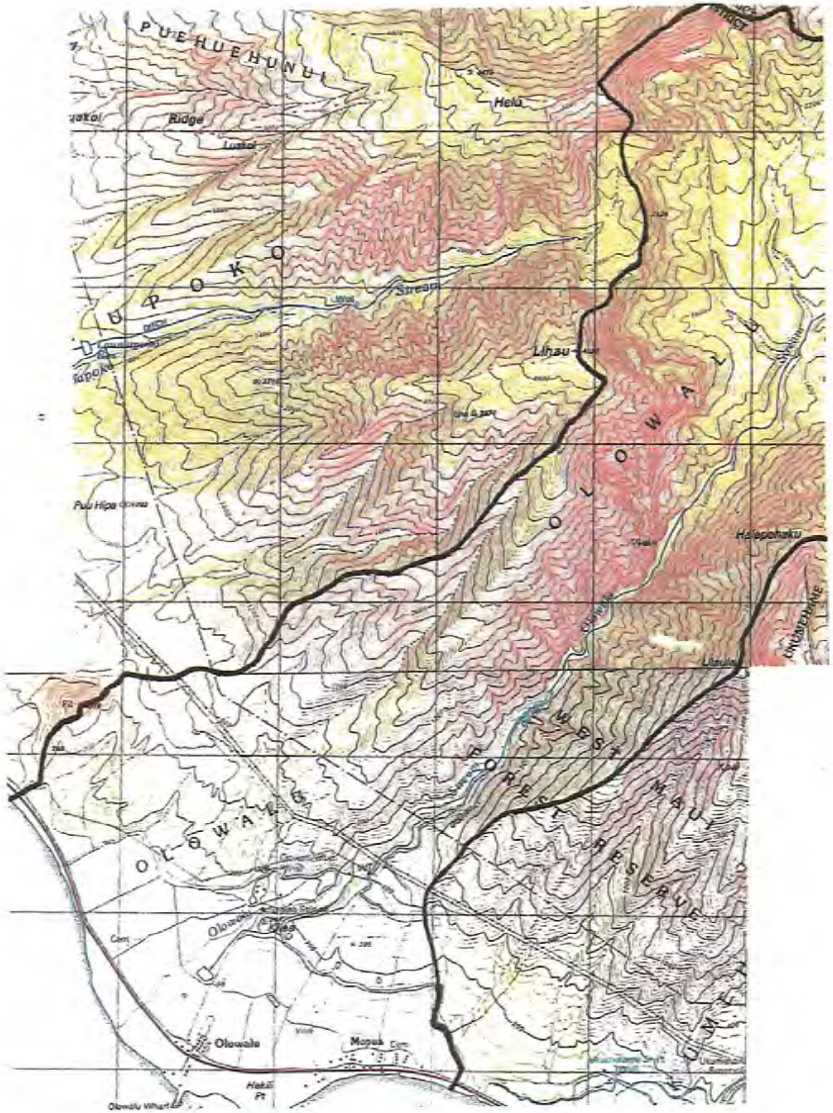


Figure 2 Combined watersheds of Tributaries

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:
State:Hawaii County/parish/borough: Maui City: Olowalu
Center coordinates of site (lat/long in degree decimal format): Lat. 20° N, Long. 156° W.
Universal Transverse Mercator: latitude 20.8226 N 156.6355 W
Name of nearest waterbody: Pacific Ocean
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Pacific Ocean
Name of watershed or Hydrologic Unit Code (HUC): Aquatic Resource 1-unnamed tributary
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☐ Office (Desk) Determination. Date:
☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]
☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** *"waters of the U.S."* within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☐ TNWs, including territorial seas
   ☐ Wetlands adjacent to TNWs
   ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☒ Non-RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   ☐ Impoundments of jurisdictional waters
   ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: yes linear feet: 1400 width (ft) and/or 4-6 feet width watershed of 98 acres.
   Wetlands: none acres.

   c. **Limits (boundaries) of jurisdiction based on: Not established at this time.**
   Elevation of established OHWM (if known): Water course rocky and overgrown, no visible OHWM.

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional.
   Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: N/A.

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):
Tributary is: ☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☐ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank
☐ changes in the character of soil
☐ shelving
☐ vegetation matted down, bent, or absent
☐ leaf litter disturbed or washed away
☐ sediment deposition
☐ water staining
☐ other (list):
☐ the presence of litter and debris
☐ destruction of terrestrial vegetation
☐ the presence of wrack line
☐ sediment sorting
☐ scour
☐ multiple observed or predicted flow events
☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
☐ oil or scum line along shore objects
☐ fine shell or debris deposits (foreshore)
☐ physical markings/characteristics
☐ tidal gauges
☐ other (list):
☐ Mean High Water Mark indicated by:
☐ survey to available datum;
☐ physical markings;
☐ vegetation lines/changes in vegetation types.

(iii) **Chemical Characteristics:**
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) **Biological Characteristics. Channel supports (check all that apply):**
- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. **Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW**

(i) **Physical Characteristics:**

(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List**. Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
- ☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) **Chemical Characteristics:**
Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) **Biological Characteristics. Wetland supports (check all that apply):**
- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. **Characteristics of all wetlands adjacent to the tributary (if any)**
All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its praximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D:This ephemeral stream flows from a dry rocky gulch with a watershed of 98 acres and an annual rainfall of 13 - 15 inches. The relevant reach extends from the Pacific ocean upstream 1400 feet to the next stream branch. Winter storms bring rainfall sufficient to make it run for two to three days, two or three times a year. The water exits the rocky gulch on to a narrow coastal plain where it spreads out and temporarily floods for 4 - 6 days per occurrence until it is absorbed into the ground or flows through a 24 inch culvert under Honoapiilani Hwy to the sea. The soil dries up between flooding events as the water table is more than three feet below the surface. This stream is small and ephemeral but it has the capacity to carry pollutants and floodwaters directly into a TNW. The small flood plain also has the capacity to filter out some of such pollutants from the flood waters before they enter the TNW. This small stream demonstrates a clear nexus with the Pacific ocean and is thus determined to be a Jurisdictional Waters of the U.S.

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or, acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**

☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial:

☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☒ Tributary waters: 1400 linear feet 4-6 width (ft).
☐ Other non-wetland waters: NO acres.
Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

[8]See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.
[10] Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.*

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

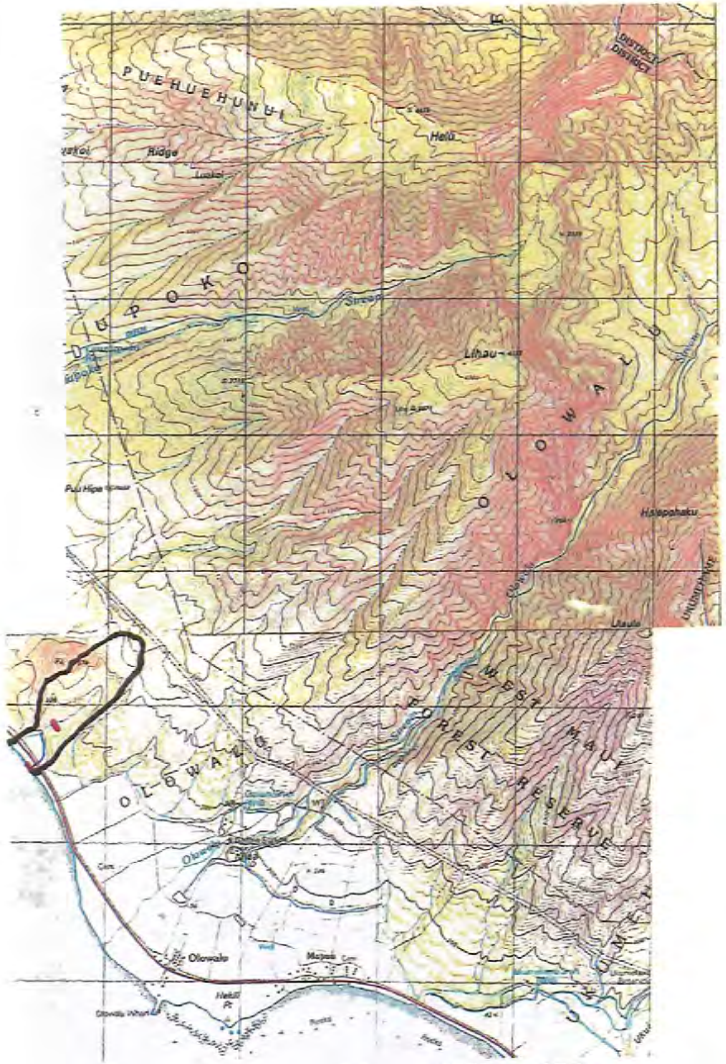
SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:U.S.G.S. Olowalu Quad Map.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Office concurs with data sheets/delineation report.
☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
☐ USGS NHD data.
☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name:Hawaii.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
☐ Photographs: ☐ Aerial (Name & Date): .
or ☒ Other (Name & Date):see attached.
☐ Previous determination(s). File no. and date of response letter: .

☐ Applicable/supporting case law:
☐ Applicable/supporting scientific literature:
☐ Other information (please specify):

B. ADDITIONAL COMMENTS TO SUPPORT JD:

9



Olowalu Town Project Aquatic Resource #1 Unnamed Tributary

_____ Watershed boundary 98 acres

▌▌ Relevant reach 1,400 feet

#1 – a A small 98 acre watershed in dry area, stream is ephemeral, stream bed is rocky and overgrown with no discernable OHWM

#1 – b Two 24 inch culverts drain a small coastal plain under Honoapiilani Highway

#1 – c Culverts deliver water to rocky shoreline

#1 – d Storm waters flow directly into the ocean

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:
State:Hawaii County/parish/borough: Maui City: Olowalu
Center coordinates of site (lat/long in degree decimal format): Lat. N20° **Pick List**, Long. 156° W.
Universal Transverse Mercator: 20.8133 N 156.6361 W
Name of nearest waterbody: Pacific Ocean
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Pacific Ocean
Name of watershed or Hydrologic Unit Code (HUC): Aquatic Resource #2-unnamed tributary
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☐ Office (Desk) Determination. Date:
☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]
☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** *"waters of the U.S."* within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☐ TNWs, including territorial seas
   ☐ Wetlands adjacent to TNWs
   ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☒ Non-RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   ☐ Impoundments of jurisdictional waters
   ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: yes linear feet: 2100 6 - 8 feet width (ft) and/or watershed of 750 acres.
   Wetlands: acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Established by OHWM.**
   Elevation of established OHWM (if known): approximately 10 inches (see attached photos).

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional.
   Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: N/A.

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):
Tributary is: ☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☐ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank
☐ changes in the character of soil
☐ shelving
☐ vegetation matted down, bent, or absent
☐ leaf litter disturbed or washed away
☐ sediment deposition
☐ water staining
☐ other (list):
☐ the presence of litter and debris
☐ destruction of terrestrial vegetation
☐ the presence of wrack line
☐ sediment sorting
☐ scour
☐ multiple observed or predicted flow events
☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
☐ oil or scum line along shore objects
☐ fine shell or debris deposits (foreshore)
☐ physical markings/characteristics
☐ tidal gauges
☐ other (list):
☐ Mean High Water Mark indicated by:
☐ survey to available datum;
☐ physical markings;
☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):
☐ Riparian corridor. Characteristics (type, average width): .
☐ Wetland fringe. Characteristics: .
☐ Habitat for:
☐ Federally Listed species. Explain findings: .
☐ Fish/spawn areas. Explain findings: .
☐ Other environmentally-sensitive species. Explain findings: .
☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:
(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List.** Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
☐ Directly abutting
☐ Not directly abutting
☐ Discrete wetland hydrologic connection. Explain: .
☐ Ecological connection. Explain: .
☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:
Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):
☐ Riparian buffer. Characteristics (type, average width): .
☐ Vegetation type/percent cover. Explain: .
☐ Habitat for:
☐ Federally Listed species. Explain findings: .
☐ Fish/spawn areas. Explain findings: .
☐ Other environmentally-sensitive species. Explain findings: .
☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)
All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: This ephemeral stream flows from 7 dry rocky gulches and gullies with a combined watershed size of 750 acres and annual rainfall ranging from 13 inches near the bottom up to about 60 inches at the top at 3,600 feet elevation. These 7 gulches come together near the bottom of the slope at the upper end of the relevant reach which extends 2,100 feet down to the Pacific Ocean. Winter storms bring rainfall sufficient to make this tributary run for 2 to 3 days, 2 or 3 times a year. The water exits the rocky gulches onto a narrow coastal plain where it spreads out and temporarily floods for 4 - 6 days per occurance until it is absorbed into the ground or flows down a 5 foot deep excavated earthen channel and through an 8 foot wide cement box culvert under Honoapiilani Hwy to the Pacific Ocean. The soil dries up between flooding events as the water table is more than 3 feet below the surface. This stream is ephemeral but it has the capacity to carry pollutants and flood waters directly into a TNW. The small flood plain also has the capacity to filter out some of such pollutants from the flood waters before they enter the TNW. This stream demonstrates a clear nexus with the Pacific Ocean and is thus determined to be a Jurisdictional Waters of the U.S.

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or, acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   - ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   - ☐ Tributary waters: linear feet width (ft).
   - ☐ Other non-wetland waters: acres.
     Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
   - ☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional waters within the review area (check all that apply):
   - ☒ Tributary waters: 2100 linear feet 6-8 width (ft).
   - ☐ Other non-wetland waters: no acres.
     Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   - ☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
     - ☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2. above. Provide rationale indicating that wetland is directly abutting an RPW: .
     - ☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
   - ☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
   - ☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
   As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
   - ☐ Demonstrate that impoundment was created from "waters of the U.S.," or
   - ☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
   - ☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

---

[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

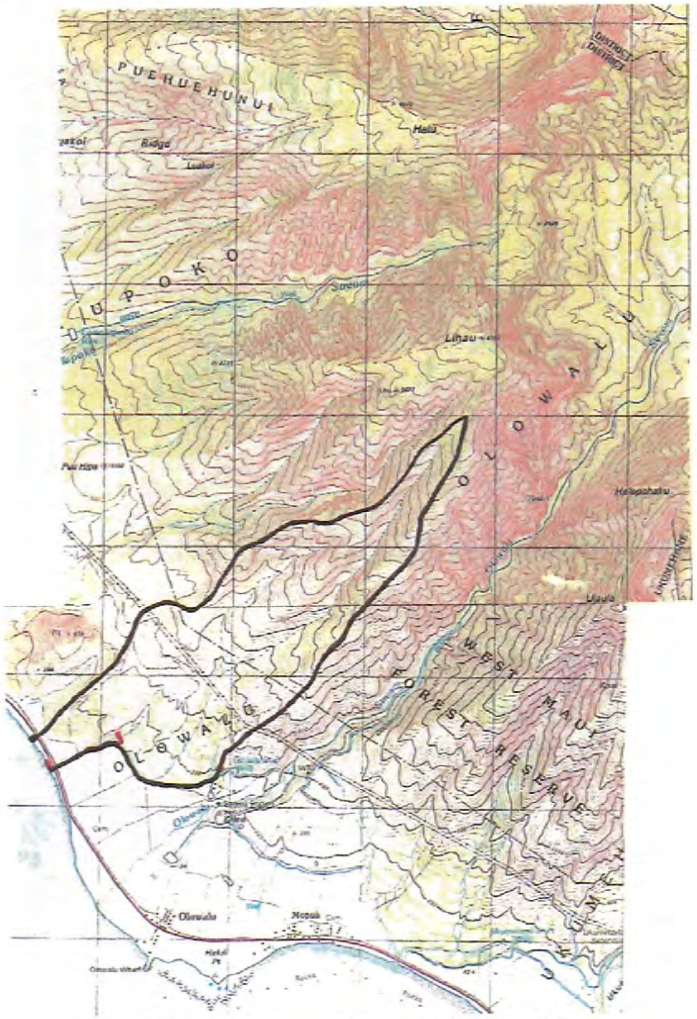
SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:U.S.G.S. Olowalu Quad Map.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Office concurs with data sheets/delineation report.
☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
☐ USGS NHD data.
☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name:Hawaii.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
☒ Photographs: ☐ Aerial (Name & Date): .

[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos*.**

or ☒ Other (Name & Date):(see attached).
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: .

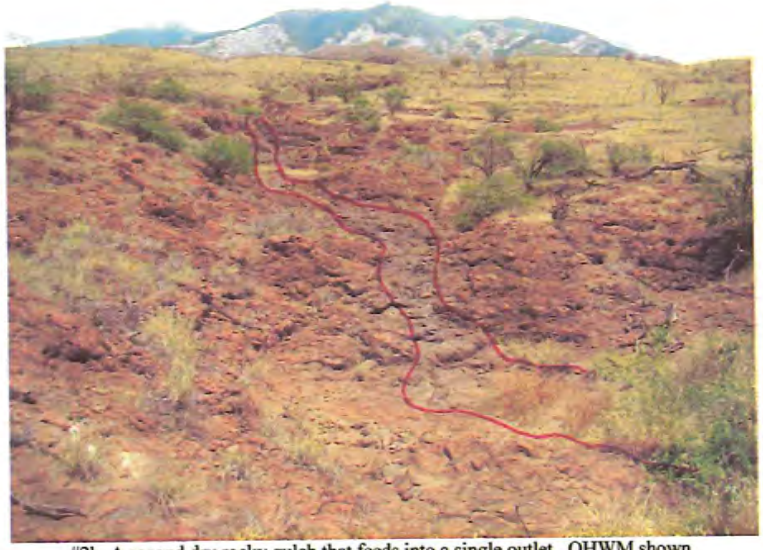


Olowalu Town Project Aquatic Resource #2 Unnamed Tributary

_____ Watershed boundary 750 acres

Relevant reach 2,100 feet

#2a One of seven dry gulches that feed into a single outlet



#2b A second dry rocky gulch that feeds into a single outlet. OHWM shown

#2c Streambed created by the combined flow from four small gulches.
This location is at the upper relevant reach of this aquatic feature. OHWM shown

#2d Combined flow from all seven gulches runs through this box culvert
and under Honoapiilani Highway

#2e Box culvert exits onto rocky shoreline

#2f Storm flow with OHWM shown runs directly into the ocean

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:
State:Hawaii County/parish/borough: Maui City: Olowalu
Center coordinates of site (lat/long in degree decimal format): Lat. 20° N, Long. 156° W.
Universal Transverse Mercator: 20.8076 N 156.6299 W
Name of nearest waterbody: Pacific Ocean
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Pacific Ocean
Name of watershed or Hydrologic Unit Code (HUC): Aquatic Resource #3 Olowalu Stream
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☐ Office (Desk) Determination. Date:
☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]
☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☐ TNWs, including territorial seas
   ☐ Wetlands adjacent to TNWs
   ☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☐ Non-RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   ☐ Impoundments of jurisdictional waters
   ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: Yes linear feet: 4 miles 15 - 20 width (ft) and/or watershed of 2,800 acres.
   Wetlands: acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Established by OHWM.**
   Elevation of established OHWM (if known): approximately 18 inches.

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional.
   Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: N/A.

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):
Tributary is: ☐ Natural
☐ Artificial (man-made). Explain:
☐ Manipulated (man-altered). Explain:

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☐ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain:

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain:
Presence of run/riffle/pool complexes. Explain:
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime:
Other information on duration and volume:

Surface flow is: **Pick List.** Characteristics:

Subsurface flow: **Pick List.** Explain findings:
☐ Dye (or other) test performed:

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank ☐ the presence of litter and debris
☐ changes in the character of soil ☐ destruction of terrestrial vegetation
☐ shelving ☐ the presence of wrack line
☐ vegetation matted down, bent, or absent ☐ sediment sorting
☐ leaf litter disturbed or washed away ☐ scour
☐ sediment deposition ☐ multiple observed or predicted flow events
☐ water staining ☐ abrupt change in plant community
☐ other (list):
☐ Discontinuous OHWM.[7] Explain:

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by: ☐ Mean High Water Mark indicated by:
☐ oil or scum line along shore objects ☐ survey to available datum;
☐ fine shell or debris deposits (foreshore) ☐ physical markings;
☐ physical markings/characteristics ☐ vegetation lines/changes in vegetation types.
☐ tidal gauges
☐ other (list):

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain:
Identify specific pollutants, if known:

[6]A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7]Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):
☐ Riparian corridor. Characteristics (type, average width):
☐ Wetland fringe. Characteristics:
☐ Habitat for:
☐ Federally Listed species. Explain findings:
☐ Fish/spawn areas. Explain findings:
☐ Other environmentally-sensitive species. Explain findings:
☐ Aquatic/wildlife diversity. Explain findings:

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:
(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain:
Wetland quality. Explain:
Project wetlands cross or serve as state boundaries. Explain:

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List.** Explain:

Surface flow is: **Pick List**
Characteristics:

Subsurface flow: **Pick List.** Explain findings:
☐ Dye (or other) test performed:

(c) Wetland Adjacency Determination with Non-TNW:
☐ Directly abutting
☐ Not directly abutting
☐ Discrete wetland hydrologic connection. Explain:
☐ Ecological connection. Explain:
☐ Separated by berm/barrier. Explain:

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:
Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain:
Identify specific pollutants, if known:

(iii) Biological Characteristics. Wetland supports (check all that apply):
☐ Riparian buffer. Characteristics (type, average width):
☐ Vegetation type/percent cover. Explain:
☐ Habitat for:
☐ Federally Listed species. Explain findings:
☐ Fish/spawn areas. Explain findings:
☐ Other environmentally-sensitive species. Explain findings:
☐ Aquatic/wildlife diversity. Explain findings:

3. Characteristics of all wetlands adjacent to the tributary (if any)
All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☒ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: Olowalu Stream is a perrenial stream that flows from deep in the West Maui mountains to the Pacific Ocean. Its total length is 5.5 miles and its watershed size is 2,800 acres. The upper valley is a broad bowl where the annual rainfall is 150 inches. The middle valley is constricted into a narrow canyon and the lower stream course breaks out onto the alluvial fan and coastal plain where the annual rainfall averages about 13 inches. The relevant reach of this stream extends 4 miles from the ocean up to the first significant branch in the upper valley. The stream was once a perrenial stream with year round flow to the ocean, but a diversion was built at the 520 foot elevation prior to 1930 that carried a significant portion of this flow to an irrigation system of ditches and reservoirs for sugarcane fields below. The reduced flow of Olowalu Stream

6

changed it into a Relatively Permanent Water with only seasonal flow. The diversion is still in use even though sugarcane production was phased out in 1992. The water is now used to supply a domestic water system and some feeds a cultural taro agricultural project in the valley bottom. None of this diverted water reaches the ocean. Olowalu Stream runs to the ocean for one to two weeks several times a year when storm waters in the upper valley overtop the intake spillway. Without the diversion this stream would undoubtedly flow continuously to the ocean. Olowalu Stream qualifies as an RPW that flows directly into a TNW and is therefore automatically a Jurisdictional Waters of the U.S.

   ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   ☒ Tributary waters: **4 miles** linear feet **15 - 20 feet** width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
   ☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional waters within the review area (check all that apply):
   ☐ Tributary waters: linear feet width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
   ☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   ☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
   ☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
   As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
   ☐ Demonstrate that impoundment was created from "waters of the U.S.," or
   ☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
   ☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

---

[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

7

E. **ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):**[10]

- ☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
- ☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
- ☐ which are or could be used for industrial purposes by industries in interstate commerce.
- ☐ Interstate isolated waters. Explain: .
- ☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):

- ☐ Tributary waters: linear feet width (ft).
- ☐ Other non-wetland waters: acres.
  - Identify type(s) of waters: .
- ☐ Wetlands: acres.

F. **NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):**

- ☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
- ☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
  - ☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
- ☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
- ☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):

- ☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):

- ☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
- ☐ Lakes/ponds: acres.
- ☐ Other non-wetland waters: acres. List type of aquatic resource: .
- ☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

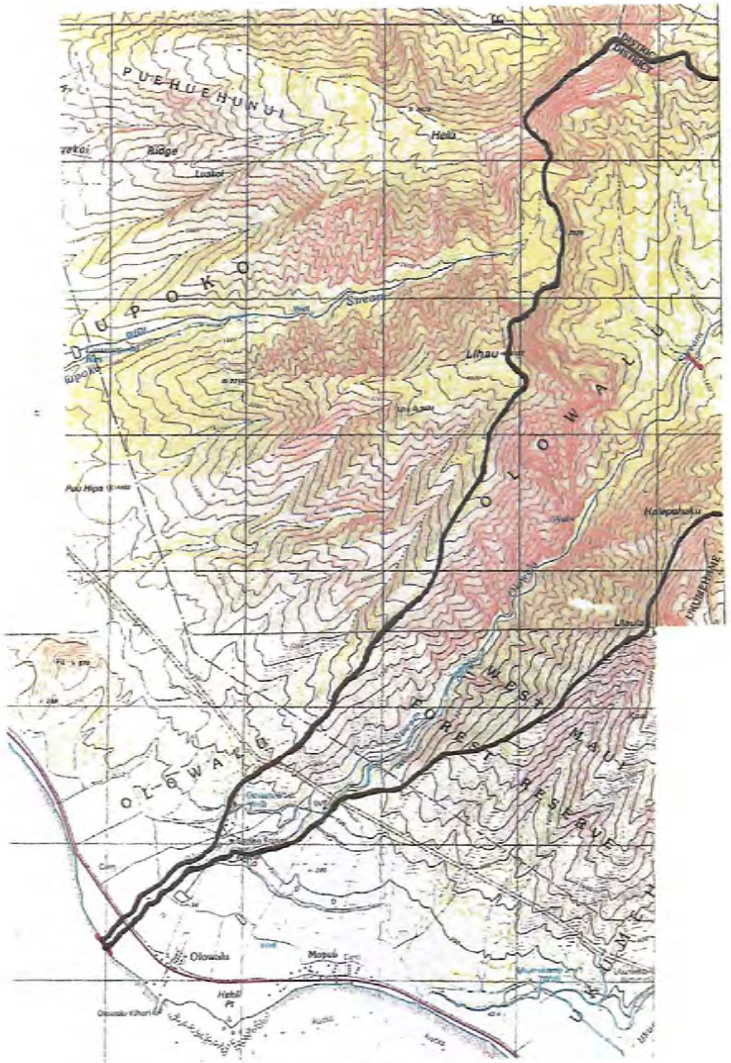
A. **SUPPORTING DATA. Data reviewed for JD (check all that apply** - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):

- ☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:U.S.G.S. Olowalu Quad Map.
- ☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
  - ☐ Office concurs with data sheets/delineation report.
  - ☐ Office does not concur with data sheets/delineation report.
- ☐ Data sheets prepared by the Corps: .
- ☐ Corps navigable waters' study: .
- ☐ U.S. Geological Survey Hydrologic Atlas: .
  - ☐ USGS NHD data.
  - ☐ USGS 8 and 12 digit HUC maps.
- ☐ U.S. Geological Survey map(s). Cite scale & quad name: .
- ☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
- ☒ National wetlands inventory map(s). Cite name:Hawaii.
- ☐ State/Local wetland inventory map(s): .

[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos*.**

- ☐ FEMA/FIRM maps: .
- ☐ 100-year Floodplain Elevation is: (National Geodetic Vertical Datum of 1929)
- ☒ Photographs: ☐ Aerial (Name & Date): .
  - or ☒ Other (Name & Date): (see attached).
- ☐ Previous determination(s). File no. and date of response letter: .
- ☐ Applicable/supporting case law: .
- ☐ Applicable/supporting scientific literature: .
- ☐ Other information (please specify): .

B. **ADDITIONAL COMMENTS TO SUPPORT JD:** .



Olowalu Town Project Aquatic Resource #3 Olowalu Stream

_____ watershed boundary 2,800 acres

| | Relevant Reach 4 miles

#3 a Olowalu Canyon has a perennial stream that flows from deep within the West Maui Mountains.

3b Olowalu Stream bed mauka of the cane haul bridge

3c Olowalu stream bridge along Honoapiilani Highway showing the span of the box culvert

3d Olowalu Stream – view makai from Honoapiilani Highway with OHWM shown

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:

State:Hawaii County/parish/borough: Maui City: Olowalu
Center coordinates of site (lat/long in degree decimal format): Lat. 20° N, Long. 156° W.
Universal Transverse Mercator: 20.8016 N 156.6179 W
Name of nearest waterbody: Pacific Ocean
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Pacific Ocean
Name of watershed or Hydrologic Unit Code (HUC): Aquatic Resource # 4 Kapaiki Village drainage channel

- ☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
- ☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):

- ☐ Office (Desk) Determination. Date:
- ☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There Are *"navigable waters of the U.S."* within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]

- ☒ Waters subject to the ebb and flow of the tide.
- ☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. Explain:

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There Are *"waters of the U.S."* within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. Waters of the U.S.

a. Indicate presence of waters of U.S. in review area (check all that apply): [1]

- ☐ TNWs, including territorial seas
- ☐ Wetlands adjacent to TNWs
- ☒ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
- ☐ Non-RPWs that flow directly or indirectly into TNWs
- ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
- ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
- ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
- ☐ Impoundments of jurisdictional waters
- ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

b. Identify (estimate) size of waters of the U.S. in the review area:

Non-wetland waters: Yes linear feet: 1,200 20 width (ft) and/or watershed of 20 acres.
Wetlands: acres.

c. Limits (boundaries) of jurisdiction based on: **Established by OHWM.**

Elevation of established OHWM (if known): approximately 12 inches above water table (see attached photos).

2. Non-regulated waters/wetlands (check if applicable):[3]

- ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional. Explain:

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: N/A.

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):
Tributary is: ☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☐ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank
☐ changes in the character of soil
☐ shelving
☐ vegetation matted down, bent, or absent
☐ leaf litter disturbed or washed away
☐ sediment deposition
☐ water staining
☐ other (list):
☐ the presence of litter and debris
☐ destruction of terrestrial vegetation
☐ the presence of wrack line
☐ sediment sorting
☐ scour
☐ multiple observed or predicted flow events
☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
☐ oil or scum line along shore objects
☐ fine shell or debris deposits (foreshore)
☐ physical markings/characteristics
☐ tidal gauges
☐ other (list):
☐ Mean High Water Mark indicated by:
☐ survey to available datum;
☐ physical markings;
☐ vegetation lines/changes in vegetation types.

(iii) **Chemical Characteristics:**
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) **Biological Characteristics. Channel supports (check all that apply):**
- ☐ Riparian corridor. Characteristics (type, average width): .
- ☐ Wetland fringe. Characteristics: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

2. **Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW**

(i) **Physical Characteristics:**

(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List**. Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
- ☐ Directly abutting
- ☐ Not directly abutting
  - ☐ Discrete wetland hydrologic connection. Explain: .
  - ☐ Ecological connection. Explain: .
  - ☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) **Chemical Characteristics:**
Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) **Biological Characteristics. Wetland supports (check all that apply):**
- ☐ Riparian buffer. Characteristics (type, average width): .
- ☐ Vegetation type/percent cover. Explain: .
- ☐ Habitat for:
  - ☐ Federally Listed species. Explain findings: .
  - ☐ Fish/spawn areas. Explain findings: .
  - ☐ Other environmentally-sensitive species. Explain findings: .
  - ☐ Aquatic/wildlife diversity. Explain findings: .

3. **Characteristics of all wetlands adjacent to the tributary (if any)**
All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: .

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or. acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☒ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: The Kapaiki Village Drainage Channel is situated along the north edge of the village in a natural low spot that shows up as a possible shallow water feature on an 1881 map of the area (see attached map). Kapaiki Village had a few houses in 1881 (and was likely peopled here in ancient times), and it has been continuously occupied since then. The village is situated on a small patch of Kealia Silt Loam which is listed as a Hydric Soil with a shallow water table. The residents here mostly have small scale subsistence agriculture because of this moisture. During the 1960s the Kapaiki Village drainage channel was excavated to its present condition to lower the water table and prevent periodic flooding. The channel follows a curve around the northern perimeter of the village. It is about 500 feet long and 20 feet wide with steep sides that

run down to below the current water table which is nearly 4 feet below grade. The top end of the channel connects with a now abandoned irrigation ditch that ran south above the village. The bottom end connects to two 24 inch culvert pipes that run under Honoapiilani Hwy. Below the highway the pipes drain into a shallow 6 foot wide channel that runs 400 feet to the ocean. Small amounts of water run continuously to a low sandy wave washed berm where high tide waves wash in and out. There is thus a continuous connection from this aquatic feature to the ocean. Kapaiki Village drainage channel qualifies as an RPW that flows directly into a TNW and is therefore automatically a Jurisdictional Waters of the U.S.

☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☒ Tributary waters: Yes 1200 linear feet 20 width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
☐ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional waters within the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
☐ Demonstrate that impoundment was created from "waters of the U.S.," or
☐ Demonstrate that water meets the criteria for one of the categories prescated above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

E. **ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]**
☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. **NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):**
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

SECTION IV: DATA SOURCES.

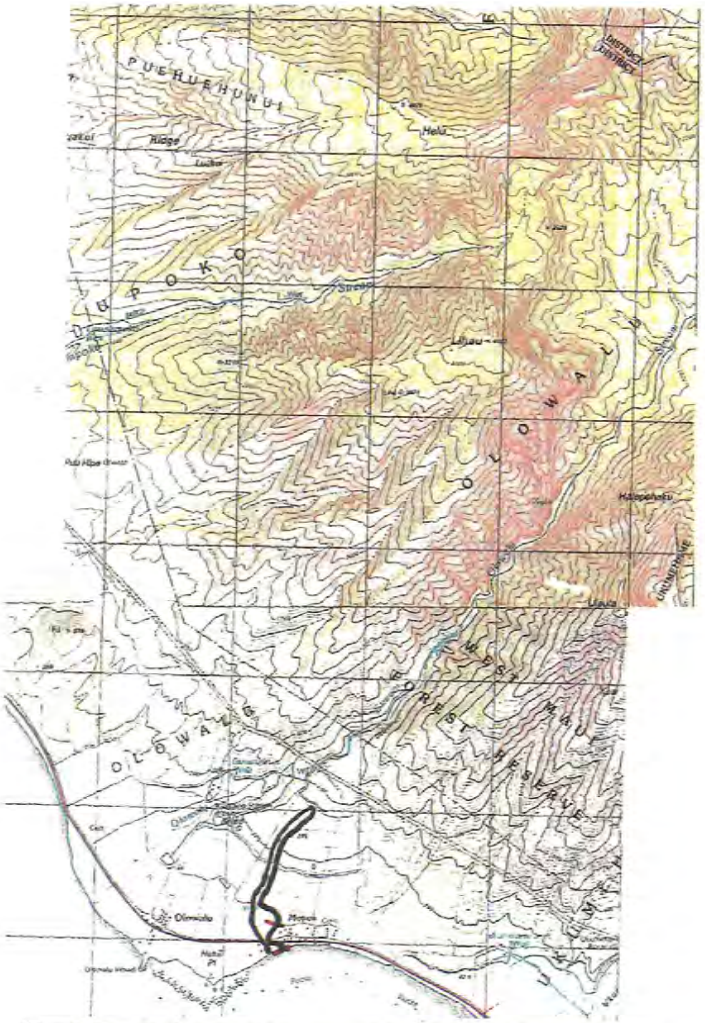
A. **SUPPORTING DATA. Data reviewed for JD (check all that apply** - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:U.S.G.S. Olowalu Quad Map, 1881 Olowalu Sugar Plantation.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Office concurs with data sheets/delineation report.
☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
☐ USGS NHD data.
☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name:Hawaii.

[10] Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.*

- ☐ State/Local wetland inventory map(s): .
- ☐ FEMA/FIRM maps: .
- ☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
- ☒ Photographs: ☐ Aerial (Name & Date): .
  or ☒ Other (Name & Date): (see attached).
- ☐ Previous determination(s). File no. and date of response letter: .
- ☐ Applicable/supporting case law: .
- ☐ Applicable/supporting scientific literature: .
- ☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: .

9



Olowalu Town Project Aquatic Resource #4 Kapaiki Village Drainage Channel

_____ Watershed boundary 20 acres

Relevant Reach 1,200 feet

#4 a View mauka along Kapaiki Village Drainage Channel

#4 b View makai along Kapaiki Village Drainage Channel where water enters two 24 inch culverts that run under Honoapiilani Highway towards the ocean. OHWM shown.

4 c Kapaiki Village Drainage Channel below Honoapiilani Highway

#4 d Kapaiki Village Drainage Channel connection to the ocean showing a Small wave washing into the channel at high tide.

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:
State:Hawaii County/parish/borough: Maui City: Olowalu
Center coordinates of site (lat/long in degree decimal format): Lat. 20° N, Long. 156° W.
Universal Transverse Mercator: 20.8016 N 156.6147 W
Name of nearest waterbody: Pacific Ocean
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Pacific Ocean
Name of watershed or Hydrologic Unit Code (HUC): Aquatic Resource #5 Kapaiki Fishpond
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☐ Office (Desk) Determination. Date:
☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]
☒ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☐ TNWs, including territorial seas
   ☐ Wetlands adjacent to TNWs
   ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☒ Non-RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   ☐ Impoundments of jurisdictional waters
   ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: Yes linear feet: 120 100 feet width (ft) and/or watershed of 10 acres.
   Wetlands: acres.

   c. **Limits (boundaries) of jurisdiction based on: Established by OHWM.**
   Elevation of established OHWM (if known): approximately 24 inches (see attached photos).

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional.
   Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: **N/A.**

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):
Tributary is: ☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List.**

Primary tributary substrate composition (check all that apply):
☐ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☐ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List.** Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank ☐ the presence of litter and debris
☐ changes in the character of soil ☐ destruction of terrestrial vegetation
☐ shelving ☐ the presence of wrack line
☐ vegetation matted down, bent, or absent ☐ sediment sorting
☐ leaf litter disturbed or washed away ☐ scour
☐ sediment deposition ☐ multiple observed or predicted flow events
☐ water staining ☐ abrupt change in plant community
☐ other (list):
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by: ☐ Mean High Water Mark indicated by:
☐ oil or scum line along shore objects ☐ survey to available datum;
☐ fine shell or debris deposits (foreshore) ☐ physical markings;
☐ physical markings/characteristics ☐ vegetation lines/changes in vegetation types.
☐ tidal gauges
☐ other (list):

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):
☐ Riparian corridor. Characteristics (type, average width): .
☐ Wetland fringe. Characteristics: .
☐ Habitat for:
☐ Federally Listed species. Explain findings: .
☐ Fish/spawn areas. Explain findings: .
☐ Other environmentally-sensitive species. Explain findings: .
☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:
(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List.** Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List.** Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
☐ Directly abutting
☐ Not directly abutting
☐ Discrete wetland hydrologic connection. Explain: .
☐ Ecological connection. Explain: .
☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List.**
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:
Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):
☐ Riparian buffer. Characteristics (type, average width): .
☐ Vegetation type/percent cover. Explain: .
☐ Habitat for:
☐ Federally Listed species. Explain findings: .
☐ Fish/spawn areas. Explain findings: .
☐ Other environmentally-sensitive species. Explain findings: .
☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)
All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D:Kapaiki Fishpond is apparently an ancient structure. It is clearly shown on the 1881 map of the area. About 1911 it was photographed with the Olowalu School House behind it (see attached photo). This small fishpond is located about 100 feet from the ocean and directly below the village. Honoapiilani Hwy passes between the fishpond and the ocean on an elevated road bed. Sometime in the 1960s this fishpond was drained. A 48 inch diameter pipe culvert connects the depression to the ocean where the pipe extends out past the beach. At high tide waves lap through the pipe creating a small ten foot diameter puddle in the bottom of the old pond. During winter rain storms flood waters accumulate in this depression from the village roadway which then drains out into the ocean. These floodwaters come from a tiny watershed of only about 10 acres. There is no stream course and all the water comes from sheet flow from the village on this coastal plain. While this watershed delivers only ephemeral amounts of flow to the ocean, it nonetheless has a clear and direct nexus with the TNW. It has the capacity to carry floodwaters and pollutants directly to the Pacific Ocean and is therefore determined to be a Jurisdictional Waters of the U.S.

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   ☐ TNWs: linear feet width (ft), Or, acres.
   ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   ☐ Tributary waters: linear feet width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
   ☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional waters within the review area (check all that apply):
   ☒ Tributary waters: **500** linear feet **1000** width (ft).
   ☐ Other non-wetland waters: acres.
   Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
   ☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   ☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
   ☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisidictional. Data supporting this conclusion is provided at Section III.C.

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
   ☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
   As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
   ☐ Demonstrate that impoundment was created from "waters of the U.S.," or
   ☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
   ☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

---

[8]See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

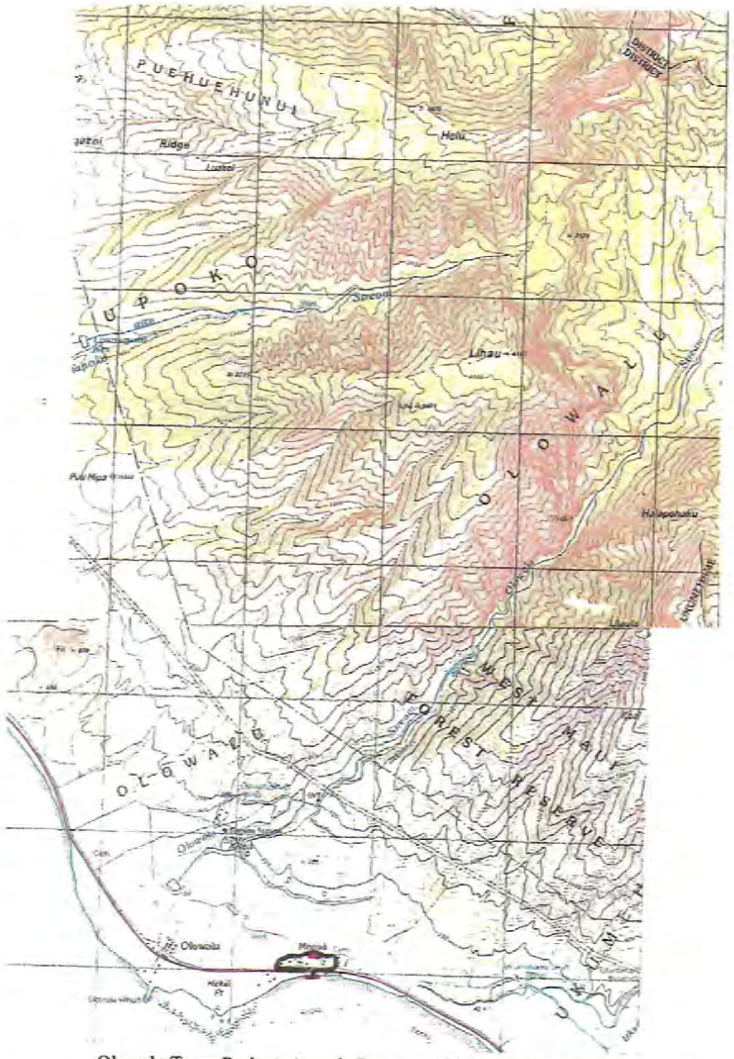
SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:U.S.G.S. Olowalu Quad Map, 1881 Olowalu Sugar Plantation Map.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Office concurs with data sheets/delineation report.
☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
☐ USGS NHD data.
☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name:Hawaii.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)

[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

☒ Photographs: ☐ Aerial (Name & Date): .
or ☒ Other (Name & Date):Old Olowalu School about 1911.
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

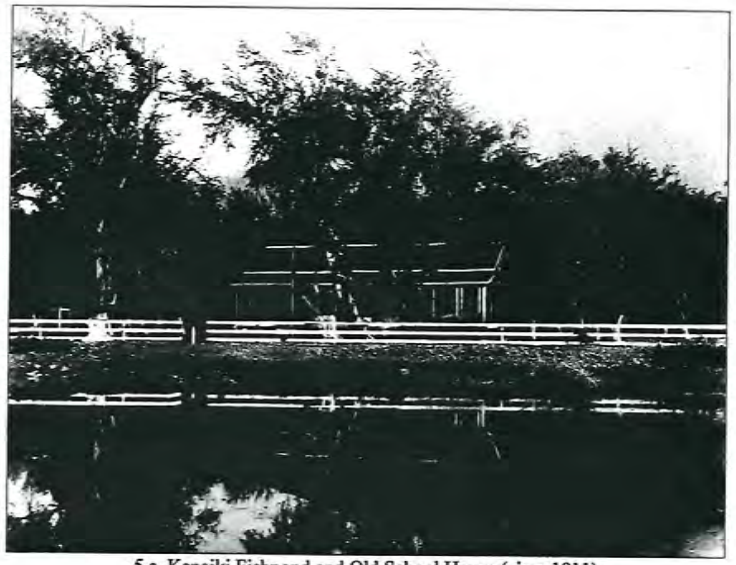
B. ADDITIONAL COMMENTS TO SUPPORT JD: .



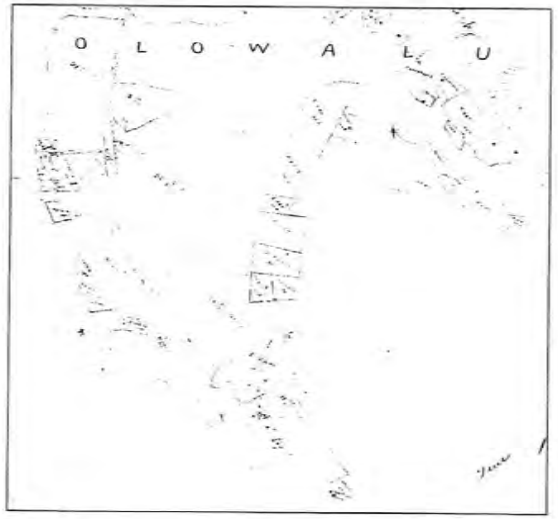
Olowalu Town Project Aquatic Resource #5 Kapaiki Fishpond

_____ Watershed boundary 10 acres

Relevant Reach 500 feet



5 a Kapaiki Fishpond and Old School House (circa 1911)



F b 1881 Olowalu Sugar Plantation Map (Monsarrat) with Kapaiki pond shown in lower center

5c Kapaiki Fishpond with Honoapiilani Highway on the left and Kapaiki Village on the right. Drainage culvert is at the end of the red OHWM line on the upper left.

5d Kapaiki Fishpond drainage pipe running under Honoapiilani Highway to the ocean.

5e Kapaiki Fishpond armored drainage pipe running out into the ocean.

5f Kapaiki Fishpond armored drainage pipe running out into the ocean.

APPROVED JURISDICTIONAL DETERMINATION FORM
U.S. Army Corps of Engineers

This form should be completed by following the instructions provided in Section IV of the JD Form Instructional Guidebook.

SECTION I: BACKGROUND INFORMATION

A. REPORT COMPLETION DATE FOR APPROVED JURISDICTIONAL DETERMINATION (JD):

B. DISTRICT OFFICE, FILE NAME, AND NUMBER:

C. PROJECT LOCATION AND BACKGROUND INFORMATION:
State:Hawaii County/parish/borough: Maui City: Olowalu
Center coordinates of site (lat/long in degree decimal format): Lat. 20° N, Long. 156° W.
Universal Transverse Mercator: 20.8016 N 156.6117 W
Name of nearest waterbody: Pacific Ocean
Name of nearest Traditional Navigable Water (TNW) into which the aquatic resource flows: Pacific Ocean
Name of watershed or Hydrologic Unit Code (HUC): Aquatic Resource #6 Unnamed Ephemeral Tributary
☒ Check if map/diagram of review area and/or potential jurisdictional areas is/are available upon request.
☐ Check if other sites (e.g., offsite mitigation sites, disposal sites, etc…) are associated with this action and are recorded on a different JD form.

D. REVIEW PERFORMED FOR SITE EVALUATION (CHECK ALL THAT APPLY):
☐ Office (Desk) Determination. Date:
☐ Field Determination. Date(s):

SECTION II: SUMMARY OF FINDINGS

A. RHA SECTION 10 DETERMINATION OF JURISDICTION.

There **Are no** "*navigable waters of the U.S.*" within Rivers and Harbors Act (RHA) jurisdiction (as defined by 33 CFR part 329) in the review area. [*Required*]
☐ Waters subject to the ebb and flow of the tide.
☐ Waters are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce.
Explain: .

B. CWA SECTION 404 DETERMINATION OF JURISDICTION.

There **Are** "*waters of the U.S.*" within Clean Water Act (CWA) jurisdiction (as defined by 33 CFR part 328) in the review area. [*Required*]

1. **Waters of the U.S.**
   a. **Indicate presence of waters of U.S. in review area (check all that apply):** [1]
   ☐ TNWs, including territorial seas
   ☐ Wetlands adjacent to TNWs
   ☐ Relatively permanent waters[2] (RPWs) that flow directly or indirectly into TNWs
   ☒ Non-RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to but not directly abutting RPWs that flow directly or indirectly into TNWs
   ☐ Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs
   ☐ Impoundments of jurisdictional waters
   ☐ Isolated (interstate or intrastate) waters, including isolated wetlands

   b. **Identify (estimate) size of waters of the U.S. in the review area:**
   Non-wetland waters: Yes linear feet: 1000 1000 width (ft) and/or watershed of 17 acres.
   Wetlands: acres.

   c. **Limits (boundaries) of jurisdiction** based on: **Pick List**
   Elevation of established OHWM (if known): approximately 18 inches (see attached photo).

2. **Non-regulated waters/wetlands (check if applicable):**[3]
   ☐ Potentially jurisdictional waters and/or wetlands were assessed within the review area and determined to be not jurisdictional.
   Explain: .

[1] Boxes checked below shall be supported by completing the appropriate sections in Section III below.
[2] For purposes of this form, an RPW is defined as a tributary that is not a TNW and that typically flows year-round or has continuous flow at least "seasonally" (e.g., typically 3 months).
[3] Supporting documentation is presented in Section III.F.

SECTION III: CWA ANALYSIS

A. TNWs AND WETLANDS ADJACENT TO TNWs

The agencies will assert jurisdiction over TNWs and wetlands adjacent to TNWs. If the aquatic resource is a TNW, complete Section III.A.1 and Section III.D.1. only; if the aquatic resource is a wetland adjacent to a TNW, complete Sections III.A.1 and 2 and Section III.D.1.; otherwise, see Section III.B below.

1. **TNW**
   Identify TNW: N/A.

   Summarize rationale supporting determination: .

2. **Wetland adjacent to TNW**
   Summarize rationale supporting conclusion that wetland is "adjacent": N/A.

B. CHARACTERISTICS OF TRIBUTARY (THAT IS NOT A TNW) AND ITS ADJACENT WETLANDS (IF ANY):

This section summarizes information regarding characteristics of the tributary and its adjacent wetlands, if any, and it helps determine whether or not the standards for jurisdiction established under *Rapanos* have been met.

The agencies will assert jurisdiction over non-navigable tributaries of TNWs where the tributaries are "relatively permanent waters" (RPWs), i.e. tributaries that typically flow year-round or have continuous flow at least seasonally (e.g., typically 3 months). A wetland that directly abuts an RPW is also jurisdictional. If the aquatic resource is not a TNW, but has year-round (perennial) flow, skip to Section III.D.2. If the aquatic resource is a wetland directly abutting a tributary with perennial flow, skip to Section III.D.4.

A wetland that is adjacent to but that does not directly abut an RPW requires a significant nexus evaluation. Corps districts and EPA regions will include in the record any available information that documents the existence of a significant nexus between a relatively permanent tributary that is not perennial (and its adjacent wetlands if any) and a traditional navigable water, even though a significant nexus finding is not required as a matter of law.

If the waterbody[4] is not an RPW, or a wetland directly abutting an RPW, a JD will require additional data to determine if the waterbody has a significant nexus with a TNW. If the tributary has adjacent wetlands, the significant nexus evaluation must consider the tributary in combination with all of its adjacent wetlands. This significant nexus evaluation that combines, for analytical purposes, the tributary and all of its adjacent wetlands is used whether the review area identified in the JD request is the tributary, or its adjacent wetlands, or both. If the JD covers a tributary with adjacent wetlands, complete Section III.B.1 for the tributary, Section III.B.2 for any onsite wetlands, and Section III.B.3 for all wetlands adjacent to that tributary, both onsite and offsite. The determination whether a significant nexus exists is determined in Section III.C below.

1. **Characteristics of non-TNWs that flow directly or indirectly into TNW**

   (i) **General Area Conditions:**
   Watershed size: **Pick List**
   Drainage area: **Pick List**
   Average annual rainfall: inches
   Average annual snowfall: inches

   (ii) **Physical Characteristics:**
   (a) Relationship with TNW:
   ☐ Tributary flows directly into TNW.
   ☐ Tributary flows through **Pick List** tributaries before entering TNW.

   Project waters are **Pick List** river miles from TNW.
   Project waters are **Pick List** river miles from RPW.
   Project waters are **Pick List** aerial (straight) miles from TNW.
   Project waters are **Pick List** aerial (straight) miles from RPW.
   Project waters cross or serve as state boundaries. Explain: .

   Identify flow route to TNW[5]: .
   Tributary stream order, if known: .

[4] Note that the Instructional Guidebook contains additional information regarding swales, ditches, washes, and erosional features generally and in the arid West.
[5] Flow route can be described by identifying, e.g., tributary a, which flows through the review area, to flow into tributary b, which then flows into TNW.

(b) General Tributary Characteristics (check all that apply):
Tributary is: ☐ Natural
☐ Artificial (man-made). Explain: .
☐ Manipulated (man-altered). Explain: .

Tributary properties with respect to top of bank (estimate):
Average width: feet
Average depth: feet
Average side slopes: **Pick List**.

Primary tributary substrate composition (check all that apply):
☐ Silts ☐ Sands ☐ Concrete
☐ Cobbles ☐ Gravel ☐ Muck
☐ Bedrock ☐ Vegetation. Type/% cover:
☐ Other. Explain: .

Tributary condition/stability [e.g., highly eroding, sloughing banks]. Explain: .
Presence of run/riffle/pool complexes. Explain: .
Tributary geometry: **Pick List**
Tributary gradient (approximate average slope): %

(c) Flow:
Tributary provides for: **Pick List**
Estimate average number of flow events in review area/year: **Pick List**
Describe flow regime: .
Other information on duration and volume: .

Surface flow is: **Pick List**. Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

Tributary has (check all that apply):
☐ Bed and banks
☐ OHWM[6] (check all indicators that apply):
☐ clear, natural line impressed on the bank
☐ changes in the character of soil
☐ shelving
☐ vegetation matted down, bent, or absent
☐ leaf litter disturbed or washed away
☐ sediment deposition
☐ water staining
☐ other (list):
☐ the presence of litter and debris
☐ destruction of terrestrial vegetation
☐ the presence of wrack line
☐ sediment sorting
☐ scour
☐ multiple observed or predicted flow events
☐ abrupt change in plant community
☐ Discontinuous OHWM.[7] Explain: .

If factors other than the OHWM were used to determine lateral extent of CWA jurisdiction (check all that apply):
☐ High Tide Line indicated by:
☐ oil or scum line along shore objects
☐ fine shell or debris deposits (foreshore)
☐ physical markings/characteristics
☐ tidal gauges
☐ other (list):
☐ Mean High Water Mark indicated by:
☐ survey to available datum;
☐ physical markings;
☐ vegetation lines/changes in vegetation types.

(iii) Chemical Characteristics:
Characterize tributary (e.g., water color is clear, discolored, oily film; water quality; general watershed characteristics, etc.).
Explain: .
Identify specific pollutants, if known: .

[6] A natural or man-made discontinuity in the OHWM does not necessarily sever jurisdiction (e.g., where the stream temporarily flows underground, or where the OHWM has been removed by development or agricultural practices). Where there is a break in the OHWM that is unrelated to the waterbody's flow regime (e.g., flow over a rock outcrop or through a culvert), the agencies will look for indicators of flow above and below the break.
[7] Ibid.

(iv) Biological Characteristics. Channel supports (check all that apply):
☐ Riparian corridor. Characteristics (type, average width): .
☐ Wetland fringe. Characteristics: .
☐ Habitat for:
☐ Federally Listed species. Explain findings: .
☐ Fish/spawn areas. Explain findings: .
☐ Other environmentally-sensitive species. Explain findings: .
☐ Aquatic/wildlife diversity. Explain findings: .

2. Characteristics of wetlands adjacent to non-TNW that flow directly or indirectly into TNW

(i) Physical Characteristics:
(a) General Wetland Characteristics:
Properties:
Wetland size: acres
Wetland type. Explain: .
Wetland quality. Explain: .
Project wetlands cross or serve as state boundaries. Explain: .

(b) General Flow Relationship with Non-TNW:
Flow is: **Pick List**. Explain: .

Surface flow is: **Pick List**
Characteristics: .

Subsurface flow: **Pick List**. Explain findings: .
☐ Dye (or other) test performed: .

(c) Wetland Adjacency Determination with Non-TNW:
☐ Directly abutting
☐ Not directly abutting
☐ Discrete wetland hydrologic connection. Explain: .
☐ Ecological connection. Explain: .
☐ Separated by berm/barrier. Explain: .

(d) Proximity (Relationship) to TNW
Project wetlands are **Pick List** river miles from TNW.
Project waters are **Pick List** aerial (straight) miles from TNW.
Flow is from: **Pick List**.
Estimate approximate location of wetland as within the **Pick List** floodplain.

(ii) Chemical Characteristics:
Characterize wetland system (e.g., water color is clear, brown, oil film on surface; water quality; general watershed characteristics; etc.). Explain: .
Identify specific pollutants, if known: .

(iii) Biological Characteristics. Wetland supports (check all that apply):
☐ Riparian buffer. Characteristics (type, average width): .
☐ Vegetation type/percent cover. Explain: .
☐ Habitat for:
☐ Federally Listed species. Explain findings: .
☐ Fish/spawn areas. Explain findings: .
☐ Other environmentally-sensitive species. Explain findings: .
☐ Aquatic/wildlife diversity. Explain findings: .

3. Characteristics of all wetlands adjacent to the tributary (if any)
All wetland(s) being considered in the cumulative analysis: **Pick List**
Approximately ( ) acres in total are being considered in the cumulative analysis.

For each wetland, specify the following:

Directly abuts? (Y/N)	Size (in acres)	Directly abuts? (Y/N)	Size (in acres)

Summarize overall biological, chemical and physical functions being performed: .

C. SIGNIFICANT NEXUS DETERMINATION

A significant nexus analysis will assess the flow characteristics and functions of the tributary itself and the functions performed by any wetlands adjacent to the tributary to determine if they significantly affect the chemical, physical, and biological integrity of a TNW. For each of the following situations, a significant nexus exists if the tributary, in combination with all of its adjacent wetlands, has more than a speculative or insubstantial effect on the chemical, physical and/or biological integrity of a TNW. Considerations when evaluating significant nexus include, but are not limited to the volume, duration, and frequency of the flow of water in the tributary and its proximity to a TNW, and the functions performed by the tributary and all its adjacent wetlands. It is not appropriate to determine significant nexus based solely on any specific threshold of distance (e.g. between a tributary and its adjacent wetland or between a tributary and the TNW). Similarly, the fact an adjacent wetland lies within or outside of a floodplain is not solely determinative of significant nexus.

Draw connections between the features documented and the effects on the TNW, as identified in the *Rapanos* Guidance and discussed in the Instructional Guidebook. Factors to consider include, for example:

- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to carry pollutants or flood waters to TNWs, or to reduce the amount of pollutants or flood waters reaching a TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), provide habitat and lifecycle support functions for fish and other species, such as feeding, nesting, spawning, or rearing young for species that are present in the TNW?
- Does the tributary, in combination with its adjacent wetlands (if any), have the capacity to transfer nutrients and organic carbon that support downstream foodwebs?
- Does the tributary, in combination with its adjacent wetlands (if any), have other relationships to the physical, chemical, or biological integrity of the TNW?

Note: the above list of considerations is not inclusive and other functions observed or known to occur should be documented below:

1. **Significant nexus findings for non-RPW that has no adjacent wetlands and flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary itself, then go to Section III.D: This ephemeral 20 acre watershed has no stream course. Rain waters originate as sheet flow off a small slope and the coastal plain and pond in a ditch on the upper side of Honoapiilani Hwy. The annual rainfall average is 13 inches and this rainfall mostly occurs in two to three winter storms. When these ponded waters reach a depth of over a foot in the ditch, they are channeled through one 24 inch pipe culvert under Honoapiilani Hwy to the shoreline. The remaining waters are absorbed into the soil within a week after each occurrence and the soil dries up. No wetlands were found in the area. Three test pits were dug in the lower coastal plain across the width of the watershed and the water table was found to be over two feet deep with no hydric soil characters and vegetation averaging FACU in character. This small ephemeral watershed has a small annual flow, but it has a clear and direct nexus with the Pacific Ocean. It has the capacity to carry floodwaters and pollutants directly into the TNW and is therefore determined to be a Jurisdictional Waters of the U.S.

2. **Significant nexus findings for non-RPW and its adjacent wetlands, where the non-RPW flows directly or indirectly into TNWs.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

3. **Significant nexus findings for wetlands adjacent to an RPW but that do not directly abut the RPW.** Explain findings of presence or absence of significant nexus below, based on the tributary in combination with all of its adjacent wetlands, then go to Section III.D: .

D. DETERMINATIONS OF JURISDICTIONAL FINDINGS. THE SUBJECT WATERS/WETLANDS ARE (CHECK ALL THAT APPLY):

1. **TNWs and Adjacent Wetlands.** Check all that apply and provide size estimates in review area:
   - ☐ TNWs: linear feet width (ft), Or, acres.
   - ☐ Wetlands adjacent to TNWs: acres.

2. **RPWs that flow directly or indirectly into TNWs.**
   - ☐ Tributaries of TNWs where tributaries typically flow year-round are jurisdictional. Provide data and rationale indicating that tributary is perennial: .
   - ☐ Tributaries of TNW where tributaries have continuous flow "seasonally" (e.g., typically three months each year) are jurisdictional. Data supporting this conclusion is provided at Section III.B. Provide rationale indicating that tributary flows seasonally: .

   Provide estimates for jurisdictional waters in the review area (check all that apply):
   - ☐ Tributary waters: linear feet width (ft).
   - ☐ Other non-wetland waters: acres.
     Identify type(s) of waters: .

3. **Non-RPWs[8] that flow directly or indirectly into TNWs.**
   - ☒ Waterbody that is not a TNW or an RPW, but flows directly or indirectly into a TNW, and it has a significant nexus with a TNW is jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional waters within the review area (check all that apply):
   - ☒ Tributary waters: Yes 1000 linear feet 1000 width (ft).
   - ☐ Other non-wetland waters: acres.
     Identify type(s) of waters: .

4. **Wetlands directly abutting an RPW that flow directly or indirectly into TNWs.**
   - ☐ Wetlands directly abut RPW and thus are jurisdictional as adjacent wetlands.
     - ☐ Wetlands directly abutting an RPW where tributaries typically flow year-round. Provide data and rationale indicating that tributary is perennial in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .
     - ☐ Wetlands directly abutting an RPW where tributaries typically flow "seasonally." Provide data indicating that tributary is seasonal in Section III.B and rationale in Section III.D.2, above. Provide rationale indicating that wetland is directly abutting an RPW: .

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

5. **Wetlands adjacent to but not directly abutting an RPW that flow directly or indirectly into TNWs.**
   - ☐ Wetlands that do not directly abut an RPW, but when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide acreage estimates for jurisdictional wetlands in the review area: acres.

6. **Wetlands adjacent to non-RPWs that flow directly or indirectly into TNWs.**
   - ☐ Wetlands adjacent to such waters, and have when considered in combination with the tributary to which they are adjacent and with similarly situated adjacent wetlands, have a significant nexus with a TNW are jurisdictional. Data supporting this conclusion is provided at Section III.C.

   Provide estimates for jurisdictional wetlands in the review area: acres.

7. **Impoundments of jurisdictional waters.[9]**
   As a general rule, the impoundment of a jurisdictional tributary remains jurisdictional.
   - ☐ Demonstrate that impoundment was created from "waters of the U.S.," or
   - ☐ Demonstrate that water meets the criteria for one of the categories presented above (1-6), or
   - ☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

E. ISOLATED [INTERSTATE OR INTRA-STATE] WATERS, INCLUDING ISOLATED WETLANDS, THE USE, DEGRADATION OR DESTRUCTION OF WHICH COULD AFFECT INTERSTATE COMMERCE, INCLUDING ANY SUCH WATERS (CHECK ALL THAT APPLY):[10]

---

[8] See Footnote # 3.
[9] To complete the analysis refer to the key in Section III.D.6 of the Instructional Guidebook.

☐ which are or could be used by interstate or foreign travelers for recreational or other purposes.
☐ from which fish or shellfish are or could be taken and sold in interstate or foreign commerce.
☐ which are or could be used for industrial purposes by industries in interstate commerce.
☐ Interstate isolated waters. Explain: .
☐ Other factors. Explain: .

Identify water body and summarize rationale supporting determination: .

Provide estimates for jurisdictional waters in the review area (check all that apply):
☐ Tributary waters: linear feet width (ft).
☐ Other non-wetland waters: acres.
Identify type(s) of waters: .
☐ Wetlands: acres.

F. NON-JURISDICTIONAL WATERS, INCLUDING WETLANDS (CHECK ALL THAT APPLY):
☐ If potential wetlands were assessed within the review area, these areas did not meet the criteria in the 1987 Corps of Engineers Wetland Delineation Manual and/or appropriate Regional Supplements.
☐ Review area included isolated waters with no substantial nexus to interstate (or foreign) commerce.
☐ Prior to the Jan 2001 Supreme Court decision in "*SWANCC*," the review area would have been regulated based solely on the "Migratory Bird Rule" (MBR).
☐ Waters do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction. Explain: .
☐ Other: (explain, if not covered above): .

Provide acreage estimates for non-jurisdictional waters in the review area, where the sole potential basis of jurisdiction is the MBR factors (i.e., presence of migratory birds, presence of endangered species, use of water for irrigated agriculture), using best professional judgment (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other non-wetland waters: acres. List type of aquatic resource: .
☐ Wetlands: acres.

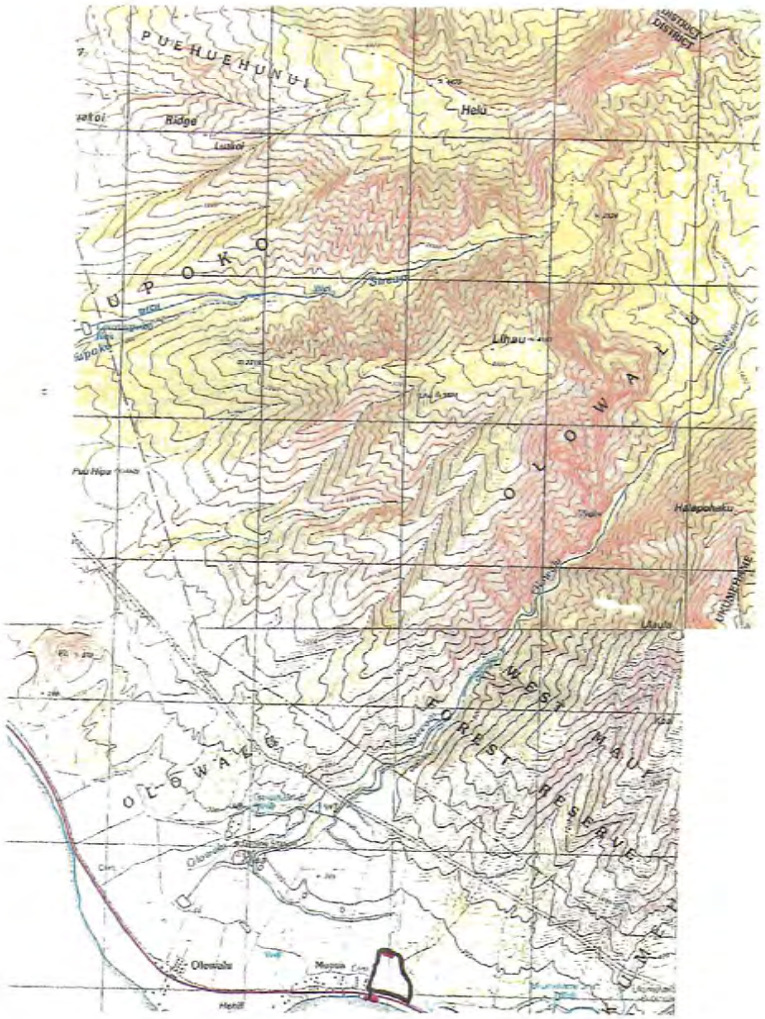
SECTION IV: DATA SOURCES.

A. SUPPORTING DATA. Data reviewed for JD (check all that apply - checked items shall be included in case file and, where checked and requested, appropriately reference sources below):
☒ Maps, plans, plots or plat submitted by or on behalf of the applicant/consultant:U.S.G.S. Olowalu Quad Map.
☐ Data sheets prepared/submitted by or on behalf of the applicant/consultant.
☐ Office concurs with data sheets/delineation report.
☐ Office does not concur with data sheets/delineation report.
☐ Data sheets prepared by the Corps: .
☐ Corps navigable waters' study: .
☐ U.S. Geological Survey Hydrologic Atlas: .
☐ USGS NHD data.
☐ USGS 8 and 12 digit HUC maps.
☐ U.S. Geological Survey map(s). Cite scale & quad name: .
☐ USDA Natural Resources Conservation Service Soil Survey. Citation: .
☒ National wetlands inventory map(s). Cite name:Hawaii.
☐ State/Local wetland inventory map(s): .
☐ FEMA/FIRM maps: .
☐ 100-year Floodplain Elevation is: (National Geodectic Vertical Datum of 1929)
☒ Photographs: ☐ Aerial (Name & Date): .

[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

or ☒ Other (Name & Date): (see attached photo).
☐ Previous determination(s). File no. and date of response letter: .
☐ Applicable/supporting case law: .
☐ Applicable/supporting scientific literature: .
☐ Other information (please specify): .

B. ADDITIONAL COMMENTS TO SUPPORT JD: .



6a Olowalu Town Project Awuatic Resource #6 Unnamed Ephemeral Tributary

_____ Watershed boundary 17 acres

Relevant Reach 1,000 feet

6b A 24 inch culvert running from a highway drainage ditch under Honoapiilani Hwy to the shoreline near the southern most tip of the Project.

APPENDIX F-2.

September 3, 2015 Letter from Robert W. Hobdy, Environmental Consultant

September 3, 2015

Dave Ward and Bill Frampton
Olowalu Town, LLC
2035 Main Street, Suite No. 1
Wailuku, Hawaii 96793

SUBJECT: Flora and Fauna Survey Report (Dated May, 2010) and Aquatic Resources Survey Report (Dated May, 2011)

Dear Mr. Ward and Mr. Frampton:

The subject reports were prepared by me and were based on my personal field work, professional knowledge and experience in areas of local flora and fauna and aquatic resources. The geographic scope of the reports covered lands mauka and makai of Honoapiilani Highway. Both reports addressed Alternative 1, the Preferred Alternative. With the adoption of the Maui Island Plan (MIP) in December, 2012, Alternative 2 was introduced as a second alternative within the realm of implementation potential. Alternative 2 reflects a master plan concept which follows the MIP's growth boundaries. That is, lands makai of Honoapiilani Highway are not included as part of the Master Plan. Both Alternatives 1 and 2 call for the development of up to 1,500 residential units and between 300,000 and 375,000 square feet of commercial space.

Inasmuch as the scope of the subject studies encompasses the Alternative 1 geographic area (i.e. mauka and makai of Honoapiilani Highway), they also address the geographic area defined by Alternative 2. Since the completion of the studies in 2010 and 2011, no new circumstances or evidence have arisen with respect to general flora, fauna and aquatic resources and communities that result in different or likely increased environmental impacts not previously dealt with in the existing studies.

Accordingly, I confirm that the findings, analysis and conclusions presented in the foregoing reports remain valid, and are also valid for both Alternative 1 and Alternative 2.

Sincerely,

Robert W. Hobdy

Robert W. Hobdy

CC: Colleen Suyama, Munekio Hiraga

APPENDIX ~~F~~G.

Pu`uhonua: The Legacy of Olowalu

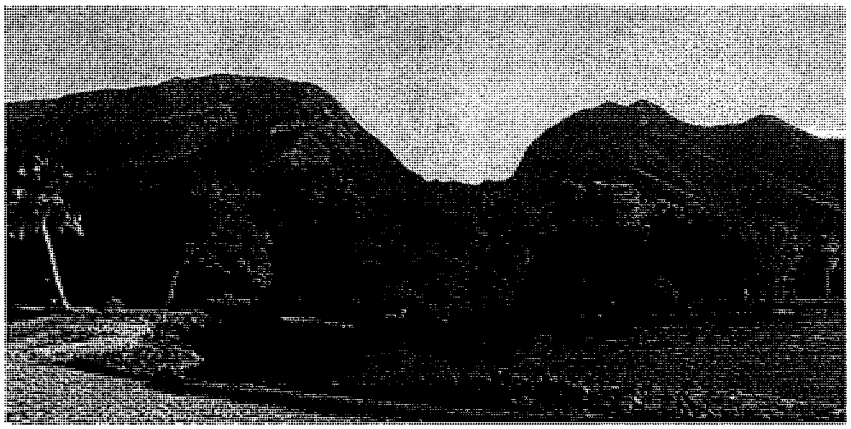
Pu'uhonua:

The Legacy of Olowalu

A History of Olowalu before 1790

Prepared for the benefit of

Olowalu Cultural Reserve



Written by Katherine Kama'ema'e Smith

Edited by Jill Engledow

Cultural Review by Hinano Rodrigues

OLOWALU CULTURAL RESERVE

http://www.olowaluculturalreserve.com

Olowalu Cultural Reserve is a Hawaiian 501(c)(3) not-for-profit organization restoring 74 acres of valley land in Olowalu, Maui. Donations and offers to volunteer at Olowalu Cultural Reserve may be made by email to Project Manager Nani Santos: lihauolowalu@live.com

Community Work Day is every third Saturday, 7am – 11am. Volunteers meet at the Ma'alaea end of The Olowalu General Store. Wear long pants, closed-toed shoes, T-shirt and a hat. Bring sunscreen, bottled water and your favorite garden tool. *Me ka hana ka 'ike;* with work comes knowledge.

Olowalu Cultural Reserve

from the present to the past...©

All proceeds from the sale of this booklet sustain
Olowalu Cultural Reserve
Suggested Donation $5.00

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Pu'uhonua:

The Legacy of Olowalu

A History of Olowalu before 1790

Prepared for the benefit of Olowalu Cultural Reserve

Written by Katherine Kama'ema'e Smith

Edited by Jill Engledow

Cultural Review by Hīnano Rodrigues

Preface

In the early morning at Olowalu Cultural Reserve, a yellow glow—all the sunlight Haleakalā and Līhau 'Ula allowed to penetrate the steep valley walls – teased the roosters; soft round tones slipped down the brook and tricked me into dreaming about other times, other days, when those who loved this land before me beheld such a morning. Līhau Mountain's beauty draws my gaze upward, and Pu'u Kukui beckons me. With every visit come new gifts: billows of fine mist from an indigo sky, gusty playful winds, spiritual and physical treasures left behind on rocks and in pebbles. With every gift a stronger connection to Olowalu pulls at my soul. Who can explain a place that draws one's heart? One can only respond with deep gratitude.

Olowalu Cultural Reserve undertook the restoration of an ahupua'a on a 74-acre plat in Olowalu valley in 2006. Rebuilding an ahupua'a occurs at many levels, but the foundational process is education and traditional cultural practice. This historical review attempts to pull together many pre-historic fragments of Olowalu's natural history, archeology, and written and oral Hawaiian traditions. In the process previously unsorted bits of information align in relationships and timelines that reveal a deeper meaning and understanding for this beautiful place and those who knew it long ago. This manuscript is dedicated to the kūpuna and 'aumakua of Olowalu.

Ka Pu'uhonua o Olowalu

Pu'uhonua is a Hawaiian designation for a land of refuge or sanctuary, stemming from early Polynesian cultural traditions. Each Hawaiian island had several pu'uhonua. Christian missionaries to the Sandwich Islands in 1823 noted the similarity of pu'uhonua to ancient Hebrew "cities of refuge,"a function assigned to church buildings in western religion. A decree by Queen Ka'ahumanu, before her death in 1832, re-established Maui pu'u honua grounds which had existed from prehistoric times, one of which was Olowalu Valley.

Ka Heiheionākeiki (Orion), a feature of winter night skies in Hawai'i, contains a star named Pu'uhonua. It also contains a tutelary navigational star called Puana Kau (Rigel) that marks the latitude of West Maui.

In ancient times a footpath through 'Īao and Olowalu Valleys connected Maui ruling chiefs' two seats of government, Wailuku and Lāhainā.

These facts compel us to revisit the history of Olowalu; to go beyond a recent story of innocents massacred at Olowalu in 1790, to ancient times when Olowalu was renowned as a sanctuary for anyone fleeing oppression. Persons pursued for committing an offense against a family group or an ali'i were untouchable once they stepped inside its borders. Violating pu'uhonua sanctuary was punishable by death. For Pacific Island cultures maintaining order, preserving peace and restricting bloodshed were family and cultural tenets. For people on Maui, the haven of Olowalu created a safe interval of space and time, during which misunderstandings and fiery emotions might resolve and trespasses might be made right.

Natural History of Olowalu

Between one million and one and three-quarters of a million years ago, lava from Pu'u Kukui formed the fifteen-mile long West Maui mountain ridge. It was named Pu'u Laina in Lāhainā and called Kahalawai in Wailuku. Just northeast of Pu'u Kukui summit sits 'Eke crater, which now looks like a large drumhead. This very old formation began as the solid pāhoehoe lava floor of a deep crater, the sides of which are now eroded away. Like Haleakalā, Pu'u Kukui was a broad volcanic mountain with multiple vents. A large erosional depression now stretches several miles southwest from 'Eke and Pu'u Kukui summit and is mistakenly referred to as a "crater." The summit depression between Olowalu and 'Īao valleys is called "the amphitheater." The first lava flows on West Maui, which occurred in the Pleistocene era, consisted of "Wailuku" basalt from Pu'u o 'Eke in the northeast; later, after the Pacific Plate eased northward, this same fine-grained basalt formed 4,192-foot Līhau, the tallest mountain in West Maui's southwest rift zone. Līhau forms the north wall of Olowalu Valley, separating it from Kaua'ula Valley. Līhau 'Ula, at 3,786 feet, creates the south side of Olowalu Valley and most of Ukumehame land division.

A trail that mounts Olowalu's deep and narrow upper valley ends near the broad amphitheater atop Pu'u Kukui. The path to Wailuku once continued back over the amphitheater's northeast wall into the head of 'Īao Valley, and was used as a land route between Wailuku and Olowalu, until recent landslides covered the trail summit. In 1790, when Kamehameha conquered Maui at the Battle of Kepaniwai, defeated Maui ali'i escaped through Olowalu Pass and Olowalu Valley and fled by sea to Moloka'i and O'ahu.

Within Olowalu's lower valley is a small cinder cone called Pu'u Kilea. From the base of this cone, metamorphic basanite lava flowed down Olowalu's streambed. Pu'u Kilea rock differs from "Wailuku "basalt in Olowalu's upper valley, and closely resembles late rejuvenation flows on O'ahu and Kaua'i. This metamorphic feature may explain a nineteenth century informant's description of a specimen of "rock salt" mined from the hills at Olowalu.

The name "Olowalu" is translated "a cluster of hills" by Pukui and Elbert. Multiple cinder cones are common features of southwest rift zones on hawaiian islands. Because much of Olowalu's gently sloping plains were cultivated both by early Hawaiian planters and modern sugar growers, it is reasonable to surmise that a number of cinder cones here were quarried or leveled in the process of farming. Even in modern times, "split hill" in northern Olowalu was completely removed to Kā'anapali Beach for the construction of Kā'anapali's executive golf course. Only the tip of the hill makai of the highway remains.

"Olowalu" is also a Hawaiian stative verb/adjective, used to describe a number of sounds occurring at once, or a din, such as drums beating, dogs barking, or chickens crowing at the sun. La'amaikahiki, who is credited with bringing the drum to Hawai'i from Tahiti in the eleventh century, is called, "*O ke ali'i ke olowalu o ka pahu o Hawai'i.*" "The ali'i is the rumble of Hawai'i's drums." Both definitions find resonance at Olowalu Valley.

Early Migrations to Hawai'i

The earliest habitation sites in the Hawaiian Islands date to 200 AD on windward Moloka'i, O'ahu, Hawai'i, and Kaua'i. Windward Maui was populated as early as 600 AD. Theories abound on timing of migrations and origins of migrants to Eastern Polynesia, but most agree that multiple colonies of immigrants from many origins blended to form the Hawaiian people first described by westerners in the late eighteenth century. Data from The Human Genome Project identify ancient Taiwanese genes in most Polynesian people groups; mutational factors place the original gene in Taiwan over ten thousand years ago. A popular theory suggests that an exodus of Taiwanese lowlanders to high points throughout the Pacific basin occurred some six thousand years ago, when the polar caps melted and ocean levels rose. Voyagers and navigators from the Indian subcontinent also contributed to the early Polynesian gene pools. Later migrations from Indonesia, identified by their use of "Lapita" pottery, colonized Western Polynesia. Hawaiians today carry the same genes as Samoans, Marquesans, Tahitians and other South Pacific islanders. In addition, Hawaiians carry a gene found in Tlingit tribes of East Alaska; the Tlingit gene is older, indicating that this gene came from Alaska to Hawai'i.

Hawaiian mele (chants), ka'ao (legends) and genealogies passed down for a millennium refer to different homelands and people groups with distinct physical characteristics. These varied creation stories give credence to theories of multiple early migrations to Hawai'i from several origins. Botanical and husbandry evidence reported by Craighill and Elizabeth Green Handy and Mary Kawena Pukui in *Native Planters* also indicated multiple migrations from both east and west. Most recently, gene mapping of various food crops and animals introduced to Polynesia further corroborates multiple origins.

In all cases, successful immigrants to Hawai'i were skilled in long distance ocean navigation and colonization methods. All possessed survival skills to sustain themselves in a new environment: seashore gathering, fishing and farming. Those who successfully fished and farmed in the new colony passed on their genes to later generations and added their historical traditions to a blended culture.

Multiple colonizing groups introduced a number of agricultural crops and mammals to Hawai'i. The number of cultivars existing today indicates how long a plant has been successful in Hawai'i and its importance to the Hawaiians. Botanists theorize that banana, taro, kukui, 'awa, yams and coconut were probably introduced from Asia via early Samoan migrations. Breadfruit, the main source of starch in the Marquesan diet, came in Marquesan migrations around 800 AD, and because this fruit tree grows best in leeward forests, its range and use was limited. Olowalu and all of Lāhainā were famous for the luxuriant shade and nourishing starchy fruit of the 'ulu (breadfruit) tree. Olowalu kūpuna still make pi'epi'ele 'ulu, a pudding made with 'ulu and coconut.

Colonists also brought their ancestors, legends, and gods with them. Ancient Polynesian gods Kāneaiakea, Kūaiakea, and Kanaloa appear in the very oldest sections of Hawaiian creation mele. Kāne, the god of farming and fresh water, is connected to taro, banana, and 'awa. Kū is associated with breadfruit. The breadfruit tree, 'ulu, is also a kino lau of the goddess Haumea, who represents fertility and procreation. Kanaloa is god of sea and things in the sea like fish, shellfish and limu. Very old Hawaiian stories about the hawk god 'Io, and myths of 'iwa and pueo are reminiscent of Tlingit bird cult traditions. Deeply blended spiritual beliefs of Hawai'i constitute seamless, timeless connections among man, family, spirit, and creation—all existing in harmony and balance.

First millennium culture in Hawai'i was organized around family groups, sparsely located in fertile valleys with running streams. Family headmen, called haku or kaulana, the oldest males in their generation, ruled their family clans. Family members yielded power and authority to their family leader in a traditional Polynesian form of governance. Primogeniture and genealogical succession were therefore important themes of many ancient chants.

Līhau and ʻEʻeke Create Puʻu Laina

Martha Warren Beckwith's *Hawaiian Mythology* contains a translation of the sad mele about Līhau, E'eke and Pu'u Laina, three sacred hills of West Maui. As in many Hawaiian myths, characters in this tale are people who actually lived and whose names appear in ancient genealogies, but the ka'ao legend personifies them with supernatural characteristics, and commemorates them by naming three hills after them.

Wahine Līhau and kāne E'eke were husband and wife and had a son named Pu'u-o-laina. E'eke strayed and fell in love with Līhau's younger sister, Pu'uwai-o-hina, who lived in Kaua'ula Valley. An enraged Līhau tried to kill baby Pu'uolaina, but 'Eeke stopped her and saved the child.

The godess Hina-i-ka-uluau mediated and placed a kapu on the two lovers, keeping them apart and thereby maintaining peace with Līhau. Nevertheless, E'eke and Pu'uwai-o-hina could not keep apart; for transgressing Hina's kapu they were changed into hills, and forever separated from one another. Pu'u o 'Eke is at the northern end of West Maui, separated from Līhau by the entire length of West Maui's mountain ridge.

Līhau then gave her son Pu'uolaina to wahine Molokini for a husband. Despite her gift, sadness persisted, for Pele's younger sisters became enamored of Pu'uolaina and desired him for themselves. When Molokini refused to give him up, Pele's anger raged. She turned Molokini into a rock islet and Pu'uolaina into hills. For this reason, Lāhainā's West Maui Mountains are called Pu'u Laina. People in Wailuku call these mountains "Kahalawai."

Today, Pu'u o 'Eke is the "table top" volcanic vent visible atop Pu'u Kukui from Honokowai to Honolua. Pu'u Laina is a hill behind Lāhainā, northwest of Pu'u Pa'upa'u at Lāhaināluna. Līhau is the mountain that forms the north side of Olowalu Valley. Molokini atoll sits off the west coast of Maui, near Mākena. [The author is still looking for Pu'uwai-o-hina.] Poetic expressions from mele refer to Līhau as a very long mountain: *Līhau wai 'eke'eke i ka lani*. Two more describe a mountain dense with lehua 'ohi'a and red with their blossoms: *Nā lehua o Līhau i pehia e ka noe*, and *Ma'ema'e Līhau pō i ka lehua*.

Olowalu Winds

The customary winds of this place are: Hau, a blustery wind that originates in the mountains, the Kilihau, which blows a fine mist, the Moa'e trade wind, the Ma'a'a and Kaomi winds. On nights when a gentle Ululoa sea breeze blows, the shores of Olowalu are kapu. In *Olelo No'eau* Mary Kawena Pukui describes a rough wind that sets up in Olowalu Valley in the afternoon called "*ka makani ha'iha'i lau hau o Olowalu,*" a gusty wind that "breaks [tough] hau leaves of Olowalu."

Eleio's Encounter at Olowalu

Mo'i Kaka'alaneo, who ruled Maui in Lāhainā with his brother Kakae in the twelfth century, planted the famous breadfruit trees in Lāhainā and was the first Hawaiian king to wear an ahu feathered cloak. King Kaka'alaneo sent Eleio, a famous Maui kukini (runner/messenger) of that time, to fetch some 'awa from Hana. Running through the hills of Olowalu he encountered a beautiful female spirit who led him to her family home in Kahikinui. Eleio was also a kahuna, and out of pity for her grieving family, prayed the girl's spirit back into her dead body. The grateful family then offered the resurrected Kanikani'āula to Eleio for a wife, but he humbly brought her to King Kaka'alaneo, along with a beautiful 'ahu (feather cloak) made by the girl's family. This is how Kaka'alaneo came into posession of the very first 'ahu, thereafter worn by all Maui high chiefs. Kanikani'āula shall always be remembered as a famous Queen of Maui, and Eleio as Maui's most famous runner. "Ke 'ahu o Kaka'alaneo" was worn by Princess Nāhi'ena'ena in the 1830s.

Ali'i Bring a New Form of Governance

The successful kapu and land management systems described by Vancouver and Cook at the time of western contact displaced Hawai'i's earliest system of family governance. Sovereign rule by ali'i chiefs, who trace their genealogy to divine ancestors, did not come to Hawai'i until Tahitian migration of the thirteenth century. Long-distance voyaging was a common activity for early settlers of Hawai'i and all Polynesian nations. The height of what is called the "Era of Navigation" in Hawaii was a two-hundred-year period between 1150 and 1350 AD. During this time, Hawaiian mele tell of many voyages by navigators La'amaikahiki and Mo'ikeha between Hawai'i and the Society Islands. A voyage to Hawai'i by one Tahitian priest named Pa'ao began a Tahitian migration that brought divine "ari'i" and their new "feudal" governing traditions to Hawai'i.

When Pa'ao returned to Tahiti and reported that Hawaiians had no divine chiefs, ali'i and the priests who tended their gods left Tahiti, came to Hawai'i, and took control of the Islands' family clan polity. *The History of Kanalu* creation chant, recently translated by Malcolm Na'ea Chun, describes the return of Pa'ao and his ali'i as an invasion rather than a migration. Ali'i did what all invaders do; they absorbed a few token pre-arriviste traditions into their new order, and systematically oppressed the early Hawaiian colonists, whom the Tahitians derided in chants as "Manahune," destitute people "without mana." Some of these early Hawaiian settlers retreated inland, and now appear in Kaua'i legends as Menehune. In light of new data from genetic and archeological studies, treasured descriptions of nā Mū and nā Wao mountain people appear to be recollections of Hawai'i's early colonists.

For some 610 years a hierarchy of ruling ali'i and their chosen land managers, called konohiki, governed Hawai'i. Chiefs were assigned land divisions to manage for the high

ranking ali'i, who in turn managed districts, islands or groups of islands. The complete succession of chiefs who ruled Olowalu Valley in prehistory is not known. High Chiefess Kalola Pupukahonokawailani was ruling in 1786. After her time, two famous konohiki in Olowalu were Ali'i Makakehau and Ali'i Na'ehu. In 1848 Kauikeaouli Kamehameha III chose constitutional monarchy as Hawai'i's most recent system of governance.

Leeward Agricultural Expansion

Early colonizing groups first populated lush windward valleys, which Hawaiians call the "male" side of the island. The progeny of the colonizers' women later populated arid leeward, or "female," sides of the islands..

Besides the obvious need to feed an exponentially growing population, one natural land feature and one milestone voyage set the stage for leeward agricultural expansion in Hawai'i. Southwest lava flows, which tend to be 'a'ā and cinder, erode to soil faster than Wailuku basalt flows. However, formation of new soil in arid leeward areas is only beneficial if a food crop exists which will grow in dry land. Introduction of the South American sweet potato, 'uala, to Hawai'i in about 1300 AD was a defining event of Hawaiian pre-history.

Whether Hawaiian explorers brought back 'uala from South America or Native Americans brought it to Hawai'i is a topic of continuing debate. In either case, the simultaneous arrival of the sweet potato and its god, Lono, gave rise to sustained dry land farming on both Maui and Hawai'i, where remnants of terraces and "C-shape shelters," associated with crop-rotation farming and harvest storage, abound. Increased food farming, prosperity and population growth between 1300 and 1700 AD also coincides with the erection and renovation dates for Hawai'i's grandest earthworks.

Olowalu Ahupua'a

Olowalu Ahupua'a begins at 4,457 feet of elevation, atop Pu'u Kukui and directly behind the head of 'Īao Valley in Wailuku. From this narrow point its boundaries trace downhill through Olowalu upper valley, with Līhau Mountain on the north and Līhau 'Ula Mountain on the south. Līhau is fabled in mele as a place of great beauty because of the dense 'ohi'a lehua trees which formerly adorned its flanks. In the fourteenth century, King Hua of Maui sent his men into the mountains of Olowalu to trap nesting 'ua'u birds. Before Maui mountains were stripped of 'iliahi, koa, kou, and 'ohi'a hardwoods, wet Kilihau mist condensed from trade winds hitting 'Īao Valley blew over Pu'u Kukui and down into Olowalu Valley. Olowalu was then a much more moist environment. Dripping dew constitutes 65 percent of forest ground water, which in turn supports undergrowth, checks erosion, percolates into lava tube springs and regenerates aquifers. When Olowalu hills were cleared of sandalwood and hardwoods in the early 1800s, Olowalu Valley became much dryer, from mountains to shore. Reforestation of Līhau with sandalwood and 'ohi'a lehua is a major long-range goal of Olowalu Cultural Reserve, and a huge undertaking requiring partnership with Hawai'i State Department of Land and Natural Resources. Increased condensation drip in the high forest, and water conservation methods on the kula, are opportunities to restore past moisture levels to this valley.

At lower elevations, Olowalu valley opens up to a gently sloped, fan-shaped alluvial plain. Hawaiian planters filled these kula (arable lands) with food crops such as taro, sweet potato and breadfruit, and material crops like kukui, wauke, 'olonā, pili and naio. A meandering stream and network of irrigation ditches nourished these crops. Olowalu was known for dry-land taro and luxuriant, shady breadfruit groves.

The Olowalu Stream originally crossed through Olowalu Valley, and emptied on the south side of Hekili Point near a point on old maps called Mōpua Village. The village no longer exists, but archaeologists have found burial sites at this location. Sugar planters altered the course of Olowalu Stream to empty north of the boat ramp, thereby increasing the arable acreage. The alluvial fan continues several hundred yards out beyond the shoreline, and a second "shoreline" is visible in satellite views of Olowalu – a shoreline perhaps created during the last ice age, when sea level was much lower.

In the ahupua'a, Hawaiian farmers created extensive gravity irrigation schemes using 'auwai irrigation ditches that took fresh stream water to all parts of the valley basin. The current concrete ditch, built by twentieth-century sugar planters, runs down the northern edge of the Olowalu kula and dumps into deep water north of Hekili Point. This ditch follows the same course as the main 'auwai used by pre-contact Hawaiian planters. The difference is that concrete contains all the water, unlike mud channels, which allowed water to percolate into the aquifer. The Hawaiian's complex cooperative system of irrigation and fresh water conservation is a practical model for water conservation today.

Salt Marsh and Fish Pond

Inshore lowlands of Olowalu and Ukumehame ahupua'a were once salt marsh habitats for nesting sea birds, shore birds, fish and mollusks. These wetlands supported native grasses and shrubs. Once nourished by Olowalu Stream and washed by the tide, these lowlands are now cut off from the sea by Honoapi'ilani Highway's elevated roadbed.

Remains of an inland fishpond called Ka Loko Kapaiki rest near Olowalu shoreline. The pond sits between Honoapi'ilani Highway, track of the Alaloa footpath circumventing all Maui, and Chiefess Kalola's kauhale site. Loko like this were normally built and maintained for ali'i. Seaweed-eating fish were grown in the loko, and predatory varieties fished out. Fishpond aquaculture provided a sustainable source of protein for the chiefs.

Heiau, Habitation Sites and Petroglyphs

In addition to many marked Hawaiian burial sites, Olowalu Cultural Reserve has several heiau. Ka'iwaloa (Kawaialoa) measures 51 by 32 meters and is interpreted as a site for major religious ceremonies involving high priests and ruling chiefs from the entire Lāhainā moku, from Ukumehame to Keka'a. The 'iwa bird frequented Olowalu, and Ka'iwaloa heiau is translated "the great 'iwa." The 'iwa is an aid to Polynesian navigators and is often pictured at the center of the navigators' sky compass. Ka'iwaloa heiau faces south-southwest toward Kaho'olawe and Ke Ala i Kahiki navigation lane to Tahiti. Another large heiau in Ukumehame is interpreted as an astronomy school for navigators. Ali'i Nui Hoapili was the last to be trained there. A smaller, unnamed heiau has been encroached by a modern rock berm lower down on the kula, southwest of Pu'u Kilea. In the upper valley, a third system of terraces and lo'i close to Olowalu Stream has been interpreted as a rare hale o papa women's heiau. In addition to these features, a ko'a (fishing heiau,) a hillside lookout, and several personal shrines associated with ancient habitation sites are also preserved.

Visible evidence of temporary and permanent habitation sites abounds throughout Olowalu Cultural Reserve lands. Of special interest are rock outcropping shelters at the bottom of Pu'u Kilea, where travelers walking the Olowalu Pass trail between Lāhainā and Wailuku stopped to rest. Pu'u Kilea rock face is the site of nearly seventy petroglyphs – symbolic drawings pecked into the basanite rock faces of the northeast wall. While the true meaning and intent of these drawings has been lost, most petroglyphs are found at stopping places and camping spots along foot trails, where travelers would await rendezvous, stand lookout or ride out bad weather. People, animals and sailing canoes are depicted in many configurations. These symbols were created over many centuries.

Economic Industry

Winslow Walker and Elspeth Sterling, the earliest archaeologists to study Olowalu, reckoned Olowalu was a junction for travelers on foot and for canoes. Destinations were Lāhainā, a frequent seat of government for Maui kings, and Wailuku, another seat of government and site of Maui's largest taro farms. Moloka'i, the "bread basket" of all Hawai'i, and famed Kaho'olawe fishing grounds were easily accessible from Olowalu's shores. Olowalu people turned their natural resources and crafts into products and services to support fishing, farming and religious life: canoe building, paddle and tool carving, net and mat weaving, tapa making and printing.

Ke Kai o Haui, the seas at Olowalu, were famed for fishing. Olowalu inshore waters were a rich source of octopus, turtle and manta ray. Beyond the Olowalu reef, the abundant fishing ground called Ka Mamali Ō'io stretches north from Mā'alaea to Ka Lae Kūnounou at Honokapohau in Lāhainā. West Maui families from as far north as Kahakuloa still fish these rich waters. Fishing families also drew sustenance from secret family fishing spots, called ko'a, where 'Au'Au Channel fish congregated in upwelling currents or around underwater hills. Fishermen sailed to these exact spots by lining up closely guarded triangulation points, such as rocks and shoreline features, superimposed on view lines of mountains, bays, coves or heavenly bodies. Tide, current, swell, moon phase, wind, cloud cover and kapu all influenced the timing, technique and variety of fish Hawaiian fishermen hunted each day.

'O Kalola Ke Ali'i Nui Wahine o Olowalu

In *Ruling Chiefs of Hawai'i* Samuel M. Kamakau writes about a high ranking ali'i who lived at Olowalu, Kalola Pupukahonokawailani. Kalola was a daughter of King Kekaulike, ruler of both Maui and Hawai'i islands at the beginning of the eighteenth century. Kalola's brothers Kamehamehanui (an uncle of Kamehameha I) and Kauhi'aimokuakama fought each other for rule of Maui in 1738 when their father, Kekaulike, died. Many human remains found at Keka'a, Honokowai, and Honokahua are warriors who died in this great struggle.

This Maui Ali'i Nui Wahine Kalola married Kalaniopu'u, ruling king of Hawai'i. Kalaniopu'u was a famous warrior, who fiercely fought against Maui, even though Kalola's brother Kamehamehanui was king of Maui. Kalola and Kalaniopu'u had two daughters, who carried the highest kapu rank of any ruling chiefs ever recorded: Kalanikauikīkīlo Kalaniakua, who died young, and Keku'iapoiwa Lilihā, the mother of Queen Keopuolani. With her brother Kamehamehanui, Kalola had one son named Kīwala'ō, who became King Kalaniopu'u's official heir. Kīwala'ō and Kamehameha grew up as brothers when Kolola and Kalaniopu'u became honored hānai guardians of young Kamehameha I. Kīwala'ō married his own sister Keku'iapoiwa Lilihā and had one daughter, named Keopuolani, who was the highest kapu ali'i of her generation. Keopuolani, who was raised in Wailuku, Olowalu and Hamakua, was the sacred queen of Kamehameha I, and mother of Liholiho Kamehameha II, Kauikeaouli Kamehameha III and Princess Nāhi'ena'ena. In 1786, Kamehameha killed Keopuolani's father Kīwala'ō in a battle called Moku'ōhai, in the enduring civil wars on Hawai'i Island.

After Kalaniopu'u died, Kalola took Maui Chief Ka'opuiki for her second husband. During a farmer's rebellion on Maui in 1786, tyrant Chief Kūkeawe was killed at Kama'ole-i-kau, near Palauea on Maui, and King Kahekili sent his oldest son, Kalanikūpule, to restore order and serve as regent of Maui. Kalanikūpule's aunt and uncle, Kalola and Ka'ōpūiki, were also sent to Maui to accompany the young ruler. Kalola's family accompanied her: two daughters, Kalanikauiokīkīlo Kalaniakua, and Kekuiapoiwa Liliha, and a granddaughter, Keopuolani. Kalanikupule's entourage included High Regent Kalanimoku, great warrior chiefs Kamohomoho and Kapakahili and Kalanikūpule's brother Koalaukāne. Kalola ruled the pu'uhonua of Olowalu and presided over Ka'iwaloa Heiau. However, her heiau of state

was Hale Ki'i Heiau in Wailuku. This fact indicates the important spiritual, political and economic connection between 'Īao and Olowalu. Kalola was still ruling at Olowalu in 1790 when Simon Metcalf fired cannon on Honua'ula and Olowalu.

Several months after the massacre at Olowalu, Kalola watched the great Battle of Kepaniwai from a panoramic flat area in the back of 'Īao Valley called Manienie. Kamehameha stormed Maui with over twenty thousand men, and after several battles Maui troops retreated to 'Īao Valley. 'Īao was not only a geographic stronghold; it was the burial place of Maui's ancient rulers, from twelfth century Kapawa to Kalanikuihonikamoku, who died in 1736. When the sacred valley was penetrated by Hawai'i warriors, Kalola, her family and seven high chiefs of Maui escaped through the pass to Olowalu, where they boarded canoes for Moloka'i and O'ahu. Kamehameha followed Kalola to Kalama'ula, Moloka'i, and asked for her granddaughter Keopuolani to be his queen. Kalola, who was sick and dying, agreed to give Kamehameha both Keopuolani and her mother Keku'iapoiwa Lilihā, if he would allow the girls to stay at her deathbed until she passed. Kamehameha camped on Moloka'i until Kalola died, and returned to Kona with his high kapu queen, twelve-year-old Keopuolani. Kamakau wrote that Kalola of Olowalu was buried at Kalama'ula on Moloka'i at Kāluaikonahale, mauka of Kamehameha's coconut grove.

The land where Kalola's kauhale stood in Olowalu is on Saffery land, near the Loko o Kapaiki. Chief Makakehau was assigned by Kamehameha to manage Ukumehame and Olowalu, where he grazed cattle given to Kamehameha by Captain Vancouver.

Pu'uhonua

Every activity in an ahupua'a was carried out within the context of a spiritual and cultural belief system that maintained harmony, balance and peace. Both seen and unseen life forms were nurtured and respected.

Sometimes actions that disturbed this balance put family groups at odds or alienated a chief from his people. Recompense from the offending group was owed to the offended. To insure that feuding and revenge did not escalate, certain lands on each island were designated pu'uhonua, places of safety and refuge where persons fleeing for their lives might find sanctuary. Within the boundaries of Olowalu, those who broke a kapu, or committed a punishable offense, and all victims of feuds or wars found rest and opportunity to seek reconciliation. West Maui pu'uhonua lands were: Kukuipuka in Waihe'e, a taro patch in Kahakuloa, a small pā in Lāhainā and Olowalu. In his *History of Maui,* M. Pogue of Lāhaināluna Seminary wrote that the entire ahupua'a of Olowalu was pu'uhonua. The earliest written reference to sanctuary at Olowalu is in 1778, when Captain Cook weighed anchor at Kealakekua, Hawai'i, and a young Kamehameha courageously boarded his ship and sailed with him for two days. In the same year, a battle called Kakanilua arose between Kahekili, ruling chief of Maui and O'ahu, and Keawehano of Hawai'i. According to the last living ku'auhau genealogist, Solomon Lehuanui Kalaniomaiheuila Peleioholani, King Kahekili gave Hawai'i chiefs land at Pu'uokapolei in Olowalu four days after he won Kakanilua. Despite civil wars, Olowalu was a place of peace.

Today we are converting 74 acres of land in Olowalu Cultural Reserve to farming, fishing and tradtional cultural practices. Healing the land is a long process of reviving and honoring Olowalu's heritage of peace and sanctuary. We do it by following the ways and teachings of the kūpuna of Olowalu. It is a daunting task, started by a few people of vision who pray for others to join the effort. After digging, weeding and harvesting fresh kalo, the bubbling waters of Olowalu Stream remind us of the importance of this Hawaiian sanctuary.

Broken Faith

At Honua'ula in 1790, a skiff and its watchman were taken from the American merchant ship *Eleanora*, and Captain Metcalf shot cannon at Honua'ula. Afterwards, Hawaiian traders he held on board revealed that the thieves fled to Olowalu for safety. The *Eleanora* sailed to Olowalu in pursuit. Ali'i Wahine Nui Kalola, who understood the gravity of guns aimed at her village, immediately proclaimed a "Mau'u Mae"(wilted grass) kapu, requiring all men to remain where they were (literally standing in one spot) for three days. The kapu effectively stopped all canoes from leaving shore, and she hoped this "cooling down" period would avoid confrontation. Despite Kalola's wise management, on the fourth day Simon Metcalf lured all trading canoes to one side of his brig and fired cannon filled with nails and scrap metal, killing over one hundred, and wounding another two hundred innocent Hawaiians. Aside from the horrific bloodshed, Metcalf's violation of the sanctity of Olowalu forever broke Hawaiians' faith in pu'uhonua. Restoring Olowalu Cultural Reserve is a foundation for bringing the concept of sanctuary back to Hawaiian culture and redeeming the powerful legacy of Olowalu as a functioning pu'uhonua.

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APPENDIX ~~F-1~~G-1.

Archaeological Literature Review

An Archaeological Literature Review for the Olowalu Town Master Plan Olowalu and Ukumehame Ahupua'a Lāhainā District, Maui Island

TMK: [2] 4-8-003: 84, 98, through 118, and 124

FINAL

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and

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Management Summary

Reference	An Archaeological Literature Review for the Olowalu Town Master Plan, Olowalu and Ukumehame Ahupua'a, Lāhainā District, Maui Island, TMK: [2] 4-8-003:84, 98, through 118, and 124
Date	February 2012 FINAL:
Project Number (s)	CSH Job Code: OLOWALU 1
Investigation Permit Number	CSH completed the archaeological fieldwork under state archaeological permit No. 11-17 issued by State Historic Preservation Division/Department of Land and Natural Resources (SHPD/DLNR), per Hawai'i Administrative Rules (HAR) Chapter 13-13-282
Project Location	Olowalu Ahupua'a, Lāhainā District, Maui Island, TMK: [2] 4-8-003: multiple parcels
Land Jurisdiction	Private: Olowalu Town, LLC. and Olowalu Ekolu, LLC.
Agencies	State: Department of Land and Natural Resources/State Historic Preservation Division (SHPD)
Project Description	The Olowalu Town Master Plan seeks to combine conservation, agricultural, rural, and urban land uses to re-establish a small-scale and mixed-use community. Approximately 1,500 residential units, ranging from single-family to multi-family dwellings, are proposed with appropriate infrastructure to be built concurrently.
Project Acreage	Approximately 636 acres
Area of Potential Effect (APE) and Survey Acreage	Based on available information, the proposed multi-use residential development will not impose adverse visual, auditory or other environmental impact to any historic properties, including standing architecture, located on lands adjacent to the project area. Accordingly, the project's APE extends no further than the proposed 636-acre footprint of the Olowalu Town Master Plan.
Historic Preservation Regulatory Context	This project will likely be subject to Hawai'i Revised Statutes (HRS) 6E-42 and Hawai'i Administrative Rules (HAR) Chapter 13-284. This investigation does not fulfill the requirements of an archaeological inventory survey investigation (per HAR Chapter 13-276). This document is intended to facilitate the project's planning and historic preservation review compliance. Based on findings, cultural resource management recommendations are presented.

Fieldwork Effort	A project site orientation was conducted with Mr. Bill Frampton, Ms. Katherine Smith, and Tanya L. Lee-Greig, M.A. on January 24, 2011. The archaeological field inspection for this study was conducted by archaeologist Tanya L. Lee-Greig, M.A. on January 28 and February 8, 2011 under the general supervision of principle investigator Hallett H. Hammatt, Ph.D.
Findings and Recommendations	The current condition of previously recorded historic properties is likely similar to what was recorded during the archaeological inventory surveys of the current project area (D. L. Fredericksen and Fredericksen 2000a, b). Results of the field inspection show that while the majority of the long-term preservation measures have been implemented for historic properties identified within the *makai* portion of the current project area, those for historic properties *mauka* have not been implemented at this time. Additional field observations resulted in the identification of four previously unrecorded historic properties within the current project area: one possible retaining wall (CSH-1); two surface scatters of cultural material (CSH-2 and CSH-3); and one historic plantation-era reservoir (CSH-4). Further GIS work also showed the presence of former *kuleana* parcels within the Olowalu Town development area indicating a potential for the presence of undocumented and historically significant subsurface cultural deposits. Continued consultation with the lineal and cultural descendants of Olowalu Ahupua'a, as well as all branches of the State Historic Preservation Division in the context of the recommendations presented in Section 4 Results of Field Inspection and Recommendations and implementation of all long-term preservation measures is advised.

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Section 1 Introduction

1.1 Project Background

At the request of Olowalu Town, LLC. and Olowalu Ekolu, LLC., Cultural Surveys Hawai'i (CSH) conducted an archaeological literature review and brief field inspection for the Proposed Olowalu Town Master Plan Project. The location of the proposed project (hereafter referred to as the current project area) is bound by the Pacific Ocean to the west and lands currently under the jurisdiction of State of Hawai'i to the north, south and east at Olowalu and Ukumehame Ahupua'a, Lāhainā District, Maui Island (TMK [2] 4-8-003:84, 98, through 118, and 124) (Figure 1 and Figure 2).

The Olowalu Town Master Plan will serve as a guide for the establishment of a small-scale "mixed-use" community with land uses that will vary from urban neighborhood town centers to rural and agricultural areas within the 636.48-acre project area (Munekiyo & Hiraga 2010:7 and Table 2). Overall, the master plan proposes the development of 1,500 residential units along with civic structures (educational facilities, community and cultural centers, and emergency worker facilities), park and gathering facilities, greenways, bikeways, and trails all of which would be constructed concurrently with the appropriate infrastructure over an approximate 10 year period (Munekiyo & Hiraga 2010:10).

Requisite archaeological inventory studies and the review and acceptance of subsequent historic preservation mitigation plans for the current project area were carried out between October 1998 and July 2002 culminating in seven separate documents (D. L. Fredericksen and Fredericksen 2000a, b; E. M. Fredericksen and Fredericksen 1999, 2001; Olowalu Elua Associates 2001, 2002a, b) and related SHPD correspondence (Appendix B). The purpose of this study is to create a comprehensive reference document of the above mentioned resources and compile GIS data using both existing spatial data and GPS data collected during archaeological field inspection as a means to evaluate the current status and condition of previously identified significant historic properties.

The project will likely be subject to Hawai'i Revised Statutes (HRS) 6E-42 and Hawai'i Administrative Rules (HAR) Chapter 13-284. This investigation does not fulfill the requirements of an archaeological inventory survey investigation (per HAR Chapter 13-276) and is only intended to facilitate the project's planning and historic preservation review compliance. Based on findings, cultural resource management recommendations are presented.

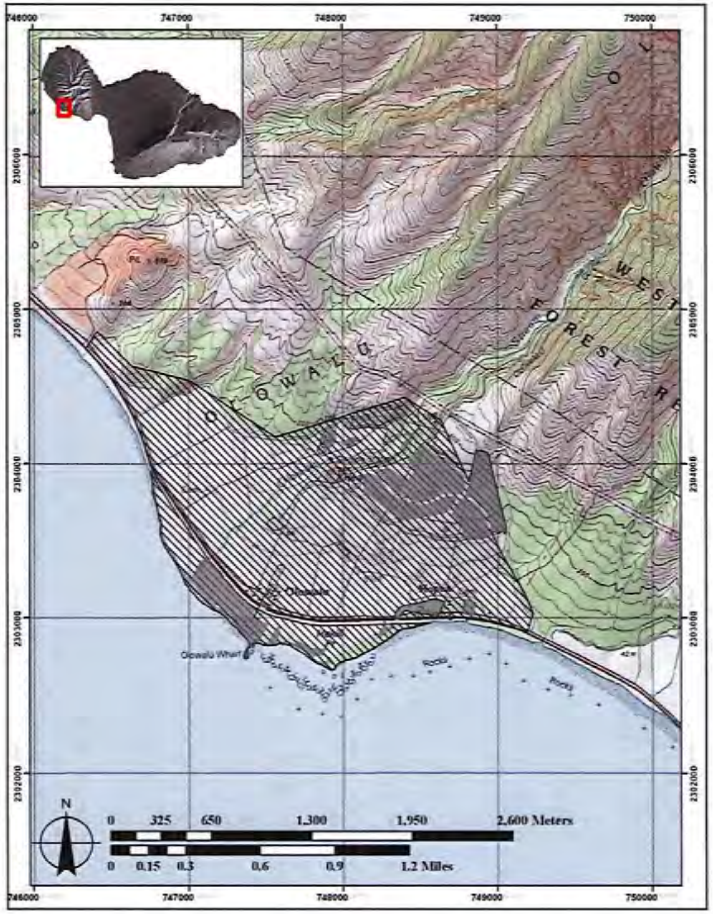

Figure 1. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

Figure 2. TMK (2) 4-8-03 showing the location of the current project area outlined in red, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

1.2 Scope of Work

1. Background research to include study of historic preservation correspondence, previous archaeological inventory survey and/or monitoring reports, and historic property preservation and/or burial treatment and preservation plans to serve as the base line data.
2. GIS work to provide a historic preservation overview in the context of the proposed project.
3. Field visits of the project area limited to verification of previously identified site location data and implementation of mitigation measures.
4. Preparation of a report to include the following:
    a. Results of the background research
    b. Maps/figures resulting from the GIS work (GIS data files/layers to be provided upon request),
    c. Updated information acquired through the limited field visits,
    d. A section presenting recommendations and/or findings.

1.3 Environmental Setting

1.3.1 Natural Environment

The current project area is located on the broad alluvial plain of Olowalu Ahupua'a where the principle geologic features consists of the Olowalu Gulch and Stream. Other contributing physical features of the landscape include smaller stream systems and their resulting gulches along the northern and southern flanks of Olowalu Gulch.

The general soils of the project area are of the Pulehu-Ewa-Jaucus Association and are largely dominated by the Pulehu Soil Series which comprises the majority of the alluvial fan of Olowalu Ahupua'a. Other soils types include sediments associated with the Jaucus Series and Beaches that are found along the southern coastal reaches of the *ahupua'a*, patches of soils that fall into the Kealia Series and Ewa Series occur *mauka* of Honoapi'ilani Highway, soils of the Wainee and Ewa Series comprises the southern flank of Olowalu Gulch, and rocky soils are found along the streambed of Olowalu Gulch (Figure 3). The Pulehu Soil Series consists of well-drained soils that developed in alluvium washed from basic igneous rock (Foote, et al. 1972:115). Pulehu clay loam, 0 to 3 percent slopes, consists of a surface layer of dark brown clay loam approximately 21 inches thick that is underlaying by stratified loam, loamy sand, fine sandy loam and silt loam that is approximately 39 inches thick (Foote, et al. 1972:115-116). The permeability of this soil type is moderate with a slow runoff rate and slight erosion hazard. Low areas characterized by PsA soils can be subject to flooding (Foote, et al. 1972:116). Pulehu cobbly clay loam, 0 to 3 percent slopes (PtA), is similar to PsA soils except that it is cobbly. The underlying parent material consists of coarse, gravelly or sandy alluvium. Pulehu cobbly clay loam, 3 to 7 percent slopes (PtB), also has slow runoff with a slight erosion hazard. Pulehu silt loam, 0 to 3 percent slopes, (PpA) are also similar to PsA soils except that the texture is silt loam. At the time of the USDA soil survey, PtA and PtB soils were used for sugarcane cultivation and pasture, PsA soils included some acreage that was used for truck crops, and finally PpA soils were noted as used for house sites (Foote, et al. 1972:115, 116).

Beaches (BS) occur as sandy, gravelly, or cobbly areas that are derived from coral and seashells and are washed and rewashed by ocean waves (Foote, et al. 1972:28). In the case of the current project area however, beach sediments are dark in color as the sands are derived from from basalt and andesite parent material (Foote, et al. 1972:28). The USDA, at the time of the soil survey determined that soils associated with this series had no value for farming and were better suited for recreational use and resort development (Foote, et al. 1972:28). It should be noted that pre-contact human burial interments are commonly found in beach sand deposits.

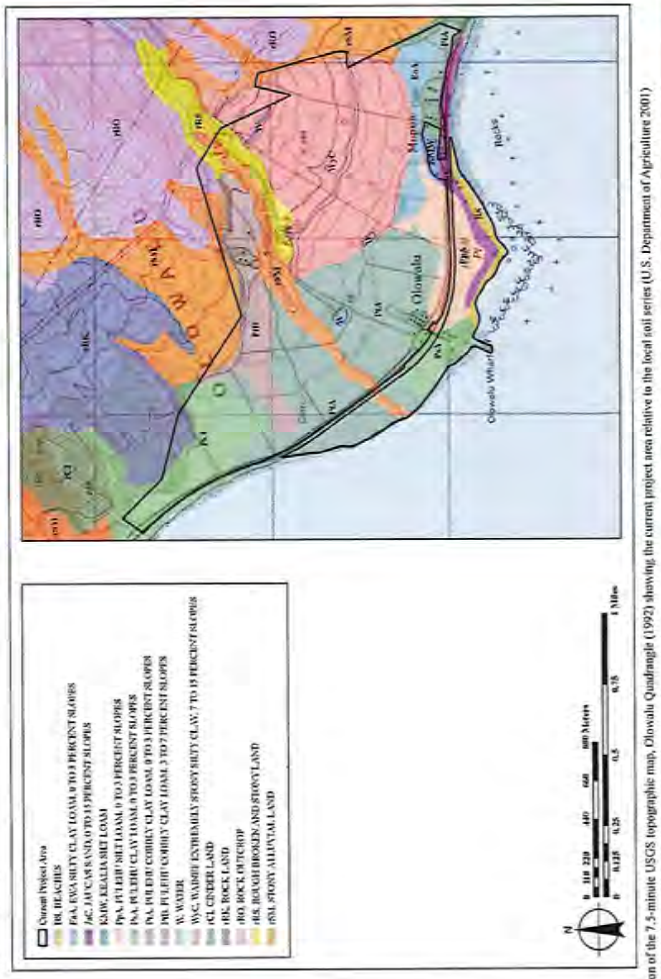

Figure 3. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the current project area relative to the local soil series (U.S. Department of Agriculture 2001)

The Jaucas Series consists of excessively drained, calcareous soils that are developed in wind and water deposited sand from coral and seashells and occur as narrow strips on coastal plains adjacent to the ocean (Foote, et al. 1972:48). Normally pale brown to very pale brown in color, within Olowalu Ahupua'a, the surface layer is dark brown as a result of the accumulation of organic matter and alluvium (Foote, et al. 1972:48). Jaucas sand, 0 to 15 percent slopes (JaC), is neutral to moderately alkaline throughout. Permeability of JaC soils is rapid and runoff is slow to very slow. The general erosion hazard is slight, but wind erosion poses a severe hazard where vegetation has been cleared. At the time of the USDA survey, JaC soils were used for pasture, sugarcane, truck crops, and urban development (Foote, et al. 1972:49). Like beach sand deposits, pre-contact human burial interments are commonly found in jaucas sand deposits.

The Kealia Soil Series consists of rather poorly drained and poorly drained soils on coastal flats, and are geographically associated with Jaucas, Mala, and Pulehu soils. Kealia silt loam (KMW) is a poorly drained soil with a high salt content. Ponding often occurs in low areas after heavy rains and when the soil dries, salt crystals accumulate on the surface. This soil has an underlying brackish water table that fluctuates with the tides. As the occurrence of the KMW soils within the project area are near the coastline, it is important to note that the water table is nearer to the surface along the shoreline than in inland areas. Permeability of KMW soil is moderately rapid with a slow to very slow runoff. The hazard of water erosion is no more than slight, but the hazard of wind erosion is severe when the soil is dry and the surface layer becomes loose and fluffy (Foote, et al. 1972:67). At the time of the USDA survey, KMW soils were used only for wildlife habitat and occasional pasturage as the high salt content and poordrainage was not suitable for agriculture (Foote, et al. 1972:68).

Wainee soils are generally well-drained soils that have developed on alluvial fans. Unlike the Pulehu Series, which is found in similar geologic environments throughout Maui County and on the island of O'ahu, Wainee soils are found only on Maui Island. Wainee extremely stony silty clay, 7 to 15 percent slopes (WyC) occur on smooth alluvial fans with a moderately rapid permeability rate and slow to medium run off rate. The erosion hazard is slight to moderate and stones cover three to 15 percent of the surface. At the time of the USDA soil survey, WyC soils were used primarily for sugarcane with small acreages used for pasture and home sites (Foote, et al. 1972:134).

The Ewa Soil Series is generally characterized by well-drained soils in basins and on alluvial fans that have developed in alluvium derived from basic igneous rock (Foote, et al. 1972:29). Ewa silty clay loam, 0 to 3 percent slopes (EeA) has very slow runoff rate and the erosion hazard is no more than slight. At the time of the USDA soil survey, EeA soils were used for sugarcane and homesites (Foote, et al. 1972:30).

Finally, Rough, Broken and Stone Land (rRS) and Stony Alluvial Lands (rSM) characterizes the soils at the base of Olowalu Gulch and adjacent soils of Olowalu Streambed respectively. Rough, Broken and Stone Land (rRS) consists of very steep, stony gulches where the local relief is generally between 25 and 500 feet with soil material general less than 20 inches deep over saprolite or bedrock (Foote, et al. 1972:119). Stony Alluvial Lands (rSM) soils consist primarily of stones, boulders, and silt deposited by streams along the bottoms of gulches and on alluvial fans (Foote, et al. 1972:120). At the time of the USDA soil survey, rRS soils was used for

pasture, wildlife habitat, and watershed (Foote, et al. 1972:119) while rSM soils were suited to pasture in dry areas and woodland in wet areas (Foote, et al. 1972:120).

The average annual rainfall accumulation within the entire project area averages from 15 to 20 inches (Giambelluca and Schroeder 1998:56) per year, with the heaviest rainfall occurring during the winter months (December through February) and little to no rainfall during the summer months (June through August) (Giambelluca and Schroeder 1998:56). This pattern of rainfall and low annual precipitation rate may have once sustained a lowland, dry shrubland and grassland native ecosystem (Pratt and Gon 1998) with some wetland environments in areas of the Kealia soil type. The landscape and watershed of the project area, however, has been heavily modified by sugarcane cultivation and supporting irrigation development from the early historic period up until modern times, with only small stands of native plants remaining. The current vegetation consists of thick *kiawe* (*Prosopis pallida*), *klu* (*Acacia farnesiana*), *koa haole* (*Leucaena leucocephala*), australian salt bush (*Atriplex semibaccata*), and pickleweed (*Batis maritime*) adjacent to the Honoapi'ilani Highway, as well as, small stands of *niu* (*Cocos nucifera*), *kou* (*Cordia sebestena*), and other introduced plant species. Inland of the highway the natural environment is dominated by fallow sugar cane fields with vegetation that can be characterized as grasslands and shrublands (Figure 4).

1.3.2 Built Environment

The most prominent feature of the modern built environment within the current project area consists of the two-lane Honoapi'ilani Highway. Other features include residential homes and associated infrastructure both *mauka* and *makai* of the Honoapi'ilani Highway, the Olowalu General Store, and unimproved cane haul access roads (Figure 4).

Figure 4. Aerial photo showing the built and natural environment of the current project area (Coastal Geology Group 2007)

Section 2 Methods

2.1 Field Methods

A project site orientation, consisting of a cursory walk through of the current project area with, Mr. Bill Frampton representing Olowalu Town, LLC. and Olowalu Ekolu, LLC., Mrs. Katherine Smith, and archaeologist Tanya L. Lee-Greig, M.A. was conducted on January 24, 2011. Follow up archaeological field inspections were conducted by archaeologist Tanya L. Lee-Greig, M.A. on January 28 and February 8, 2011 under the general supervision of principle investigator Hallett H. Hammatt, Ph.D. The approximate locations of historic properties as determined through GIS processing (see Section 2.3 GIS Methods below) were loaded onto an Archer Datalogger as waypoints for use with the Trimble ProXH GPS unit. Historic properties that were re-identified were photographed in both single shot and panorama modes; where present, interpretive sign and protective fencing locations, as well as historic property corners where recorded location data of historic properties appeared inconsistent with field inspection ground findings, were shot in with the Trimble ProXH GPS unit.

2.2 Document Review

Research venues included the library of the State Historic Preservation Division of the Department of Land and Natural Resources, the UH System Library at Maui Community College, the Survey Office of the Department of Accounting and General Services, and the archives of the Hale Pa'i at Lahainaluna High School.

2.3 GIS Methods

Previous archaeology study area, site location maps, historic maps and AutoCAD files were georeferenced in relation to Maui Island TMK shapefile and portions of the Olowalu Quadrangle (1992) 7.5-minute USGS topographic quadrangles using known points and ArcView 9.3. All topographic maps presented herein were created using ArcView 9.3 and TOPO! ©2003 National Geographic Maps, All Rights Reserved. The project area boundary depicted on historic maps, as well as, previously identified archaeological site locations included as a part of this report should be considered approximate and used for reference information only.

Section 3 Historic Preservation Efforts within the Current Project Area

3.1 Summary of Previous Archaeological Research within the Current Project Area

In 1916, John F. Stokes of the Bishop Museum performed the first systematic reconnaissance of monumental, pre-contact architecture as a part of an archaeological reconnaissance of *heiau* on Maui Island. At Olowalu, Stokes recorded Kaiwaloa Heiau with the following notation:

> ... on a hill near power line. Large, walled heiau in fair condition. Many graves inside. (Stokes 1916:5)

Between 1928 and 1929 Winslow Walker, also of the Bishop Museum, conducted an island-wide systematic archaeological survey that built upon the initial work carried out by Stokes. Like Stokes, the primary focus of the Walker Survey, was on the identification of monumental architecture and ceremonial structures in the form of *heiau* (temples) and *ko'a* (shrines). At Olowalu Walker re-identified Kaiwaloa Heiau and recorded a smaller unnamed *heiau* below the ditch. The following descriptive information from Walker's survey (1931) for both *heiau*, with a notable variation in the spelling of the name from Kaiwaloa (Stokes 1916:5) to Kawaialoa (Walker 1931:108) and Kawailoa (Walker 1931:109 map illustration), is offered below:

Table 1. Walker Sites within Olowalu Ahupua'a, adapted from Walker (1931)

Walker Site	Name	Location	Description
4	Kawaialoa Heiau Kawailoa Heiau	On the rising ground south of Kilea Hill above the ditch	Measures approximately 156' by 110'. The walls range in thickness from 8 ½ feet on the west to 12 feet on the south and east where it is composed of two terraces. The highest part is 10 feet high. The north wall is lower and ranges from 5 to 6 feet thick. Several low terraces and enclosures are found inside. The low platforms in the western part are probably graves of recent date. The entrance evidently was the north. At a point on the west wall and at two points on the south wall are piles of stones cone-shaped whose use or purpose could not be determined. Rough red vesicular basalt is the material used in the heiau construction and no coral is found. Nor artifacts were found there.
5	Unknown	In the cane lands below the ditch	Measures 40 x 60 feet but all interior structures have been destroyed.

While Walker was primarily concerned with the identification of ceremonial sites, he made survey notations of house and village sites within the regions that he visited. At Olowalu, Walker corroborated the later observation of Handy and Handy (1991) regarding the prominence of *lo'i* agriculture and permanent habitation within Olowalu Ahupua'a by noting that:

> Terraces for the cultivation of taro were seen on West Maui in the vicinity of ... Lāhainā, Olowalu, and Ukumehame (Walker 1931:71):

> Above Mrs. Naho'oikaika's house are evidences of old taro patches and house sites. The site of the ancient ditch bringing down water from Olowalu Gulch is now used for the modern ditch supplying the cane fields. At the edge of a house platform measuring 15 x 28 feet, is a large flat stone of red basalt used as a *papamu* for the game of *konane*. It has 9 rows of holes ½ inch deep, and 12-15 holes in a row (Walker 1931:77).

In 1973 the Department of Land and Natural Resources, State Parks Division conducted a similar island-wide archaeological survey, as a follow-up to Winslow Walker's study. As a result of the 1973 survey, Kaiwaloa/Kawaialoa Heiau was thoroughly documented and the site was given State Inventory of Historic Property (SIHP) number 50-50-08-00004 (Connolly 1973a) (Appendix A). While an attempt to re-identify Walker Site 5 (50-50-08-00005) was made at this time, it was concluded that the *heiau* was destroyed by sugar cane cultivation (Hawai'i Department of Land and Natural Resources State Historic Preservation Division 1974). Other historic properties that were identified during the State sponsored survey included the Olowalu Petroglyph Complex (50-50-08-01200 and -01200) (Connolly 1973b), features associated with the Olowalu Mill District (50-50-08-01602) (Wright 1974a), and the Olowalu Stone Church at Mōpua (50-50-08-01603) (Wright 1974b) (Appendix A).

Robins and others (1994) conducted an archaeological inventory survey of a power transmission line from Ma'alaea to Lāhainā within the upper reaches of the current project area (Figure 5). During the survey 34 sites and site complexes were identified throughout their project corridor. The archaeological sites that were identified consisted of a wide range of formal pre-contact site types that included agricultural features characteristic of intensive non-irrigated agriculture, temporary and permanent habitation sites, major *heiau* and shrine sites, a travel route, a marker site, possible human burials, historic ranching walls, in addition to, irrigation canals, flumes and a possible railroad bed associated with large-scale, historic sugarcane cultivation. The traditional Hawaiian sites that were identified during the survey, however, were clustered in the Ukumehame and Launiupoko valley regions, with more isolated pre-contact historic properties located near Kaua'ula Stream and in the upland alluvial plains of Ukumehame Ahupua'a. Within Olowalu Ahupua'a, two historic properties (50-50-08-03172 and -03180) primarily associated with the historic sugar industry were identified adjacent to the Olowalu Stream (Robins, et al. 1994:37 and 83). The scarcity of traditional Hawaiian sites within the project corridor as it crossed the Olowalu valley area was attributed to the destructive nature of large-scale cane agriculture that encompassed nearly all of Olowalu lands within the project corridor (Robins, et al. 1994:99).

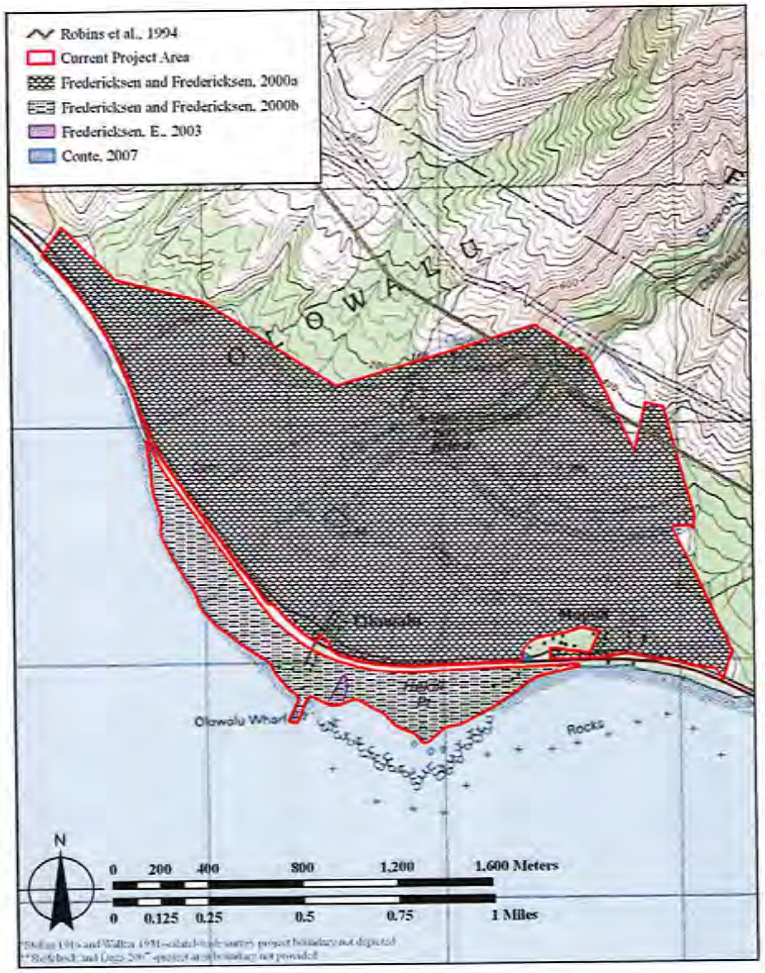

Figure 5. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the locations of previous archaeological studies within the current project area.

Specific to the current project area, a phased inventory survey which resulted in the production of two reports under separate cover, was conducted by Xamanek Researches along a section *makai* of Honoapi'ilani Highway (Phase 1 – approximately 73-acres) (D. L. Fredericksen and Fredericksen 2000a) and a section *mauka* of Honoapi'ilani Highway (Phase 2 – approximately 662-acres) (D. L. Fredericksen and Fredericksen 2000b) for an overall 735-acre project area (Figure 5). Both sections of the project area were covered by cultivated sugarcane lands at the time of the archaeological inventory survey. Seven historic properties consisting of pre-contact and early post-contact traditional Hawaiian habitation and burial sites, as well as, historic era features associated with commercial sugar cane cultivation and government infrastructure were identified within the *makai* section of the *makai* section of the current project area (D. L. Fredericksen and Fredericksen 2000a) (SHPD LOG NO: 24957; DOC. NO: 000RC39 – see also Appendix B). Six of these historic properties were newly identified (50-50-08-4693 through -4698 and -4822) while one, the Olowalu Mill District (50-50-08-01602), was previously recorded during the State of Hawaii sponsored inventory survey (see Section 3.2 Table 2 for summary historic property information).

A total of 31 sites, both pre-contact and historic, were identified within the *mauka* portion of the current project area (D. L. Fredericksen and Fredericksen 2000b) (SHPD: LOG NO: 25237; DOC. NO: 0004RC1O – see also Appendix B). Three historic properties were previously identified and recorded (50-50-08-00004, -01200, -01201 and -01603) while 27 were newly identified (50-50-08-04699 through -04721, -04758, and -04820 through -04823) (see Section 3.2 Table 2 for summary historic property information). Pre-contact sites recorded in the *mauka* section include habitation sites (walls, enclosures, and rock shelters), ceremonial and religious sites (*heiau* and burials), and agricultural sites (terraces and modified outcrops); as well as, rock art features. Historic era properties identified within the *mauka* study were associated with the sugar industry and subsequent historic era settlement of the area. These features include the remnants of a church, a cemetery, and sites related to historic agriculture. Radio carbon dates from four rockshelters and a permanent habitation site (D. L. Fredericksen and Fredericksen 2000b:66) indicates that settlement of Olowalu Ahupua'a was chronologically established during the middle of the time period that Kirch (1985:Figure 239) identifies as the "Expansion Period" (A.D. 1100-1650). Throughout this 550-year time span, the Hawaiian population expanded to several hundred thousand; economic production intensified through the development of large irrigation works and dryland field systems as well as aquaculture methods and new fishing technology; and social and political organization became highly stratified (Kirch 1985:303-306).

Archaeological monitoring for the installation of a septic tank within an approximate 1.3 acre project area along the coastal boundary of the current project area was carried out by Xamanek Researches (E. M. Fredericksen 2003) (Figure 5). While no significant historic properties were identified within a subsurface context, the excavation did encounter coastal sand deposits. As sensitive historic properties are often found in these types of environments, continued archaeological monitoring within adjacent areas was recommended and approved (SHPD LOG NO: 2003.0954; DOC. NO: 0306MK31 – see also Appendix B).

An archaeological field inspection of a residential parcel (TMK [2] 4-8-004:010) within the current project area (Figure 5) was carried out by CRM Solutions Hawai'i (Conte 2007) (SHPD LOG NO: 2008.0957; DOC. NO: 0802TD16-- Appendix B). The field inspection resulted in no new or previously recorded historic properties being identified. It was further noted that the

property had been previously grubbed and graded on several occasions and, due to proposed method of dwelling construction (post and pier over imported fill), no further archaeological work was recommended.

Finally, following the large brush fires of 2007, Scientific Consultant Services was contracted by the current project applicant to conduct a field inspection of approximately 500-acres that had been cleared by fire (Shefcheck and Dega 2007). One new historic property, consisting of agricultural terraces, was identified during the course of the field inspection. Due to the horizontal proximity and morphological similarities of these terraces to Feature B of previously recorded SIHP 50-50-08-04708, the newly identified historic property was designated as Feature C of Site -04708. Additionally, two historic properties (SIHP 50-50-08-04758 and -01200) were noted as adversely impacted by the fire. Several headstones of Site -04758, historic Awalua Cemetery, had cracked and spalled as a result of the heat of the fire. Similarly, thermal damage was also noted at Site -01200, the Olowalu Petroglyph Complex, where smoke damage and spalling of some of the petroglyphs panels were noted.

3.2 Historic Properties Identified within the Current Project Area

A total of 41 historic properties, some consisting of multiple features, were identified and recorded during previous archaeological studies within the current project area (Connolly 1973a; D. L. Fredericksen and Fredericksen 2000a, b; Robins, et al. 1994; Shefcheck and Dega 2007; Stokes 1916; Walker 1931). The following section provides a summary of all known historic properties that have been identified along with recommended significance evaluations by the recording archaeologists (Table 2 and Figure 6).

The State Department of Land and Natural Resources (DLNR) Chapter 13-284, Hawai'i Administrative Rules (HAR), entitled "Rules Governing Procedures for Historic Preservation Review to Comment on Section 6E-42, Hawai'i Revised Statutes (HRS), Projects," Chapter 13-284-6, entitled "Evaluation of Significance", states that once a historic property is identified, an assessment of significance shall occur (Department of Land and Natural Resources 2002b:12). To be significant, a historic property shall possess integrity of location, design, setting, materials, workmanship, feeling, and association and shall meet one or more of the following criteria (Department of Land and Natural Resources 2002b:12- 13):

1. Criterion "a". Be associated with events that have made a significant contribution to broad patterns of our history;
2. Criterion "b". Be associated with the lives of persons significant in our past;
3. Criterion "c". Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possesses high artistic values;
4. Criterion "d". Have yielded, or is likely to yield, information important for research on prehistory or history; or
5. Criterion "e". Have an important value to the native Hawaiian people or to another ethnic group of the State due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events, or oral accounts-these associations being important to the groups' history and cultural identity.

Table 2. Summary of Historic Properties Identified and Recorded within the Current Project Area (SIHP Prefix 50-50-80-), see also Figure 6

SIHP No	Formal Type	Probable Function	Age[1]	Significance	Brief Description
00004[2 3 4]	Heiau (Kaiwaloa/Kawaialoa Heiau)	Ceremonial	P	C,D,E	Site consists of "...[L]arge walled heiau...156 x 110 feet..." interior features include: "... terraces and enclosures...graves...piles of stones cone-shaped
01200[5]	Olowalu Petroglyph Complex	Rock Art	P	C,D,E	Petroglyph panels (2): Area 1 = minimum of 37 petroglyphs, Area 2 = minimum of 31 petroglyphs. Some are badly vandalized; Shefcheck and Dega (2007) noted fire damage.
01201[6]	Rock Shelter	Temporary Habitation	P	D	Rock shelter associated with Area 1 of SIHP -01200
01602[7 8]	Olowalu Mill District	Habitation/Mill/ Wharf	H	A,D	Historic District: structures, sugar mill, wharf, manager's house.

[1]P=Pre-contact; H=Historic; U=Undetermined (used where the archaeological report indicated a "?" in age determination)

[2] **Stokes, John F. G.**

1916 Maui Heiau. December 1916. (typeset notes). Unpublished Bernice Pauahi Bishop Museum, Honolulu, HI.

[3] **Walker, Winslow M.**

1931 Archaeology of Maui. Manuscript. Bernice Pauahi Bishop Museum. Honolulu, HI.

[4] **Connolly, Robert D. III**

1973a *50-50-08-00004 Kawaialoa Heiau*. Hawaii Register of Historic Places Archaeological Forms. Hawai'i Department of Land and Natural Resources State Historic Preservation Division. Kapolei, HI

[5] 1973b *50-50-08-01200 Olowalu Petroglyphs*. Hawaii Register of Historic Places Archaeological Forms. Hawai'i Department of Land and Natural Resources State Historic Preservation Division. Kapolei, HI

[6] **Fredericksen, Demaris L. and Erik M. Fredericksen**

2000b *Archaeological Inventory Survey of Mauka Portion of Olowalu Development Parcel Phase 2, Olowalu Ahupua'a, Lahaina District, Maui Island (TMK 4-8-3:10)*. Prepared for Olowalu Elua Associates. Kahului, Maui. Xamanek Researches. Pukalani, HI

[7] **Wright, J.C.**

1974a *50-50-08-01602 Olowalu Mill District*. Hawaii Register of Historic Places Archaeological Forms. Hawai'i Department of Land and Natural Resources State Historic Preservation Division. Kapolei, HI

[8] **Fredericksen, Demaris L. and Erik M. Fredericksen**

2000a *Archaeological Inventory Survey of Makai Portion (Phase 1) of Olowalu Development Parcel, Olowalu Ahupua'a, Lahaina District, Maui Island (TMK 4-8-3:por.5)*. Prepared for Olowalu Elua Associates. Kahului, HI. Xamanek Researches. Pukalani, HI

SIHP No	Formal Type	Probable Function	Age[1]	Significance	Brief Description
01603[9]	Lanakila Hawaiian Protestant Church	Church/Cemetery	H	D,E	Historic church and graveyard.
03172[10 6]	Concrete Irrigation Ditch	Agriculture	H	D	Site consists of a historic irrigation ditch constructed of cement and boulders.
03180[10 6]	Historic Cattle Wall	Ranching	H	D	Site consists of a wall located on west side of Olowalu Stream; 234 x .85 x 1.45m; an alternative interpretation of function was as an *ahupua'a* boundary wall.
04693[8]	Burial Complex	Burial	P	D,E	Site consists of 6 *in situ* burials ranging from .05 to .80-.85cmbs; burials 1 thru 5 were articulated, burial 6 interpreted as scattered
04694[8]	L-Shape	Habitation	P	D	Site consists of an L-shape wall, 10m long (E/W) and 9.5m long (N/S) x 1.2 m wide x 0.3-0.6m high; located on Hekili Point.
04695[8]	Wall/terrace	Erosion Control	H	D	Site consists of retaining wall segment, 10 x 4.5 x 1.1m
04696[8]	Old Government Road	Transportation	H	D	Site consists of an old road segment that follows a traditional trail, 100m long x 15m wide;; located 15-18m northeast of SIHP -4695.
04697[8]	Subsurface Cultural Deposit	Habitation	U	D	Site consists of a possible historic dog burial, possibly associated with nearby kuleana house lots; and a subsurface cultural deposit, 6 x 3-4 x .12m deep.
04698[8]	Subsurface Cultural Deposit	Habitation	P	D	Site consists of subsurface cultural deposit, 35 x 50m (depth and thickness not provided).
04699[6]	Habitation Complex	Habitation/Burial/ Possible Boundary	U	D,E	Habitation Complex located along S-SE side of ridge: 8 rock shelters (Features A-H) with one containing a probable burials (Feature D); and a modified outcrop (Feature I), 12.6 x 0.8 x 0.75m; overall site complex dimensions = 155 x 30m.

[9] **Wright, J.C.**

1974b *50-50-08-01603 Olowalu Stone Church Ruins*. Hawaii Register of Historic Places Archaeological Forms. Hawai'i Department of Land and Natural Resources State Historic Preservation Division. Kapolei, HI

[10] **Robins, Jennifer J, William H. Folk and Hallett H. Hammatt**

1994 *An Archaeological Inventory Survey of an Approximately 14.7 Mile Proposed Transmission Line, from Ma'alaea to Lahaina, Maui, Hawai'i*. Prepared for Dames & Moore. Cultural Surveys Hawai'i Inc. Kailua, HI

SIHP No	Formal Type	Probable Function	Age[1]	Significance	Brief Description
04700[6]	Habitation Complex	Habitation/Undetermined	P	D	Habitation Complex: 7 rockshelters: (Features A and C-I); one C-shape (Feature B), 1.7 x 2 x 0.5m; and a wall segment (Feature J), 2.3 x 0.8 x 0.7m; overall site complex dimensions = 55 x 40m.
04701[6]	Possible Ko'a	Ceremonial	P	D,E	Site consists of a platform, 15 x 11 x 0.3m and paved area; overall site area = 33 x 27m.
04702[6]	L-Shape	Boundary	H	D	Site consists of L-shape wall, 47 x .75 x 1.2m; 6 x 0.75 x 1.2m and an inactive historic concreted ditch.
04703[6]	Complex	Boundary	U	D	Site complex consisting of features of an indeterminate age: enclosure/alignment/uprights (Feature A), 4 x 3 x 0.7m; wall remnant (Feature B), 5.5 x 0.65 x 0.65m; alignment (Feature C), 3 x 1 x .6m; overall site complex dimensions = 30 x 8m.
04704[6]	Habitation Complex w/Petroglyphs	Habitation	P	C,D,E	Habitation Complex: 27 individual petroglyphs (Feature A), 14 x 3.6m; terraces (Features B-G), 8.5 x 4 x 0.75m to 2.3 x 2.4 x .8m; overall site complex dimension = 61 x 23m.
04705[6]	Rock Shelters	Temporary Habitation	P	D	Site consists of 2 rock shelters: Feature A, 4.5 x 1.75 x 2m; Feature B, 2.5 x 1.3 x .9m.
04706[6]	Rock Shelter	Temporary Habitation	P	D	Rock shelter: 4.25 x 2.25 x 1.25m; located on west side of Olowalu Stream.
04707[6]	Wall and Mound	Marker/ Burial	U	D,E	Two features: wall or alignment (Feature A), 77 x 3.5 x .8m high; and a rock mound (Feature B), 5 x 2.7 x .85m; overall site dimensions = 77 x 5.5m.
04708[6 11]	Platform and Terrace Complex	Agriculture/ Ceremonial	P	D,E	Agricultural Complex: terrace/platform (Feature A), 19 x 8 x 2.6m; terrace complex (Feature B), 40 x 22m; terrace complex (Feature C[11]); overall site complex dimensions = 62 x 23m.
04709[6]	Historic Hydro-Electric Plant	Historic Agriculture	H	C,D	Site consists of foundation that formerly supported a hydro-electric plant measuring 29 x 23m.

[11] **Shefcheck, Donna and Michael F. Dega**
2007 *Letter Report: Field Inspection of Previously Identified Sites within a Burned Area (Approximately 500-acres of a Total 660 Acres) in Olowalu Ahupua'a, Lahaina District, Island of Maui [TMK: 4-8-3:10 por.].* Prepared for Olowalu Town, LLC. Wailuku, HI. Scientific Consultant Services, Inc. Honolulu, HI

SIHP No	Formal Type	Probable Function	Age[1]	Significance	Brief Description
04710[6]	Habitation Complex	Agriculture/Burial	P	D,E	Habitation Complex: terrace w/ enclosure (L-shape alignment) (Feature A), 14.5 x 9 x .9m; four terraces (Features B and F-G); two enclosures (Features C and D); and an oval alignment indicating a possible burial (Feature E), 2.1 x 1.5 x 0.3m
04711[6]	Alignment and Terrace	Agriculture	P	D	Site consists of 2 features: alignment (Feature A), 5.5 x 2 x 0.6m; and a terrace (Feature B), 3.2 x 3.5 x 0.5m; overall site dimension = 16 x 6m.
04712[6]	Terrace and Mound	Agriculture/Burial	P	D,E	Site consists of 2 features: terrace and rock pile (Feature A), 14 x 3 x 1.3m; modified outcrop (Feature B), 1.8 x 0.8 x 0.6m; overall site dimensions = 30 x 6m.
04713[6]	Rock Shelter	Temporary Habitation	P	D	Site consists of rock shelter, 6 x 3.5 x 2.4m; located on east slope of Pu'u Kilea.
04714[6]	Rock Shelter	Temporary Habitation	P	D	Site consists of rock shelter, 2 x 2.4 x 0.7m; located on northwest side of Pu'u Kilea.
04715[6]	Cemetery	Burial	P/H	D,E	Site consists of cemetery containing minimum of 33 graves; located on the summit of Pu'u Kilea; overall site dimensions = 38 x 20m.
04716[6]	Terrace and Wall	Boundary/Habitation	P	D	Site consists of 2 features: terrace/platform (Feature A), 5 x 3.5 x 2.3m; wall (Feature B), 22 x 1 x 1m.
04717[6]	Retaining Walls	Historic Agriculture	H	D	Site consists of 5 retaining wall segments: Feature A, 15 x 4 x 2.6m; Feature B, 25 x 2.5 x 2.9m; Feature C, 20 x 2.7 x 0.9m; Feature D, 51 x 3.3 x 1.3m; and Feature E; 12 x 1.8m.
04718[3 6]	Heiau Complex	Ceremonial	P	C,D,E	Site is believed to be the "unnamed heiau" identified by Walker 1931 (SIHP 50-50-08-00005, see also Section 3.1 Summary of Previous Archaeological Research within the Current Project Area) and documented as destroyed during the 1973 inventory (Hawai'i Department of Land and Natural Resources State Historic Preservation Division 1974); Complex consists of 3 features: an enclosure (Feature A), 12 x 6 x 0.7m; and two burials (Features B and C); overall site complex dimensions = 21 x 12 x 0.7m.
04719[6]	Rock Wall	Boundary	H	D	Site consists of a dry-stacked wall, 8 x 0.8 x 0.9m.
04720[6]	Retaining Wall	Transportation	H	D	Site consists of a retaining wall.

SIHP No	Formal Type	Probable Function	Age[1]	Significance	Brief Description
04721[6]	Rectangular Platform	Habitation	H	D	Site consists of a small rectangular platform with a retaining wall on the western side. Historic era artifacts found.
04758[6]	Historic Cemetery	Burial	H	D,E	Site is historic Awalua Cemetery containing a minimum of 60 graves, 80 x 30m; Shefcheck and Dega (2007) noted fire damage to some of the headstones.
04820[6]	Surface Scatter Human Skeletal Remains	Burials	P	D,E	Surface scatter of human skeletal remains; overall site area: 100m sq; located in cane field; no indication of an *in situ* burial..
04821[6]	Surface Scatter Human Skeletal Remains	Burial	P	D,E	Surface scatter of human skeletal remains; overall site area: 50-60m sq; no indication of an *in situ* burial..
04822[6]	Kaloko o Kapa'iki Pond?	Pond	P	D	Site consists of probable fishpond sediments; located between shoreline and Olowalu Subdivision in eastern section of Olowalu Subdivision.
04823[6]	Marsh/Lagoon, Olowalu	Lagoon	P	D	Site consists of gleyed deposits.

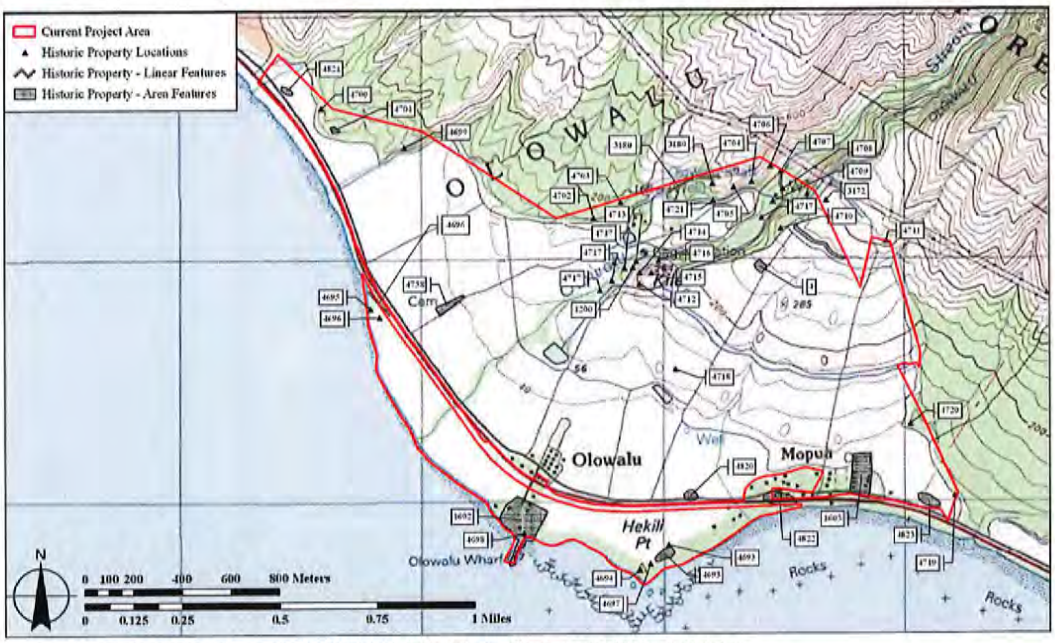

Figure 6. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the locations of historic properties within the current project area.

3.3 Mitigation Recommendations and Preservation Commitments for Documented Historic Properties within the Current Project Area

The final mitigation and preservation recommendations for the 41 historic properties documented within the current project area were initially presented in the archaeological inventory studies conducted by Xamanek Researches (D. L. Fredericksen and Fredericksen 2000a, b). Continued archaeological monitoring was recommended in the eastern near shore areas of the *makai* or Phase I portion of the current project area (D. L. Fredericksen and Fredericksen 2000b:57); as well as, at the former location of SIHP 50-50-08-04820 and -04821 where human skeletal remains were identified on the surface in a secondary context (see Figure 6).

Preservation recommendations were followed up with preservation plans for historic properties that did not include features associated with human burials for both the *makai* and *mauka* portions of the current project area (Olowalu Elua Associates 2001, 2002a) (SHPD LOG NOS: 27621 and 29336; DOC NOS: 0105MK20 and 29336 respectively -- see also Appendix B) and burial treatment and preservations plans for historic properties containing both known and possible human burials (E. M. Fredericksen and Fredericksen 1999, 2001). The following sections provide an outline of the activities that require archaeological monitoring in the designated shoreline monitoring area (Section 3.3.1), a summary of historic properties considered either "no longer significant" or where "no further work" was recommended (Section 3.3.2); and a summary of preservation commitments as outlined in the accepted preservation plans (Section 3.3.3) (Figure 7 and Figure 8).

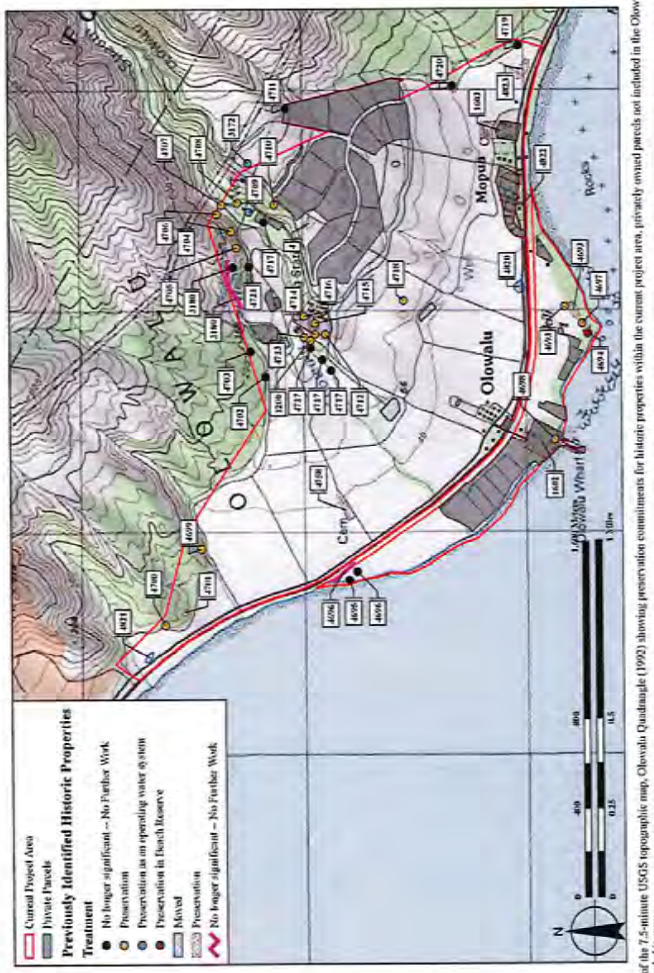

Figure 7. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing preservation commitments for historic properties within the current project area, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

3.3.1 Monitoring Requirements

Monitoring plans for future work within a designated near shore area along the eastern shoreline (Figure 9) and SIHP -04820 and -04821 were produced by Olowalu Elua Associates, LLC (2001:Appendix B; 2002b) and approved by SHPD (SHPD LOG NOS: 27285 and 30376; DOC NO: 0103MK08 and 0207MK11 respectively-- see also Appendix B).

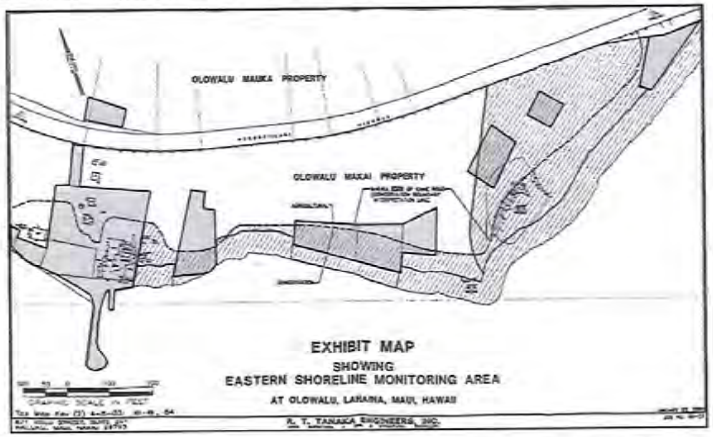

Figure 9. Map of eastern shoreline of the current project area showing the area of required archaeological monitoring in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray (Olowalu Elua Associates 2001:Appendix C).

According to the accepted monitoring plan for the eastern shoreline area within the current project area, the following activities within the designated area (see Figure 9) would require on-site archaeological monitoring (Olowalu Elua Associates 2001:Appendix B, p.B-1):

1. Subdivision development and improvements:
    a. Trenching;
    b. Roadwork;
    c. Grading; and
    d. Landscape work
2. Development and improvements for private residence:
    a. Trenching for footings;
    b. Trenching for foundations;
    c. Trenching for utilities below 2' from current grade; and

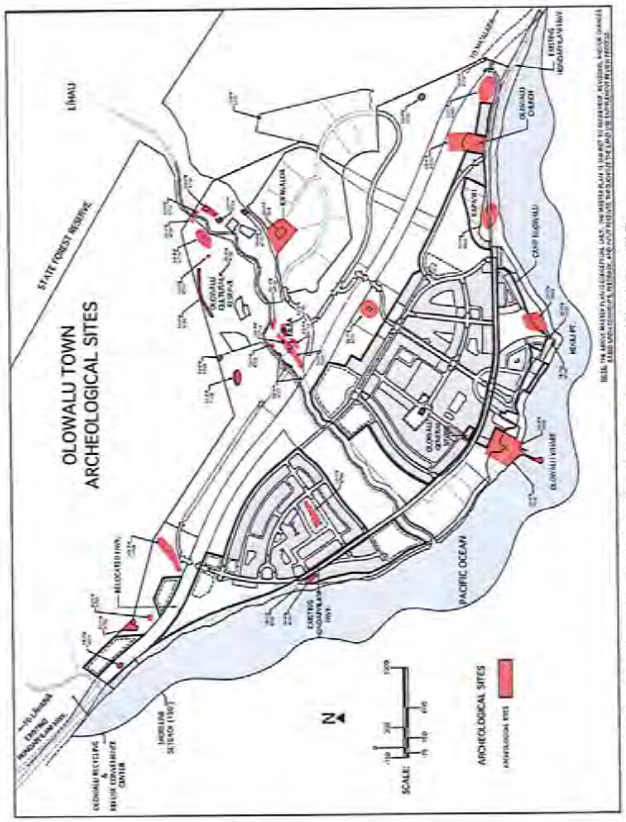

Figure 8. Archaeological sites with proposed preservation buffers (in orange) in relation to the Olowalu Town Master Plan (figure courtesy of Olowalu Town, LLC).

d. Grading below 2' from current grade

With respect to the the former location of SIHP -04820 and -04821, any sub-surface activity including but not limited to the following activities would require on-site archaeological monitoring (Olowalu Elua Associates 2002b:3):

1. Trenching;
2. Grading;
3. Landscape work; and
4. Any building improvements.

3.3.2 Historic Properties with No Further Work Recommended

Of the historic properties documented within the current project area, 10 were determined to be "no longer significant" and therefore carried a recommendation of "no further work" while 2 were relocated from their recorded location to Awalua Cemetery (50-50-08-04758). The following table (Table 3) provides a list of historic properties that were either recommended for no further work or moved:

Table 3. Summary of Historic Properties that are No Longer Significant (SIHP Prefix 50-50-80-)

SIHP NO	Formal Type	Probable Function	Treatment
3180[12]	Historic Cattle Wall	Ranching	No Longer Significant -- No Further Work
4695[13]	Wall/terrace	Erosion Control	No Longer Significant -- No Further Work
4696[13]	Old Government Road	Road	No Longer Significant -- No Further Work
4702[12]	L-Shape	Boundary	No Longer Significant -- No Further Work
4703[12]	Complex	Boundary	No Longer Significant -- No Further Work
4711[12]	Alignment and Terrace	Agriculture	No Longer Significant -- No Further Work
4717[12]	Retaining Walls	Historic Agriculture	No Longer Significant -- No Further Work
4719[12]	Rock Wall	Boundary	No Longer Significant -- No Further Work
4720[12]	Retaining Wall	Transportation	No Longer Significant -- No Further Work
4721[12]	Rectangular Platform	Habitation	No Longer Significant -- No Further Work

[12] **Fredericksen, Demaris L. and Erik M. Fredericksen**
2000b *Archaeological Inventory Survey of Mauka Portion of Olowalu Development Parcel Phase 2, Olowalu Ahupua'a, Lahaina District, Maui Island (TMK 4-8-3:10)*. Prepared for Olowalu Elua Associates. Kahului, Maui. Xamanek Researches. Pukalani, HI
Table 4 (p.73)

[13] 2000a *Archaeological Inventory Survey of Makai Portion (Phase 1) of Olowalu Development Parcel, Olowalu Ahupua'a, Lahaina District, Maui Island (TMK 4-8-3:por.5)*. Prepared for Olowalu Elua Associates. Kahului, HI. Xamanek Researches. Pukalani, HI
(p.58)

SIHP NO	Formal Type	Probable Function	Treatment
4820[14]	Surface Scatter Human Skeletal Remains	Burials	Moved to Awalua Cemetery – continued archaeological monitoring in the area
4821[14]	Surface Scatter Human Skeletal Remains	Burial	Moved to Awalua Cemetery – continued archaeological monitoring in the a area

3.3.3 Historic Properties with Preservation Commitments

Originally, three historic properties (SIHP -04701, -04716, -04823) along with individual features from two historic properties (SIHP -04700 Features B, J and SIHP -04707 Feature A) were intended for archaeological data recovery (D. L. Fredericksen and Fredericksen 2000b:Table 4). Olowalu Elua Associates, however, decided to preserve SIHPs -04700, -04701 and -04823 while reserving the option for data recovery at SIHP -04823, a gleyed soil deposit, by a future landowner (Olowalu Elua Associates 2002a:8, footnote). Additionally, the presence of SIHPs -04707and -04716 within the Olowalu Cultural Reserve resulted in a modification to the mitigation recommendations from data recovery to preservation in its entirety (Olowalu Elua Associates 2002a). Therefore, all significant historic properties were to be preserved.

The State Department of Land and Natural Resources (DLNR) Chapter 13-277, Hawai'i Administrative Rules (HAR), entitled "Rules Governing Requirements for Archaeological Site Preservation and Development," lists the following forms of preservation for historic properties (Department of Land and Natural Resources 2002a)

1. Avoidance and protection (conservation);
2. Stabilization;
3. Rehabilitation;
4. Restoration;
5. Reconstruction;
6. Interpretation – where information about a historic property is presented to the public; or
7. Appropriate cultural use.

Of the 29 historic properties currently under preservation commitments, 10 are intended for preservation through avoidance and protection (conservation) and 17 are intended for interpretative preservation. It was unclear, however, what the intended form of preservation for SIHP -01200 and -01201 would be. The following table (Table 4) summarizes the preservation measures for each of the 29 historic properties:

[14] **Fredericksen, Erik M. and Demaris L. Fredericksen**
2001 *Preservation Plan for Human Remains, Burials, and Probable and Possible Burial Features Contained on the Olowalu Mauka Project Area, Olowalu Ahupua'a, Lahaina District, Island of Maui (TMK: 4-8-3:10)*. Prepared for Olowalu Elua Associates, LLC. Kahului, Maui. Xamanek Researches. Pukalani, HI
Footnote 10 (p.8)

Table 4. Summary of Historic Properties and Associated Preservation Measures within the Current Project Area (historic properties shaded in green located within the boundaries of the Olowalu Cultural Reserve; SIHP Prefix 50-50-80-)

SIHP NO	Formal Type	Probable Function	Buffer (ft)	Buffer Markers	Signage[15]	Preservation Type[15]	Comment[15]
00004[16]	Heiau (Kaiwaloa/Kawaialoa Heiau)	Ceremonial	100	Yes	Yes	Interpretive	Viewing platform overlooking the *heiau* for the general public, pedestrian access to the *heiau* interior restricted to Native Hawaiian traditional cultural practices(pp.10-11); Buffer markers to consist of a native hedge and boulders (p.11)
01200[17]	Olowalu Petroglyph Complex	Habitation	30	No	Yes	Undetermined	Site extent makes permanent buffer markers difficult
01201[17]	Rock Shelter	Temporary Habitation				Undetermined	To be preserved within SIHP -01200 buffer area
01602[18]	Olowalu Mill	Habitation/ Mill/Wharf	30	No	Yes	Interpretive	Site extent makes permanent buffer markers difficult; Signage will include a plot map of the preservation area (Appendix A: A-1)
01603[16]	Lanakila Hawaiian Protestant Church Site	Church/ Cemetery	0	Yes	Yes	Conservation	Buffer is the original church boundary; native hedge, boulder alignment or other appropriate buffer marker (p.14)
03172[17]	Concrete Irrigation Ditch	Agriculture	0	No	No	Conservation	Preservation as an operating water system; appears to be located outside the boundaries

[15] See respective preservation plans for signage wording and detailed interpretive requirements

[16] **Fredericksen, Erik M. and Demaris L. Fredericksen**

2001 *Preservation Plan for Human Remains, Burials, and Probable and Possible Burial Features Contained on the Olowalu Mauka Project Area, Olowalu Ahupua'a, Lahaina District, Island of Maui (TMK: 4-8-3:10)*. Prepared for Olowalu Elua Associates, LLC. Kahului, Maui. Xamanek Researches. Pukalani, HI

[17] **Olowalu Elua Associates, LLC.**

2002a *Archaeological Preservation Plan, Mauka Portion (Phase 2), Olowalu Ahupua'a, Lahaina District, Maui Island, TMK 4-8-3:10, 50-82; TMK 4-8-4:11-16.* Olowalu Elua Associates, LLC. Kahului, HI

(p.9)

[18] 2001 *Archaeological Mitigation & Preservation Plan, Makai Portion (Phase 1), Olowalu Ahupua'a, Lahaina District, Maui Island, TMK 4-8-3:1, 3, 4, 5, 6, 33, 41-49, 83 & 84*, Olowalu Elua Associates, LLC. Kahului, HI

Table 1

SIHP NO	Formal Type	Probable Function	Buffer (ft)	Buffer Markers	Signage[15]	Preservation Type[15]	Comment[15]
							of the current project area
04693[19]	Burial Complex	Burial	see comment	Yes	Yes	Conservation	Buffer: vertical buffer of 10-15 cm of clean sand followed by 10 cm of cinder or permeable gravel. Boundary will be marked with a hedge. Landscaping of the preservation area to ensure long-term integrity utilizing drip irrigation and shallow irrigation lines.
04694[18]	L-Shape	Habitation	10	Yes	Yes	Interpretive	Preservation within the beach reserve; Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (Horcajo 2002) (SHPD DOC NO: 0204MK20 – see Appendix B).
04697[18]	Subsurface Cultural Deposit	Habitation	10	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (Horcajo 2002) (SHPD DOC NO: 0204MK20 – see Appendix B).
04698[18]	Subsurface Cultural Deposit	Habitation	0	No	Yes	Interpretive	Surface currently used as a beach access; Location to be included with interpretive signage for -01602 (Appendix A: A-1)
04699[16, 17]	Habitation Complex	Habitation/ Burial/ Boundary?	30	Yes	Yes	Conservation	Recommended sealing Feature D[16] (p. 14); Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags[17] (p. 11)
04700[17]	Habitation Complex	Habitation	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (p. 11)
04701[17]	Possible Ko'a	Ceremonial	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased

[19] **Fredericksen, Erik M. and Demaris L. Fredericksen**

1999 *Archaeological Preservation Plan for Burial Ground on the Makai Project Area, Site 50-50-08-4693, Olowalu Ahupua'a, Lahaina District, Island of Maui (TMK: 4-8-3:Por. 5)*. Prepared for Olowalu Elua Associates, LLC. Kahului, Maui. Xamanek Researches. Pukalani, HI

SIHP NO	Formal Type	Probable Function	Buffer (ft)	Buffer Markers	Signage[15]	Preservation Type[15]	Comment[15]
							concrete blocks and hard plastic identification tags (p. 11)
04704[17]	Habitation Complex w/Petroglyphs	Habitation	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (p. 11)
04705[17]	Rock Shelters	Temporary Habitation	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (p. 11)
04706[17]	Rock Shelter	Temporary Habitation	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (p. 11)
04707[16, 17]	Wall and Mound	Marker/ Burial	15	Yes	Yes	Conservation	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags[17] (p. 11)
04708[17]	Platform and Terrace Complex	Agriculture/ Ceremonial	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (p. 11)
04709[17]	Historic Hydro-Electric Plant	Historic Agriculture	0	No	No	Conservation	Preservation as an operating water system
04710[16]	Habitation Complex	Agriculture/ Burial	30	Yes	Yes	Interpretive	Trail leading to a viewing platform overlooking the site complex for the general public
04712[16, 17]	Terrace and Mound	Agriculture/ Burial	30	Yes	Yes	Conservation	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags[17] (p. 11)
04713[17]	Rock Shelter	Temporary Habitation	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (p. 11)
04714[17]	Rock Shelter	Temporary Habitation	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (p. 11)
04715[16]	Cemetery	Burial	30	Yes	Yes	Conservation	Landscape buffer; improved gate at the base of the old access road (p.16)

SIHP NO	Formal Type	Probable Function	Buffer (ft)	Buffer Markers	Signage[15]	Preservation Type[15]	Comment[15]
04716[17]	Terrace and Wall	Boundary/ Habitation	15	Yes	Yes	Interpretive	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (p. 11)
04718[16]	Heiau Complex	Ceremonial	100	Yes	Yes	Interpretive	Cinder path leading to a viewing platform overlooking the *heiau* for the general public (p.13); interior restricted to Native Hawaiian traditional cultural practices(p.12); Buffer markers to consist of a native hedge and/or boulders (p.13); design and implement drainage measures to divert runoff (p.13)
04758[16]	Historic Cemetery	Burial	60	Yes	Yes	Conservation	Buffer markers to consist of a native hedge and/or boulders or other form of demarcation as approved by SHPD and the MLIBC; design and implement drainage measures to divert runoff (p.13);
04822[17]	Kaloko o Kapa'iki Pond?	Pond	0	No	Yes	Interpretive	Bound by existing roads and maintained as a drainage basin by the State of Hawaii
04823[17]	Marsh/Lagoon, Olowalu	Lagoon	15	No	No	Conservation	Originally intended for data recovery (D. L. Fredericksen and Fredericksen 2000b:Table 4); Olowalu Elua Associates, LLC opted to preserve the site with the caveat that data recovery was to be the responsibility of the landowner.

3.3.3.1 Interim Protection Measures

Interim protection measures are implemented to protect significant historic properties and their buffers during construction activities (Department of Land and Natural Resources 2002a:3-4). For each historic property under long term preservation commitments (see Table 4) the following interim, or short term, preservation measures must be carried out during construction activities within 100 feet of the historic property (E. M. Fredericksen and Fredericksen 2001:9-10; Olowalu Elua Associates 2001:Appendix A, p. A-1; 2002a:10):

1. Temporary fencing demarcating the edge of the buffer;
2. Flush cutting of non-native trees within the preservation areas should vegetation clearing be required;
3. Notification to SHPD in writing that interim protection measures are in place; and
4. Notification to construction crews, both written and verbal, of the following items concerning nearby historic properties:
    a. The location of the site;
    b. A description of the designated buffer zone; and
    c. Avoidance instruction with an emphasis of the caution needed when working near these sites.

3.3.3.2 Long Term Preservation Measures

Long term preservation measures shall follow the appropriate Secretary of the Interior's Standards for Historic Preservation Projects and include the following (Department of Land and Natural Resources 2002a:4):

1. Maintenance measures to be followed;
2. Methods for clearing vegetation;
3. The manner in which litter is controlled;
4. Access to the site and possible use of the site for cultural practices, if appropriate;
5. Approaches to interpret and inform the public about the site, if appropriate;
6. Permanent marked markers, if appropriate;
7. If appropriate, provisions to address potential future impacts and site stability; and
8. Provisions for reasonable monitoring of site integrity by the person or agency, and SHPD inspection to assure compliance.

For details on the long term preservation measures for each historic property refer to Table 4 for a brief summary and the respective preservation plans for both the *makai* lands (south-southwest of the current alignment of Honoapi'ilani Highway) and *mauka* lands (north-northeast of the current alignment of Honoapi'ilani Highway) portions of the current project area.

Section 4 Results of Field Inspection and Recommendations

The field inspection for this study was focused on re-visiting previously recorded historic properties within the Olowalu Town Master Plan APE that may be directly or indirectly affected by ground altering activities associated with construction and development. Therefore, the historic properties that were re-visited were limited to those properties located along the foothills and alluvial fan that comprises the topography of the current project area (Table 5 and Figure 10). Historic properties located within the Olowalu Cultural Reserve (OCR) as it encompasses Olowalu Valley were not examined at this time. The objectives of the field inspection were as follows: 1. Document the current condition of each historic property; 2. Verify location information; and 3. Discern if either interim or long-term preservation measures, as outlined in the accepted archaeological mitigation and preservation plans (see also Sections 3.3), have been implemented. The following section details the results of the field inspection. The information gathered will be used in an effort to understand the next steps in the planning progression with respect to the proposed project and the historic preservation review process.

Table 5. Re-visted Historic Properties for the Current Study (SIHP Prefix 50-50-80).

SIHP NO	Formal Type	Probable Function
-0004	Heiau (Kaiwaloa/Kawaialoa Heiau)	Ceremonial
-1602	Olowalu Mill	Habitation/Mill/Wharf
-1603	Lanakila Hawaiian Protestant Church Site	Church/Cemetery
-4693	Burial Complex	Burial
-4694	L-Shape	Habitation
-4697	Subsurface Cultural Deposit	Habitation
-4698	Subsurface Cultural Deposit	Habitation
-4699	Habitation Complex	Habitation/Burial/ Boundary?
-4700	Habitation Complex	Habitation
-4701	Possible Ko'a	Ceremonial
-4712	Terrace and Mound	Agricultural/Burial
-4715	Cemetery (Pu'u Kilea Cemetery)	Burial
-4718	Heiau Complex	Ceremonial
-4758[20]	Historic Cemetery (Awalua Cemetery)	Burial
-4822	Kaloko o Kapa'iki Pond?	Pond
-4823[21]	Marsh/Lagoon, Olowalu	Lagoon

[20] Not revisited at this time due to access difficulties

[21] Not included in this field inspection due to the subsurface depth (0.6 to 1.2 m below surface) and nature (gleyed soils) of this deposit

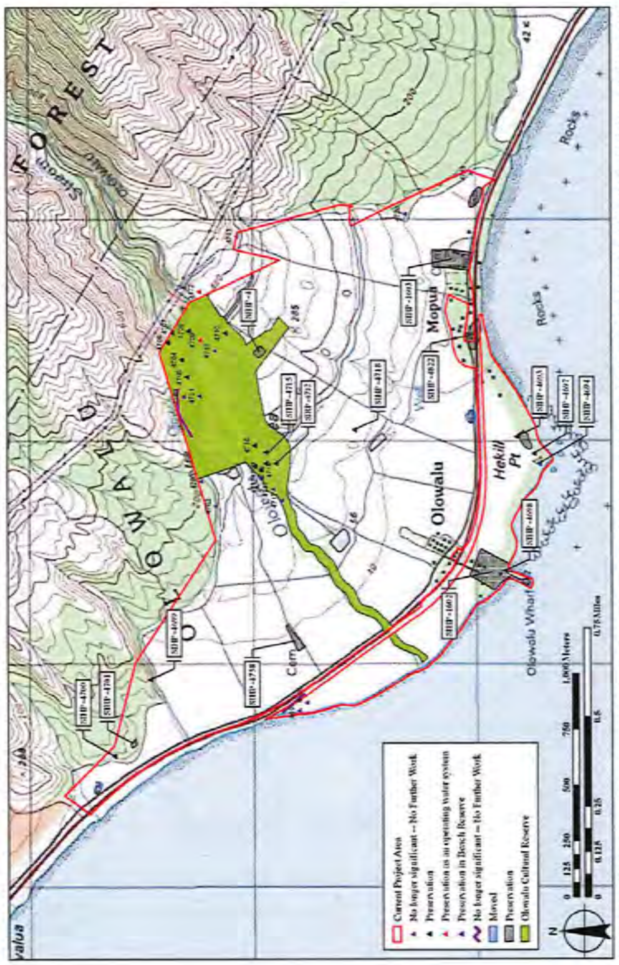

Figure 10. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing approximate historic property locations within the current project area with site identification labels for re-visited historic properties called out.

Overall ground visibility ranged from fair to poor. General vegetation in the areas that were re-visited consisted of a dense growth of kiawe (*Prosopis pallida*), opiuma (*Pithecellobium dulce*) and haole koa (*Leucaena leucocephala*) along the coastal portions, non-native head high grasses and dense kiawe, haole koa, opiuma, and klu (*Acacia farnesiana*) at the lower inland elevations, and open pasture and scrub lands consisting of ankle to knee high natal redtop (*Melinis repens*), buffelgrass (*Cenchrus ciliaris*) and other non-native grasses with kiawe saplings at the mid-elevations. Commonly observed ground disturbance appeared to be associated with landscaping, sugar cane operations, camp ground improvements at Camp Olowalu (formerly known as Camp PECUSA). Extensive ground alteration associated with fire break construction during the last wildfire was also observed along the west-northwest base of the northernmost ridge of the project area.

4.1 Previously Recorded Historic Properties

4.1.1 SIHP 50-50-08-0004 (Kaiwaloa/Kawaialoa Heiau)

4.1.1.1 Current Condition

While the enclosing walls and interior area of Kaiwaloa/Kawaialoa Heiau (SIHP 50-50-08-0004) are overgrown with haole koa, klu, and buffel grass, the overall structural condition of this historic property ranges from fair to good (Figure 11). Within the 100 ft preservation buffer, however, there appears to have been some encroachment as dozer push, greenwaste, and christmas palms (*Adonidia merrillii*) were noted within and on the buffer boundary (Figure 12 through Figure 14).

Figure 11. SIHP 50-50-08-0004. View to north.

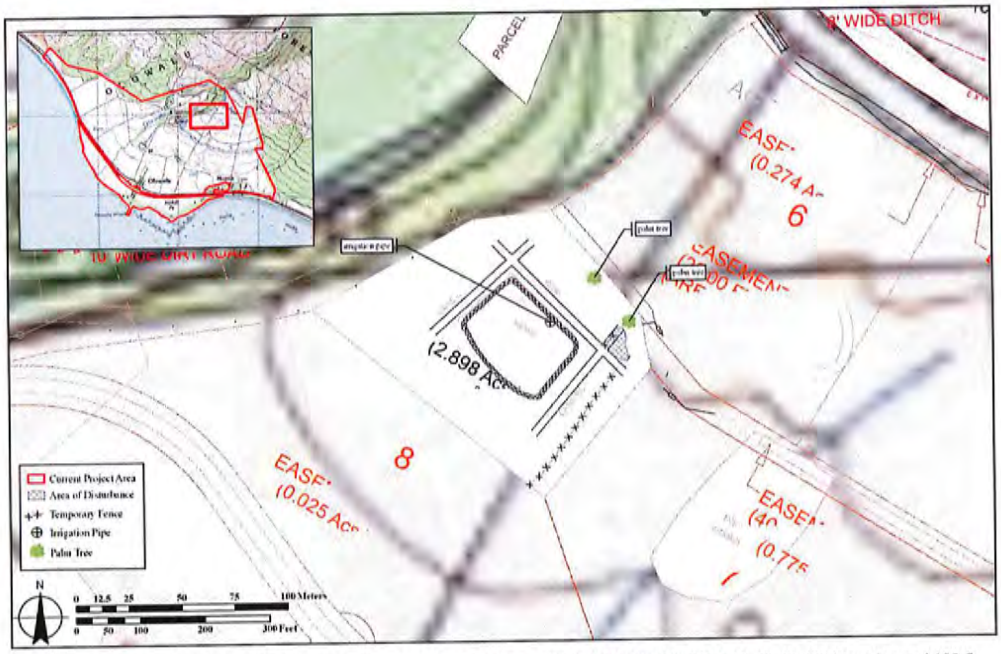

Figure 12. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-0004 location and 100 ft preservation buffer boundary in gray in relation to remnant temporary fence, Christmas Palms, and green waste push.

Figure 13. Pushpile and green waste within the 100' preservation buffer. View to northeast.

Figure 14. SIHP 50-50-08-0004 access, green waste in the foreground, left of frame; Christmas Palms lining the preservation buffer boundary beginning at third and fourth palm in the middle ground, right of frame; SIHP -0004 in the background, center of frame. Overall view to northwest.

4.1.1.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

A remnant portion of orange temporary fencing was observed approximately 10 m (32 ft) from the southeastern boundary line and within the 100' preservation boundary for this historic property (Figure 15, see also Figure 13) the *mauka* portion of which had fallen and been displaced. Temporary fencing along the northeastern and southwestern buffer boundary was not observed. As the southern ridge of Olowalu Gulch delineates the northwestern boundary of the preservation area buffer, the placement of temporary fencing was not expected at this location.

Figure 15. Remnant temporary fencing at SIHP 50-50-08-0004. View to north-northwest.

Long-Term Preservation Measures

Surrounded by the Olowalu Mauka Subdivision, current access to this historic property is via Kala'i Place through a gated entry constructed by a private landowner and along an unimproved gravel road (Figure 16, see also Figure 14). Long-term preservation measures for SIHP -0004 as outlined in the accepted preservation plan included the following (E. M. Fredericksen and Fredericksen 2001):

Buffer (ft)	100
Buffer Markers	Yes
Signage[22]	Yes
Preservation Type	Interpretive
Comment	Pathway or foot trail, viewing platform overlooking the heiau for the general public, pedestrian access to the heiau interior restricted to Native Hawaiian traditional cultural practices (pp.10-11); Buffer markers to consist of a native hedge and boulders (p.11)

[22] See respective preservation plans for signage wording and detailed interpretive requirements

While the long-term preservation measures as indicated above had not been implemented at the time of this field inspection, the landowners have been in preliminary talks with the families of Olowalu and caretakers of this *heiau* regarding planning and design of the required preservation elements.

Figure 16. Access entry to SIHP 50-50-08-0004.View to north-northwest.

4.1.1.3 Recommendations

Based on the above findings the following recommendations are presented:

- Hand clearing of vegetation growing within the architectural features of SIHP -0004 to prevent root displacement and maintain structural integrity.
- Additional community consultation with the lineal and cultural descendants of Olowalu Ahupua'a, as well as the designated caretakers of this *heiau* and OCR regarding the layout and design of both the pathway and viewing platform; as well as plant type for the native hedge to serve as the buffer boundary.
- Implementation of the long-term preservation measures following consultation and design development for the preservation area.
- Re-establishment of temporary orange fencing at the buffer boundary in the interim and removal of any green waste within the preservation area.

- Notice to the landowner who shares the northernmost boundary of the preservation area regarding the removal of the built features located at the access entrance, as well as the green waste and palms that encroach on the buffer boundary.

4.1.2 SIHP 50-50-08-1602 (Olowalu Mill Complex)

4.1.2.1 Current Condition

SIHP 50-50-08-1602 borders the lands covered by the proposed Olowalu Town Master Plan (see Figure 7) and consists of the structural remnants of the Olowalu Mill Complex and Wharf (Figure 17 through Figure 19). The current condition of this historic property is likely similar to that of the 1998-1999 archaeological inventory survey field work (D. L. Fredericksen and Fredericksen 2000a:47-50). Vegetation within the interior portion of the preservation area consisted of a stand of mature kiawe trees, non-native grasses, and low-lying shrubs. Shoreline improvements within the preservation area included well maintained and manicured landscaping; as well as, a commemorative bench dedicated to the memory of Mr. Alfredo Sarian.

4.1.2.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

As the long-term preservation measures for SIHP -1602 have been implemented, interim preservation measures were not needed at this historic property.

Long-Term Preservation Measures

Current access to this historic property is via a beach access road off of Honoapi'ilani Highway and along an unimproved dirt road (Figure 20). Long-term preservation measures for SIHP -1602 as outlined in the accepted archaeologocial preservation plan included the following (Olowalu Elua Associates 2001):

Buffer (ft)	30
Buffer Markers	No
Signage	Yes
Preservation Type	Interpretive
Comment	Site extent makes permanent buffer markers difficult; Signage will include a plot map of the preservation area (Olowalu Elua Associates 2001:Appendix A: A-1)

At the time of the field inspection, the required signage for SIHP -1602 (Olowalu Mill Complex) was in place and located near the *makai* end of beach acces trail (Figure 21 and Figure 22).

4.1.2.3 Recommendations

As the long-term preservation measures have been implemented no further historic preservation work is recommended.

Figure 17. SIHP 50-50-08-1602, Olowalu Mill remnant. View to north.

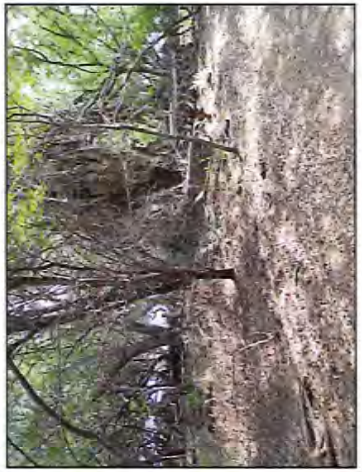

Figure 18. SIHP 50-50-08-1602, Olowalu Mill remnant. View to south.

Figure 19. Panorama of SIHP 50-50-08-1602, Olowalu Wharf. View from left to right –southwest-west.

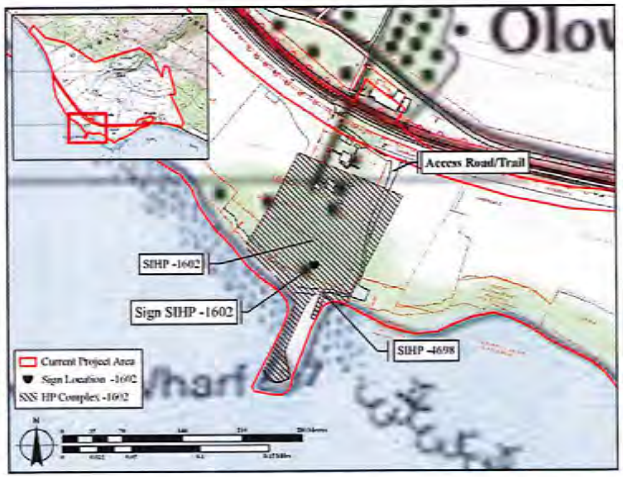

Figure 20. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-1602 preservation area, SIHP 50-50-08-4698, and interpretive sign location.

Figure 21. SIHP 50-50-08-1602, interpretive sign location. View to northeast.

Figure 22. Close up of SIHP 50-50-08-1602 interpretive sign showing inclusion of a diagram of the complex features as specified in the preservation plan.

4.1.3 SIHP 50-50-08-1603 (Lanakila Historic Church)

4.1.3.1 Current Condition

SIHP 50-50-08-1603 consists of both the original stone *hale pule*, or sanctuary, as well as an associated graveyard with marked burials to the west of the *hale pule* (borderd by lands covered by the proposed Olowalu Master Plan) and unmarked grave plots in former cane lands that were once property of the church to north and within lands covered by the proposed Olowalu Town Master Pland (D. L. Fredericksen and Fredericksen 2000b:57) (see also Figure 7). With the exception of the placement of a cross in the former location of the altar, the current condition of the *hale pule* and western graveyard is likely similar to what it had been during the inventory survey of the *mauka* project area (D. L. Fredericksen and Fredericksen 2000b). While recent rains have caused increased vegetation growth within the sanctuary and the immediate surrounding area (Figure 23), the grounds of the church proper are continuously maintained with cleared paths leading to the sanctuary (Figure 24). A cursory inspection of the former church parcel north of the sanctuary showed the area covered in a dense growth of opiuma trees and grasses with a barbed wire fence currently running along the modern *mauka* boundary of the church lot (Figure 25).

Figure 23. SIHP 50-50-08-1603, interior of *hale pule*. View to north.

Figure 24. Overall view of SIHP -1603. View to northeast.

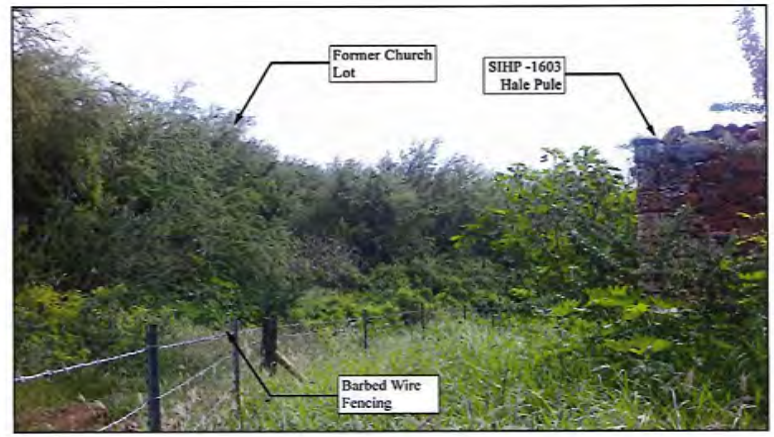

Figure 25. Area *mauka* of the stone church sanctuary, former church lot where unmarked grave plots were identified to the left of frame.

4.1.3.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

No interim preservation measures demarcating the northern (*mauka*) preservation area were observed.

Long-Term Preservation Measures

Current access to this historic property is via an old cane haul road directly adjacent and *mauka* of Honoapi'ilani Highway. Long-term preservation measures for SIHP -1603 as outlined in the accepted burial preservation plan included the following (E. M. Fredericksen and Fredericksen 2001):

Buffer (ft)	0
Buffer Markers	Yes
Signage	Yes
Type	Conservation
Comment	Buffer is the original church boundary; native hedge, boulder alignment or other appropriate buffer marker (p.14).

While the grounds of the church are well maintained, at the time of the field inspection the interpretive signage and hedge demarcating the boundary of the preservation area directly *mauka* of SIHP -1603 was not observed.

4.1.3.3 Recommendations

Based on the above findings the following recommendations are presented:

- Land survey of the preservation area *mauka* of the *hale pule* and establishment of temporary orange fencing along the boundary for visibility.
- Additional community consultation with the lineal and cultural descendants of Olowalu Ahupua'a and designated caretakers of the church grounds regarding the placement of either a native hedge or boulder alignment as permanent preservation area boundary markers; as well as the propriety of signage denoting the presence of the preservation area.
- Implementation of the long-term preservation measures, as worked out through consultation, for the *mauka* portion of the preservation area that falls within the current project area.

4.1.4 SIHP 50-50-08-4693

4.1.4.1 Current Condition

Currently, the preservation area for SIHP 50-50-08-4693, a pre-contact burial ground (D. L. Fredericksen and Fredericksen 2000a:27-34), is heavily overgrown with kiawe and non-native grasses (Figure 26). Earthen berms, from what appears to have been a result of dozer push, were observed within the preservation area while a makeshift shower facility for campers is located directly adjacent to the eastern preservation area boundary (Figure 28). Finally, campground encroachement into the burial preserve area, as it is depicted on the survey CAD drawing, was observed and confirmed through GPS location of Camp Areas 10 and 15 with the Trimble ProXH GPS unit at the time of the field inspection(see also Figure 28). As of this writing however, the campsites have since been dismantled and the areas blocked from general access with the placement of kiawe log barriers.

4.1.4.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

Not Applicable

Figure 26. SIHP 50-50-08-4693, preservation area. View to northwest.

Figure 28. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the preservation area for SIHP 50-50-08-4693 in relation to the earthen berm (shown as both a solid and dotted red line within the preservation area), shower facility, previous location of former camp sites, and sign location.

Figure 27. Camp Olowalu outdoor shower facility. View to northwest.

Figure 29. Close up of identifying sign for SIHP 50-50-08-4693.

Long-Term Preservation Measures

Current access to this historic property is through both the beach reserve and road that services the Camp Olowalu campground off of Honoapi'ilani Highway. Long-term preservation measures for SIHP -4693 as outlined in the accepted burial treatment and preservation plan included the following (E. M. Fredericksen and Fredericksen 1999):

Buffer (ft)	See comment
Buffer Markers	Yes
Signage	Yes
Preservation Type	Conservation
Comment	Vertical buffer of 10-15 cm of clean sand followed by 10 cm of cinder or permeable gravel and a thin layer of top soil. Boundary will be marked with a hedge. Landscaping of the preservation area to ensure long-term integrity utilizing drip irrigation and shallow irrigation lines.

At the time of the field inspection, the required signage for SIHP -4693 was in place and located near the northeastern corner of the preservation area (Figure 29, see also Figure 26). Client records and photographs show that the placement of the vertical buffer had been carried by September 2000, along with the planting of *naupaka* (*Scaevola* sp.) (Figure 30) and the setting of a large boulder alignment to mark the preservation boundary (Figure 31) in accordand with the burial preservation plan. The current field inspection identified the boulder markers along the south and west buffer boundary, however, the *naupaka* planted in 2000 was no longer present. Drip irrigation lines for landscaping, as called for in the burial preservation plan, were also observed within the preserve area; however, regular landscaping maintenance of the preseravation interior and *naupaka* boundary hedge appears to have been discontinued.

Figure 30. Signage for SIHP 50-50-08-4693 showing preservation measures carried out in 2000, view to west (photo courtesy of Olowalu Town, LLC.)

Figure 31. Preservation measures, 2000, view to south (photo courtesy of Olowalu Town, LLC.)

4.1.4.3 Recommendations

Based on the above findings the following recommendations are presented:

- Clarification and land survey of the preservation area boundary in relation to encroaching features from adjacent land uses and establishment of temporary orange fencing along the boundary for visibility.

- Consultation with the Camp Olowalu regarding the feasibility of re-locating the shower facility on the boundary of the preservation area (see also Figure 28).
- Re-establishment of the *naupaka* hedge that served as the permanent preservation area boundary marker and regular maintenance of the hedge to prevent future encroachment from heavy recreational use of the coastal environs immediately adjacent to this historic property.
- Removal of invasive non-native trees and re-establishment of the native vegetation called for in the preservation plan within the interior and establishment of regular landscaping maintenance.

4.1.5 SIHP 50-50-08-4694

4.1.5.1 Current Condition

The condition of SIHP 50-50-08-4694, an L-Shaped habitation enclosure (Figure 32), ranges from fair to poor and is likely similar to that of the original archaeological inventory survey (D. L. Fredericksen and Fredericksen 2000a:34-35). While some recent vegetation clearing and maintenance was evident in the immediate vicinity of the enclosure at the time of the field inspection (Figure 33 and Figure 34), the preservation area for SIHP 50-50-08-4694 was largely dominated by mature kiawe trees and opiuma followed by new growth of non-native grasses and kiawe saplings.

Figure 32. SIHP 50-50-08-4698, view to east.

Figure 33. SIHP 50-50-08-4694, showing recent clearing event. View to north.

4.1.5.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

No interim preservation measures were observed.

Long-Term Preservation Measures

Current access to this historic property is via the beach reserve. Long-term preservation measures for SIHP -4694 as outlined in the accepted archaeological preservation plan included the following (Olowalu Elua Associates 2001):

Buffer (ft)	10
Buffer Markers	Yes
Signage	Yes
Preservation Type	Interpretive
Comment	Preservation within the beach reserve; Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (Horcajo 2002) (SHPD DOC NO: 0204MK20 – see Appendix B).

While the required signage for SIHP -4694 is present (Figure 35), the permanent preservation buffer markers as described above were not observed Vegetation maintenance within the preservation buffer appears to occur on a periodic basis.

4.1.5.3 Recommendations

Based on the above findings the following recommendations are presented:

- Vegetation clearance of the buffer area to facilitate installation of permanent preservation area markers.

4.1.6 SIHP 50-50-08-4699

4.1.6.1 Current Condition

SIHP 50-50-08-4699 consists of eight rock shelters and a modified outcrop (D. L. Fredericksen and Fredericksen 2000b:41-42) along the southeastern edge of a ridge located in the northwestern extent of the current project area (Figure 36 and Figure 37). An unimproved access road runs along the southeastern foot of the ridgeline where an earthen berm created by road construction and maintenance separates the ridge and rockshelters from the road. The foot, or base, of the ridgeline that comprises SIHP -4699 is currently over grown with waist to head high buffel grass and koa haole. Unfortunately, feature correlation could not be made during the field inspection as the individual historic property feature maps for the *mauka* portion of the project area were not available at that time.

4.1.6.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

No interim preservation measures were observed.

Long-Term Preservation Measures

Current access to this historic property is via an unimproved road off of a cane haul road that parallels Honoapi'ilani Highway on the *mauka* side. Long-term preservation measures for SIHP -4699 as outlined in the accepted archaeological preservation plan included the following (E. M. Fredericksen and Fredericksen 2001; Olowalu Elua Associates 2002a):

Buffer (ft)	30
Buffer Markers	Yes
Signage	Yes
Preservation Type	Conservation
Comment	Recommended sealing Feature D (E. M. Fredericksen and Fredericksen 2001:14); Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (Olowalu Elua Associates 2002a:11)

At the time of the field inspection, while no signange denoting the presence of this historic property was observed, one pre-cased concrete block marking the buffer boundary on top of the ridge was noted.

Figure 34. SIHP 50-50-08-4694, showing overall vegetation. View to northeast.

Figure 35. SIHP 50-50-08-4694 interpretive sign.

Figure 36. SIHP 50-50-08-4699, overall. View to northeast.

Figure 37. SIHP 50-50-08-4699, overall. View to west.

4.1.6.3 Recommendations

Based on the above findings the following recommendations are presented:

- Re-identification of Feature D to determine if this feature had been sealed per the recommendation of Xamanek Researches (E. M. Fredericksen and Fredericksen 2001:14).
- Implementation of the long-term preservation measures to include sealing Feature D in the event that the shelter is still open, community consultation regarding the proper placement of the interpretive signage in the context of the proposed layout of the Honoapi'ilani Highway re-alignment and subdivision plans (Figure 38), and establishment of the permanent preservation area boundary markers.

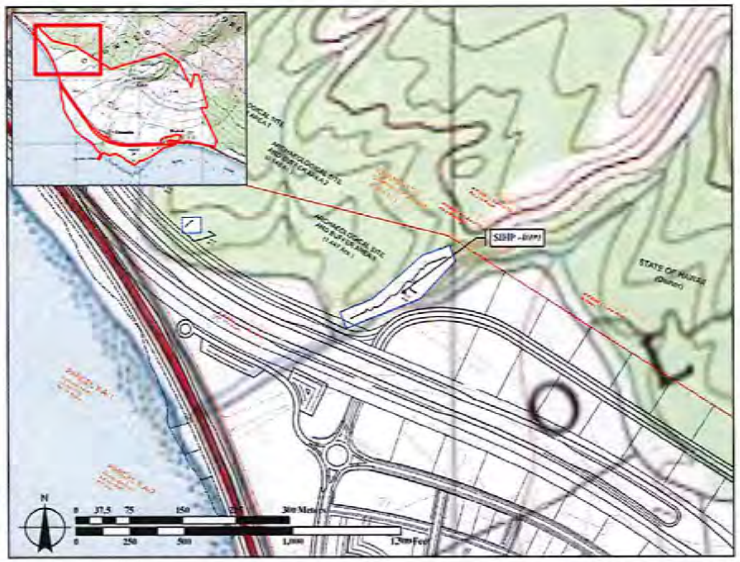

Figure 38. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4699 location in relation to proposed plans for Olowalu Town.

4.1.7 SIHP 50-50-08-4700

4.1.7.1 Current Condition

SIHP 50-50-08-4700 consists of eight rock shelters, a possible C-shaped enclosure, and a modified outcrop/rock wall (D. L. Fredericksen and Fredericksen 2000b:42-46) along the northwestern face of a ridge located in the northwestern extent of the current project area. Currently, the base of the ridgeline that comprises SIHP -4700 is overgrown with a dense thicket of kiawe trees and klu shrubs along with waist to head high grasses. Extensive ground disturbance, likely associated with firebreak construction from previous wildfires, have created a network of earthen berms and vegetation push along the base of this ridge. While Feature J, the section of modified outcrop, was easily identifiable (Figure 39), feature correlation for the rock shelters associated with this historic property within the current project area could not be made during the field inspection as the individual historic property feature maps for the *mauka* portion of the project area were not available at the time of inspection.

Currently, the condition and integrity of SIHP -4700 Feature J is consistent with that of the archaeological inventory survey description (D. L. Fredericksen and Fredericksen 2000b:45-46). During the field inspection, it was noted that Feature J was located outside of the preservation area for SIHP -4700 as indicated by the real-time GPS position taken during the field inspection and in relation to the survey CAD map. A single GPS point was collected on a culturally modified section of Feature J and post processed to within an average horizontal error of ±30 cm. Overlay of the post-processed data showed that this feature is located approximately 38 m (124 ft) from the preservation area as depicted on CAD survey map and within the proposed corridor for the Honoapi'ilani Highway realignment (Figure 40).

Figure 39. SIHP 50-50-08-4700 Feature J. View to east.

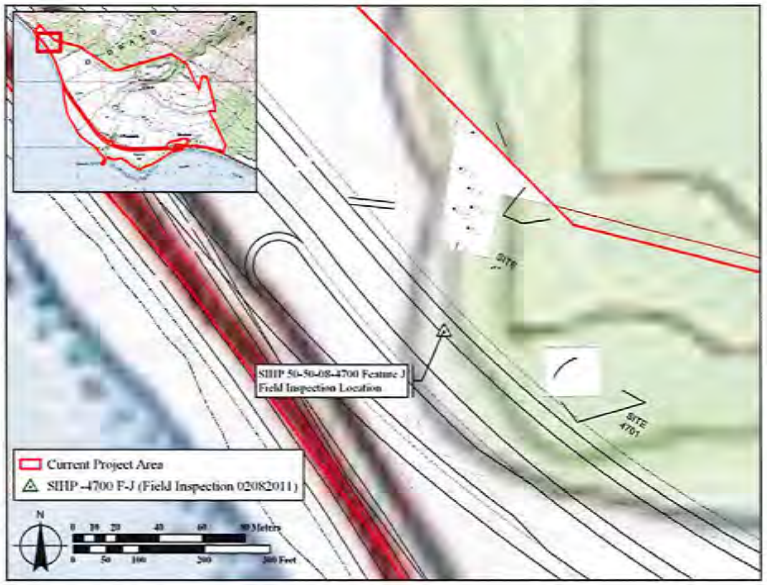

Figure 40. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4700 preservation area (white polygon) in relation to SIHP -4700 Feature J.

4.1.7.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

No interim preservation measures were observed.

Long-Term Preservation Measures

Current access to this historic property is off of a cane haul road that parallels Honoapi'ilani Highway on the *mauka* side. Long-term preservation measures for SIHP -4700 as outlined in the accepted archaeologocial preservation plan included the following (Olowalu Elua Associates 2002a):

Buffer (ft)	15
Buffer Markers	**Yes**
Signage	Yes
Preservation Type	Interpretive
Comment	Buffer boundary to be marked with pre-cased concrete blocks and hard plastic identification tags

At the time of the field inspection, it did not appear that the long term preservation measures had been implemented. The heavy vegetation in this area, however, may have obscured visibility and recognition of the buffer boundary markers and presence of identifying signage.

4.1.7.3 Recommendations

Based on the above findings the following recommendations are presented:

- Update of CAD drawing to include Feature J.
- Clarification of the proposed right of way and slope easements for the Honoapi'ilani Highway re-alignment to ascertain if Feature J will be adversely impacted by construction and consideration of re-design or minimization options.
- In the event that the proposed Honoapi'ilani Highway re-alignment will adversely impact Feature J, further consultation with SHPD and descendants and community of Olowalu Ahupua'a to revisit the archaeological inventory survey recommendation of data recovery (D. L. Fredericksen and Fredericksen 2000b:Table 4).
- Implementation of the long-term preservation measures for this historic property to include community consultation regarding the proper placement of the interpretive signage in the context of the proposed layout of the Honoapi'ilani Highway re-alignment and land use plans.

4.1.8 SIHP 50-50-08-4701

4.1.8.1 Current Condition

SIHP 50-50-08-4701 is a possible ceremonial structure, or *ko'a*, that consists of an irregularly shaped low-lying platform or paved area atop a ridge in the northwestern extent of the current project area. Construction integrity, cultural materials, heavy machinery impacts to the southeast portion of the site observed during the field inspection was consistent with the description provided in the archaeological inventory survey report for this section of the current project area (D. L. Fredericksen and Fredericksen 2000b:46). *Ili'ili* and coral fragments were also observed eroding downslope from this possible ceremonial structure.

At the time of the field inspection, SIHP -4701 was surrounded by ankle high, non-native grasses with patches of the same species of grass growing within the pavement (Figure 41). When verifying the site location during the field inspection, it was noted that the real-time position of this historic property appeared to differ slightly from the location indicated on the survey CAD map. The extent of the structure, or site boundary, was then collected as an area feature and GPS data post processed to within an average horizontal error of ±30 cm. Overlays show that the location of SIHP -4701 differs from that of the survey CAD map in both location and horizontal extent (Figure 42). Application of a 15 ft buffer (see Section 4.1.8.2 below) to the site boundary shows that the southwestern edge of the buffer and what appears to be the edge of the proposed realignment for the Honoapi'ilani Highway share a common boundary.

Finally, what appears to be a retaining wall (CSH-1) reinforcing the southern embankment and edge of a wash located approximately 6.5 m to the north-northwest of this historic property was also observed (see also Figure 42). Possibly associated with SIHP -4701, the material used

for construction of this retaining wall is similar to that of the *ko'a* and consists of roughly stacked medium to large subangular and angular bedrock cobbles (Figure 43 and Figure 44).

Figure 41. SIHP 50-50-08-4701. View to west-northwest.

4.1.8.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

No interim preservation measures were observed.

Long-Term Preservation Measures

Current access to this historic property is off of the cane haul road immediately *mauka* of Honoapi'ilani Highway. Long-term preservation measures for SIHP -4701 as outlined in the accepted archaeologocial preservation plan included the following (Olowalu Elua Associates 2002a):

Buffer (ft)	15
Buffer Markers	Yes
Signage	Yes
Preservation Type	Interpretive
Comment	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (Olowalu Elua Associates 2002a:11).

At the time of the archaeological field inspection, long term preservation measures had not been implemented.

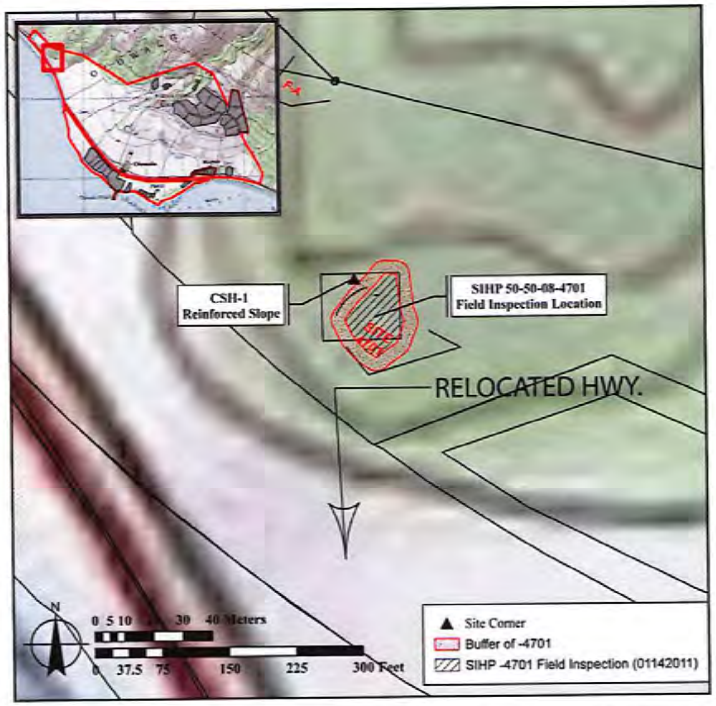

Figure 42. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4701 preservation area (white polygon) and outline (in black) as indicated on the survey CAD map in relation to the location recorded during the archaeological field inspection (shaded in black) and approximate 15 ft buffer.

Figure 43. CSH-1, close up showing construction material. View to west.

Figure 44. CSH-1 (foreground), showing relationship to the surrounding topography where ground slopes to the right of frame. View to west-southwest.

4.1.8.3 Recommendations

Based on the above findings the following recommendations are presented:

- Hand clearing of this historic property to determine the actual horizontal extent of the both the structure and associated cultural material scatter.
- Hand clearing of CSH-1 to determine the horizontal extent of this possible historic property that may be associated with SIHP -4701 and archaeological inventory survey level documentation of this feature.
- Update of the survey CAD drawing to include the revised boundary of SIHP -4701 and possible associated feature (CSH-1) with the addition of the 15 ft preservation buffer.
- Clarification of the proposed right of way and slope easements for the Honoapi'ilani Highway re-alignment to determine if there will be encroachment into the buffer area for this historic property and consideration of re-design options in the event that road construction would adversely impact the preservation area of SIHP -4701.
- Implementation of the long-term preservation measures for this historic property to include community consultation regarding the proper placement of the interpretive signage in the context of the proposed layout of the Honoapi'ilani Highway re-alignment and land use plans.

4.1.9 SIHP 50-50-08-4712

4.1.9.1 Current Condition

Located on the southwest slope of Pu'u Kilea, SIHP 50-50-08-4712 consists of a narrow terrace (Feature A) and small oval shaped mound representing a possible burial feature (Feature B) (Figure 45). At the time of the archaeological field inspection, the area in which this historic property is located was overgrown with knee to waist high grasses. While Feature A was re-identified (Figure 45), the small oval mound (Feature B) could not be re-located likely due to obscured visibility from dense vegetation growth. It appears that the current condition of SIHP -4712 Feature A is consistent with that of the original inventory survey.

4.1.9.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

No interim preservation measures were observed.

Long-Term Preservation Measures

Current access to this historic property is via an unimproved access road off of Luawai Road within Olowalu Mauka Subdivision. Long-term preservation measures for SIHP -4715 as outlined in the accepted burial and archaeological preservation plan included the following (E. M. Fredericksen and Fredericksen 2001; Olowalu Elua Associates 2002a):

Buffer (ft)	30
Buffer Markers	Yes
Signage	Yes
Preservation Type	Conservation

Comment	Boundary to be marked with pre-cased concrete blocks and hard plastic identification tags (Olowalu Elua Associates 2002a:11)

At the time of this field inspection, long-term preservation measures as indicated above, either in part or in full, were not observed at this historic property.

4.1.9.3 Recommendations

Based on the above findings, implementation of the long-term preservation measures to include community consultation regarding the proper placement of the interpretive signage in the context of the proposed plans for Olowalu Mauka and Olowalu Town (Figure 47), and establishment of the permanent preservation area boundary markers is recommended.

Figure 45. SIHP 50-50-08-4712 and southwest slope of Pu'u Kilea overview. View to north-northeast.

Figure 46. SIHP 50-50-08-4712, Feature A. View to east.

Figure 47. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4715 and -4715 location in relation to proposed plans for Olowalu Town (black lines), Olowalu Mauka Private Parcels (shaded gray), and archaeological site buffers (outlined in blue).

4.1.10 50-50-08-4715 (Pu'u Kilea Cemetery)

4.1.10.1 Current Condition

SIHP 50-50-08-4715 is a pre-contact to post-contact cemetery situated atop the summit of Pu'u Kilea (Figure 48) that consists of rock mounds, platforms, paved areas of *'ili'ili*, and upright stone burial markers along with several depressions (D. L. Fredericksen and Fredericksen

2000b:53). At the time of the field inspection, the cemetery area was overgrown with natal redtop and kiawe saplings. With regard to structural integrity of the burial markers, the condition of these features are likely similar to the condition observed during the original inventory survey. The only change noted was that the railroad rails that served as fence posts during the archaeological inventory survey (D. L. Fredericksen and Fredericksen 2000b:53) had been replaced with steel fence T-posts and straight wire.

4.1.10.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

No interim preservation measures were observed.

Long-Term Preservation Measures

Current access to this historic property is via an unimproved access road off Luawai Road within Olowalu Mauka Subdivision. Long-term preservation measures for SIHP -4715 as outlined in the accepted burial preservation plan included the following (E. M. Fredericksen and Fredericksen 2001):

Buffer (ft)	30
Buffer Markers	Yes
Signage	Yes
Preservation Type	Conservation
Comment	Landscape buffer; improved gate at the base of the old access road, signage to be placed in the vicinity of the USGS monument (E. M. Fredericksen and Fredericksen 2001:24).

While a large boulder, in lieu of a gate, had been placed at bottom of the cemetery access road to discourage vehicle traffic to the top of the *pu'u* (Figure 49), no signage denoting the presence of this historic property was observed and the landscaped buffer was not evident.

Figure 48. SIHP 50-50-08-4715 overview. Foot trail to cemetery from parking area left of frame, cemetery area center of frame, USGS monument located atop the ridge to the right of frame.

Figure 49. Base of access road to Pu'u Kilea Cemetery. View to west

4.1.10.3 Recommendations

Based on the above findings the following recommendations are offered:

- Consider installing a gate at the turn off of Luawai Road rather than at the base of the cinder access road to the summit as a means to deter vehicular traffic from entering the area.
- Consider moving the identifying sign location from the USGS monument to either the top of the cinder roadway leading to the summit of Pu'u Kilea or the trail head of the foot path into the cemetery as placement at the USGS monument would require walking through the cemetery to access it.
- Implementation of the long-term preservation measures to include community consultation regarding the above suggestion for placement of the interpretive signage in the context of the proposed plans for Olowalu Mauka and Olowalu Town (see also Figure 47) and regular maintenance of the landscaped buffer.

4.1.11 50-50-08-4718 (Walker Site 0005)

4.1.11.1 Current Condition

At the time of the archaeological field inspection, the remnant enclosing walls and interior area of SIHP 50-50-08-4718 was completely overgrown with non-native grasses and kiawe saplings while the surrounding area was dominated by open pasture (Figure 50) . The current condition of this historic property as a remnant of a *heiau* is consistent with the description provided in the archaeological inventory survey report (D. L. Fredericksen and Fredericksen 2000b:54) and although overgrown, the forms of the interior platform and terrace features are visible. Further examination of the GIS data shows that the *makai* or southern easment of the proposed realignment for Honoapi'ilani Highway as currently planned crosses the northernmost boundary of the proposed 100 ft. buffer zone (Figure 51, see also Section 4.1.11.2 below).

4.1.11.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

Interim protection measures to prevent cattle trampling of the enclosing walls for this historic property consisted of a well maintained fence around the edge of the structure comprised of steel T-Posts and barbed wire (Figure 52).

Figure 50. Overall condition and *mauka* view plane for SIHP 50-50-08-4718. View to north.

Figure 51. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4718 preservation area (outlined in blue) as indicated on the survey CAD map in relation to the proposed highway realignment.

Figure 52. SIHP 50-50-08-4718. View to northeast.

Long-Term Preservation Measures

Current access to this historic property is through a pasture gate and unimproved dirt road off of Luawai Road within the Olowalu Mauka Subdivision. Long-term preservation measures for SIHP -4718 as outlined in the accepted burial preservation plan included the following (E. M. Fredericksen and Fredericksen 2001):

Buffer (ft) 100
Buffer Markers Yes
Signage Yes
Preservation Type Interpretive
Comment Cinder path leading to a viewing platform overlooking the *heiau* for the general public (p.13); interior restricted to Native Hawaiian traditional cultural practices(p.12); Buffer markers to consist of a native hedge and/or boulders (p.13); design and implement drainage measures to divert runoff (p.13).

While preliminary planning for the location of the viewing platform had been in progress in November 2001 (Figure 53), at the time of the archaeological field inspection, the long term preservation measures had not yet been implemented.

Figure 53. Proposed view platform location at boulder push pile for SIHP 50-50-08-4718, November 2011, view to east (photo courtesy of Olowalu Town, LLC.)

4.1.11.3 Recommendations

Based on the above findings the following recommendations are presented:

- Clarification of the proposed right of way and slope easements for the Honoapi'ilani Highway re-alignment to determine if there will be construction encroachment into the buffer area for this historic property and consideration of re-design or minimization options in the event that road construction would adversely impact the preservation area (see also Figure 51).
- Additional community consultation with the lineal and cultural descendants of Olowalu Ahupua'a, as well as the designated caretakers of the heiau regarding the layout and design of both the pathway and viewing platform; as well as plant type for the native hedge or boulder alignment to serve as the buffer boundary.
- Implementation of the long-term preservation measures following consultation and design development for the preservation area to also include regular landscaping and vegetation maintenance within the constructed features of the heiau to prevent root displacement and further degradation of structural integrity.

4.1.12 50-50-08-4822 (Ka Loko o Kapa'iki)

4.1.12.1 Current Condition

SIHP 50-50-08-4822, the former location of Ka Loko o Kapa'iki (Figure 54 and Figure 55), currently functions as a drainage basin between the present alignment of Honoapi'ilani Highway and the access road to Kapa'iki Village (see also Figure 10). When examining the current built environment and proposed Olowalu Town plans in relation to the surveyed features of the 1881 Olowalu Sugar Plantation map (see Figure 54), it is clear that the present alignment of the

Honoapi'ilani Highway bisects the former pond. Currently, a proposed access road also bisects site in nearly the same location. At the time of the archaeological field inspection, the location identified as SIHP -4822 was heavily overgrown with mature kiawe, buffel, other non-native grasses, and a single palm (Figure 56 through Figure 58).

4.1.12.2 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

As the current alignments of Honoapi'ilani Highway and access roads to Kapa'iki Village serve as boundaries for this historic property, interim preservation measures are needed at this time.

Long-Term Preservation Measures

Current access to this historic property is via the current access road for Kapa'iki Village. Long-term preservation measures for SIHP -4822 as outlined in the accepted archaeological preservation plan consists of the following (Olowalu Elua Associates 2002a):

Buffer (ft)	0
Buffer Markers	No
Signage	Yes
Preservation Type	Interpretive
Comment	Bound by existing roads and maintained as a drainage basin by the State of Hawai'i.

At the time of the archaeological field inspection, signage indicating the former presence of Ka Loko o Kapa'iki was not observed at the former pond location.

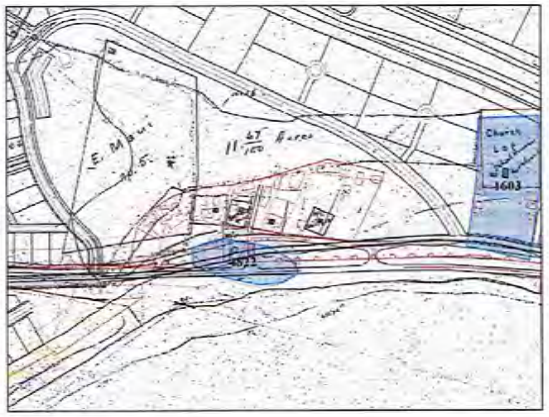

Figure 54. A portion of the 1881 Olowalu Sugar Plantation map (Monsarrat 1881) showing the former pond location and *kuleana* parcels of Kapa'iki Village in approximate relation to current historic property boundaries (shaded in blue), current built environment (outlined in red) and proposed Olowalu Town plans (outlined in black).

Figure 55. Ka Loko o Kapa'iki at Olowalu (foreground) and school house (middle ground) (Photo courtesy of Frampton and Ward, LLC.)

Figure 56. Current drainage basin in the former location of Loko o Kapa'iki. View to southeast.

Figure 57. Current drainage area in the former location of Loko o Kapa'iki. View to west.

Figure 58. Current drainage basin in the former location of Loko o Kapa'iki. View to northwest.

4.1.12.3 Recommendations

Based on the above findings the following recommendations are offered:

- Revisit the long-term preservation measures in consultation with the lineal and cultural descendants of Olowalu Ahupua'a, as well as SHPD in light of current land use plans.
- Re-examination of the alignment for the proposed access road to Kapa'iki Village along with consultation with the lineal and cultural descendants of Olowalu Ahupua'a regarding layout of the alignment in relation to Loko o Kapa'iki.
- Consultation regarding the proper placement of the interpretive signage in the context of the proposed plans for Olowalu Town.

4.1.13 50-50-08-4823

SIHP 50-50-08-4823 is a subsurface deposit of gleyed soils (D. L. Fredericksen and Fredericksen 2000b:58) located in the easternmost portion of the current project area. Originally, this historic property had been recommended for data recovery (D. L. Fredericksen and Fredericksen 2000b:Table 4) as pollen, phytolith, and carbon data which are helpful in understanding pre-contact climate, chronology, and land use patterns (D. L. Fredericksen and Fredericksen 2000b:69) are often preserved in such deposits. During the development of the *mauka* preservation plan, however, SIHP -4823 was scheduled for preservation (Olowalu Elua Associates 2002a:8) with long-term preservation commitments. Unfortunately, the subsurface nature of this historic property precluded a field inspection of current conditions. An examination of the GIS data however, shows a planned coastal access road off of the proposed Honoapi'ilani Highway realignment through the extent of SIHP-4823 as currently understood (Figure 59).

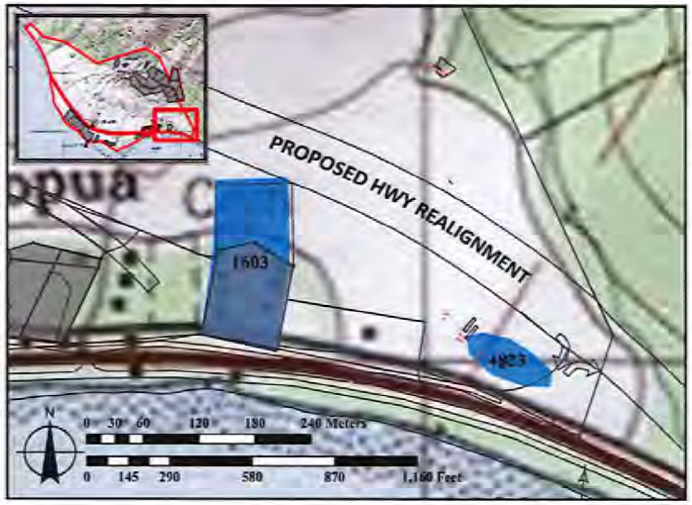

Figure 59. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing location of SIHP 50-50-08-4823 (shaded in blue) in relation to a proposed coastal access road (to the right of frame), private parcels not a part of the current proposed project shaded in gray.

4.1.13.1 Implemented Mitigation and Preservation Measures

Interim Preservation Measures

No interim preservation measures were observed.

Long-Term Preservation Measures

Long-term preservation measures for SIHP -4823 as outlined in the accepted preservation plan included the following (Olowalu Elua Associates 2002a:8):

Buffer (ft)	15
Buffer Markers	No
Signage	No
Preservation Type	Conservation
Comment	Originally intended for data recovery (D. L. Fredericksen and Fredericksen 2000b:Table 4); Olowalu Elua Associates, LLC opted to preserve the site with the caveat that data recovery would be left to the discretion and responsibility of the landowner.

4.1.13.2 Recommendations

Based on the above findings the following recommendations are presented:

- Examination of the proposed right of way, slope easements, and possible underground utility installation associated with the proposed coastal access road to determine if SIHP -4823 will be adversely impacted by construction and consideration of re-design or minimization options.
- In the event that the proposed coastal access road will adversely impact this historic property, further consultation with SHPD, as well as, descendants and community of Olowalu Ahupua'a to revisit the archaeological inventory survey recommendation of data recovery (D. L. Fredericksen and Fredericksen 2000b:Table 4).

4.2 Additional Field Observations within the Current Project Area

4.2.1 Previously Unrecorded Surface Scatters

During the field inspection, two areas of branch coral surface scatters (CSH-2 and CSH-3) were observed atop exposed bedrock approximately 17 m west and 60 m northwest of SIHP -4699 respectively (Figure 60 through Figure 62). The vegetation surrounding these surface scatters consisted of sparse patches of non-native grasses. A cursory inspection of the immediate surrounding area did not identify a clear source for the material and, while the presence of branch coral at formally constructed traditional Hawaiian historic properties is often associated with a ceremonial function, the informal nature of these features make an interpretation of possible function difficult at this time.

4.2.2 Previously Undocumented Historic Era Plantation Infrastructure

During the field inspection of SIHP -4718, a historic plantation-era reservoir (CSH-4) was identified approximately 100 m to the south-southwest (Figure 63). Overall construction of this reservoir consists of cut basalt brick and mortar on the interior (Figure 64) and large subrounded basalt boulders, both drystacked and mortared, on the downslope (southwestern) face of reservoir. The *mauka* or northeastern edge of the reservoir is flush with surface and bordered by a conctrete irrigation ditch. The surrounding vegetation consists of a ground cover of *'uhaloa* (*Waltheria indica*) and non-native grasses along with sparse occurences of koa haole. A review of the GIS data shows that the historic reservoir is located in an area that is currently planned for a traffic intersection managed by a round about (see also Figure 63). It should be noted that construction of this intersection as planned will adversely affect this historic property.

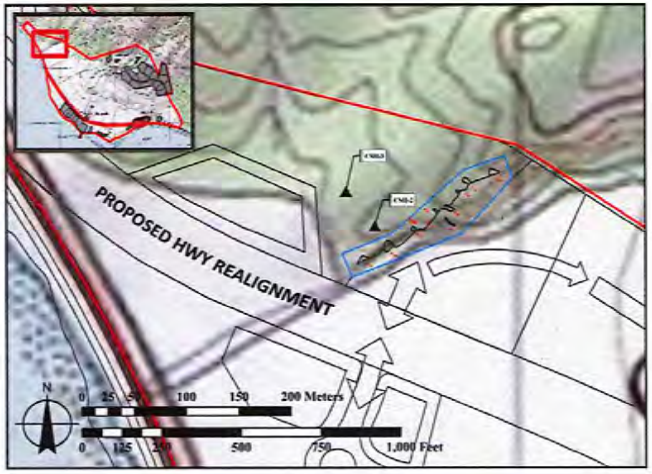

Figure 60. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing locations of branch coral scatters (CSH-2 and CSH-3).

Figure 61. Branch coral surface scatter (CSH-2). View to south.

Figure 62. Branch coral surface scatter (CSH-3). View to southeast.

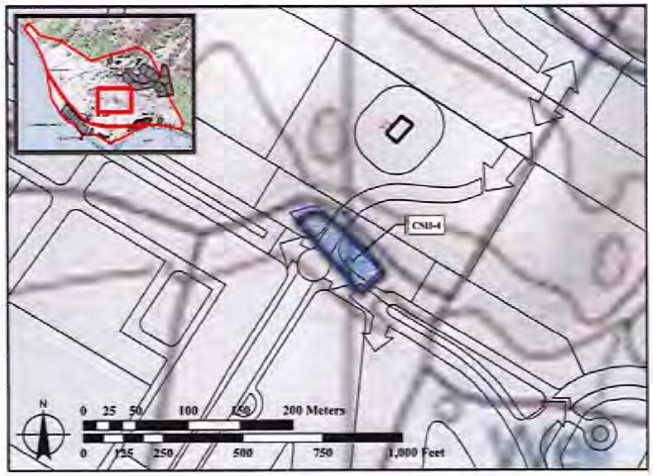

Figure 63. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the plantation-era reservoir (CSH-4).

Figure 64. Plantation-era reservoir interior. View to south.

4.2.3 Recommendations

With regard to the additional observations within the current project area, the following recommendations are offered:

- CSH-2 and CSH-3 – Branch coral surface scatters
  - Additional consultation with lineal and cultural descendants of Olowalu Ahupua'a to aid in understanding the traditional land use and possible relationship between the presence of these scatters in the context of the surrounding landmarks and adjacent historic properties.
  - Archaeological inventory survey level documentation of the newly identified cultural material scatters
- CSH-4 – Historic plantation reservoir
  - Consultation with SHPD – Architectural Branch regarding the documentation requirements of both CSH-4.
  - Consultation with the lineal descendants and community of Olowalu Ahupua'a with regard to potential preservation commitments related to historic plantation infrastructure.
  - Continued consultation with the Architectural Branch of SHPD regarding other previously unrecorded historic plantation infrastructure features within the current project area.

4.3 Observations Made During Review of GIS Data

During a review of the GIS data, an overlay of the proposed Olowalu Town plans shows that the anticipated Honoapi'ilani Highway re-alignment corridor, as well as residential development is planned within an area of former *kuleana* or Land Commission Award parcels (Table and Figure 65). Relatively recent archaeological testing within the fallow sugar cane fields along the Olowalu shoreline (D. L. Fredericksen and Fredericksen 2000a) and *mauka* areas of Waine'e Ahupua'a (E. M. Fredericksen and Fredericksen 2003) shows that historically significant and culturally sensitive subsurface historic properties have been identified in former *kuleana* parcels within and below the agricultural plow zone. Unfortunately, active sugar cane cultivation within the portion of the current project area *mauka* of the current Honoapi'ilani Highway alignment precluded archaeological subsurface testing at the time of the inventory survey. While the *mauka* portion of the current project area has already undergone an archaeological inventory survey (D. L. Fredericksen and Fredericksen 2000b) with mitigation commitments reviewed and approved by the State Historic Preservation Division (SHPD: LOG NO: 25237; DOC. NO: 0004RC1O), and aside from work to be conducted adjacent to historic property preservation areas, there is no archaeological monitoring provisions in place for ground disturbing activities. Considering the results of the GIS data review and in light of relatively recent subsurface archaeological findings in fallow sugar cane fields, consultation with SHPD with regard to archaeological monitoring during ground disturbing activities within the former *kuleana* parcels is recommended.

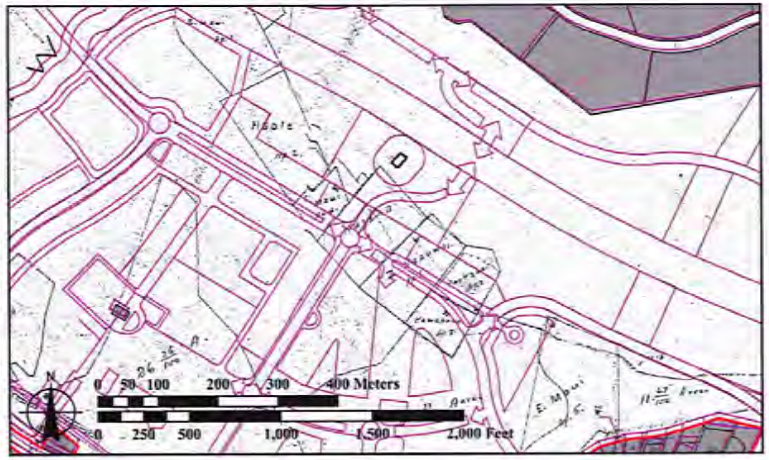

Figure 65. A portion of the 1881 Olowalu Sugar Plantation map (Monsarrat 1881) showing the *mauka kuleana* parcels in approximate relation to the proposed Olowalu Town plans (outlined in magenta).

Section 5 Summary and Conclusions

As mentioned in the preceding section (Section 4 Results of Field Inspection), the historic properties that were re-visited or re-examined for this study were limited to those properties located along the foothills and alluvial fan that comprises the topography of the current project area. Historic properties located within the Olowalu Cultural Reserve (OCR) as it encompasses Olowalu Valley were not examined as a part of this study. Overall, the current condition of previously recorded historic properties is likely similar to what was recorded during the recent archaeological inventory surveys of the current project area (D. L. Fredericksen and Fredericksen 2000a, b) and it is clear that efforts have been made toward protection of historic properties designated for preservation. Results of the field inspection show that while the majority of the long-term preservation measures have been at least partially implemented for historic properties identified within the *makai* portion of the current project area west of Honoapi'ilani Highway, long-term preservation measures for historic properties *mauka,* or east of the highway have not been implemented at this time (see Table 6). Additional field observations resulted in the identification of four previously unrecorded historic properties within the current project area. These included one possible retaining wall (CSH-1), two surface scatters of cultural material (CSH-2 and CSH-3), and one historic plantation-era reservoir (CSH-4). Further GIS work also showed the presence of former *kuleana* parcels within the Olowalu Town development area indicating a potential for the presence of undocumented and historically significant subsurface cultural deposits. Continued consultation with the lineal and cultural descendants of Olowalu Ahupua'a, as well as all branches of the State Historic Preservation Division in the context of the recommendations presented in the preceding section (Section 4 Results of Field Inspection) and implementation of all long-term preservation measures is advised.

Table 6. Summary of Field Inspection Findings

SIHP NO	Current Condition	Interim Preservation Measures	Long Term Preservation Measures	Comments
0004	Fair to Good	Partial	None	Remnants of orange temporary fencing observed; buffer encroachment along the northeastern boundary by adjacent land uses
1602	Remnant to Fair	Not Applicable	Implemented	
1603	Remnant to Fair	Not Applicable	Partially Implemented	Maintenance of church grounds continuous. Other elements of the long-term preservation plan not implemented.
4693	Overgrown	Not Applicable	Partially Implemented	Signage in place; no permanent buffer demarcation currently in place; buffer encroachment along the southeastern boundary by adjacent land uses
4694	Remnant to Fair	Not Applicable	Partially Implemented	Signage in place; no permanent buffer demarcation

SIHP NO	Current Condition	Interim Preservation Measures	Long Term Preservation Measures	Comments
4695	Good	Not Applicable	Partially Implemented	Signage not in place; a single concrete block and probable buffer marker was noted along the northwestern boundary
4700	Fair to Good	None	None	Feature J not accounted for on the CAD drawing
4701	Fair to Good	None	None	Potential new feature possibly associated with this historic property identified to the north-northwest
4712	Fair to Good	None	None	
4715	Fair	None	None	
4718	Remnant	None	None	Possible buffer encroachment along the northeastern boundary by the proposed realignment of Honoapi'ilani Highway.
4822	Overgrown	In Place	None	

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Appendix A Hawai'i Register of Historic Places Forms

SIHP 50-50-08-0004

SIHP 50-50-08-1200

SIHP 50-50-08-1602

SIHP 50-50-08-1603

ARCHAEOLOGICAL COVER SHEET

HAWAII REGISTER OF HISTORIC PLACES

OK

50 - 50 - 08 - ____ 4
1 2 3 4 5 6 7 8 9
SITE IDENTIFICATION NUMBER

2 1 PRE-1778
10 11 12 13 14 15 16 17 18 19 20
CARD No. DATE/PERIOD

SITE NAME/TYPE: KAWAIALOA HEIAU
DISTRICT: LAHAINA
AREA: 22 ~~square~~ ACRES s
CATEGORY: X Single Feature ___Complex ___Places
OWNERSHIP: ___Public X Private
PHOTOGRAPHS: X Yes ___No (Temp/Tech)
KNOWN PRESSURES ON SITE: NONE

PRESENT LAND USES: SUGAR CANE

DESTRUCTION: X No Known Future Danger ___Possible Future Danger ___Future Danger Certain ___Present Danger ___Presently Being Destroyed

STATUS: ___Occupied X Unoccupied CONDITION: ___Excellent X Good ___Fair ___Deteriorated

INTEGRITY: X Unaltered, Orig Loc ___Unaltered, Moved ___Altered, Orig Loc ___Altered, Moved

ACCESSIBILITY: ___Unrestricted X Restricted ___Inaccessible

LEGENDARY MATERIALS KNOWN: ___Yes X No WRITTEN HISTORICAL MATERIALS: ___Yes X No

IMPORTANCE AS EXAMPLE OF TYPE SITE: X Good ___Moderate ___Poor

SUSCEPTABILITY TO INTERPRETATION: X Good ___Moderate ___Poor

RESEARCH POTENTIAL: X Good ___Moderate ___Poor

LOCAL ATTITUDES ABOUT SITE: ___Valuable ___Moderate Value ___Low Value ___Ambivalent X Unknown

BRIEF DESCRIPTION (Columns 21-80): A LARGE HEIAU ON WEST MAUI IN A SUGAR CANE FIELD

STAFF EVALUATION: ___High Value X Valuable ___Reserve ___Marginal

SUGGESTED THEMES: POLYNESIAN HAWAII, RELIGION; DISPOSITION OF THE DEAD

DATE SUBMITTED TO REVIEW BOARD: ____

REVIEWER'S RECORD AND EVALUATION

NAME: ____ DATE REVIEWED ____

CATEGORY: ___High Value ___Valuable ___Reserve ___Marginal

SIGNIFICANCE: ___National ___State ___Local

RECOMMENDED DISPOSITION: ___Nominate National Register ___State Register ___Staff Files

RECOMMENDED THEMES: ____

REVIEWER'S COMMENTS: ____

REVIEW BOARD EVALUATION RECORD

DATE REVIEWED: ____ RECORDER: ____

OFFICIAL CATEGORY: ___High Value ___Valuable ___Reserve ___Marginal

OFFICIAL SIGNIFICANCE: ___National ___State ___Local

OFFICIAL THEMES: ____

OFFICIAL DISPOSITION: ___National Register Nomination ___State Register ___Staff Files

REVIEW BOARD COMMENTS: ____

VOTING RECORD: Daws ___ Hormann ___ Jackson ___ Kikuchi ___
Lind ___ Mark ___ Nagata ___ Paglinawan ___
Roche ___ Tuggle ___

ARCHAEOLOGICAL COVER SHEET

HAWAII REGISTER OF HISTORIC PLACES

0 - 50 - 08 - ____ 4
1 2 3 4 5 6 7 8 9
SITE IDENTIFICATION NUMBER

2 2 20TH CENT
0 11 12 13 14 15 16 17 18 19 20
RD No. DATE/PERIOD

SITE NAME/TYPE: ____
DISTRICT: ____
AREA: ____ square ____ s
CATEGORY: ___Single Feature ___Complex ___Places
OWNERSHIP: ___Public ___Private
PHOTOGRAPHS: ___Yes ___No (Temp/Tech)
KNOWN PRESSURES ON SITE: ____

RESENT LAND USES: ____

ESTRUCTION: ___No Known Future Danger ___Possible Future Danger ___Future Danger Certain ___Present Danger ___Presently Being Destroyed

TATUS: ___Occupied ___Unoccupied CONDITION: ___Excellent ___Good ___Fair ___Deteriorated

NTEGRITY: ___Unaltered, Orig Loc ___Unaltered, Moved ___Altered, Orig Loc ___Altered, Moved

CCESSIBILITY: ___Unrestricted ___Restricted ___Inaccessible

EGENDARY MATERIALS KNOWN: ___Yes ___No WRITTEN HISTORICAL MATERIALS: ___Yes ___No

MPORTANCE AS EXAMPLE OF TYPE SITE: ___Good ___Moderate ___Poor

USCEPTABILITY TO INTERPRETATION: ___Good ___Moderate ___Poor

ESEARCH POTENTIAL: ___Good ___Moderate ___Poor

OCAL ATTITUDES ABOUT SITE: ___Valuable ___Moderate Value ___Low Value ___Ambivalent ___Unknown

RIEF DESCRIPTION (Columns 21-80): ____

TAFF EVALUATION: ___High Value ___Valuable ___Reserve ___Marginal

UGGESTED THEMES: ____

ATE SUBMITTED TO REVIEW BOARD: ____

REVIEWER'S RECORD AND EVALUATION

AME: ____ DATE REVIEWED ____

ATEGORY: ___High Value ___Valuable ___Reserve ___Marginal

IGNIFICANCE: ___National ___State ___Local

ECOMMENDED DISPOSITION: ___Nominate National Register ___State Register ___Staff Files

ECOMMENDED THEMES: ____

EVIEWER'S COMMENTS: ____

REVIEW BOARD EVALUATION RECORD

ATE REVIEWED: ____ RECORDER: ____

FFICIAL CATEGORY: ___High Value ___Valuable ___Reserve ___Marginal

FFICIAL SIGNIFICANCE: ___National ___State ___Local

FFICIAL THEMES: ____

FFICIAL DISPOSITION: ___National Register Nomination ___State Register ___Staff Files

EVIEW BOARD COMMENTS: ____

OTING RECORD: Daws ___ Hormann ___ Jackson ___ Kikuchi ___
Lind ___ Mark ___ Nagata ___ Paglinawan ___
Roche ___ Tuggle ___

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE PARKS DIVISION

HAWAII REGISTER OF HISTORIC PLACES

ARCHAEOLOGICAL FORMS

FORM 0 1 / 1 2: FIELD SURVEY

12 — 4 CORNER

2 13 14 15 16 . 17 18 N. / 19 20 21 . 22 23 E.
SINGLE POINT COORDINATE LOCATION

54 (24 25)	5 (26)	3 (27)	22 (28 29 30)	1 (31)	10 (32 33)	61 (34 35)
DISTRICT	LOC	FACTOR	AREA SQUARE	CATEGORY	SIG 1	SIG 2

1 (36)	98 (37 38 39)	1 (40)	RDC (41 42 43)	05 (44 45)	08 (46 47)	73 (48 49)
DESTR	LAND CLASS	PHOTOS	INITIALS	INSTITUTION	MONTH	YEAR

HISTORICAL OR COMMON NAME: KAWAIALOA HEIAU (50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67)

541 (68 69 70) . 20 (76 77)	2 (78)	1 (79)	5 (80)
FEATURE CLASSIFICATION CODE	COND	INTG	PERIOD

CLASS: Nominated ___ Accepted ___ NRHP

Category A ___ B ___ C ___ HRHP

Keypunched

FORM 1 1 / 1 2: FOUR CORNER LOCATION

	QUAD	NORTH GRID COORDINATE	EAST GRID COORDINATE
NW CORNER:	12 13	2 14 15 16 17 . 18 19 N. /	20 21 22 . 23 24 E.
NE CORNER:	25 26	2 27 28 29 30 . 31 32 N. /	33 34 35 . 36 37 E.
SE CORNER:	38 39	2 40 41 42 43 . 44 45 N. /	46 47 48 . 49 50 E.
SW CORNER:	51 52	2 53 54 55 56 . 57 58 N. /	59 60 61 . 62 63 E.

ISLAND 50 - 50 (3 4) - QUAD 08 (5 6) - IDENTIFICATION NO. 7 8 9 10 11 4

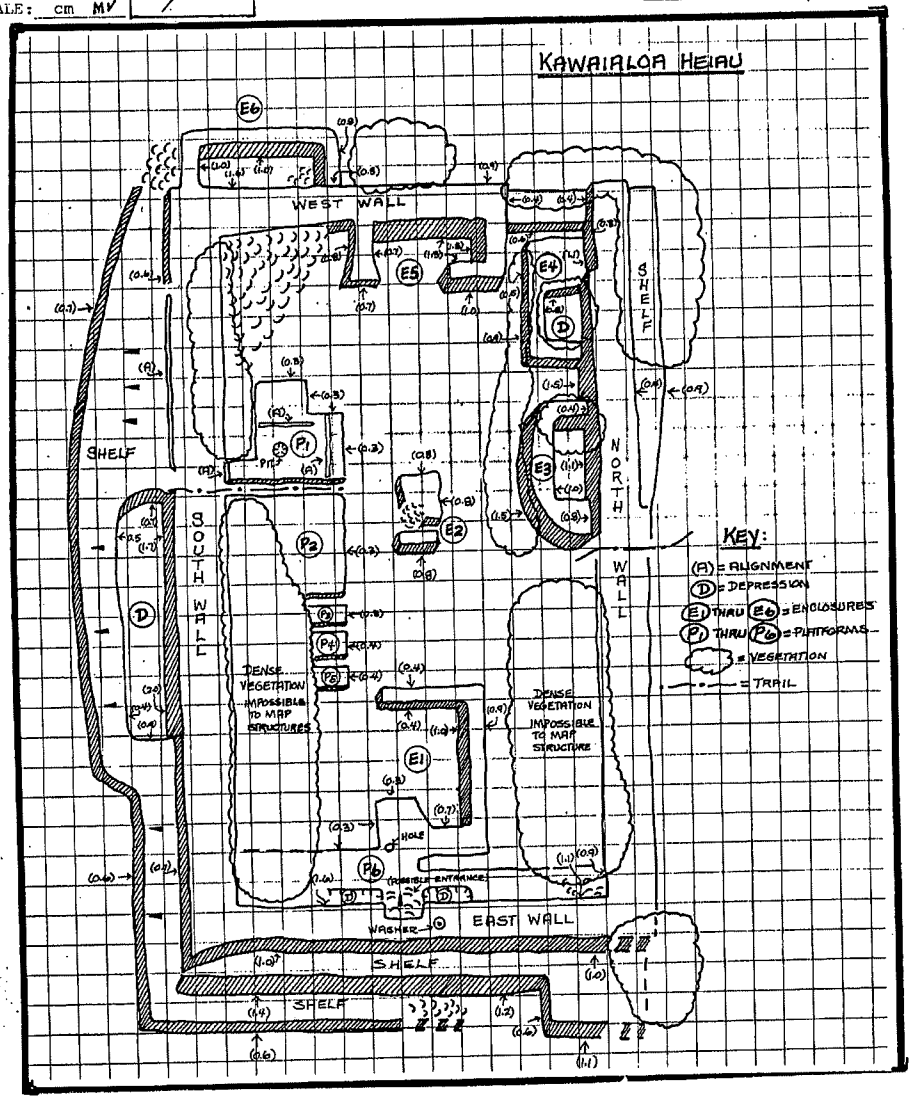
FEATURE MAP FORM

50-50-8-4

NORTH ARROW — TRUE NORTH

SCALE: 0 2 4 6 8 cm MV

MAPPING TECHNIQUE: 03



^^° 29' 30" N / 156° 36' 59"W.

FEATURE DESCRIPTION FORM

50 - 5 0 - 0 8 - _ _ _ _ 4
ISLAND QUAD IDENTIFICATION NO.

VERBAL DESCRIPTION MUST INCLUDE: bearings and sources used to locate feature; size; shape; construction technique; materials used; terrain features; condition; surface artifacts; midden. SIGNIFICANCE STATEMENT MUST INCLUDE: research potential; interpretive potential; unusual or important characteristics; probable function; importance as representative of its class; recommendation of Register status.

DESCRIPTION

This is known as Kawaialoa heiau. To reach the heiau we drove on Highway 30 past Maalaea toward Lahaina. Two cane roads before Olowalu, we turned inland and proceeded 0.6 mi through the cane fields to the site, which is on the left side of the road. It is in a natural area within the cane fields and is easily distinguishable. The heiau itself measures approximately 55 m x 39 m and is rectangular in shape. Among the features of this heiau are (1) walls, (2) shelves, (3) depressions, (4) enclosures, and (5) platforms. All of these features are discussed individually below. The heiau is mostly constructed of waterworn, reddish basalt boulders.

See Insert A below.

WALLS: All walls are constructed of reddish waterworn basalt boulders arranged in multiple-stacked construction.

N wall: The N wall measures approximately 51 m in length and approximately 3 to 4 m in width. Its average height is 1.3 m outside (from the top of the wall to the ground) and 1.3 m inside. These height readings are deceptive because the ground inland of the N wall slopes up and the interior of the heiau is too heavily overgrown to permit reading of the height. On the western portion of the wall is an external shelf which will be discussed later.

E wall: The E wall measures approximately 32 m long by 2.3 m wide and ranges in height along the interior from S at 1.6 m high to N at 1.1 m high. The height on the outside (from the top of the wall to the ground) ranges from 3 m on the S to 2.1 m on the N end. Along this wall run 2 external shelves which will be discussed later. This wall runs parallel to the cane road that passes the heiau. About midway in this wall is a short tumbled-down area leading into the interior which might have been the entrance into the heiau. Along the interior of this wall is a platform (6) with 2 depressions in it. The depressions are located on either side of the opening in the E wall.

S wall: The S wall is approximately 51 m long by 3.5 m wide. The interior height could not be ascertained because of the large quantity of haole koa* refuse in the interior of the structure. The exterior height is approximately 1.3 m from the ground. This wall, like the others, is quite well built; only on the western end is it broken down to a sloping pile of rocks, where it is hard to distinguish between the wall and the external shelf that runs along it. There are many internal features directly inland of this wall in the interior of the heiau but their outlines are obscured by the dense vegetative refuse which has been placed on top of them.

W wall: The W wall is approximately 31.5 m long by 2 to 3 m wide. Its internal height ranges from 1.3 to 0.6 m and its external height ranges from 1.6 m in the S to 0.5 m at the N end. This is the only wall without external shelves. It has an external enclosure on the S, and 2 internal enclosures use part of its wall for their boundaries.

Insert A

This site is located in the middle of a sugarcane field, so that the original environment has been completely obliterated, except the site itself, which is covered with haole koa.* The site is in relatively good condition and could easily be rebuilt for interpretation. No surface artifacts or midden were found by the inventory team.

*haole koa - (Leucaena glauca)

FEATURE DESCRIPTION FORM

50 - 5 0 - 0 8 - _ _ _ _ 4 - _ _ _ _
ISLAND QUAD IDENTIFICATION NO. FEATURE NUMBER

VERBAL DESCRIPTION MUST INCLUDE: bearings and sources used to locate feature; size; shape; construction technique; materials used; terrain features; condition; surface artifacts; midden. SIGNIFICANCE STATEMENT MUST INCLUDE: research potential; interpretive potential; unusual or important characteristics; importance as representative of its particular class; probable function; recommendation for Register status.

Page 2

SHELVES: Like the walls, all the shelves are built of reddish basalt waterworn boulders, and are of multiple-stacked construction. There are 4 external shelves surrounding this heiau. One along the N wall is 22 m long, 1 to 2 m wide, and 0.9 m high, and one along the S wall is 56 m long, 2 to 6 m wide, and from 0.6 to 1.3 m in height. In this shelf is a depression 16 m x 3 m. It is devoid of any rocks and has haole koa growing in it. A trail from the interior of the heiau leads into it. The function of this depression is unknown. The E wall has 2 external shelves. One is 32 m long by 1 m wide with a 4 m wide portion at the N end. The other shelf is 17 or 18 m long and disappears into rubble at the NE end.

External Enclosure #6: This is the only external feature yet to be discussed and it is located at the southern portion of the W wall. It is 10 m long by 4 m wide, and 1 to 1.6 m high inside, and 0.8 m high on the outside. The outside measurement is approximate because of rubble. No midden or artifacts were found in this enclosure.

INTERNAL FEATURES

PLATFORMS:

Platform #1: Measures approximately 8 m x 8 m and is only about 0.3 m high. On this platform, 2 easily distinguishable rock alignments can be seen. The function of these rock alignments could not be determined without excavation of this area. Also in the middle of this platform is a pit which is about 1 m in diameter and 1 m in depth. This pit might have been dug by pot hunters. The pit also looks as if it might have been a collapsed man-made chamber. This platform is paved with fist-sized rocks and is quite uniformly flat.

Platforms #2, 3, 4, and 5: These platforms were described by W. Walker (1931) as burials. Walker did not give any evidence in support of his assertions and apparently did not excavate these sites. Excavation of the mounds would be necessary to determine whether these are in fact burials.

Platform #6: This platform runs along the length of the E wall. It is approximately 25 m long and varies in width from 2 to 3.5 m. This platform also adjoins enclosure #1 and forms its E wall. This platform has 2 depressions in it on either side of what

(continued)

SIGNED Robert D Cassidy Jr
ARCHAEOLOGIST

DATE Oct 28, 1973

FEATURE DESCRIPTION FORM

50 - 5 0 - 0 8 - 4 -
ISLAND QUAD IDENTIFICATION NO. FEATURE NUMBER

VERBAL DESCRIPTION MUST INCLUDE: bearings and sources used to locate feature; size; shape; construction technique; materials used; terrain features; condition; surface artifacts; midden. SIGNIFICANCE STATEMENT MUST INCLUDE: research potential; interpretive potential; unusual or important characteristics; importance as representative of its particular class; probable function; recommendation for Register status.

appears to be an opening in the E wall. This opening appears to come over and down the E wall and down onto the platform. In this platform near the enclosure is a hole that looks as if it might be a post hole. This platform is near the N wall and overgrown with haole koa near the S wall.

ENCLOSURES:

Enclosure #1: This enclosure uses part of platform #6 as one of its 3 walls. It is approximately 6.5 m x 11. 4 m and varies in height from 0.3 m to 1 m. This enclosure is probably the biggest internal structure in this heiau. Its walls are well constructed with large, reddish, waterworn boulders as is every other structure in the heiau.

Enclosure #2: This structure, according to Walker (1931), is a C-shape. The inventory team found in its place a mound and a wall but with considerable fall so that it might have once been a C shape. The wall and the mound measured together are 4.5 m x 3.75 m and are about 0.8 m high. The amount of rubble does suggest more construction than is presently there.

Enclosures #3 and 4: Both these enclosures are located along the N wall in the western half of the heiau. Both measure about 9 m long by 3.5 m wide, and vary greatly in height because of the unevenness of the ground. No entrances to these enclosures are visible. The function of these structures is unknown.

Enclosure #5: Walker recorded this structure as completely enclosed but we observed that it is in actuality not. The enclosure uses the W wall for one wall and has a wall on the S, 4.5 m long. There is also a N wall of the same length but the E wall is only about 4 m long. There is, therefore, an opening of 5 m in the E wall since the enclosure utilizes 10.5 m of the W wall. The walls vary from 1 m to 1.8 m in thickness and wall heights vary from 0.7 to 1.5 m. Walker also mentions 2 pavements in this area, but these were not observed by the inventory team.

Enclosure #6: This was discussed earlier, under W wall.

SIGNIFICANCE: This site offers a number of good research possibilities. First, the platforms in the interior of the heiau should be excavated to determine whether they are burials. This would affect the interpretive potential of the site. Second, the numerous interior and exterior features could be excavated in order to determine their

SIGNED Robert D. Conroy III DATE Oct. 28, 1973
ARCHAEOLOGIST

FEATURE DESCRIPTION FORM

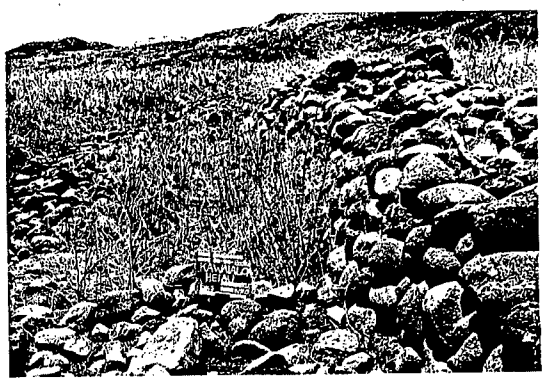
50 - 5 0 - 0 8 - 4 -
ISLAND QUAD IDENTIFICATION NO. FEATURE NUMBER

VERBAL DESCRIPTION MUST INCLUDE: bearings and sources used to locate feature; size; shape; construction technique; materials used; terrain features; condition; surface artifacts; midden. SIGNIFICANCE STATEMENT MUST INCLUDE: research potential; interpretive potential; unusual or important characteristics; importance as representative of its particular class; probable function; recommendation for Register status.

function. The interpretive potential of this site is very high for a number of reasons. First, it is an interesting and complex structure and is still in good condition. Litle restoration would be needed to put it into excellent condition. The heiau has an excellent view of the Island of Lanai. The site is also easily accessible from a well-traveled road (Highway 30), the road from Maalaea to Lahaina.

The possible graves in this site, as they are not part of a recognized cemetery, limit the interpretive potential and should be accorded legal protection.

The overall good condition of the site, despite the occasional tumbled walls, and the high research potential combine to convince the inventory team to recommend Valuable status, State Register.



KAWAIALOA HEIAU; SOUTH EXTERIOR ENCLOSURE

SMa(a)48-3

SIGNED Robert D. Conroy III DATE Oct. 28, 1973
ARCHAEOLOGIST

9

10

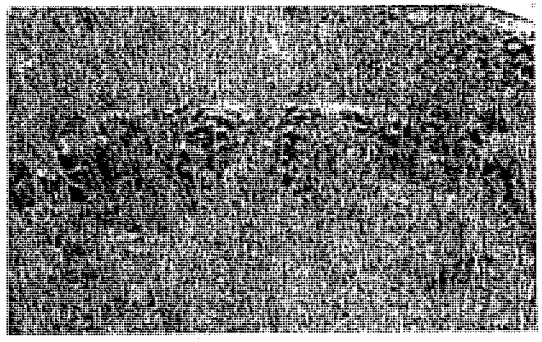
...TURE DESCRIPTION FORM

50 - 5 0 - 0 8 - _ _ _ _ 4
ISLAND QUAD IDENTIFICATION NO.

VERBAL DESCRIPTION MUST INCLUDE PERTINENT DATA ON: bearings and sources used to locate feature; terrain and vegetation; size; shape; construction technique; materials used; condition; surface artifacts or midden visible. SIGNIFICANCE STATEMENT MUST INCLUDE: unusual or important characteristics; accessibility; interpretive and research potential; evaluation of the site's importance as a representative of its class; recommendations for register category.

KAWAIALOA HEIAU;
Interior Enclosure, NW Corner

SMa(a)48-6



KAWAIALOA HEIAU;
Interior Enclosure by E Wall.

SMa(a)48-10

KAWAIALOA HEIAU;
Interior, W Wall

SMa(a)48-11

SIGNED:

DATE:

FORM 3 1: PROPERTY OWNERSHIP

50 - 5 0 - 0 8 - _ _ _ _ 4
ISLAND QUAD IDENTIFICATION NO.

1 1 (12 13) USE 1; _ _ (14 15) USE 2; 2 (16) STAT; 2 (17) OWNR; 1 (18) ATTD; 2 (19) ACCS; 4 (20) zone; 8 (21) sect — TAX; _ 0 3 (22 23 24) plat — MAP; _ 1 0 (25 26 27) parcel — KEY

PROPERTY OWNER: P I O N E E R _ M I L L _ C O _ (28–45)

STREET ADDRESS: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ (46–63)

TOWN OR CITY: L A H A I N A _ _ _ (64–73) H I (74 75) STATE; 9 6 7 6 1 (76–80) ZIP CODE

FORM 4 1: BACKGROUND DATA

50 - 5 0 - 0 8 - _ _ _ _ 4
ISLAND QUAD IDENTIFICATION NO.

AHUPUA'A: O L O W A L U _ _ _ _ _ _ _ _ _ _ _ _ _ (12–26)

PREVIOUS SURVEYS: A R C H A E O L _ O F _ M A U I _ _ _ (27–44)

PREVIOUS SITE DESIGNATION(S): M A - D 2 - 1 _ _ 4 _ _ _ _ _ _ _ _ _ _ _ (45–62)

LAST NAME OF SURVEYOR: W A L K E R _ _ _ _ _ _ _ _ _ _ _ (63–74)

0 5 (75 76) INSTITUTION; 3 1 (77 78) YEAR; 0 6 (79 80) FILED AT

FORM 51

50 - 50 - 08 - 4

1/10 CARD 1/11 NO

SITE NAME/TYPE (Columns 12-43) KAWAIALOA HEIAU

DISTRICT (Columns 44-55) LAHAINA

AHUPUA'A (Columns 56-80) OLOWALU

PREVIOUS SITE NUMBER(S) MA-D2-1 ; 4 NUMBER SYSTEM BISHOP ; WALKER

BACKGROUND DATA

Source	Volume	Page(s)
75975		108
9025		Ma-D2-1

CONDITION DATA

Extent of Destruction

Agent of Destruction

Destruction Reported by (Source/Page)

Date Reported

PROCESSING CHECKLIST

	DATE	INITIALS		DATE	INITIALS
Literature xeroxed	10/20	MJ	Form 31 complete	10/25	DK
Field Map plot	6/7	SDC	Form 41 complete	10/25	DK
Final Mylar plot			Supplementals complete		
Final ink sketch(es)	10/23	JAF	Checked	10/28	LMP
Statement drafted	10/19	SDC	To typist	10/26	LMP
Cover sheet complete	10/20	LMP	Typing complete	10/25	DK
Form 01/11 complete	10/20	SDC	Typing proofed	10/26	LMP
Form 21 complete			To xeroxing		
			Xeroxing complete		

DISPOSITION

3/10 CARD 1/11 NO

10 / 61 / 65 / 12 13 / 14 15 / 16 17 / 18 19 / 20 21 / 22 23 / 24 25 26 27 28 , 19 29 30 THEME (S) TO REVIEW BOARD

31 32 33 34 35 , 19 36 37 REVIEWED

STATE CATEGORY 38 SIG LEVEL 39 NAT'L REG NOM 40

41 42 43 44 45 , 19 46 47 TO TRUSTEES

48 49 50 51 52 , 19 53 54 TO STATE LIAISON OFFICER

55 56 57 58 59 , 19 60 61 TO NATIONAL REGISTER

62 63 64 65 66 , 19 67 68 NATIONAL REGISTER ACTION

NRHP DISPOSITION: 69 OK 70 NO 71 RET

9025 Ma-D2-1 50-50-08-4

Site: Ma-D2-1 State: 50-50-8 Kaiwaloa heiau 4 Kawaialoa Walker Date:

Land: Olowalu, Lahaina

TMK: 4-8-03

Owner:

General Survey x Excavation Artifacts HHD- HRC-

Description: Large walled heiau in good condition on the rising ground S of Kilea Hill above the ditch. Several low terraces and enclosures inside. Rough red vesicular basalt used in construction.

Sources: Walker, Site 4 p. 108
Stokes, 4,5; cf. Thrum Stokes Kawaialoa

Photos: Color Eips
B/W

Geographic coordinates latitude 20-49-26 longitude 156-36-56

USGS Quadrangle Olowalu

Bishop Museum

1000 Meter Grid N/ E

UNISORT ANALYSIS CARD FORM Y2 BURROUGHS CORPORATION - TODD DIV. - L HADLEY PRINTED IN U.S.A.

50-50-08-4 12

LAHAINA DISTRICT 50-50-08-4 108

Olowalu Region 75975 Walker 1931:108

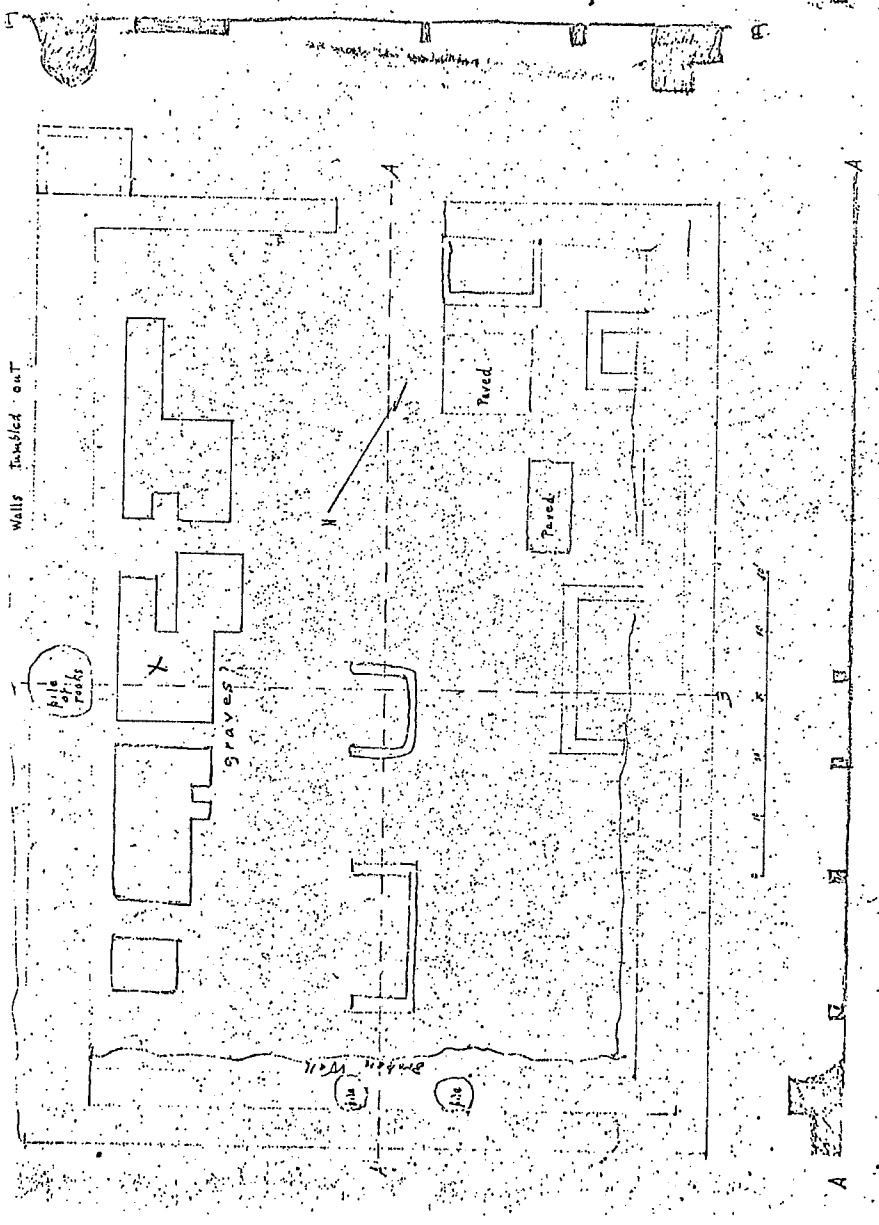
D2-1 Heiau Sites D2-1, D2-3

Name: Kawaialoa

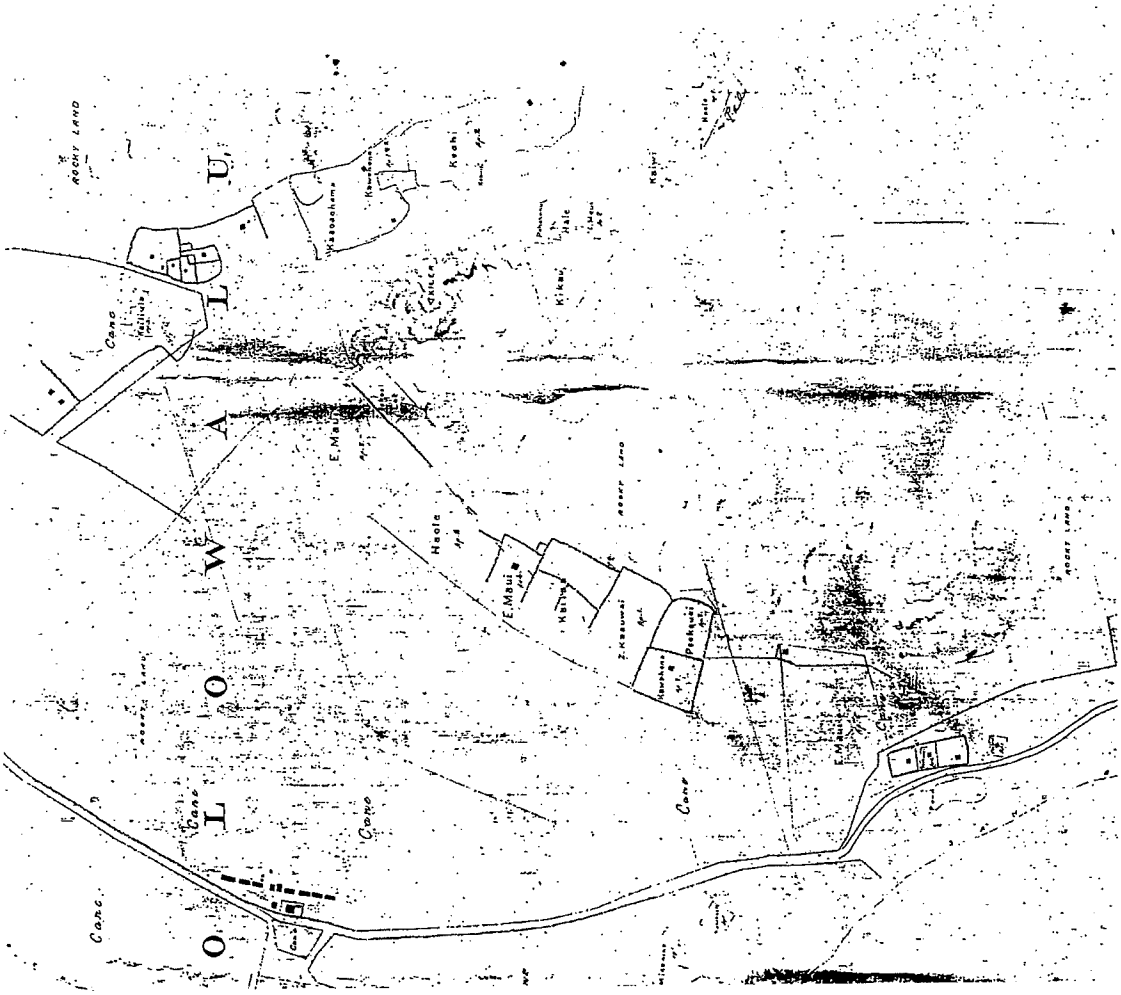
Location: On the rising ground south of Kilea Hill above the ditch.

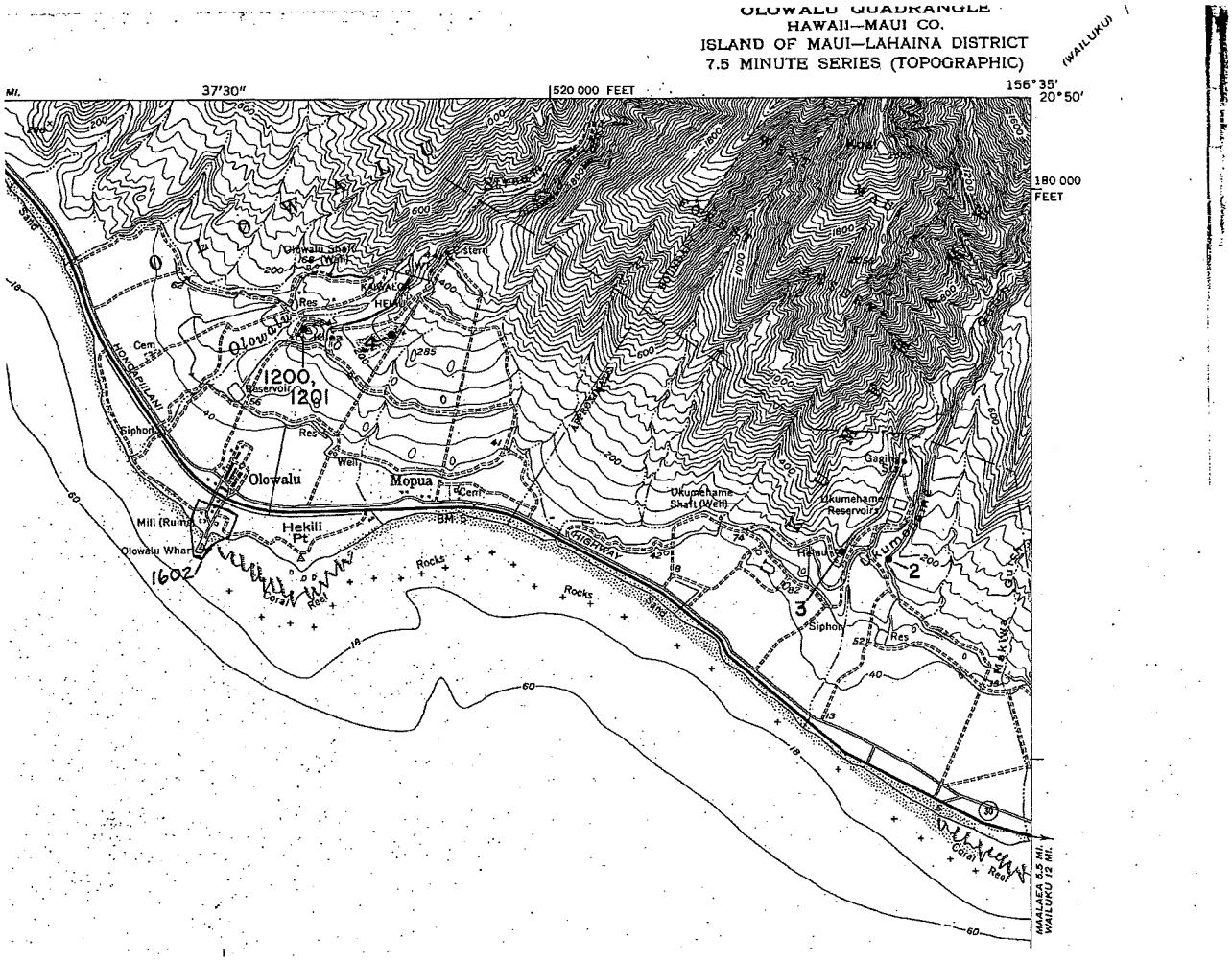
Description: A large walled heiau in good condition. It measures 156 x 110 feet. The walls range in thickness from 8 1/2 feet on the west to 12 feet on the south and east where it is composed of two terraces. The highest part is 10 feet high. The north wall is lower and ranges from 5 to 8 feet thick. Several low terraces and enclosures are found inside. The low platforms in the western part are probably graves of recent date. The entrance evidently was at the north. At a point on the west wall and at two points on the south wall are piles of stones cone-shaped whose use or purpose could not be determined. Rough red vesicular basalt is the material used in the heiau construction and no coral is found. No artifacts were found there. (Fig. III, fig. 4)

75975 WALKER 1931 fig 4 50-50-08-4



10/1/71
X "caved in" hole
2" x 3" x 2"


OLOWALU
Rocky Land
Cane
Haole
E. Maui
Kaihu
Cane


OLOWALU QUADRANGLE
HAWAII—MAUI CO.
ISLAND OF MAUI—LAHAINA DISTRICT
7.5 MINUTE SERIES (TOPOGRAPHIC)
(WAILUKU)
MI.
37'30"
520 000 FEET
156°35'
20°50'
180 000 FEET
Olowalu Shaft (Well)
Estate
KAWALOA
HEIAU
Res
Olowalu
Kilns
1200,
1201
Reservoir
Cem
HOUOPILANI
Siphon
Res
Well
Olowalu
Mopua
Cem
Mill (Ruins)
Olowalu Wharf
Hekili Pt
BM 3
1602
Rocks
Coral Reef
Rocks
HIGHWAY
Ukumehame Shaft (Well)
Ukumehame Reservoirs
Gaging Sta
Heiau
Siphon
Res
UKUMEHAME
MAKUA
MAALAEA 5.5 MI.
WAILUKU 12 MI.

DR. BOYD DIXON
2065 Lanihuli Dr., Apt. U-8
Honolulu, HI 96822

UNIVERSITY OF CALIFORNIA

Los Angeles

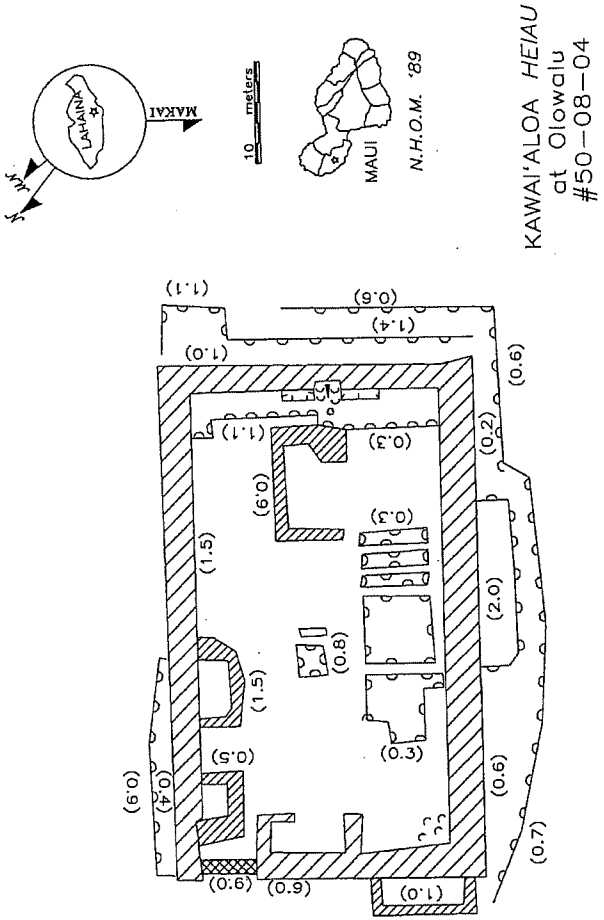
Social Power, Chiefly Authority, and Ceremonial Architecture, in an Island Polity, Maui, Hawaii

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Anthropology

by

Michael John Kolb

1991



1/22/02

Olowalu Elua Associates, LLC

ARCHAEOLOGICAL PRESERVATION PLAN

Mauka Portion (Phase 2)
Olowalu Ahupua'a, Lahaina District, Maui Island
TMK 4-8-3:10, 50-82;
TMK 4-8-4:11-16

January 2002 (1st revision)

Prepared by:

OLOWALU ELUA ASSOCIATES, LLC

173 Ho'ohana Street, Suite 201

Kahului, Hawai'i 96732

(808) 877-4202

SITE IDENTIFICATIONS PROPOSED MITI

SIGNIFICANCE EVALUATION		STATUS	CONDITION	ICF	
SHPD SITE #50-50-06-[illegible]	NRS criteria	Ethnohistoric	Fair	Individuals	
		A-Archaeological	P-Poor	N-Unknown	PROPOSED
4[1]	C, D, E	*heiau*	U	G	—	Prese
1200	C,D,E	Petroglyph panel	A	F	—	Prese
1201	D	Temporary habitation	A	F	—	Preservation as
1603[1,2]	D,E	Burial; religious	A	F	H	Prese
3172	D	Irrigation system	U	G	H	Preservation as an o
3180	NLS	Historic wall	A	G	H	N
4699[1]	D, E	Temporary habitation; burial	Varies	G	I/H	Prese
4700	D	Temporary habitation	U	G	—	Prese
4701	D,E	Ceremonial/habitation	A	P	—	Prese
4702	NLS	Boundary wall	A	G	?	N
4703	NLS	Temporary habitation	A	Varies	?	N
4704	C,D,E	Petroglyph panel; irrigated agriculture	U	G	—	Prese
4705	D	Temporary habitation	U	G	—	Prese
4706	D	Temporary habitation	U	G	—	Prese
4707[1]	D,E	Burial, wall marker	A	F-P	—	Prese
4708	D,E	Ceremonial/religious	A	G	I/H	Prese
4709	C,D	Irrigation system	A	G	H	Preservation as an o
4710[1]	D,E	Permanent habitation	A	G-F	—	Prese
4711	NLS	Agricultural terrace	U	G-P	—	N
4712[1]	D,E	Possible burial	A	F	—	Prese
4713	D	Temporary habitation	U	G	I/H	Prese
4714	D	Temporary habitation	U	G	—	Prese
4715[1]	D, E	Cemetery	U	G	I/H	Prese
4716	D	Habitation	A	F-G	I/H	Prese
4717	NLS	Flood control walls	U	G-P	H	N
4718[1]	C,D,E	*heiau*	A	FP	—	Prese
4719	NLS	Boundary wall	A	P	H	N
4720	NLS	Road crossing	A	G	H	N
4721	NLS	Permanent habitation	A	F	H	N
4758[1]	D,E	Cemetery	A	F	H	Prese
4820[1]	D,E	Remnant of burial	A	P	—	n
4821[1]	D,E	Remnant of burial	A	P	—	n
4822[3]	D	Pond Remnant	A	P	I/H	Prese
4823	D	Marsh/lagoonal soils	U	G	I/H	Prese

[1] *The preservation of this site or burial feature(s) within this site was approved by the Maui/Lana'i Islands Burial Council (see Appen*

[2] *Site 1603 (stone church) is on an adjoining parcel (TMK 4-8-03:18). The coffin burial inadvertently discovered is assumed associa toward the location of the coffin burial. The preservation area around this burial is the original church boundaries.*

[3] *Site 4822 is bordered by the Honoapiilani Highway, two highway accesses, and an existing service road. The State of Hawaii mai*

BACKGROUND RESEARCH SUMMARY

Xamanek Researches conducted an archaeological inventory survey of the 661--acre mauka portion of the Olowalu ahupua'a. The fieldwork was conducted in late 1998 and early 1999 and consisted of an intensive pedestrian survey, extensive backhoe trenching, and limited subsurface testing.

A total of 34 sites were identified during the inventory survey. Of these, six had previously been recorded and numbered (Sites 04, 1200, 1201, 1603, 3172, 3180). The only sites not additionally described here are Site 3172, a plantation-era concrete irrigation ditch; and Sites 1200 and 1201, which were recorded in a 1973 survey, and are discussed in the Archaeological Inventory Report associated with this Preservation Plan.

Twenty-one of the sites are interpreted as precontact cultural resources. There are 52 recognizable features associated with these 21 sites. These features include structures or areas for religious purposes, petroglyphs panels, burials, permanent and temporary habitation shelters, agricultural features, boundary walls, boundary markers, a pre-contact fishpond and subsurface marsh soils.

Nine of the sites are interpreted as historic sites associated with the Plantation Era. Features include a boundary marker, a habitation platform, features associated with sugar cane agriculture activity and cemeteries or burial features. The other sites have both a pre-contact and historic context.

During its regular meeting held on November 30, 2000, the Maui/Lana'i Islands Burial Council approved the Burial Treatment Plan for the burial features within the mauka lands. At its regular meeting held on February 22, 2001, the Maui/Lana'i Islands Burial Council approved a Burial Preservation Plan for all burial features or sites within the mauka lands.

In summary, of the 34 sites identified during the inventory survey, 8 were deemed "no longer significant" and 2 of the sites are plantation irrigation systems currently being used, and therefore no mitigation measures are proposed for those sites. Seven of the remaining 24 sites are solely burial sites, and the preservation plans for these sites were approved by the Maui/Lanai Island Burial Council (MLIBC). This plans addresses the remaining 17 sites, 4 of which have burial features within a larger site whose preservation measures for the burial features were approved by the MLIBC.

LONG-TERM PRESERVATION MEASURES

SHPD SITE #50-50-08	FUNCTION	FLUSHED CUT	PLATFORM	MARKERS
4*	*heiau*	Yes	No	Yes
1200[2]	Petroglyph panel	Yes	No	No[2]
1201[2]	Temporary habitation	Yes	No	No[2]
1603*	Burial; religious	Yes	No	No
3172[1]	Irrigation system	Yes[1]	No	No
4699*	Temporary habitation; burial	Yes	No	Yes
4700	Temporary habitation	Yes	No	Yes
4701	Ceremonial/habitation	Yes	No	Yes
4704	Petroglyph panel; irrigated agriculture	Yes	No	Yes
4705	Temporary habitation	Yes	No	Yes
4706	Temporary habitation	Yes	No	Yes
4707*	Burial, wall marker	Yes	No	Yes
4708	Ceremonial/religious	Yes	No	Yes
4709[1]	Irrigation system	Yes[1]	No	No
4710*	Permanent habitation	Yes	Yes	Yes
4712*	Possible burial	Yes	No	Yes
4713	Temporary habitation	Yes	No	Yes
4714	Temporary habitation	Yes	No	Yes
4715*	Cemetery	Yes	No	Yes
4716	Habitation	Yes	No	Yes
4718*	*heiau*	Yes	Yes	Yes
4758*	Cemetery	Yes	No	Yes
4820*	Remnant of burial	N/A	N/A	N/A
4821*	Remnant of burial	N/A	N/A	N/A
4822[3]	Pond Remnant	No[3]	No	No[3]
4823	Marsh/lagoonal soils	No	No	No

1. Site 3172 and portions of Site 4709 are currently being maintained as an operating water distribution system (from stream water) to service existing agricultural pursuits within the project area. Should all or a part of the system be abandoned or damaged beyond repair, the applicant will cease to maintain that portion of the water system.

2. The size and breadth of these sites (1200 & 1201) would make it difficult to place markers that would have any relevance.

3. Site 4822 (pond remnant) is being maintained by the State of Hawaii (Highways Division) as a drainage basin. The fact that it is surrounded on all sides by road right of ways makes markers somewhat irrelevant.

*Burial features (See Appendix A)

SIGNAGE TEXT

Introductory sign: Olowalu Ahupua'a Olowalu was a land unit (ahupua'a) before Europeans arrived in the islands. Archaeologists believe that Olowalu could have been permanently occupied as early as the A.D. 900s-1000s. Its residents were part of the district (moku) of Lahaina, which was part of a larger kingdom on Maui beginning in the A.D. 1300s-1400s. In 1795, the Maui Kingdom was defeated in battle by Kamehameha's Hawaii Kingdom, and all the Maui lands became part of the Hawaii Kingdom.

The ahupua'a of Olowalu ran from the shoreline to the top ridges of West Maui Mountains and provided the community of Olowalu with all the resources necessary for living. Water resources were managed for drinking, bathing and irrigation. Wild and cultivated plants provided food, clothing, canoes, weapons and many other products.

The people and land of Olowalu were linked to other communities of the Maui Kingdom by trails. A costal trail near today's highway once led on to Lahaina and on around the island. Little known today, another major trail led up Olowalu Valley into and across the West Maui Mountains into Iao Valley in the Wailuku ahupua'a.

Olowalu is characterized by four main topographic zones-the flat coastal plain, the dry gradual slopes extending up to the base of the steeper West Maui Mountains, the narrow Olowalu stream floodplains and the narrower and wetter upper valley floor and ridges within West Maui Mountains. Generally, each zone had a primary function to the community depending on its natural attributes. The coastal plains acted primarily as houselots, although temporary and permanent habitation sites could be expected in all the topographic zones. The dry gradual slopes provided kula (farm) lands for crops such as u'ala (sweet potato). The wetter upper valley floor and the lower stream floodplains to a lesser extent, provided kalo (taro) for sustenance. The forest of the upper valley also provided trees for canoes and other woodcraft products.

Unfortunately, 100 + years of sugar cultivation destroyed many of the pre-contact and historic cultural sites. What sites are available today however, do provide a glimpse into the community of pre-contact and historic Olowalu. Evidence of temporary and permanent habitation sites were located along the shoreline, the stream and along the natural rock cliffs. Burials were noted in the three (3) known cemeteries of Olowalu, however, the *kanaka maoli* were also known to bury their family members near their homesites. Surface scatters of human remains that were found in a couple sugarcane fields seem to substantiate this practice. Evidence of irrigated fields for kalo (taro) along the Olowalu streambed and a fishpond near the shoreline used for fish cultivation validate agricultural components of community life in pre-contact times. Lastly, religious components are evident in the three (3) heiau (temple) sites and several habitation sites.

While these sites are probably only a portion of what was here, these existing sites confirms the existence of a thriving community at Olowalu. The upper valley of Olowalu has yet to undergo archaeological survey, but because no major mechanized agricultural operation like sugarcane existed in the upper valley, it is expected that archaeological ruins such as irrigated kalo (taro) fields and habitation sites should be numerous.

Site 04: Large Heiau This large heiau (temple) was called Kawaialoa or Kaiwaloa heiau. It is the largest heiau site in Olowalu, measuring approximately 51 meters long by 32 meters in width. The size and location of this heiau suggest Olowalu played a significant role in religious matters in the moku (district) of Lahaina. It is considered the site of major religious ceremonies, probably involving high chiefs and rulers. Features within the heiau suggest possible burials as well.

The "kanaka maoli" (indigenous people) of these islands were very religious and even considered paganistic by Christian standards. Therefore, this heiau would have played an important part in the daily lives of residents in Olowalu.

Sites 1200 & 1201: Petroglyphs & Temporary Habitation Site This complex is made up of petroglyphs (pecked images) on the rock faces and a natural rock overhang at the base of the cliff that was used as a shelter. The shelters may have been used by people who traveled on the trail which ran up Olowalu Valley and over the mountains to Iao Valley, or they may have been made and used by residents of Olowalu

There are approximately 70 petroglyphs in this area. Many are basic triangular human figures of men, women and children, but others seem to reflect typical life activities. There are animals, boats, lateen sails, a canoe paddle, a fisherman, a diver, a father with children. Unfortunately, recent vandalism and modern imitations have marred portions of this site.

Site 1603: Burial; religious *For description, please refer to signage descriptions contained in the Mitigation Plan approved by the Maui Lana'i Islands Burial Council at its February 22, 2001 meeting, attached hereto as Appendix "A".*

Site 4699: Temporary Habitation For description, please refer to signage descriptions contained in the Mitigation Plan approved by the Maui Lana'i Islands Burial Council at its February 22, 2001 meeting, attached hereto as Appendix "A".

Site 4700: Temporary Habitation Site Temporary habitation sites or shelters that were used for a few hours, a day or longer, were scattered throughout Olowalu. These were used by people when fishing, farming or gathering resources in the forest. These series of rock overhangs, a rock wall and a C-shaped structure are interpreted as temporary shelters.

For farmers (mahiai) in the area, daytime shelter from the very hot sun or strong winds would have been important. Being close to the shoreline, the shelters facing the coast would have also afforded the fishermen (lawai'a) an observation point.

Site 4701: Possible Shrine The kanaka maoli (indigenous people) of Old Olowalu believed that numerous deities (akua) could provide help in their everyday lives. For example, certain gods were associated with fishing and others with farming. Families had small shrines where they gave prayers and offerings to these gods.

This platform contains branch coral, an archaeological indicator of past religious activities. The close proximity of the site to the shore suggests it may have been a fishing shrine (ko'a) used by Olowalu families in the past.

Site 4704: Permanent Habitation, Agricultural & Religious Site With its location next to Olowalu Stream, this site is located in an area where Native Hawaiians lived and farmed. Some of these farms were able to irrigate with stream water and were irrigating kalo (taro) fields (lo'i).

This site's stone terraces are ruins of irrigated fields and a house. Archaeological excavations found food remains and tools in the habitation terrace. Over 27 petroglyph images were located on the basalt cliff face, adding a religious component to this site.

Site 4705: Temporary Habitation Site This site is another one associated with the fields found along Olowalu Stream. Not all the houses in this area were typical thatched dwellings; some were field shelters used briefly by people who lived nearer the shore. This site is one of those field shelters, consisting of two rock overhangs which would have provided shelter from the sun, wind or rain.

Site 4706: Temporary Habitation Site Near the fields along Olowalu Stream, this site is another temporary shelter used by a family residing elsewhere, probably near the shore. This rock overhang

- **SITE 4**

Site type: known *heiau*—Kawaialoa

Function: ceremonial

Comments: This is a large walled *heiau* in remarkably good condition, considering it is surrounded on 3 sides by cane roads, and an active cane field on the *makai* side. The walls range in thickness from 2.6 meters on the west side to 3.8 meters on the south and east, where it is composed of 2 terraces. The north wall is lower and ranges from 1.5 to 2.5 meters thick. Several low terraces and enclosures are identifiable inside. The low platforms in the western part are probably graves. The *heiau* is constructed of rough red vesicular rock.

Winslow Walker recorded this site during his 1929-1930 inventory of ceremonial structures on Maui. It is considered to be the most culturally significant indigenous site on the survey property.

- **SITE 1200 / 1201**

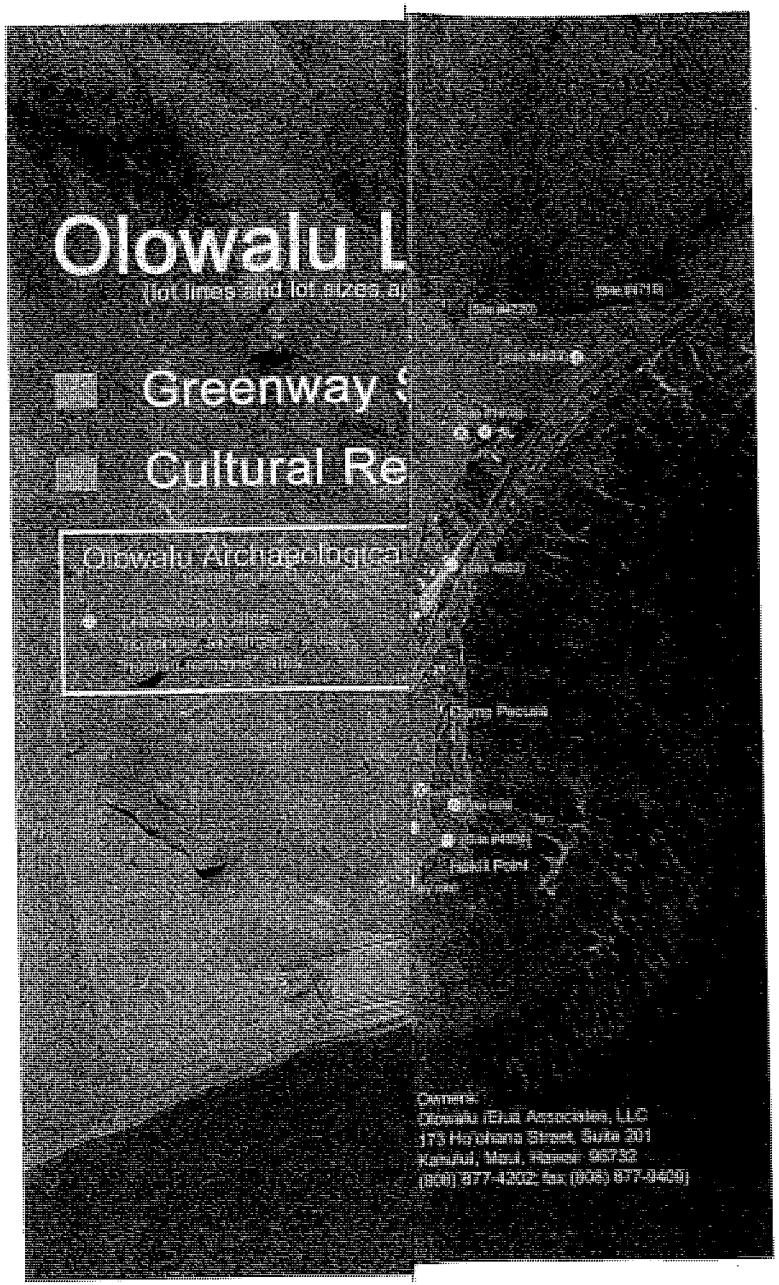
Site 1200 was identified in the Statewide Inventory (conducted in 1973-74) as the "Olowalu Complex," a complex made up of two features – the Olowalu Petroglyphs, and a natural rock overhang at the base of the cliff, which was probably used as a shelter (HRHP, Connolly, 1973) (Subsequently the Olowalu Rock Shelter part of the Olowalu Complex was given the site number 50-50-08-1201).

- **SITE 1603**

Site type: Olowalu Hawaiian Protestant Church

Function: ceremonial

Comments: While this site is technically excluded from study parcel, informants indicated that the church property had been more extensive in the past. There was concern that graves of church members might be present in the adjacent cane fields. For this reason, we undertook a series of backhoe trench tests in this area. A backhoe trench located an unmarked casket burial quite near the old church ruins, which vindicated their concern.



PRESERVATION PLAN FOR HUMAN REMAINS BURIALS AND PROBABLE AND POSSIBLE BURIAL FEATURES CONTAINED ON THE OLOWALU ELUA PROJECT AREA, OLOWALU, MAUI, LAHAINA DISTRICT, ISLAND OF MAUI, TMK: 4-8-5-11

Prepared on behalf of:

Mr. Robert Horcajo, Project Manager
Olowalu Elua Associates, LLC
Kahului, Maui

Prepared by:

Erik Fredericksen
Demaris L. Fredericksen
Xamanek Researches
Pukalani, Maui

January 15, 2001
(Final revisions—March 8, 2001)

INTRODUCTION

Xamanek Researches was contacted during late August 1998 by Mr. Robert Horcajo, Project Manager, Olowalu Elua Associates LLC, Kahului, Maui, regarding the Olowalu project area at Olowalu *ahupua'a*, Lahaina District, Maui. The overall project area encompassed much of the existing Olowalu *ahupua'a* and a small portion of Ukumehame *ahupua'a* (Figure 1). We were asked to prepare and submit a proposal for an archaeological inventory survey, following an onsite meeting.

Xamanek Researches was subsequently contracted to carry out an inventory survey of the c. 732 acre property, which was to be carried out in two phases. Phase 1 focussed on the area *makai* (southwest) of Honoapi'ilani Highway, while Phase 2 was carried out on the area *mauka* (northeast) of the road. We located Site 50-50-08-4693, a precontact burial ground on the eastern portion of the *makai* project area, in November 1998. A burial preservation plan for Site 4693 was prepared in consultation with the Maui/Lana'i Islands Burial Council (MLIBC) [Fredericksen and Fredericksen, 28 Feb. 1999]. Fieldwork on the *mauka* project area began in late 1998 and continued through June 1999. We identified 11 sites that contain or are thought likely to contain human remains during the Phase 2 inventory survey. We recently prepared a burial treatment plan for these 11 sites on behalf of Olowalu Elua Associates, LL. The Maui/Lanai Islands Burial Council (MLIBC) at its November 2000 meeting approved this treatment plan (Fredericksen and Fredericksen November 2000). The following preservation plan for these sites has been prepared in order to address State Historic Preservation Division requirements for these sites on the *mauka* portion of the Olowalu project area. This plan has again been prepared on behalf of Olowalu Elua Associates, LLC.

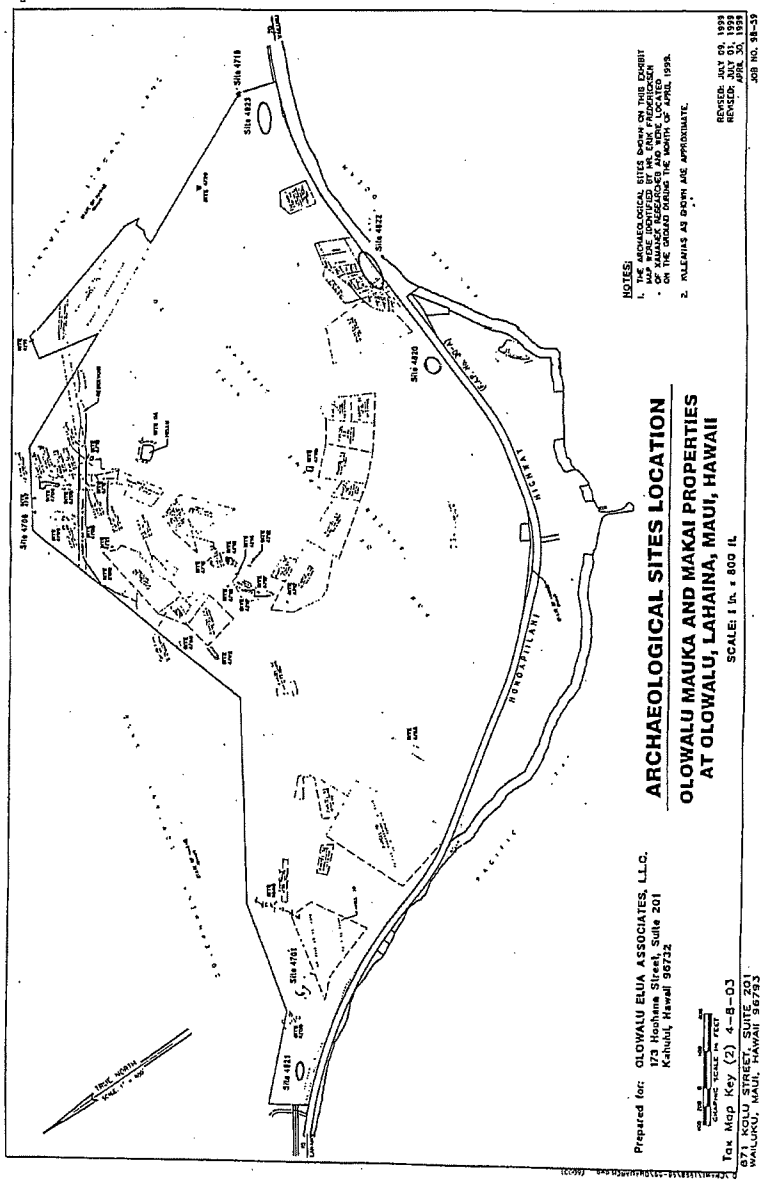


Figure 1 – Plan view of the project area, including recorded sites.

1

recommended site preservation areas and the tree roots left in place to rot. This methodology will help minimize potential disturbance to the sites slated for preservation.

Long-term preservation

As noted earlier, three sites (Sites 04, 4710, and 4718) are recommended for interpretive preservation, and six sites (Sites 1603, 4699, 4707, 4712, 4715, and 4758) are recommended for "as is" preservation. Comments and recommendations from Native Hawaiian lineal and cultural descendents of Olowalu have been included in the recommended long-term actions for each of these sites listed below:

Sites Recommended for interpretive preservation

Site 04 – Kawaialoa/Kaiwaloa *heiau* (Figure 3)

1. Interpretive preservation is recommended for this large *heiau*. This impressive structure is constructed with large rounded boulders and cobbles, and measures c. 50 meters (165 feet) N-S by c. 36 meters (120 feet) E-W. Several probable burials are likely contained in this site.[12] The *heiau* has been placed in the proposed Cultural Reserve for Olowalu.[13] Site 04 is bounded by three parcels that are slated for development (Lots 6, 7 and 8).[14]

2. Interpretive signage shall be placed on the northern (*mauka*) side of the Site 04 preservation area. This sign should be placed where it is clearly visible at the trail terminus/parking area. The placement of this sign will help to inform the public of the site's overall significance. However, given the site's cultural significance, it has been requested that access to the interior of the *heiau* be reserved for traditional Native Hawaiian cultural purposes.[15] Text and graphics will relay basic information about the *heiau*.

3. Provisions for access to the interior will be made for Native Hawaiians who wish to visit the *heiau* for traditional cultural purposes. Access to the interior of the structure by the general public will not be encouraged.

4. It is recommended that a path lead from the interpretive sign to a natural viewing platform that overlooks the site. The intention of this platform is to

[12] Walker noted that burials were contained in Site 04 in his island inventory in 1931. At the writing of this preservation plan, contemporary informants Ms Katie Nahina, Mr. William Waiohu, and Ms. Adeline Rodrigues, all lineal and cultural descendants of Olowalu, have indicated that traditional burials are indeed contained within Kawaialoa/Kaiwaloa *heiau*.

[13] A nonprofit corporation—Olowalu Cultural Reserve—has been formed under 503 C3 rules to administer the c. 75-acre Cultural Reserve in Olowalu.

[14] Mr. Robert Horcajo, Project Manager for Olowalu Elua Associates, LLC, has indicated that all parcels bordering the proposed Cultural Reserve will have a set back buffer of nearly 10 meters (30 feet), as required by a condition of the SMA permit.

[15] This request has been put forth by lineal descendents of Olowalu, including Ms. Katie Nahina, Ms. Adeline Rodrigues, and Mr. William Waiohu.

help reduce foot traffic in the *heiau* itself. The planned location of this path and platform will be reviewed by Xamanek Researches, Olowalu lineal and cultural descendants, and the Olowalu Cultural Reserve to help ensure that Site 04 is not inadvertently impacted by the placement of the pathway or platform.

5. At this time, minimal landscaping actions are recommended for Site 04, including flush cutting *kiawe* trees and other alien tree species that are in and nearby the site.[16] It may be possible—over time—to encourage drought tolerant native plants such as *'ilima* (*Sida fallax*) in the site preservation area. A request has been made to mark the boundaries of the preservation area with a native hedge and boulders to help buffer the preservation area from the planned development of Olowalu.

6. Olowalu Elua Associates LLC shall maintain a preservation area buffer of c. 30 meters (100 feet) for Site 04.

Site 4710 – habitation complex with probable burial—Feature E (Figure 4)

1. This late pre- to early post-European contact habitation complex consists of seven features including a probable burial (Feature E). It is located along the northeastern crest of Olowalu Valley relatively near the northern boundary of the project area. Interpretive preservation is recommended for this complex because it is a rare surviving example of a habitation complex that includes agricultural terraces in the project area. This site has been placed in the proposed Cultural Reserve for Olowalu. Site 4710 is bounded to the south by Parcel 6, a property slated for development. The southern portion of this site has been impacted by previous earth disturbance activities associated with sugarcane agricultural operations.

2. Interpretive signage shall be placed on the southern side of the Site 4710 preservation area. This sign should be placed where it is clearly visible at the trail head/parking lot. The placement of this sign will help to inform the public of the site's function and age. Text and graphics will relay basic information about Site 4710.

3. Access to the site will be from the proposed Cultural Reserve. The site will be readily visible from a natural viewing platform just to the south of the exposed portion of this complex.

4. It is recommended that a path lead from the interpretive sign to a viewing platform that overlooks this site. The intention of this platform is to help

[16] Ms. Katie Nahina, a lineal and cultural descendant of Olowalu, has indicated that a group that includes her son, Mr. Daniel Kalanihou Lunalilo Nahina, and Mr. Ke'eaumoku Kapu, a family member, shall serve as caretakers of this *heiau*.

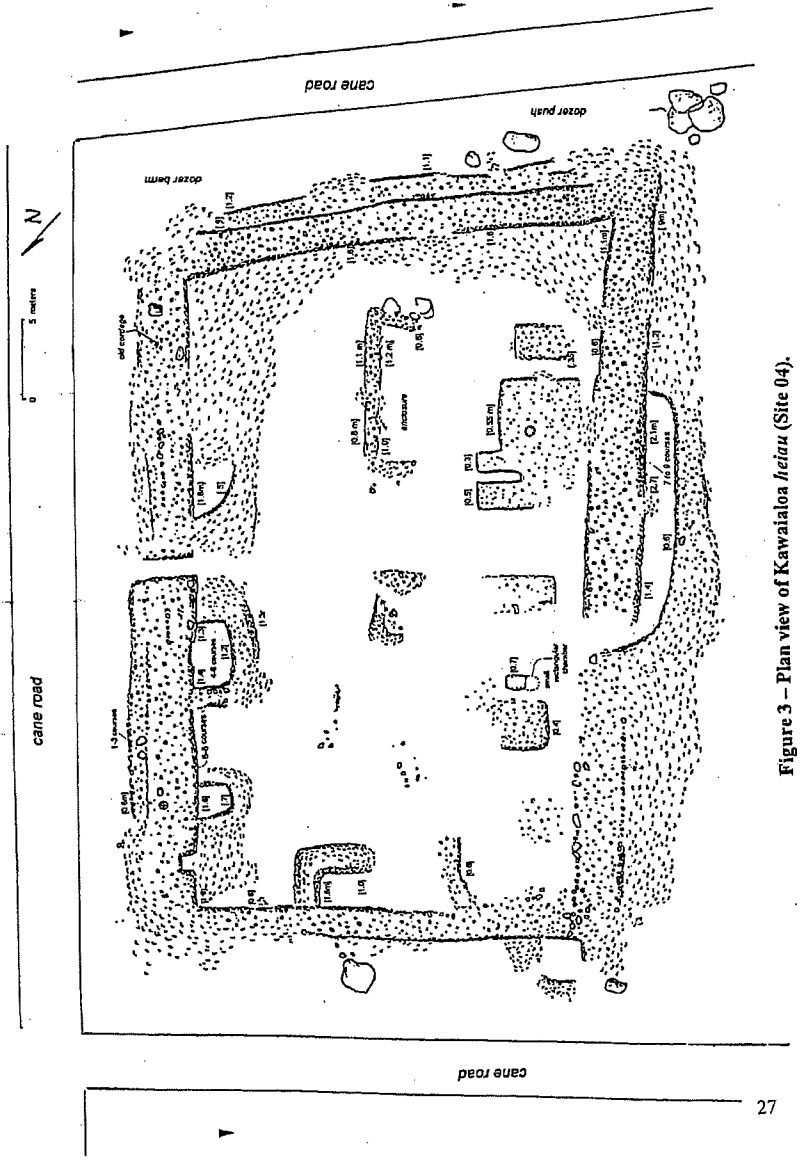


Figure 3 – Plan view of Kawaialoa *heiau* (Site 04).

FORM 51

50 - 5 0 - 0 8 - 1 2 0 0
(1 2 / 3 4 / 5 6 7 8 9)

1/10 CARD, 1/11 NO

SITE NAME/TYPE (Columns 12-43) OLOWALU COMPLEX

DISTRICT (Columns 44-55) LAHAINA

AHUPUA'A (Columns 56-80) OLOWALU

PREVIOUS SITE NUMBER(S) MA-D2-2,4 NUMBER SYSTEM BISHOP MUSEUM

BACKGROUND DATA

Source	Volume	Page(s)
0 2 5		Bishop Museum

CONDITION DATA

Extent of Destruction

Agent of Destruction

Destruction Reported by (Source/Page)

Date Reported

PROCESSING CHECKLIST	DATE	INITIALS		DATE	INITIALS
literature xeroxed	5-7-73	SDC	Form 31 complete	7/12/74	RDC
Field Map plot	5/7/73	SDC	Form 41 complete	7/12/74	RDC
Final Mylar plot			Supplementals complete	na	
Final Ink sketch(es)	8/20/73	JH	Checked		
Statement drafted	7/12/74	RDC	To typist	7/15/74	
Cover sheet complete	7/12/74	RDC	Typing complete	7/15/74	mj
Form 01/11 complete	7/15/74	RDC	Typing proofed		
Form 21 complete	7/15/74	RDC	To xeroxing		
			Xeroxing complete		

DISPOSITION

3/10 CARD, 1/11 NO — 10/13 / 85/15 / 62/17 / 18 19 / 20 21 / 22 23 — 24 25 26 . 27 28, 19 29 30
THEME (S) — TO REVIEW BOARD

31 32 33 . 34 35, 19 36 37 — STATE CATEGORY 38 — SIG LEVEL 39 — NAT'L REG NOM 40
REVIEWED

41 42 43 . 44 45, 19 46 47 — 48 49 50 . 51 52, 19 53 54 — 55 56 57 . 58 59, 19 60 61
TO TRUSTEES — TO STATE LIAISON OFFICER — TO NATIONAL REGISTER

62 63 64 . 65 66, 19 67 68
NATIONAL REGISTER ACTION

NRHP DISPOSITION: 69 OK, 70 NO, 71 RET

DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE PARKS DIVISION

HAWAII REGISTER OF HISTORIC PLACES

ARCHAEOLOGICAL FORMS

FORM 01: FIELD SURVEY

12 4 CORNER

2 13 14 15 16 . 17 18 N. / 19 20 21 . 22 23 E.
SINGLE POINT COORDINATE LOCATION

24 25	26	27	28 29 30	31	32 33	34 35
DISTRICT	LOC	FACTOR	AREA SQUARE	CATEGORY	SIG 1	SIG 2

36	37 38 39	40	41 42 43	44 45	46 47	48 49
DESTR	LAND CLASS	PHOTOS	INITIALS	INSTITUTION	MONTH	YEAR

HISTORICAL OR COMMON NAME: 50 O 51 L 52 O 53 W 54 A 55 L 56 U 57 C 58 O 59 M 60 P 61 L 62 E 63 X 64 65 66 67

68 69 70 71 72 73 74 75 76 77	78	79	80
FEATURE CLASSIFICATION CODE	COND	INTG	PERIOD

FORM 11: FOUR CORNER LOCATION

NW CORNER: 12 13 — 2 14 15 16 17 . 18 19 N. / 20 21 22 . 23 24 E.

NE CORNER: 25 26 — 2 27 28 29 30 . 31 32 N. / 33 34 35 . 36 37 E.

SE CORNER: 38 39 — 2 40 41 42 43 . 44 45 N. / 46 47 48 . 49 50 E.

SW CORNER: 51 52 — 2 53 54 55 56 . 57 58 N. / 59 60 61 . 62 63 E.

QUAD — NORTH GRID COORDINATE — EAST GRID COORDINATE

CLASS: Nominated ___ Accepted ___ NRHP

Category A B C HRHP

Keypunched

50 - 5 0 - 0 8 - 1 2 0 0
ISLAND QUAD IDENTIFICATION NO.

FORM 3 1: PROPERTY OWNERSHIP
1 2

50 - 5 0 - 0 8 - 1 2 0 0
3 4 (ISLAND) 5 6 (QUAD) 7 8 9 10 11 (IDENTIFICATION NO.)

1 9		2	2	1	1	4	8	0 3	1 0
12 13	14 15	16	17	18	19	20	21	22 23 24	25 26 27
USE 1	USE 2	STAT	OWNR	ATTD	ACCS	zone	sect (TAX)	plat (MAP)	parcel (KEY)

PROPERTY OWNER: P I O N E E R M I L L C O
28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

STREET ADDRESS:
46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63

TOWN OR CITY: L A H A I N A H I 9 6 7 6 1
64 65 66 67 68 69 70 71 72 73 74 75 (STATE) 76 77 78 79 80 (ZIP CODE)

FORM 4 1: BACKGROUND DATA
1 2

50 - 5 0 - 0 8 - 1 2 0 0
3 4 (ISLAND) 5 6 (QUAD) 7 8 9 10 11 (IDENTIFICATION NO.)

AHUPUA'A: O L O W A L U
12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

PREVIOUS SURVEYS: M A U I S I T E S
27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44

PREVIOUS SITE DESIGNATION(S): M A - D 2 : 4
45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62

LAST NAME OF SURVEYOR: S T E R L I N G
63 64 65 66 67 68 69 70 71 72 73 74

0 5 (INSTITUTION) 75 76 — 6 2' (YEAR) 77 78 — 0 5 (FILED AT) 79 80

ARCHAEOLOGICAL COVER SHEET

HAWAII REGISTER OF HISTORIC PLACES

50 - 5 0 - 0 8 - 1 2 0 0
1 2 3 4 5 6 7 8 9
SITE IDENTIFICATION NUMBER

2 1 P R E - 1 7 7 8
10 11 12 13 14 15 16 17 18 19 20
CARD No. DATE/PERIOD

SITE NAME/TYPE: OLOWALU COMPLEX
DISTRICT: LAHAINA
AREA: 500 square meters s
CATEGORY: ___Single Feature _x_Complex ___Places
OWNERSHIP: ___Public _x_Private
PHOTOGRAPHS: _x_Yes ___No (Temp/Tech)
PRESENT LAND USES: PARK
KNOWN PRESSURES ON SITE: VANDALISM
DESTRUCTION: ___No Known Future Danger _X_Possible Future Danger ___Future Danger Certain
___Present Danger ___Presently Being Destroyed
STATUS: ___Occupied _x_Unoccupied CONDITION: ___Excellent _x_Good ___Fair ___Deteriorated
INTEGRITY: ___Unaltered, Orig Loc ___Unaltered, Moved _x_Altered, Orig Loc ___Altered, Moved
ACCESSIBILITY: _x_Unrestricted ___Restricted ___Inaccessible

LEGENDARY MATERIALS KNOWN: ___Yes _x_No WRITTEN HISTORICAL MATERIALS: ___Yes _x_No
IMPORTANCE AS EXAMPLE OF TYPE SITE: _x_Good ___Moderate ___Poor
SUSCEPTABILITY TO INTERPRETATION: _x_Good ___Moderate ___Poor
RESEARCH POTENTIAL: ___Good _x_Moderate ___Poor
LOCAL ATTITUDES ABOUT SITE: _x_Valuable ___Moderate Value ___Low Value ___Ambivalent ___Unknown
BRIEF DESCRIPTION (Columns 21-80): PETROGLYPHS AND SHELTER CAVE IN SMALL PARK AREA.

STAFF EVALUATION: ___High Value _x_Valuable ___Reserve ___Marginal
SUGGESTED THEMES: POLYNESIA: HAWAI'I: PETROGLYPHS, HABITATION

DATE SUBMITTED TO REVIEW BOARD:

REVIEWER'S RECORD AND EVALUATION

NAME: DATE REVIEWED
CATEGORY: ___High Value ___Valuable ___Reserve ___Marginal
SIGNIFICANCE: ___National ___State ___Local
RECOMMENDED DISPOSITION: ___Nominate National Register ___State Register ___Staff Files
RECOMMENDED THEMES:

REVIEWER'S COMMENTS:

REVIEW BOARD EVALUATION RECORD

DATE REVIEWED: RECORDER:
OFFICIAL CATEGORY: ___High Value ___Valuable ___Reserve ___Marginal
OFFICIAL SIGNIFICANCE: ___National ___State ___Local
OFFICIAL THEMES:

OFFICIAL DISPOSITION: ___National Register Nomination ___State Register ___Staff Files
REVIEW BOARD COMMENTS:

VOTING RECORD: Daws___ Hormann___ Jackson___ Kikuchi___
Lind___ Mark___ Nagata___ Paglinawan___
Roche___ Tuggle___

Olowalu 50-50-08-1200 Lahaina

Olowalu Petroglyphs

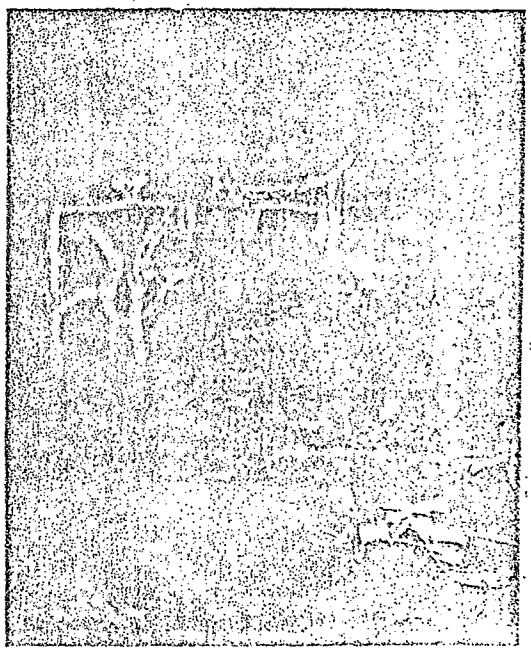
Of an entirely different sort, two particularly interesting areas of these rock writings are to be found right in the middle of Pioneer Mill Co.'s cane fields near Lahaina. Of the two, the better known and more easily reached is in the Olowalu area, about a mile through the cane, mauka of the highway to Lahaina. Plainly seen, even from the access road, they're scratched in the bare stone sides of a hill. Further along, there's a heiau (temple) too.

The Olowalu petroglyphs are of several types and of apparently different periods, some appearing fresher than others. The most recent were obviously made after the Hawaiians learned the written alphabet, as evidenced by names painstakingly carved above the older and more historic scratchings.

The majority of the Olowalu figures are of triangular form. Others, apparent of a different era, display more shape and body. One, reminiscent of an American Indian -- he certainly possesses a feathered headress resembling an Indian's war bonnet -- seems to be held firmly in the grasp of another figure.

Images of dogs, too, are plentiful, along with those of women and children.

Jeanne Booth Johnson
Maui's Past Shown in Stone
Hawaiian Holiday, Dec. 7, 1958 Honolulu Advertiser



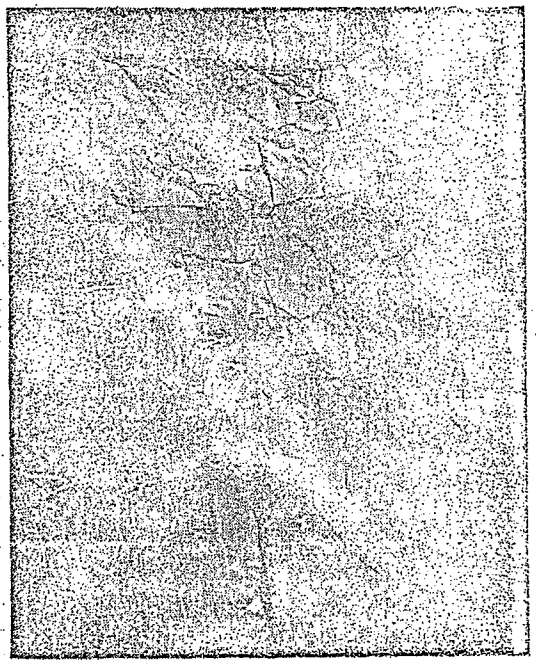
Jeanne Booth Johnson

Figures from Olowalu petroglyphs.

Hawaiian Holiday, Dec. 7, 1958 Honolulu Advertiser

Site: Ma-D2-2 State: HO-50-8 Petroglyphs Date:
Land: Olowalu, Lahaina
TMK: 4-8-03
Owner:
General Survey x Excavation Artifacts HHD- HRC-
Description:
See Field M.S. 1 Petroglyphs known for years
Sources:
Photos: Color B/W
Geographic coordinates USGS Quadrangle 1000 Meter Grid
Latitude 20-49-22 ? Olowalu
Longitude 156-37-45 ? Bishop Museum N/ E
UNISORT ANALYSIS CARD FORM Y8 BURROUGHS CORPORATION - TRED DIV. - LINCOLN PRINTED IN U.S.A.

50-50-08-1200



PETROGLYPHS OR ROCK-WRITING as it is sometimes referred to, is found in many locations around the Island of Maui as well as on the other Isles of Hawaii. Still somewhat of a mystery, it seems to tell the story of the passing of early Polynesians in these different locations. This photo, supplied by Roy Okada, shows the fine examples at Olowalu, fairly close to the road that turns towards the mountains at Ichiki Store. —Roy Okada photo.

Maui News Sept. 21, 1963

Olowalu Petroglyphs

DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE PARKS DIVISION

HAWAII REGISTER OF HISTORIC PLACES

ARCHAEOLOGICAL FORMS

FORM 01: FIELD SURVEY

12 — 4 CORNER

2 — N. / E. — SINGLE POINT COORDINATE LOCATION

DISTRICT	LOC	FACTOR	AREA SQUARE	CATEGORY	SIG 1	SIG 2
54	5	4	68	1	01	05

DESTR	LAND CLASS	PHOTOS	INITIALS	INSTITUTION	MONTH	YEAR
4	98	1	RDC	05	8	73

HISTORICAL OR COMMON NAME: OLOWALU PETROS

FEATURE CLASSIFICATION CODE	COND	INTG	PERIOD
5 5 1 2 3 20	2	1	4

CLASS: Nominated ___ Accepted ___ NRHP

Category A ___ B ___ C ___ HRHP

Keypunched

FORM 11: FOUR CORNER LOCATION

NW CORNER:	12 13	2 14 15 16 17 . 18 19 N. /	20 21 22 . 23 24 E.
NE CORNER:	25 26	2 27 28 29 30 . 31 32 N. /	33 34 35 . 36 37 E.
SE CORNER:	38 39	2 40 41 42 43 . 44 45 N. /	46 47 48 . 49 50 E.
SW CORNER:	51 52	2 53 54 55 56 . 57 58 N. /	59 60 61 . 62 63 E.
	QUAD	NORTH GRID COORDINATE	EAST GRID COORDINATE

50 - 50 - 08 - 1200

ISLAND QUAD IDENTIFICATION NO.

ARCHAEOLOGICAL COVER SHEET

HAWAII REGISTER OF HISTORIC PLACES

50 - 50 - 08 - 1200

SITE IDENTIFICATION NUMBER

CARD No. 2 1 — PRE - 1778 — 10 11 12 13 14 15 16 17 18 19 20

SITE NAME/TYPE: OLOWALU PETROGLYPHS

DISTRICT: LAHAINA

AREA: 68 square meter s

CATEGORY: ~~X Single Feature~~ ___ Complex ___ Places

OWNERSHIP: ___ Public X Private

PHOTOGRAPHS: X Yes ___ No (Temp/Tech)

KNOWN PRESSURES ON SITE: VANDALISM

DATE/PERIOD:

PRESENT LAND USES: PARK

DESTRUCTION: ___ No Known Future Danger ___ Possible Future Danger ___ Future Danger Certain X Present Danger ___ Presently Being Destroyed

STATUS: ___ Occupied X Unoccupied CONDITION: ___ Excellent X Good ___ Fair ___ Deteriorated

INTEGRITY: X Unaltered, Orig Loc ___ Unaltered, Moved ___ Altered, Orig Loc ___ Altered, Moved

ACCESSIBILITY: X Unrestricted ___ Restricted ___ Inaccessible

LEGENDARY MATERIALS KNOWN: ___ Yes X No WRITTEN HISTORICAL MATERIALS: ___ Yes X No

IMPORTANCE AS EXAMPLE OF TYPE SITE: X Good ___ Moderate ___ Poor

SUSCEPTABILITY TO INTERPRETATION: X Good ___ Moderate ___ Poor

RESEARCH POTENTIAL: ___ Good X Moderate ___ Poor

LOCAL ATTITUDES ABOUT SITE: X Valuable ___ Moderate Value ___ Low Value ___ Ambivalent ___ Unknown

BRIEF DESCRIPTION (Columns 21-80): PETROGLYPHS ON TWO DIFFERENT FACES; AREA HAS BEEN MADE INTO A SMALL PARK.

STAFF EVALUATION: ___ High Value X Valuable ___ Reserve ___ Marginal

SUGGESTED THEMES: HAWAIIAN SITE/ART

DATE SUBMITTED TO REVIEW BOARD: ___

REVIEWER'S RECORD AND EVALUATION

NAME: ___ DATE REVIEWED ___

CATEGORY: ___ High Value ___ Valuable ___ Reserve ___ Marginal

SIGNIFICANCE: ___ National ___ State ___ Local

RECOMMENDED DISPOSITION: ___ Nominate National Register ___ State Register ___ Staff Files

RECOMMENDED THEMES: ___

REVIEWER'S COMMENTS: ___

REVIEW BOARD EVALUATION RECORD

DATE REVIEWED: ___ RECORDER: ___

OFFICIAL CATEGORY: ___ High Value ___ Valuable ___ Reserve ___ Marginal

OFFICIAL SIGNIFICANCE: ___ National ___ State ___ Local

OFFICIAL THEMES: ___

OFFICIAL DISPOSITION: ___ National Register Nomination ___ State Register ___ Staff Files

REVIEW BOARD COMMENTS: ___

VOTING RECORD: Daws ___ Hormann ___ Jackson ___ Kikuchi ___ Lind ___ Mark ___ Nagata ___ Paglinawan ___ Roche ___ Tuggle ___

FEATURE MAP FORM

50-50-8-1200

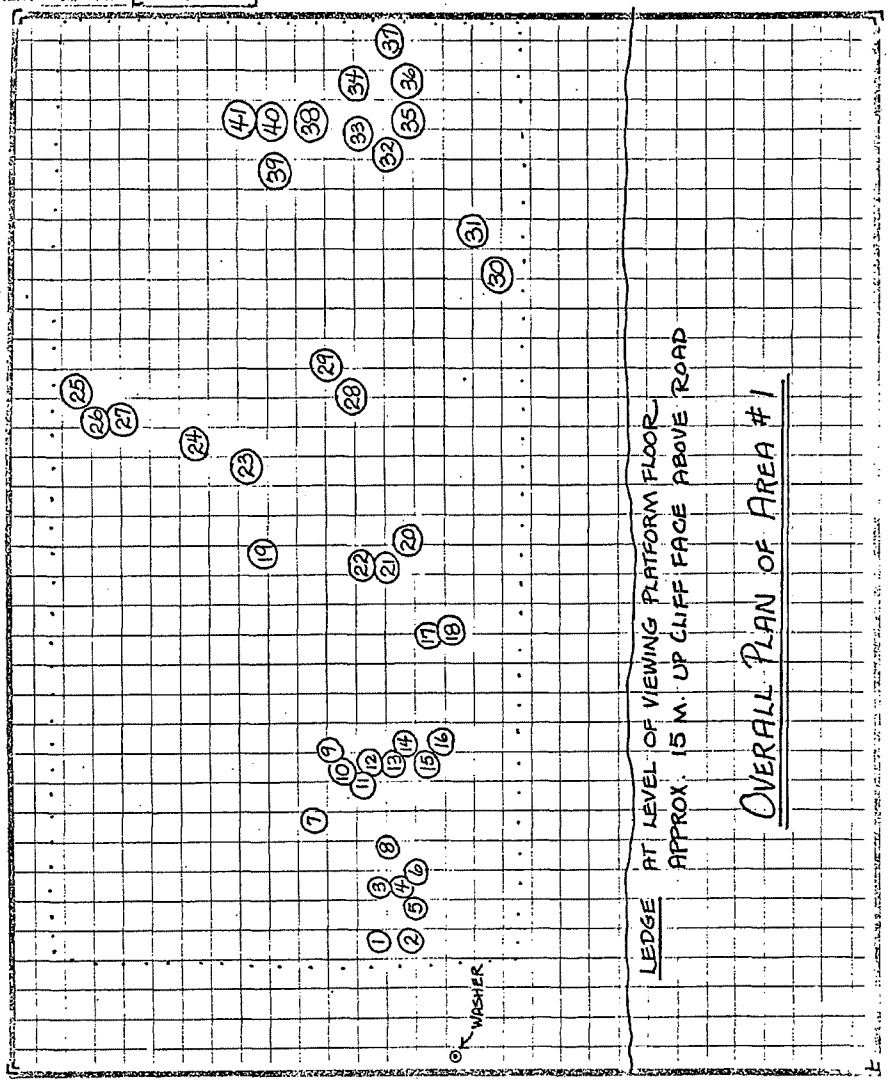
NORTH ARROW

TRUE NORTH

0 0.5 1

SCALE: cm mV

MAPPING TECHNIQUE: 01 AND 03



Coordinates
20°49'21" N
156°37'15" W

FEATURE DESCRIPTION FORM

50 - 5 0 - 0 8 - 1 2 0 0
ISLAND QUAD IDENTIFICATION NO.

VERBAL DESCRIPTION MUST INCLUDE: bearings and sources used to locate feature; size; shape; construction technique; materials used; terrain features; condition; surface artifacts; midden. SIGNIFICANCE STATEMENT MUST INCLUDE: research potential; interpretive potential; unusual or important characteristics; probable function; importance as representative of its class; recommendation of Register status.

DESCRIPTION:
This site is known as Olowalu Petroglyphs. To locate it, we drove to Olowalu General Store by way of Highway 30. Just past the store we turned right (inland) and proceeded to the old road that parallels Highway 30. We turned left onto this road. About 50 m down, there is a dirt road with a yellow sign saying "petroglyphs". We turned right onto this road and continued for 0.5 mi to the site area. The area has already been converted into a small park, complete with a viewing platform that rises about 15 m up the cliff face to allow the public to enjoy the rock art. The site consists of 2 areas. Area 1 is the large cliff where the viewing platform is located. The petroglyphs extend along this cliff face 8 m and are situated from 1 to about 4.7 m up the face. Area 2 is about 15 m S of Area 1 and is right next to the road. The petroglyphs here extend along the cliff (and on rocks in front of the cliff) about 60 m, and are situated from 0.5 to 3.3 m up the cliff face. In Area 1, there are at least 41 petroglyphs. The figures include human forms (with both stick and triangular bodies); animals, probably dogs and horses; circles; a sail, and other indistinct forms. They range in size from 2 x 2 cm to 35 x 55 cm. In Area 2, there are at least 31 petroglyphs. The figures here include human forms (with both stick and triangular bodies), historic writing, animals including dogs and horses, a figure resembling a coffee pot, a large fish or whale, a figure with five lines radiating from the head, an outrigger canoe with sail, and many indistinct forms. The forms range in size from 4 cm x 6 cm. to 40 cm x 40 cm. One of the historic forms, early Hawaiian writing, measures 80 cm by 10 cm. The petroglyphs are basically in good condition except for the fact that vandals have covered the petroglyphs with paint, crayon, chalk, and charcoal. Also many of the figures have been scratched over. Finally, many very modern "petroglyphs" have been added in recent years including such additions as names of people, profanity, and poor attempts to imitate the early Hawaiian petroglyph forms.

The site is situated on the NW side of Puu Kilea next to sugar cane fields. Directly opposite the site are kiawe trees (algaroba).

SIGNIFICANCE: Complete and accurate data should be recorded on all petroglyphs sites due to the scarcity of this type of site on Maui. After this is completed little further research can be done. The interpretive potential is already high. The site has easy access and has many visitors each day. However, some sort of cleaning program should be initiated to remove the chalk, paint, charcoal, and crayon that presently mar the petroglyphs. We recommend valuable status.

This is a National Register quality site, but in no way could this S.I. statement [illegible]

Pierce A. Cummings III

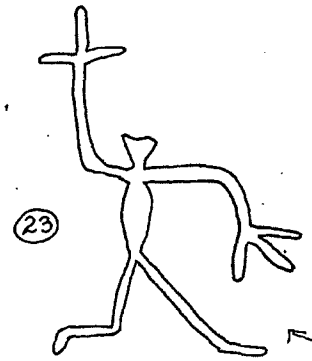
Sept 4 1972

50-50-8-1200

0 3 6 9 12
cm

03

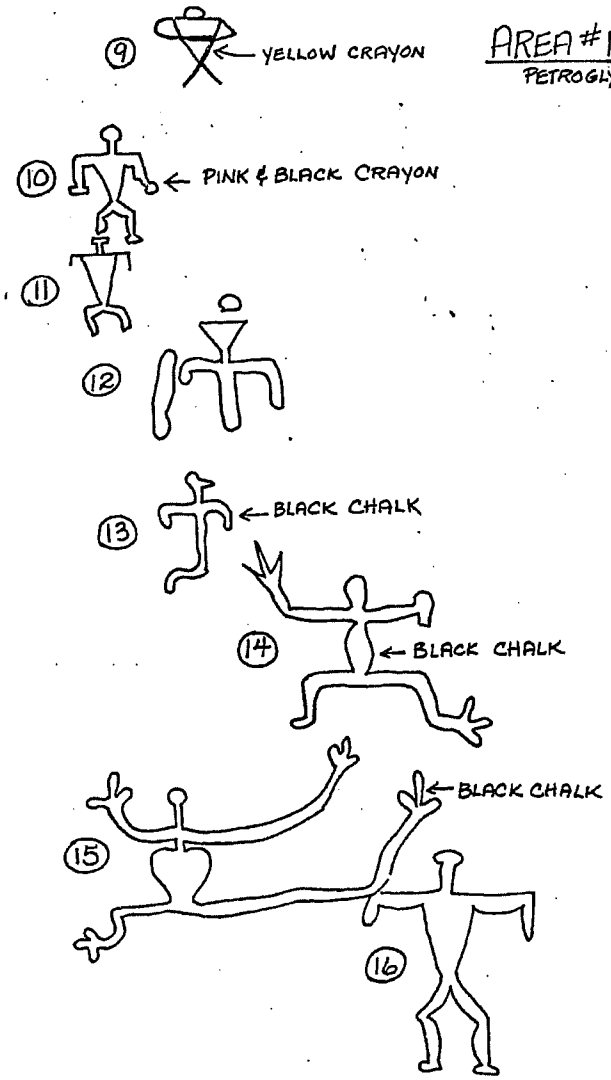
AREA #1 - PETROGLYPH



0 5 10 15 20
cm

03

AREA #1
PETROGLYPHS



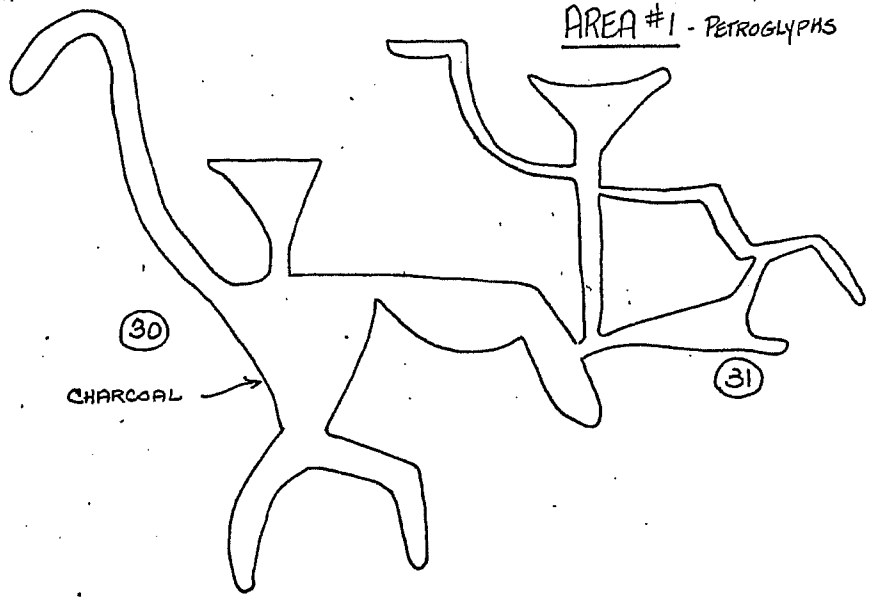
00-50-8-1200

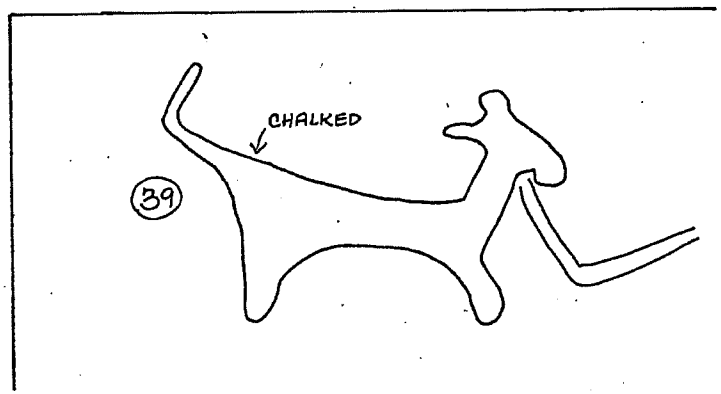
0 2 4 6 8

cm

03

AREA #1 - PETROGLYPHS





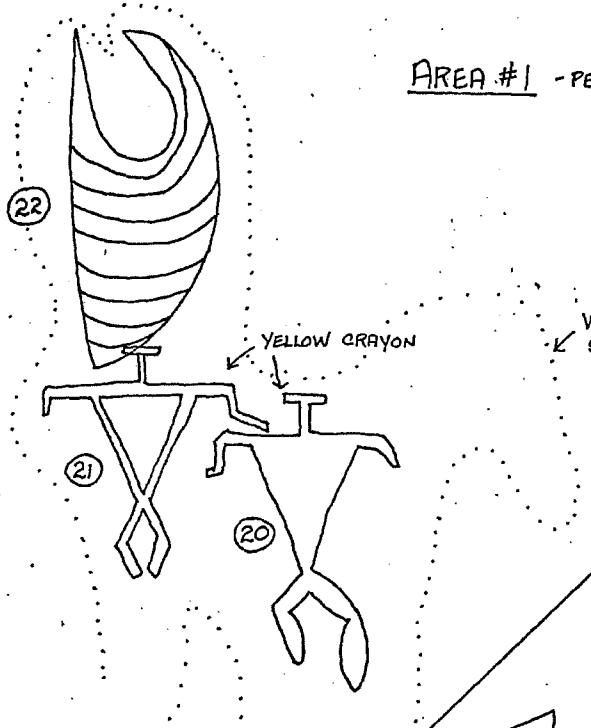
50-50-8-1200

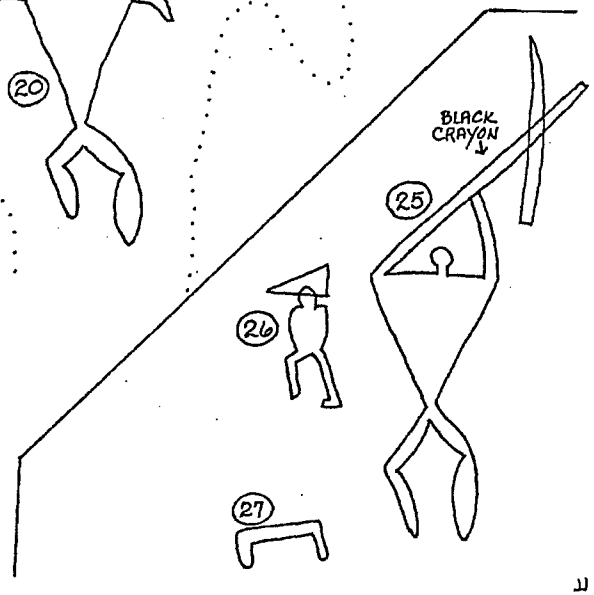
0 5 10 15 20

cm

03

AREA #1 - PETROGLYPHS

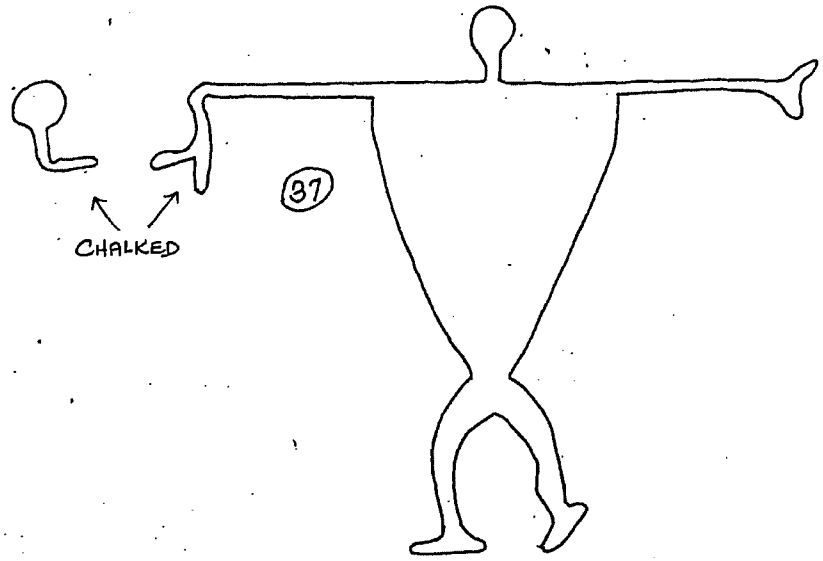




0 2 4 6 8
cm

03

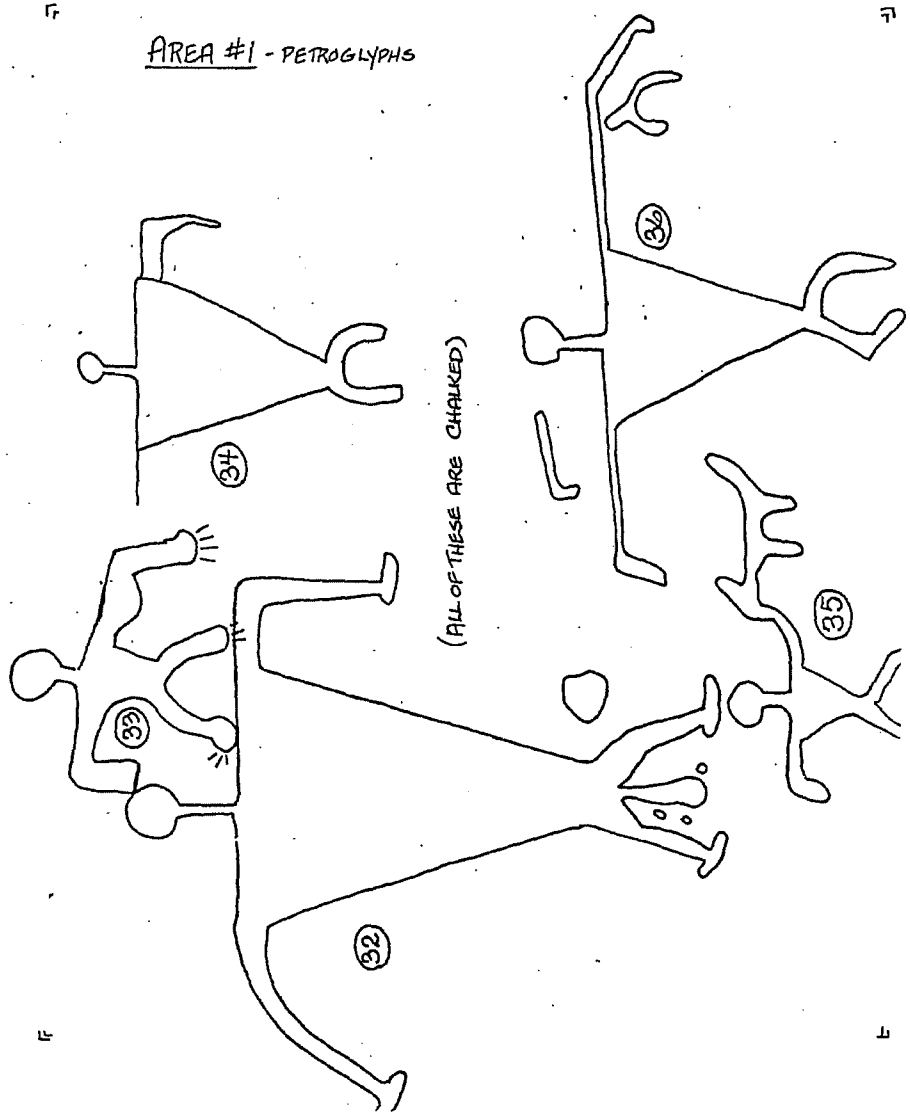
AREA #1 - PETROGLYPH



0 2 4 6 8
cm

03

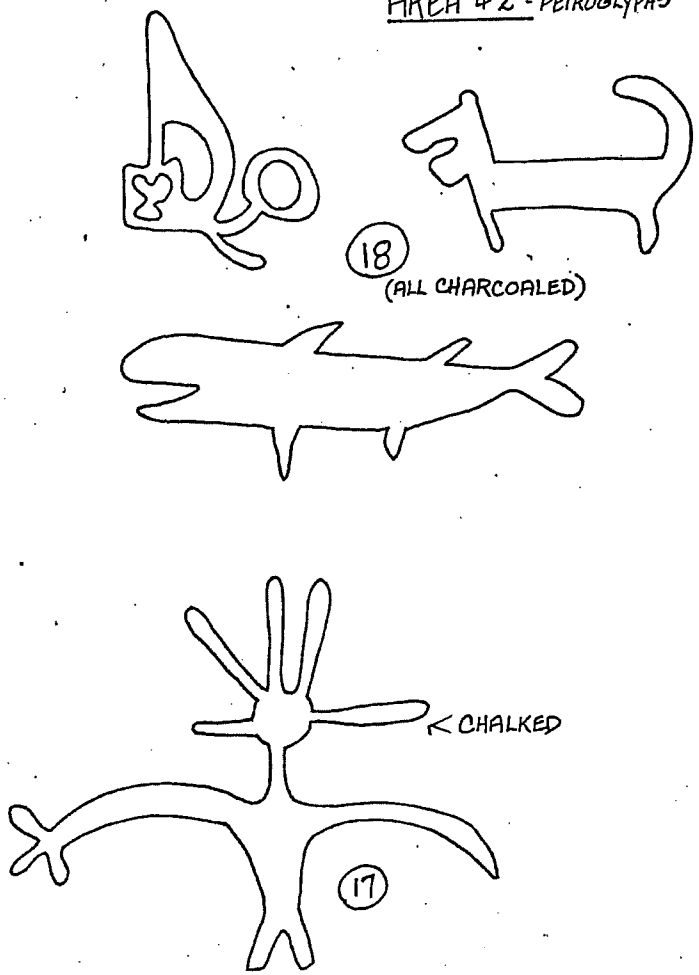
AREA #1 - PETROGLYPHS



OVERALL PLAN OF AREA #2

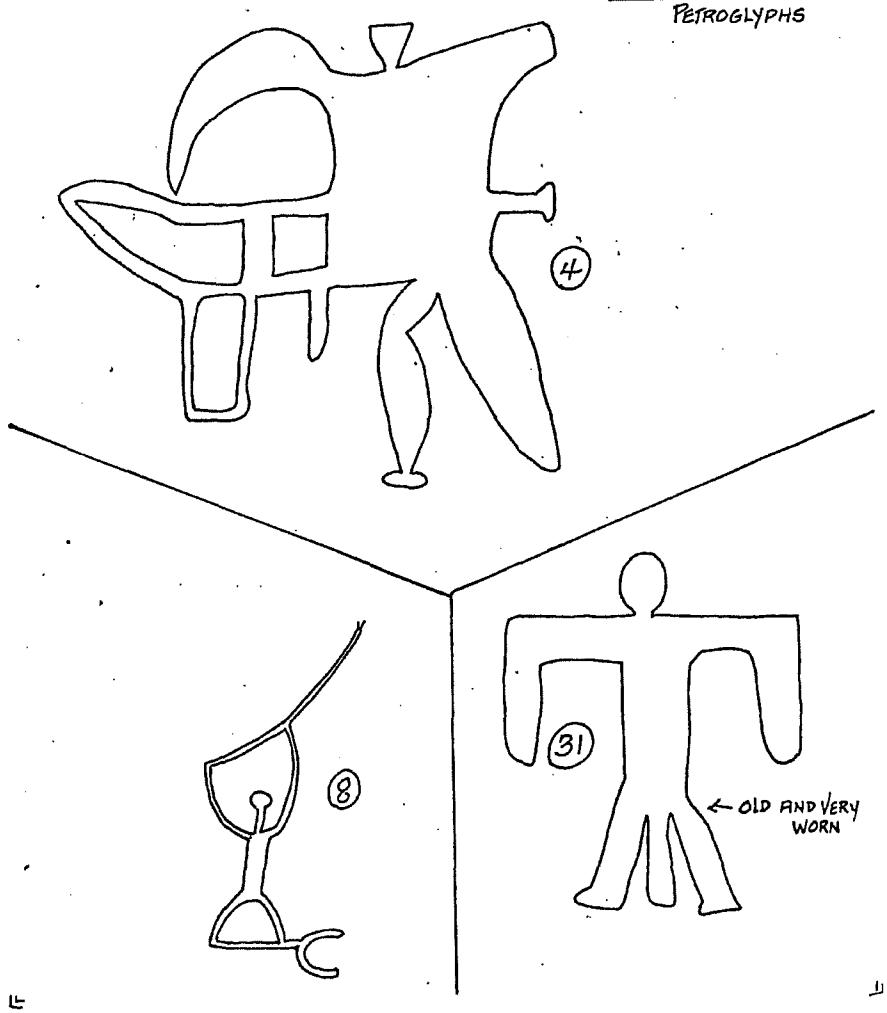
0 2 4 6 8
cm✓

AREA #2 - PETROGLYPHS



0 2 4 6 8
cm✓

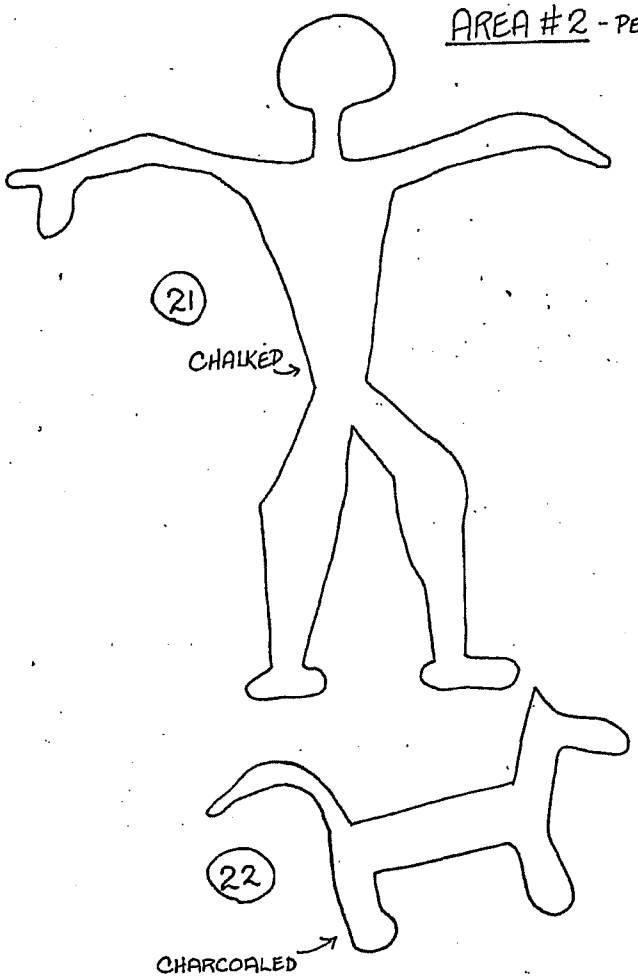
AREA #2
PETROGLYPHS



0 2 4 6 8
cm

03

AREA #2 - PETROGLYPHS



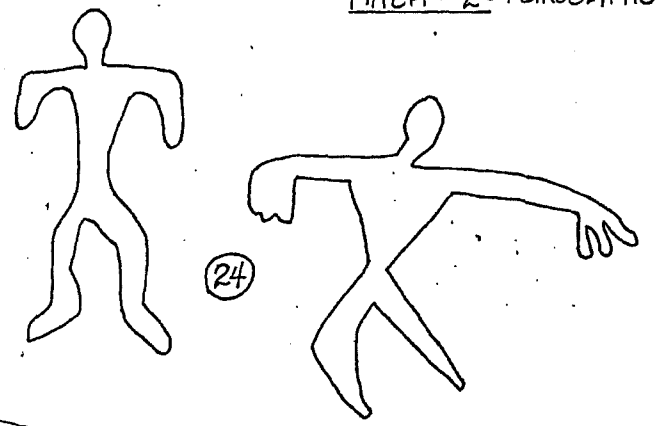
10

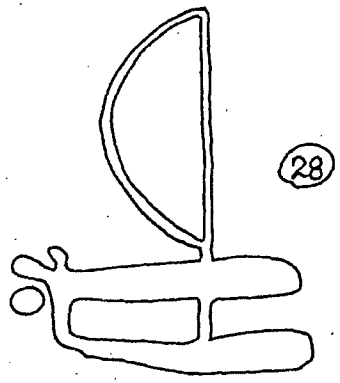
50-50-8-1200

0 2 4 6 8
cm

03

AREA #2 - PETROGLYPHS





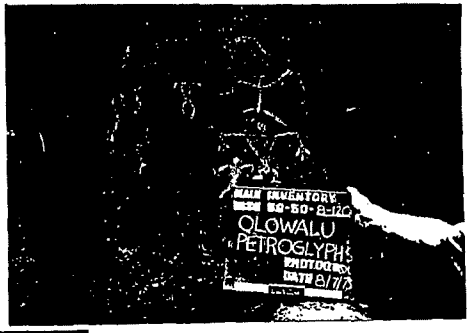
FEATURE DESCRIPTION FORM

50 - 5 0 - 0 8 - 1 2 0 0
ISLAND QUAD IDENTIFICATION NO.

VERBAL DESCRIPTION MUST INCLUDE PERTINENT DATA ON: bearings and sources used to locate feature; terrain and vegetation; size; shape; construction technique; materials used; condition; surface artifacts or midden visible. SIGNIFICANCE STATEMENT MUST INCLUDE: unusual or important characteristics; accessibility; interpretive and research potential; evaluation of the site's importance as a representative of its class; recommendations for register category.

OLOWALU PETROGLYPHS;
Area 1, Groups 1-6, 8

SMa(a)45-2



OLOWALU PETROGLYPHS;
Area 1, Group 7

SMa(a)45-4

OLOWALU PETROGLYPHS;
Area 1 (cliff face), Groups 28, 29

SMa(a)45-7

SIGNED:

DATE:

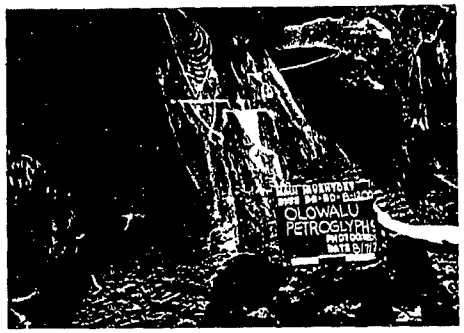
FEATURE DESCRIPTION FORM

50 - 5 0 - 0 8 - 1 2 0 0
ISLAND QUAD IDENTIFICATION NO.

VERBAL DESCRIPTION MUST INCLUDE PERTINENT DATA ON: bearings and sources used to locate feature; terrain and vegetation; size; shape; construction technique; materials used; condition; surface artifacts or midden visible. SIGNIFICANCE STATEMENT MUST INCLUDE: unusual or important characteristics; accessibility; interpretive and research potential; evaluation of the site's importance as a representative of its class; recommendations for register category.

OLOWALU PETROGLYPHS;
Area 1, Groups 17-22

SMa(a)45-5



OLOWALU PETROGLYPHS;
Area 2, Group 18

SMa(a)45-22

OLOWALU PETROGLYPHS;
Area 1, cliff face

SMa(a)45-10

SIGNED:

DATE:

FORM 3 1: PROPERTY OWNERSHIP
1 2

50 - 50 - 08 - 1200
ISLAND QUAD IDENTIFICATION NO.

USE 1	USE 2	STAT	OWNR	ATTD	ACCS	zone	sect	plat	parcel
19		2	2	1	1	4	8	03	10

TAX MAP KEY

PROPERTY OWNER: PIONEER MILL CO

STREET ADDRESS:

TOWN OR CITY: LAHAINA HI 96761
STATE ZIP CODE

FORM 4 1: BACKGROUND DATA
1 2

50 - 50 - 08 - 1200
ISLAND QUAD IDENTIFICATION NO.

AHUPUA'A OLOWALU

PREVIOUS SURVEYS: NONE

PREVIOUS SITE DESIGNATION(S): MA-D2-2

LAST NAME OF SURVEYOR:

INSTITUTION YEAR FILED AT

FORM 51

50 - 50 - 08 - 1200

CARD 1 NO 1

SITE NAME/TYPE (Columns 12-43) OLOWALU PETROGLYPHS

DISTRICT (Columns 44-55) LAHAINA

AHUPUA'A (Columns 56-80) OLOWALU

PREVIOUS SITE NUMBER(S) MA-D2-2 NUMBER SYSTEM BISHOP MUSEUM

BACKGROUND DATA

Source	Volume	Page(s)
Johnson "Maui's Past in Stone" in Hawn Hol. ~~Honolulu Adv. 12/7/58~~		
photo-Maui News. Sept 21, 1963		

CONDITION DATA

Extent of Destruction SLIGHT

Agent of Destruction VANDALS/NATURE

Destruction Reported by _____ Source/Page

Date Reported _____

PROCESSING CHECKLIST	DATE	INITIALS
Literature xeroxed	5-7	SDC
Field Map plot	5/7	SDC
Final Mylar plot		
Final ink sketch(es)	8/20	JH
Statement drafted	8/6/73	SDC
Cover sheet complete	8/6/73	SDC
Form 01/11 complete	8-6-73	SDC
Form 21 complete	—	—
Form 31 complete	8/15	DK
Form 41 complete	8-15	DK
Supplementals complete	—	—
Checked	8-15	LM-P
To typist	8/14	DK
Typing complete	8/14	DK
Typing proofed	8-15	L-M-P
To xeroxing		
Xeroxing complete		

DISPOSITION

CARD 3 NO 1

THEME (S) 01 / 05

TO REVIEW BOARD 19

REVIEWED 19

STATE CATEGORY

SIG LEVEL

NAT'L REG NOM

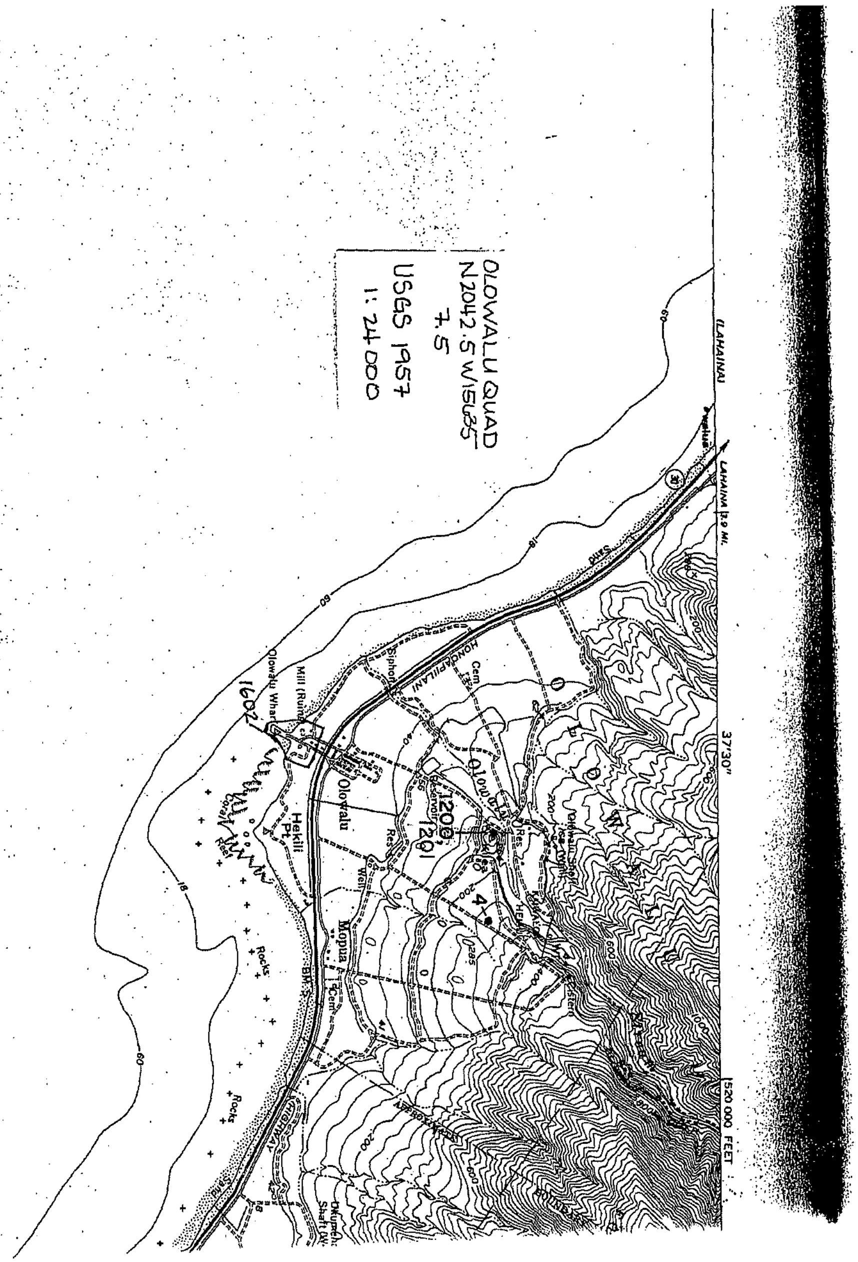
TO TRUSTEES 19

TO STATE LIAISON OFFICER 19

TO NATIONAL REGISTER 19

NATIONAL REGISTER ACTION 19

NRHP DISPOSITION: OK NO RET



ARCHAEOLOGICAL COVER SHEET

HAWAII REGISTER OF HISTORIC PLACES

50 - 50 - 08 - 1602 (1 2 / 3 4 / 5 6 7 8 9)
SITE IDENTIFICATION NUMBER

2 (10) 1 (11) 1884-1931 (12 13 14 15 16 17 18 19 20)
CARD No. DATE/PERIOD

PRESENT LAND USES: Residential

SITE NAME/TYPE: OLOWALU MILL DISTRICT
DISTRICT: LAHAINA
AREA: ____ square ____ e
CATEGORY: ___ Single Feature X Complex ___ Places
OWNERSHIP: ___ Public X Private
PHOTOGRAPHS: X Yes ___ No (Temp/Tech)
KNOWN PRESSURES ON SITE: NONE

DESTRUCTION: X No Known Future Danger ___ Possible Future Danger ___ Future Danger Certain ___ Present Danger ___ Presently Being Destroyed

STATUS: X Occupied ___ Unoccupied
CONDITION: ___ Excellent X Good ___ Fair ___ Deteriorated
INTEGRITY: X Unaltered, Orig Loc ___ Unaltered, Moved ___ Altered, Orig Loc ___ Altered, Moved
ACCESSIBILITY: ___ Unrestricted X Restricted ___ Inaccessible

LEGENDARY MATERIALS KNOWN: ___ Yes X No
WRITTEN HISTORICAL MATERIALS: X Yes ___ No
IMPORTANCE AS EXAMPLE OF TYPE SITE: ___ Good X Moderate ___ Poor
SUSCEPTABILITY TO INTERPRETATION: ___ Good ___ Moderate X Poor
RESEARCH POTENTIAL: ___ Good X Moderate ___ Poor
LOCAL ATTITUDES ABOUT SITE: ___ Valuable X Moderate Value ___ Low Value ___ Ambivalent ___ Unknown
BRIEF DESCRIPTION (Columns 21-80): mill district including mill, wharf, company manager's house.

STAFF EVALUATION: ___ High Value ___ Valuable X Reserve ___ Marginal
SUGGESTED THEMES: Economic-Agriculture; Transportation / Social-Habitation

DATE SUBMITTED TO REVIEW BOARD: ____

REVIEWER'S RECORD AND EVALUATION

NAME: ____ DATE REVIEWED ____
CATEGORY: ___ High Value ___ Valuable ___ Reserve ___ Marginal
SIGNIFICANCE: ___ National ___ State ___ Local
RECOMMENDED DISPOSITION: ___ Nominate National Register ___ State Register ___ Staff Files
RECOMMENDED THEMES: ____

REVIEWER'S COMMENTS: ____

REVIEW BOARD EVALUATION RECORD

DATE REVIEWED: ____ RECORDER: ____
OFFICIAL CATEGORY: ___ High Value ___ Valuable ___ Reserve ___ Marginal
OFFICIAL SIGNIFICANCE: ___ National ___ State ___ Local
OFFICIAL THEMES: ____

OFFICIAL DISPOSITION: ___ National Register Nomination ___ State Register ___ Staff Files
REVIEW BOARD COMMENTS: ____

VOTING RECORD: Daws ___ Hormann ___ Jackson ___ Kikuchi ___
Lind ___ Mark ___ Nagata ___ Paglinawan ___
Roche ___ Tuggle ___

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF STATE PARKS
P. O. BOX 621
HONOLULU, HAWAII 96809

50 / 08 / 1602
Island Quad Site No.

HAWAII REGISTER OF HISTORIC PLACES
SHORT FORM

SITE NAME/TYPE Olowalu Mill District

LOCATION Olowalu, Lahaina

OWNER Pioneer Mill Company

Lahaina, Maui

MERIT: x Architectural x Historical

INFORMATION: Written No x Yes: MAUI NEWS, October 8, 1915; J.C. Conde, Sugar Trains, Felton, 1973; Olowalu Sugar Co., Annual Reports

Informant No x Yes: M.N. Nelson, Pioneer Mill Co/ Olowalu resident

GENERAL DESCRIPTION AND STATEMENT OF SIGNIFICANCE:

This site is being recommended for Reserve status based on a combination of architectural and historical interest. The general interest is mainly historical.

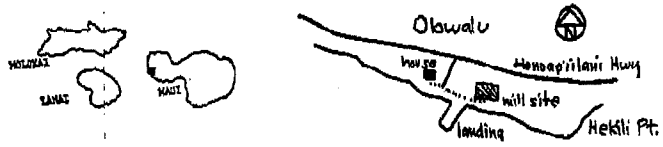
The early history of Olowalu Sugar Company is not clear, and is said to have originated as an enterprise of Kamehameha V (reigned 1863-1872) and was sold in 1877. When Olowalu Sugar Company was incorporated on May 6, 1881, H. Hackfeld & Co. were agents. From about 1898 to 1910, W.G. Irwin & Co. were agents. With the consolidation of Irwin into C. Brewer & Co., the latter assumed the agency until Dedember, 1931, when Olowalu was purchased by Pioneer Mill Co., Ltd.

References to repairs made to Olowalu wharf in 1884, with costs shared by the Hawaiian government and the sugar company, indicate the wharf as having been built several years previously. Little else is known of it at this time.

In 1915, new boilers were installed in the mill and other improvements made. The boilers replaced some which had been in service for 35 years (1880).

The house, built for the company manager, is assumed to have been built either just before or after 1915, with 1910 assumed.

The house is a one-story wooden structure with a sloping hip roof and ventilated gable ends. A front porch seven bays long is marked by a simple balustrade. Rafter ends are left exposed and the house is raised approximately three feet above the grade.



20-48-46 N
156-37-32 W

REASON FOR USE OF SHORT FORM: limited architectural interest- engineering site

SURVEYED BY J.C. Wright RECOMMENDATION Reserve

DATE OF SURVEY March 1974 TAX KEY 4-8-03

LOCATION MAP IS DRAWN ON OPPOSITE SIDE OF SHORT FORM

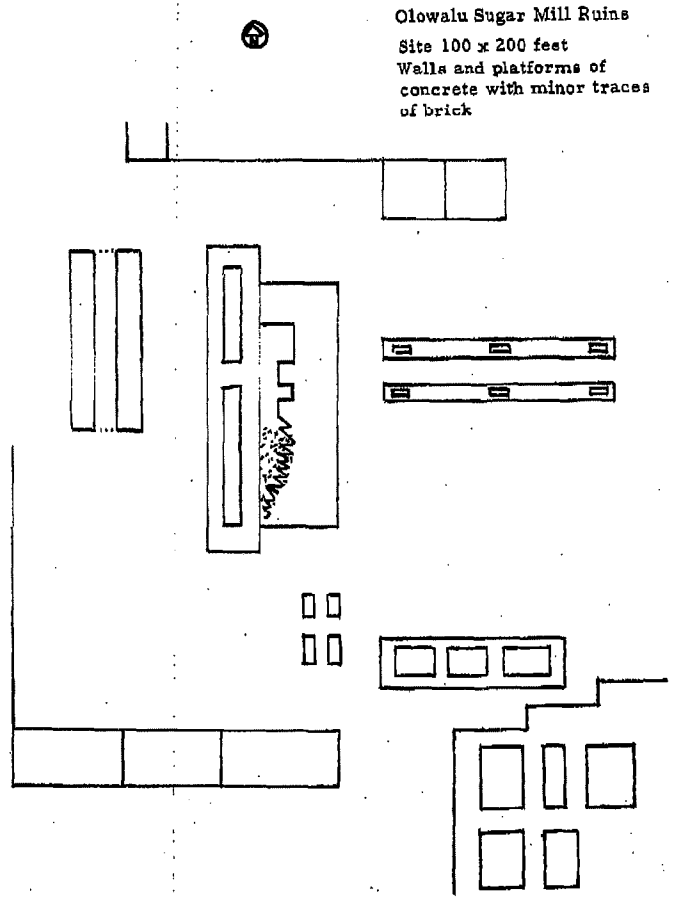
HRHP-4-73A

50-08-1602

HAWAII REGISTER OF HISTORIC PLACES

HISTORICAL SITES INFORMATION AND REVIEW FORM---CONTINUATION SHEET p. 1

Please note subject heading (Statement of Significance, etc.; use separate sheet for each heading).



FORM CS-1

Number 50-08-1602

Name Olowalu Mill District

Review

31 Jul 74 originals sent to state

Review Board Action

Files

Original _____

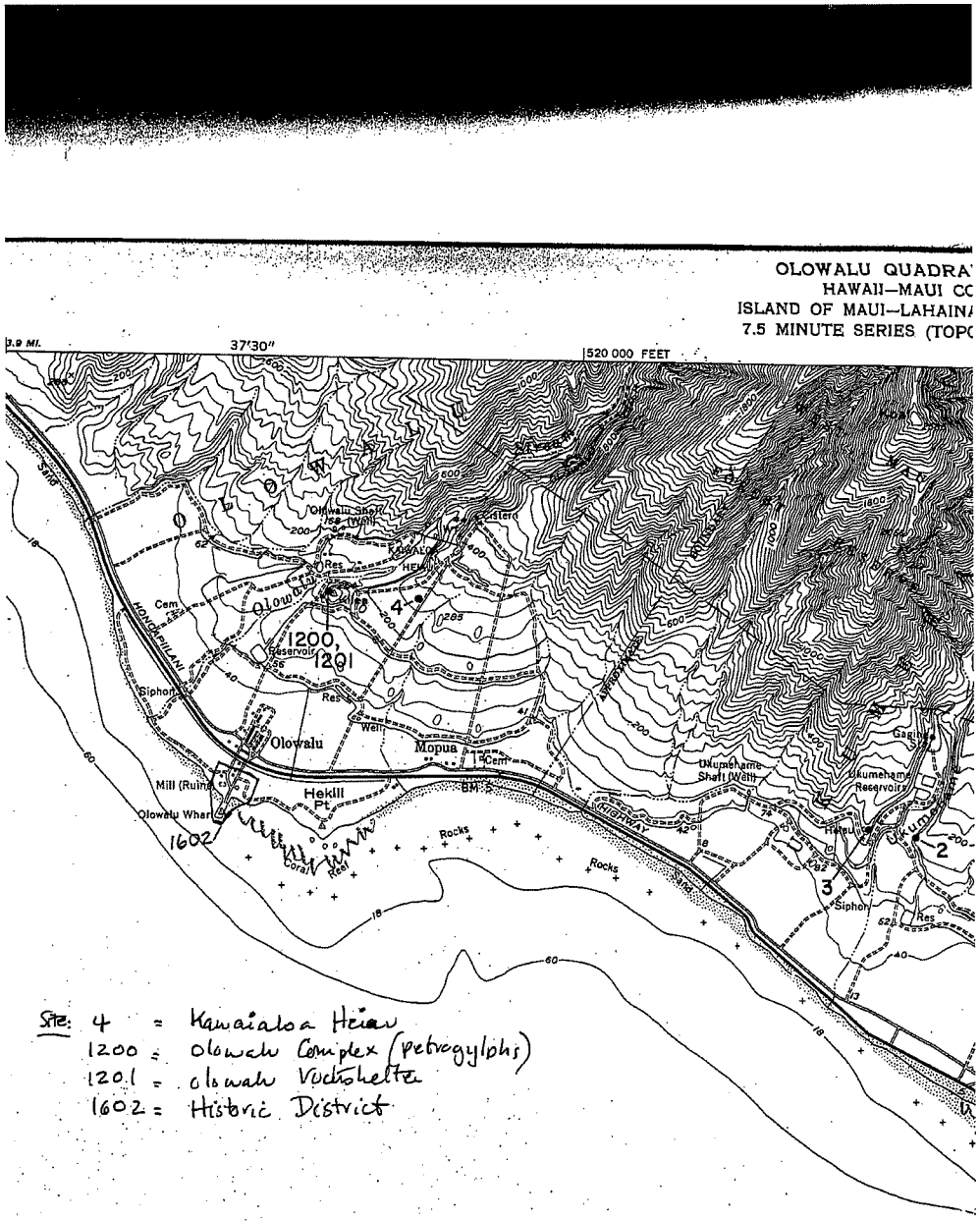
Certification _____

Working _____

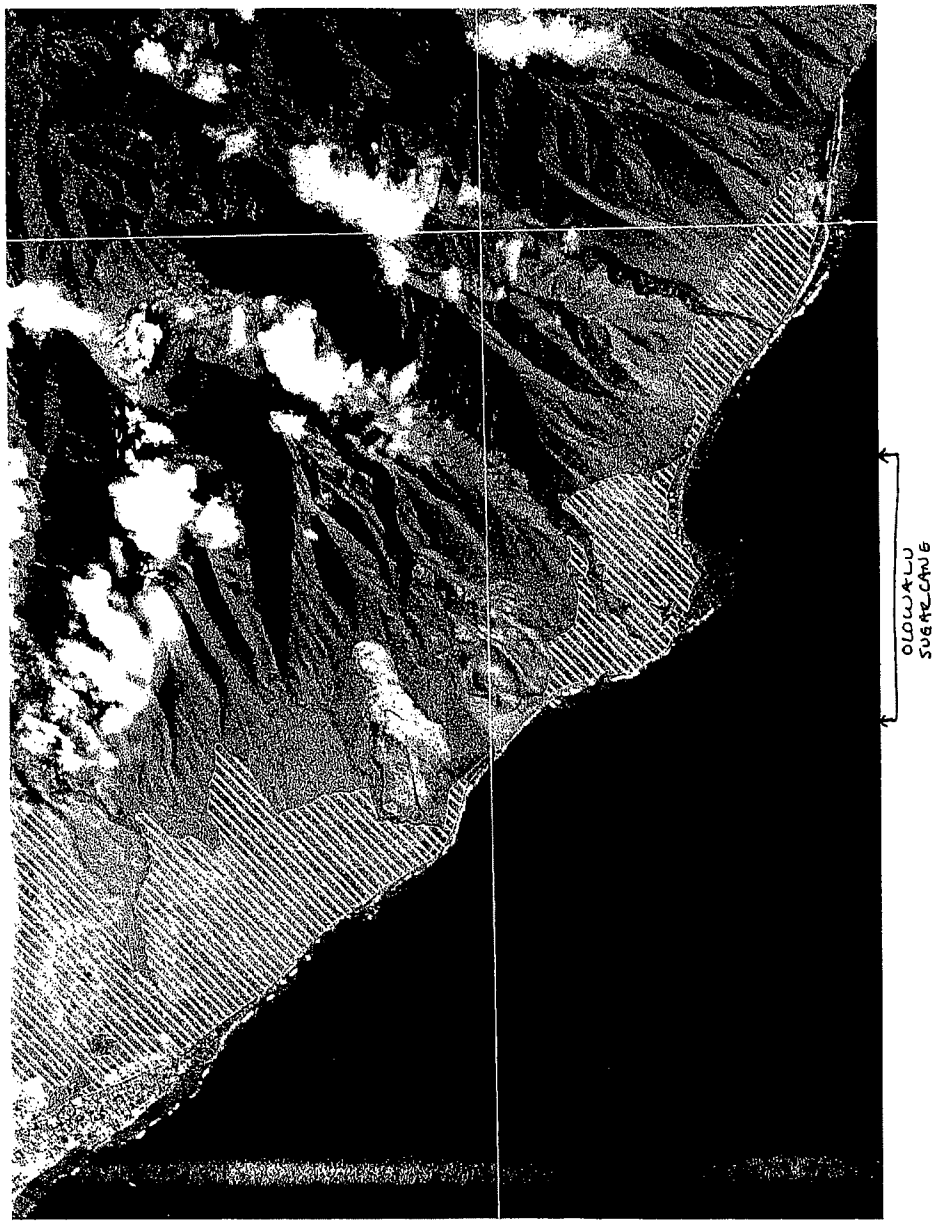
Certification _____

Form 51 ✓

Comment Not yet received (4 Feb 1974)



Site: 4 = Kawaialoa Heiau
1200 = Olowalu Complex (petroglyphs)
1201 = Olowalu Rockshelter
1602 = Historic District



ARCHAEOLOGICAL COVER SHEET

HAWAII REGISTER OF HISTORIC PLACES

50 - 50 - 08 - 1603
1 2 3 4 5 6 7 8 9
SITE IDENTIFICATION NUMBER

2 1 1835
10 11 12 13 14 15 16 17 18 19 20
CARD No. DATE/PERIOD

SITE NAME/TYPE: OLOWALU STONE CHURCH RUINS
DISTRICT: LAHAINA
AREA: Two acres
CATEGORY: X Single Feature ___Complex ___Places
OWNERSHIP: ___Public ___Private
PHOTOGRAPHS: X Yes ___No (Temp/Tech)
KNOWN PRESSURES ON SITE: NONE

PRESENT LAND USES: Religious
DESTRUCTION: X No Known Future Danger ___Possible Future Danger ___Future Danger Certain
___Present Danger ___Presently Being Destroyed
STATUS: X Occupied ___Unoccupied CONDITION: ___Excellent ___Good X Fair ___Deteriorated
INTEGRITY: X Unaltered, Orig Loc ___Unaltered, Moved ___Altered, Orig Loc ___Altered, Moved
ACCESSIBILITY: ___Unrestricted X Restricted ___Inaccessible

LEGENDARY MATERIALS KNOWN: ___Yes X No WRITTEN HISTORICAL MATERIALS: X Yes ___No
IMPORTANCE AS EXAMPLE OF TYPE SITE: X Good ___Moderate ___Poor
SUSCEPTABILITY TO INTERPRETATION: ___Good X Moderate ___Poor
RESEARCH POTENTIAL: ___Good X Moderate ___Poor
LOCAL ATTITUDES ABOUT SITE: X Valuable ___Moderate Value ___Low Value ___Ambivalent ___Unknown
BRIEF DESCRIPTION (Columns 21-80): Ruins of the early mission stone church 30 x 60 feet.

STAFF EVALUATION: ___High Value X Valuable ___Reserve ___Marginal
SUGGESTED THEMES: World View-Religion / Art-Architecture

DATE SUBMITTED TO REVIEW BOARD: ___

REVIEWER'S RECORD AND EVALUATION

NAME: ___ DATE REVIEWED ___
CATEGORY: ___High Value ___Valuable ___Reserve ___Marginal
SIGNIFICANCE: ___National ___State ___Local
RECOMMENDED DISPOSITION: ___Nominate National Register ___State Register ___Staff Files
RECOMMENDED THEMES: ___

REVIEWER'S COMMENTS: ___

REVIEW BOARD EVALUATION RECORD

DATE REVIEWED: ___ RECORDER: ___
OFFICIAL CATEGORY: ___High Value ___Valuable ___Reserve ___Marginal
OFFICIAL SIGNIFICANCE: ___National ___State ___Local
OFFICIAL THEMES: ___

OFFICIAL DISPOSITION: ___National Register Nomination ___State Register ___Staff Files
REVIEW BOARD COMMENTS: ___

VOTING RECORD: Daws___ Hormann___ Jackson___ Kikuchi___
Lind___ Mark___ Nagata___ Paglinawan___
Roche___ Tuggle___

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF STATE PARKS
P. O. BOX 621
HONOLULU, HAWAII 96809

50 / 08 / 1603
Island Quad Site No.

HAWAII REGISTER OF HISTORIC PLACES
SHORT FORM

SITE NAME/TYPE Olowalu Stone Church Ruins

LOCATION Mopua, Lahaina

OWNER Hawaii Conference United Church of Christ

Honolulu, HI

MERIT: x Architectural x Historical

INFORMATION: Written __No x Yes: Maui Historical Society, Lahaina Historical Guide. 1971
Reports, Hawaiian Mission Children's Society

Informant x No __Yes:

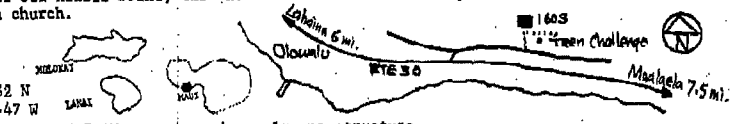
GENERAL DESCRIPTION AND STATEMENT OF SIGNIFICANCE:

This site is being recommended for Valuable status based on a combination of architectural and historical interest.

The general shore district of Olowalu was a small Hawaiian village of farmers and fishermen, located about half way between Lahaina and Maalaea, toward Wailuku. A mission station from Lahaina was established at Mopua in 1835, and in 1837 a small adobe and thatch roof church was built. Early in 1858, work began on the construction of a stone church and by May, 1859, the walls were completed. The exact date of the finishing of the church is not known. Originally, it may have had a thatch roof, but a previously unidentified photograph, most likely taken about 1890, shows the church with a shingled gable roof and short square steeple.

Members of the church voted in 1868 to become an independent church, keeping that status until 1897 when again the church affiliated with the mother church in Lahaina. (The usual founding date of May 10, 1868, relates to this) At some time prior to 1930 the church was abandoned. Clearing and reconditioning work was done in 1960 by an ecumenical work group. Services in Lahaina during the Whaling Spree include an offering of funds for eventual reconstruction of the church. Care is given to the property by the nearby camp used by Teen Challenge, a religiously oriented drug rehabilitation program.

The church ruins stand on a slightly sloping plain with the mountains to the northeast forming a spectacular background. On the W side of the ruins are remains of a cemetery, heavily overgrown. The walls of the church are 30 by 60 feet, parts being collapsed, and the loose rock has been piled outside the S entrance. Three window openings are indicated for each side, with one at the N end, the altar end. Constructed of fieldstone set in mortar, with quoins of coral blocks cut from the reef off Hekili Point, the church once was a fine example of a Protestant mission church.



20-48-52 N
156-36-47 W

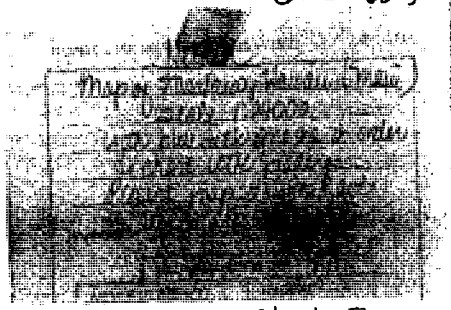
REASON FOR USE OF SHORT FORM: stone ruins only- no structure

SURVEYED BY J.O. Wright RECOMMENDATION Valuable

DATE OF SURVEY March 1974 TAX KEY 4-8-03-18

LOCATION MAP IS DRAWN ON ~~OPPOSITE~~ SIDE OF SHORT FORM

Site 1603



Memo to Short Form

FORM CS-1

Number 50-08-1603

Name Olowalu Stone Church Ruins

Review

31 Jul 74 Originals sent to state

Review Board Action

Files

Original _____

Certification _____

Working _____

Certification _____

Form 51 ✓

Comment Not yet reviewed (Oct 20th, 74)
poor reason for use of short form
with actual history for valuable site

Appendix B SHPD Correspondence

4-8-003 : por010

April 12, 2000

TMK: 4-8-3:10

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

TIMOTHY E. JOHNS, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES

DEPUTIES
JANET E. KAWELO

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
Kakuhihewa Building, Room 555
601 Kamokila Boulevard
Kapolei, Hawaii 96707

AQUATIC RESOURCES
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CONSERVATION AND RESOURCES
ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
LAND
STATE PARKS
WATER RESOURCE MANAGEMENT

April 12, 2000

Mr. Robert Horcajo
Olowalu Elua Associates, LLC
173 Ho Ohana Street, Suite 201
Kahului, Hawaii 96732

LOG NO: 25237
DOC NO: 0004RC10

Dear Mr. Horcajo:

SUBJECT: Review of Archaeological Inventory Survey –Mauka Olowalu Lands
Olowalu, Lahaina, Maui
TMK: 4-8-3: 10

This letter reviews this revision of this report which our staff received March 20, 2000 (Dee Fredericksen & Erik Fredericksen 2000. Archaeological Inventory Survey of Mauka Portion of Olowalu Development Parcel ... Xamanek ms.). The report is now acceptable.

We can now conclude that all historic sites have been found, totaling 34 sites. It now seems clear that the irrigated kalo fields along the lower stretches of Olowalu Stream were destroyed by intensive land clearing activities of the sugarcane industry. The background section is acceptable, as are site descriptions and interpretations.

Only remnants of the precontact to early 1800s Hawaiian settlement pattern survive – notably one large heiau (site 4, Kawaiakoa heiau), a medium-size heiau (4718), the burial area on Pu'u Kilea (4715), and inland of Pu'u Kilea, sites along Olowalu Stream associated with habitation and irrigated kalo farming (including two small, possible agricultural heiau in sites 4701 and 4708). Petroglyphs are also present in sites 1200, 4704, 4708. Remnants of the sugarcane era (late 1800s-1900s) include walls, canals, and a workers' cemetery. Burials are present in 9 sites – including cemeteries at Pu'u Kilea (Hawaiian), some unmarked graves extending from the Old Hawaiian Protestant Church, and a plantation era Japanese cemetery.

We agree with the significance evaluations that are proposed in Table 4 (p. 73). Eight of the 34 sites were significant solely for their information content, but they contained minimal information (being late 1800s-1900s walls, or having been severely damaged) and this information was adequately and reasonably recorded, making these sites "no longer significant". The remaining 26 sites are significant – 9 solely for their information content and 17 for multiple criteria.

We also agree with the proposed mitigation commitments for the 26 significant sites, with some clarifications. Nineteen of the sites are proposed for preservation, while 5 sites are proposed for archaeological data recovery, and 2 are proposed partly to be preserved/partly data recovered.

APR 17 2000

We are pleased to see that a number of the sites are proposed for interpretive preservation, which we believe will enhance the public's understanding of past settlement in this area of Maui. These sites include the large heiau and moderate-sized heiau on the slopes not far from the former houses and lo'i once located along Olowalu Stream, two sites with sizable numbers of petroglyphs, and an irrigated kalo field complex. This part of Maui (indeed the entire island) has very few interpreted historic sites which are accessible to the public. Some sites are to be interpreted in the Launiupoko area (habitations and some dry land agricultural features near the mouth of the upper valley and some temporary habitations – rock shelters – along the lower reaches of Launiupoko Stream), and with the addition of sites being interpreted in Olowalu, the public will be able to go to a series of historic preserves and see how Hawaiians used the landscape in the Lahaina area in the past. We hope eventually to expand this picture with sites being preserved in the upper valleys (such as upper valley lo'i and houses) and along the shore (coastal habitations in the form of subsurface deposits, ponds, and irrigated kalo fields) including important places in Lahaina which was a royal center in precontact times up to the time of Kamehameha III. Having such sites preserved improves the public's understanding of the past, enabling people to see and touch places where people once lived, farmed and worshipped in addition to seeing objects in Museums and reading about the past in books.

We are also pleased to see that one of the sites to be archaeologically data recovered is the buried marsh/lagoonal soils (site 4823). These soils may have the potential (through pollen cores) to identify when permanent settlement began along this shoreline. Often pollen shows vegetation changes reflecting human clearing of vegetation for farming. Current scientific models suggest that the Lahaina area may have been one of the earliest leeward areas settlement on Maui with its small flowing streams, perhaps as early as the A.D. 1000s. Thus, data recovery work may be able to shed light on this important subject.

Our few clarifications are:

1. The Maui Island Burial Council must vote on the burial treatment proposals, before those proposals can be considered final. Most burials are recommended for preservation in place, which is the general policy of our office and the councils. But, we note that two sites (4820 & 4821, each a scatter of human bone, evidently single burials disturbed by cane activities) are proposed for removal (and data recovery) and reinterment. The text on page 69 states as if this will occur. However, the Burial Council must first vote on this proposal, and it is possible that they would recommend preservation in place. (If removal were approved, then archaeological data recovery and monitoring would be a component of removal. If preservation in place were approved, then archaeological monitoring in the vicinity, to ensure all bones are recovered and placed in the preservation area, would be a component of the preservation plan.)

2. It must be understood that no preservation activities should occur without an approved preservation plan. We understand that your firm may be planning to deed over preserve areas to a local group for them to care for the sites, or possibly have a group act as curator. While this seems fine, it needs to be clear that no preservation tasks should begin without a plan approved by our office and the County. This means that the preservation actions will be appropriate. In cases like this, where native Hawaiian sites are involved, our policy is that the local Hawaiian community be consulted in the preparation of the preservation plan or be able to comment on the plan before the plan is submitted to our office for review.

Again, we find the survey report acceptable. Please send a copy of the final report to our Maui office also.

Clearly, the proposed development of this area will impact the significant historic sites that are present. The proposed mitigation commitments (preservation and data recovery) will help reduce the impacts of the development and should have educational benefits to the public at large. To ensure that the mitigation commitments are acceptably carried out, we recommend to the County by copy of this letter that any approved permit application contain the following standard conditions:

1. The Maui/Lana'i Islands Burial Council must vote on the mitigation proposals for all burials.

2. The survey report identifies sites which shall be preserved. The applicant shall submit a detailed preservation plan (scope of work) for these sites to the State Historic Preservation Division (SHPD) for approval. This plan will include buffer zones, interim protection measures (as needed), and long-range preservation plans. No land alteration may occur in the vicinity of these sites until minimally the buffer zones and interim protection measures are approved and the SHPD verifies the interim protection measures are in place. No preservation activities may occur in these sites until the preservation plan is approved. The SHPD shall verify in writing to the County when the plan has been successfully executed.

3. Archaeological data recovery shall occur at the sites so identified in the survey report. The applicant shall submit an archaeological data recovery (scope of work) for these sites to the State Historic Preservation Division (SHPD) for approval. The SHPD shall verify in writing to the County when the plan has been successfully executed.

If you have any questions, please feel free to contact our office. Assuming that all permits will be obtained from the County and/or State, we will await receiving the preservation and data recovery plans. Ross Cordy, our Branch Chief for Archaeology (692-8025), can be contacted on those matters. Please contact Ka'iana Markell of our Burials Program (587-0044) for placement on the Burial Council's agenda and for information that the Council will need to see.

Aloha,

Don Hibbard, Administrator
State Historic Preservation Division

RC:jen

c: Public Works Department, County of Maui
Planning Department, County of Maui
Maui Cultural Resource Commission
Ed Henry, DLNR Land Division
Chair, Maui/Lanai Island Burial Council
Dee Fredericksen, Xamanek Researches

4-8-003:010,050-82,
4-8-004:011-016
Mar 7, 2002

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

4-8-3:10 50-82
4-8-4:11-16

GILBERT S. COLOMA-AGARAN, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCES MANAGEMENT

DEPUTIES
ERIC T. HIRANO
LINNEL NISHIOKA

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
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601 KAMOKILA BOULEVARD
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STATE PARKS

March 7, 2002

Mr. Bob Horcajo
Olowalu Elua Associates
173 Ho'ohana Street, Suite 201
Kahului, Hawai'i 96732

LOG NO: 29336
DOC NO: 0202MK03

Dear Mr. Horcajo,

SUBJECT: Historic Preservation Review - Site Preservation Plan, Draft 2
Mauka Portion, Olowalu Elua Associates
Olowalu Ahupua'a, Lahaina District, Maui
TMK (2) 4-8-3:10, 50-82, 4-8-4:11-16

Thank you for the opportunity to review this revised plan which was sent to our office on January 22, 2002.

In this letter we specifically address your revisions to our initial recommendations. The buffer zones have been established and field checked by our office. The boundaries of the cultural preserve will not serve as the buffer, and you have provided a rationale for this decision. Instead, each site within the cultural preserve will have a set buffer zone boundary. You have clarified the following points.

1. Public access. You have clearly stated that access will be provided from either new or existing roads or trails. For sites within the preserve, access will be facilitated by pedestrian trails. Maintenance roads within the preserve may provide vehicular and ADA compliant access.

2. Maintenance. Clarification has been made regarding the removal of alien trees which will occur by flush cutting and rotting, not mechanical removal, and some trees may be left as barriers or to provide shade.

3 and 4. Fencing/Hedges and Landscaping. No landscaping is proposed at this time. The rationale for this is that sites within the cultural preserve will be under the jurisdiction of the OCR (Olowalu cultural preserve), a non-profit corporation. No plans are formalized for these sites, as input from the Board of the OCR is necessary. It is clear in the preservation plan that when specific landscaping plans are developed, they will be submitted to our Division for review, as amendments to the plan.

5. Viewing platforms. Viewing platforms will be constructed only for Sites 4718 and 4710. These will utilize existing natural materials, including soil and field boulders. You have indicated that the platforms serve only to afford a view of the site, but other forms of access will be discouraged by signage.

6. Boundary Markers. The markers will consist of concrete blocks, 12" at the base, 7" at the top, with an overall height of 12". We question the height, it might be more appropriate to have the boundary markers higher so that they would be more visible. The hard plastic tags are satisfactory, providing they cannot be easily defaced.

7. Sign Text. The sign texts have incorporated some of our suggested language and seem acceptable, with one minor exception, and with the understanding that it will be addressed, we can approve the text.

1. Site 4 text. We recommend that the last paragraph be deleted. The reference to paganistic could be misinterpreted by some individuals. The first paragraph is sufficient to clearly indicate the importance of the heiau.

8. Preservation Commitment. Appropriate clarification has been made to this section.

The preservation plan is acceptable. If you have any questions, please contact Dr. Melissa Kirkendall at 243-5169.

Aloha,

Don Hibbard, Administrator
State Historic Preservation Division

MK:jen

c: John Min, Director, Department of Planning, County of Maui, FAX 270-7634
Bert Ratte, County of Maui, Land Use and Codes, FAX 270-7972
Glen Ueno, County of Maui, Land Use and Codes, FAX 270-7972

MAR 11 2002

4-8-3:1, 3, 4, 5, 6, 33, 41-49, 8 & 84

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

GILBERT S. COLOMA-AGARAN, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

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April 16, 2001

Mr. Robert Horcajo
Olowalu Elua Associates, LLC
173 Ho'ohana Street, Suite 201
Kahului, Hawai'i 96732

LOG NO: 27285
DOC NO: 0103MK08

Dear Mr. Horcajo,

SUBJECT: Review of Archaeological Mitigation and Preservation Plan the Makai Portion
Olowalu Ahupua'a, Lahaina District, Maui
TMK 4-8-3:1, 3, 4, 5, 6, 33, 41-49, 83 &84

Thank you for the opportunity to review this combined mitigation and preservation plan which our staff received on January 25, 2001 (Olowalu Elua Associates, LLC, 2001, *Archaeological Mitigation & Preservation Plan, Makai Portion (Phase I) Olowalu Ahupua'a, Lahaina District, Maui Island, TMK 4-8-3:1,3,4,5,6,33,41-49,83&84)*...Olowalu Elua Associates, LLC ms.

The preservation plan includes six sites recommended for in-place preservation – Site 4693, consisting of burials and a subsurface archaeological deposit outside of the burial area (burials covered under a separate preservation plan), Site 4694 (a wall structure on the subject parcel and on State Beach Reserve Land), Site 4697 (subsurface archaeological deposit), Site 4698 (subsurface archaeological deposit) and Site 1602 (the Olowalu Mill Complex), and the gleyed soils.

Interim protection of the sites will be provided by placement of temporary fencing along the buffer edge where construction may occur. This will be in place for any sites where construction will occur within one hundred feet (100'). Construction supervisors will be notified as to the nature and location of the site through written and verbal notice. This is acceptable, but the plan needs minor revision to include a statement saying that once the fences are in place our Division will be contacted, and our Division will then verify in writing that the interim protection measures are in place.

Long term preservation will consist of boundary markers along the outer edge of the buffer zones. Buffer zones vary on each site (10 feet for Sites 4694, 4697, and 4693, 30 feet for Site 1602). This is acceptable.

Public Access for Site 4694 is along Beach Reserve access, and has no limitations. Access to Site 1602, the mill area, will be during daylight hours seven days a week. Access issues are not applicable for Sites 4697, and 4698, subsurface deposits. This part of the plan is acceptable.

Maintenance measures are applicable for Site 4693 (detailed in burial treatment plan) and 1602 (flush cut trees, native plants in an area that will not damage the structure). All maintenance is the responsibility of Olowalu Elua Associates, LLC.

Signage as indicated in the preservation plan consists of the State Site Number, the ahupua'a, moku, and island, and function. A brief description/explanation of each site is also included on each sign. Signs conclude with citation of appropriate statutes. The heading and text of some signs do need revision. Please see the attachment.

Archaeological monitoring will be conducted on the Eastern shoreline sand areas in case subsurface historic sites are found, allowing for their identification, documentation and appropriate treatment. The monitoring plan is acceptable.

Please make the minor revisions to the preservation plan. You can replacement pages if you wish. As always, if you disagree with our comments or have any questions, please contact our review staff as soon as possible to resolve these concerns. Should you have questions, please contact Dr. Melissa Kirkendall (Maui/Lana'i SHPD 243-5169).

Aloha,

Don Hibbard, Administrator
State Historic Preservation Division

MK:jen

Attachment

c: John Min, Director, Department of Planning, County of Maui, FAX 270-7634
Bert Ratte, County of Maui, Land Use and Codes, FAX 270-7972
Glen Ueno, County of Maui, Land Use and Codes, FAX 270-7972

ATTACHMENT

REVISIONS FOR SIGNAGE OLOWALU MAKAI

1. To standardize the headings of all the signs, please have them read like the following:

   Historic Site 4694
   Olowalu Ahupua'a
   Lahaina Moku, Maui

   Habitation Site

2. Sign for 4694.

   a. There should be an initial paragraph supplying some ahupua'a context. For example, it could say "In pre-European times, Olowalu had permanent houses located along the shoreline, scattered up along Olowalu stream, and in the distant upper valley. When the land system was converted to private lands in the late 1840s, several house lots (kuleana) were awarded to commoner families in this area."
   b. There should then be a second brief paragraph which says something about this specific site. What does it look like? What was found in it? How old was it? Any of these points could be made.

3. Sign for 4697

   a. As with 4694, a brief introductory paragraph is needed to provide some ahupua'a context for the reader. This should not be the same paragraph as in previous signs.
   b. As with 4694, then say something about this specific site's archaeological appearance, finds, function, or age.

4. Sign for 4698

   a. As with 4694, a brief introductory paragraph is needed to provide some ahupua'a context for the reader. This should not be the same paragraph as in previous signs. This sign text mentions that a family would also have farm lands in the lowlands or upper valley, and that could be the focus of the general statement.
   b. As with 4694, then say something about this specific site's archaeological appearance, finds, function, or age. Do not say late-precontact habitation site. If a radiocarbon date is available, say something like: Two archaeological dates from this site indicate it was occupied from the A.D. 1600s to European contact (1779).

5. Sign for Site 1602. This sign text is good. In the heading, delete the "Historic" in front of "Sugar Mill Ruins". It will already say historic site at the top of the sign.

TMK 4-8-3 por 5

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

STATE OF HAWAII

DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
Kakuhihewa Building, Room 555
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February 25, 2000

Mr. Robert Horcajo, Project Manager
Olowalu Elua Associates, LLC
173 Ho Ohana Street, Suite 201
Kahului, Hawaii 96732

LOG NO: 24957
DOC NO: 0002RC39

Dear Mr. Horcajo:

SUBJECT: Review of Revised Archaeological Inventory Survey Report – Olowalu Makai Development Parcel
Olowalu, Lahaina, Maui TMK: 4-8-3: portion 5

This letter reviews the revised report which was submitted February 7, 2000 and received in our office on February 9th (D. Fredericksen & E. Fredericksen 2000. Archaeological Inventory Survey of Makai Portion (Phase 1) of Olowalu Development Parcel ... Xamanek ms.). This revision addresses our review letter of January 14, 2000 (Log: 24,721; Doc: 0001RC11).

The summary of the ahupua'a settlement pattern in the background section of the report is better, but it still does not summarize the details of all the important information that was presented in that section of the report. However, rather than ask for another revision, our staff will prepare a detailed summary which will be placed in our library along with the report.

The revision has addressed all our other concerns, particularly regarding site size, descriptions, and interpretation matters. The report is now acceptable.

Although many precontact and early 1800s habitation sites may have been along the shoreline in this project area, sugarcane cultivation has apparently destroyed most of these sites. A fishpond to the east seems to be under the highway today, and it appears not to be in the project area. Seven archaeological sites, plus gleyed marsh soils with [illegible] cultural importance, survive in the project area. These include 4 precontact to early 1800s sites (3 [illegible] – 4694, 4697, and 4698; 1 burial site – 4693) plus the gleyed marsh soils, and 3 late 1800s-[illegible] the Olowalu Mill Complex – 1602; a road remnant – 4696; a sea wall apparently associated with a road remnant – 4695).

[illegible] report's significance [illegible] The road remnant [illegible] sea wall [illegible] "[illegible]" [illegible] revealed important information [illegible] during the survey. The precontact to early 1800s habitation sites are significant [illegible] condition, as are the gleyed marsh [illegible] contain important pollen and charcoal material for dating initial settlement along this coast. [illegible] (4693) and the Olowalu Mill Complex (1602) are significant under multiple criteria. As [illegible] our review letter of January 14th contained an error in final editing. Table 2 should have "no longer significant", not D, in the significance column for 4695 and 4696 and simply "no further work" or no entry at all in the mitigation column (as only significant sites need mitigation). We apologize for this, but could you please have Table 2 revised accordingly and send a replacement page? This change will clearly show to all readers of the report that these 2 sites are not significant.

Last, we agree with the revised mitigation proposals for the 5 significant sites and the gleyed marsh soils. The 5 sites will be preserved, and the gleyed marsh soils will undergo archaeological data recovery. These actions will alleviate (mitigate) the adverse effects of the proposed project to these sites.

Thus, by a copy of this letter, we recommend to the County and State permitting agencies that the following standard conditions be attached to any approved permits, to ensure that the mitigation commitments to treat the significant sites are acceptably carried out:

1. Five sites shall be preserved (3 precontact to early 1800s habitations sites – 4694, 4697, 4698; 1 burial site – 4693; and the Olowalu Mill Complex – 1602). A preservation plan for all sites but the burial site must be submitted to and be approved by the State Historic Preservation Division (SHPD) (including buffer zones, as appropriate around the sites, interim protection measures, and long-term preservation measures). The preservation proposal and plan for the burial site shall be submitted to the Maui/Lana'i Islands Burial Council for vote. Minimally, the buffer zones and interim protection measures shall be in place (and verified in writing by the SHPD) prior to land alteration in the area of the sites. The SHPD shall verify in writing to the permitting agencies when the plan has been successfully completed.

2. The gleyed marsh soils shall undergo archaeological data recovery. An archaeological data recovery plan (scope of work) shall be submitted to and be approved by the State Historic Preservation Division (SHPD) prior to the beginning of the data recovery work. This scope should be completed, before a data recovery contract is negotiated. Minimally, data recovery fieldwork must be successfully concluded (and verified in writing by the SHPD) prior to land alteration in this part of the project area. The SHPD shall verify in writing to the permitting agencies when the plan has been successfully completed.

3. Archaeological monitoring of land altering construction in the sand areas along the shore shall occur, as a contingency to identify, document and treat any burials that might be found. A monitoring plan (scope of work) shall be submitted to and be approved by the State Historic Preservation Division (SHPD) prior to the beginning of the monitoring. This plan (which need only be a few pages long) must specify how any burials that are found will be documented archaeologically, notification procedures, and treatment measures that will be taken. This scope should be completed, before a monitoring contract is negotiated.

If you have any questions, please feel free to contact Dr. Cordy at 692-8025.

Aloha,

Don Hibbard, Administrator
State Historic Preservation Division

RC:jen

c: Land Division, DLNR (CDUA application)
Planning Department, County of Maui
Public Works Department, County of Maui
Burials Program, DLNR
Maui/Lana'i Islands Burial Council Chair

MR – 7 [illegible]

4-8-03:44

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

HISTORIC PRESERVATION DIVISION
KAKUHIHEWA BUILDING, ROOM 555
601 KAMOKILA BOULEVARD
KAPOLEI, HAWAII 96707

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

DAN DAVIDSON
DEPUTY DIRECTOR - LAND

ERNEST Y.W. LAU
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
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CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
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FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

June 25, 2003

Mr. Erik Fredericksen
Xamanek Researches
P.O. Box 880131
Pukalani, Hawai'i 96788

LOG NO: 2003.0954
DOC NO: 0306MK31

Dear Mr. Fredericksen,

SUBJECT: Chapter 6-E-42 Historic Preservation Review-Archaeological Monitoring Report 1.3 Acres of Land on the Olowalu Makai Project Area, for Mr. Glenn Mason
Olowalu Ahupua'a, Lahaina District, Maui
TMK (2) 4-8-03:44

Thank you for the opportunity to review this report which was sent to our office on May 14, 2003 (Fredericksen 2003, *Archaeological Monitoring Report for a 1.3 Acre of land on the Olowalu makai project area, Olowalu ahupua'a, Lahaina District, Maui,[TMK:2-4-8-03:44].* Xamanek ms). Monitoring was required because the parcel is located within Pu'uone Sand series.

The monitoring program conformed to DLNR/SHPD guidelines governing standards for monitoring and included the following provisions. An archaeologist was on site on a full-time basis with the authority to halt excavation in the event that cultural materials were identified. Consultation with Maui SHPD was to occur in this event, to determine acceptable course of action. Coordination meetings with the construction crew were held prior to project initiation. The monitoring report has been submitted to this office within 180 days of project completion.

No historic properties were identified during the monitoring program. The deposits consisted of sterile marine sand, underlying most of the impacted portions of the project.

We concur with the recommendation that future projects in the Olowalu makai area continue be monitored archaeologically, as three historic properties, Site 50-50-08-4693, 4697, and 4698 were identified below the plow zone of the former sugar cane land, and additional historic properties may be identified in the future.

The report is acceptable. If you have any questions, please contact Dr. Melissa Kirkendall at 243-5169.

Aloha,

P. Holly McEldowney

P. Holly McEldowney, Administrator
State Historic Preservation Division

MK:jen

c: Michael Foley, Director, Department of Planning, County of Maui, FAX 270-7634
Bert Ratte, County of Maui, Land Use and Codes, FAX 270-7972
Glen Ueno, County of Maui, Land Use and Codes, FAX 270-7972
Cultural Resources Comm, Plng Dept, 250 S. High Street, Wailuku, HI 96793

4-8-003:008 + 040

4-7-001:002

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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

December 15, 2008

Erik M. Fredericksen, M.A.
Xamanek Researches, LLC
P.O. Box 880131
Pukalani, Hawai'i 96768

LOG NO: 2008.3073
DOC NO: 0812PC10
Archaeology

Dear Erik:

SUBJECT: **Chapter 6E-8 Historic Preservation Review –**
Archaeological Inventory Survey for the Proposed Lihau Natural Area Reserve System
Firebreak Corridor and Associated Lateral Road Improvements
Olowalu and Launiupoko Ahupua'a, Lahaina District, Island of Maui
TMK: (2) 4-8-003:008 por., 040 por. and (2) 4-7-001:002 por.

Thank you for the opportunity to review this report, which our staff received on July 25, 2008 (Madeus and Fredericksen 2008): *An Archaeological Inventory Survey for the Proposed Lihau Natural Area Reserve*...Xamanek Researches, LLC.

Please accept our apologies for the lengthy delay in commenting, which was due to misinformation regarding the Department of Forestry and Wildlife's exemption from report/plan review fees. The SHPD agrees that such documents submitted for contract work *paid for by* other divisions within the state Department of Land and Natural Resources should be reviewed free of charge and is in the process of determining whether we can offer this as a courtesy at the time of review or whether it will require a formal change in our program rules.

The survey area as described in the report consists primarily of a 4.8 kilometer (3 mile) long x 16 meter (52 foot) wide corridor of pre-existing unpaved access roads totaling approximately 18.2 acres (7.28 hectare) in size, which the DLNR Division of Forestry and Wildlife would like to improve for use as a firebreak corridor. Field work, undertaken on December 11 of 2007, was comprised of a 100% pedestrian survey of the proposed area of impact with a follow-up field inspection on March 10 of 2008 and included the manual excavation of one 1.0 m x 1.0 m test unit. One new post-Contact era site, now on record as SIHP #50-50-03-6481 Feature A [three rock wall segments with posts and wire fence] and Feature B [crudely built non-weathered circular rock mound] was identified. Feature A is believed to have been related to animal husbandry activity, while the function of Feature B is not certain, as subsurface testing within it produced no significant material culture which might otherwise indicate its purpose. Although not formally recorded, four additional historically significant plantation era features [1933 entrance to the Olowalu Well, concrete irrigation ditch, basalt terrace and basalt wall segments] were also observed just outside of the current project area.

The report contains most of the required information as specified in HAR §13-276-5 regarding report documentation of inventory level field work completed in general; however, the following revisions are requested:

1. Please clarify whether the two lateral roads in need of improvement are included in the 18.2 acre figure provided for the total land area surveyed. If not, this information must be added to the report. The information is necessary not only for SHPD's own records, but we required to accurately

document how many acres are covered by inventory surveys each fiscal year as a condition of our federal grant operating grant appropriation;
2. Page 8: references Olowalu LCAs being in the "upper reaches of the property" (see below) but the last sentence of the third paragraph then states that no LCAs are present within the project area;
3. Page 9/Table 1: this table appears to have been taken directly from an earlier report located solely within Olowalu *ahupua'a* and although the inventory survey report states that no LCAs are within current project area, it is like a fish out of water because there is no similar discussion of the LCAs within/near the portion of Launiupoko *ahupua'a* included in the survey – reusing something you've already got is not a problem as long as you add what's missing so it is complete;
4. Page 18: a significant amount of previous archaeological work has been conducted within the *mauka* portions of Launiupoko *ahupua'a* within recent years, yet there is no mention of it here;
5. Page 27 (Results of Fieldwork): given that the project area includes multiple TMKs, the specific TMK where identified sites are located needs to be specified.

We concur that SIHP #50-50-03-6481 is significant under Criterion D of the Hawai'i Register of Historic Places for its ability to yield important information related to prehistory or history and that no further work with respect to the site itself is needed because it is significant solely for information content and a reasonable and adequate amount of that information was collected during the survey. Further, in light of the fact that SIHP #50-50-03-6481 is expected to be impacted by the proposed firebreak corridor as well as the presence of four nearby unrecorded features, we agree with your recommendation for precautionary archaeological monitoring during all ground altering disturbance work near the site and those areas which have not been previously subjected to such disturbance.

We have received a monitoring plan for review, to which we will respond under separate cover once the AIS report has been accepted. However, to eliminate further delay you may choose to proactively revise and resubmit the monitoring plan if it does not clearly specify the distance around SIHP #50-50-03-6481 and other locations within the subject parcels that will be subject to precautionary monitoring and depict the location of proposed orange fencing in relation to the site(s) on a U.S.G.S. topo map.

In support of SHPD's digital archiving project, you may submit one copy of the revised document in PDF format directly to the reviewer at the following email address: Patty.J.Conte@hawaii.gov.

Aloha,

Nancy A. McMahon

Nancy McMahon, Deputy SHPO/State Archaeologist
State Historic Preservation Division

c: Jeff Hunt, Director, Dept. of Planning, 250 S. High Street, Wailuku, Hawai'i 96793
Maui CRC, Dept. of Planning, 250 S. High Street, Wailuku, Hawai'i 96793
Bryon Stevens, DLNR-DOFAW Maui, 54 S. High Street, Wailuku, Hawai'i 96793

February 11, 2008
4-8-004:010

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February 11, 2008

Ms. Patty J. Conte
CRM Solutions Hawaii, Inc.
P.O. Box 1866
Makawao, Hawaii 96768

LOG NO: 2008.0957
DOC NO: 0802TD16
Archaeology

Dear Ms. Conte:

SUBJECT: Chapter 6E-42 Historic Preservation Review of an Archaeological Field Inspection Report for a 10,459 square foot Parcel in the Olowalu Subdivision Olowalu Ahupua'a, Lahaina District, Island of Maui TMK: (2) 4-8-04:10

Thank you for submitting a letter report entitled *Notice of Field Inspection Completed* (P.J. Conte letter to M. Kirkendall January 9, 2007). The letter was submitted in response to a prior recommendation from our office that an inventory survey be conducted of the parcel (LOG NO 2006.3482; DOC No 0610JP18). Our review was conducted in connection with a building permit application.

Photographs of the current conditions of the property are provided, along with the following information: the property has been subjected to prior excavation for soil borrowing; it was subjected to mechanized sugar cane cultivation; no evidence of historic properties is present on the property; a minimum of two feet of fill will be brought onto the parcel prior to house construction; and the proposed residence will be post and pier construction, with one associated subsurface excavation for a septic tank.

The letter provides sufficient information to support a determination that the proposed construction will have no effect on historic properties, and we concur with this recommendation. No further archaeological work is warranted in connection with this proposed building permit.

We request that in the future, you include the tax map parcel information, ahupua'a, and district in the subject line of your letter reports, as these reports are filed and tracked by subject line.

If you have any questions regarding this letter, please contact Theresa Donham (Theresa.K.Donham@hawaii.gov).

Aloha,

Nancy McMahon, Acting Archaeology Branch Chief
State Historic Preservation Division

cc:

4-8-03:5

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

GILBERT S. COLOMA-AGARAN, CHAIRPERSON
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COMMISSION ON WATER RESOURCES MANAGEMENT

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May 7, 2002

Mr. Bob Horcajo
Olowalu Elua Associates LLC
173 Ho Ohana Street, Suite 201
Kahului, Hawaii 96732

LOG NO: 29826
DOC NO: 0204MK20

Dear Mr. Horcajo,

SUBJECT: Historic Preservation Review - Clarification to Preservation Plan Olowalu Elua Associates, Boundary Markers for Makai Archaeological Sites Olowalu Ahupua'a, Lahaina District, Maui TMK (2) 4-8-03:5

Thank you for the opportunity to review the proposed changes in site signage which was sent to our office on March 26, 2002.

We understand the changes apply to the archaeological site boundary markers to keep the mauka and makai markers consistent. The previously approved makai site markers were to be constructed of field boulders encased in cement in the form of a monument, with no identification tags. The markers currently proposed for the makai sites and previously approved for the mauka Olowalu sites consist of pre-cased concrete blocks with hard plastic identification tags. We agree that it is acceptable to keep the signs consistent throughout the ahupua'a.

The State Historic Preservation Division supports the requested change in signage style. If you have any questions, please contact Dr. Melissa Kirkendall at 243-5169.

Aloha,

Don Hibbard, Administrator
State Historic Preservation Division

MK:jen

c: John Min, Director, Department of Planning, County of Maui, FAX 270-7634
Bert Ratte, County of Maui, Land Use and Codes, FAX 270-7972
Glen Ueno, County of Maui, Land Use and Codes, FAX 270-7972

4-8-003: por 10 July 25, 2002

~~4-8-3:~~ 10 R

BENJAMIN J. CAYETANO
GOVERNOR OF HAWAII

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July 25, 2002

Robert Horcajo
Olowalu Elua Associates LLC
173 Ho Ohana Street, Suite 201
Kahului, Hawaii 96732

LOG NO: 30376
DOC NO: 0207MK11

Dear Mr. Horcajo,

SUBJECT: Chapter 6-E-42 Historic Preservation Review of an Archaeological Monitoring Plan Sites 50-50-08-4820 and 50-50-08-4821 Olowalu Ahupua'a, Lahaina District, Maui TMK (2) 4-8-03:por of 10

Thank you for the opportunity to review this plan which was sent to our office on July 9, 2002. Monitoring is required because the parcel contains two known sites which consisted of scattered human remains. The remains were reinterred at Site 4758, Awalua Cemetery.

The plan conforms with DLNR/SHPD guidelines governing standards for monitoring and includes the following provisions. An archaeologist will be on site on a full-time basis and will have the authority to halt excavation in the event that cultural materials are identified. Consultation with Maui SHPD will occur in this event, to determine acceptable course of action. If human burials are identified, work will cease and Maui SHPD office will be notified, and compliance with procedures outlined in HRS 6.E-43 will be followed. Coordination meetings with the construction crew will be held prior to project initiation. An acceptable report will be submitted to this office within 180 days of project completion.

The plan is acceptable. If you have any questions, please contact Dr. Melissa Kirkendall at 243-5169.

Aloha,

Don Hibbard, Administrator
State Historic Preservation Division

MK:jen

c: John Min, Director, Department of Planning, County of Maui, FAX 270-7634
Bert Ratte, County of Maui, Land Use and Codes, FAX 270-7972
Glen Ueno, County of Maui, Land Use and Codes, FAX 270-7972

Consultation Plan for Assessing Potential Cultural Impacts for the Proposed Olowalu Town Master Plan Olowalu Ahupua'a, Lāhaina District, Island of Maui

TMK: (2) 4-8-003: 84, 98 through 118, and 124

Prepared for

Olowalu Town, LLC

and

Olowalu Ekolu, LLC

Prepared by

Tanya L. Lee-Greig, M.A.

and

Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai'i, Inc.

Wailuku, Hawai'i

(Job Code: OLOWALU 3)

February 2012

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Management Summary

Reference	Consultation Plan for Assessing Potential Cultural Impacts for the Proposed Olowalu Town Master Plan Olowalu Ahupua'a, Lāhaina District, Island of Maui TMK: (2) 4-8-003: 84, 98 through 118, and 124
Date	February 2012 (Draft)
Project Number (s)	Cultural Surveys Hawai'i (CSH) Job Code: OLOWALU 3
Project Location	Olowalu Ahupua'a, Lāhainā District, Maui Island, TMK: [2] 4-8-003: multiple parcels as depicted on the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) (see Section 1.1 Project Background)
Land Jurisdiction	Private: Olowalu Town, LLC. and Olowalu Ekolu, LLC.
Agencies	State: Hawai'i Department of Health/Office of Environmental Quality Control (DOH/OEQC) Hawai'i Department of Land and Natural Resources/State Historic Preservation Division (DLNR/SHPD)
Project Description	The Olowalu Town Master Plan seeks to combine conservation, agricultural, rural, and urban land uses to re-establish a small-scale and mixed-use community. Approximately 1,500 residential units, ranging from single-family to multi-family dwellings, are proposed with appropriate infrastructure to be built concurrently.
Area of Potential Effect (APE) and the Overall Region of Influence (ROI)	The area of direct effect for the proposed undertaking is considered as the footprint of the proposed 636-acre footprint of the Olowalu Town Master Plan When assessing the presence or absence of direct, indirect, or cumulative effects of the proposed project on the traditional cultural practices of this region, traditional use and access to resources from the mountains to ocean, or *mauka* to *makai*, must be taken into consideration. As such, the ROI for this undertaking is defined as the geographic area encompassed by the known traditional boundaries of Olowalu Ahupua'a, which includes any offshore traditional fisheries that may have been associated with Olowalu Ahupua'a.
Regulatory Context	With regard to State of Hawai'i Environmental Regulations, this undertaking is subject to Hawai'i Administrative Rules (HAR) Title 11 Chapter 200-4(a) and Chapter 343 of the Hawai'i Revised Statutes (HRS) which requires consideration of a proposed project's effect on traditional cultural practices. As the proposed project seeks to re-establish an entire town center and residential community within the *ahupua'a* of Olowalu, CSH has put forward this research design as a guide for assessing the potential impacts of the proposed project on extant cultural practices and traditional beliefs. This document is intended to facilitate the project's state environmental review and provide the framework for the project's consultation efforts.

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Consultation Plan for Assessing Potential Cultural Impacts

Consultation Plan for Assessing Potential Cultural Impacts for the Proposed Olowalu Town Master Plan
Olowalu Ahupua'a, Lāhaina District, Island of Maui
TMK: (2) 4-8-003: 84, 98 through 118, and 124

Prepared for

Olowalu Town, LLC

and

Olowalu Ekolu, LLC

Prepared by

Tanya L. Lee-Greig, M.A.

and

Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai'i, Inc.

Wailuku, Hawai'i

(Job Code: OLOWALU 3)

February 2012

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Date	February 2012 (Draft)
Project Number (s)	Cultural Surveys Hawai'i (CSH) Job Code: OLOWALU 3
Project Location	Olowalu Ahupua'a, Lāhainā District, Maui Island, TMK: [2] 4-8-003: multiple parcels as depicted on the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) (see Section 1.1 Project Background)
Land Jurisdiction	Private: Olowalu Town, LLC. and Olowalu Ekolu, LLC.
Agencies	State: Hawai'i Department of Health/Office of Environmental Quality Control (DOH/OEQC) Hawai'i Department of Land and Natural Resources/State Historic Preservation Division (DLNR/SHPD)
Project Description	The Olowalu Town Master Plan seeks to combine conservation, agricultural, rural, and urban land uses to re-establish a small-scale and mixed-use community. Approximately 1,500 residential units, ranging from single-family to multi-family dwellings, are proposed with appropriate infrastructure to be built concurrently.
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Section 1 Introduction

At the request of Olowalu Town, LLC and Olowalu Ekolu, LLC., Cultural Surveys Hawai'i (CSH) has prepared this research design for a Cultural Impact Assessment for the Proposed Olowalu Town Master Plan Project. The location of the proposed project is bound by the Pacific Ocean to the west and lands currently under the jurisdiction of State of Hawai'i to the north, south and east at Olowalu and Ukumehame Ahupua'a, Lāhainā District, Maui Island (TMK [2] 4-8-003:84, 98 through 118, and 124) (Figure 1 and Figure 2).

1.1 Project Background

The Olowalu Town Master Plan will serve as a guide for the establishment of a small-scale "mixed-use" community with land uses that will vary from urban neighborhood town centers to rural and agricultural areas within the 636-acre project area (Munekiyo & Hiraga 2010:7 and Table 2). Overall, the master plan proposes the development of 1,500 residential units along with civic structures (educational facilities, community and cultural centers, and emergency worker facilities), park and gathering facilities, greenways, bikeways, and trails all of which would be constructed concurrently with the appropriate infrastructure over an approximate 10 year period (Munekiyo & Hiraga 2010:10) (Figure 3).

The area of direct effect, or area that may be physically altered by the proposed project, consists of the entire 636.48-acre project footprint as described above (hereafter referred to as the "project area"). To ensure that potential impacts to traditional cultural practices which may not occur within the area of direct effect, but may nonetheless be adversely affected by the proposed project are identified (e.g. where a proposed action that may not physically alter subsistence and medicinal gathering resources but may affect access to such gathering areas,) the *ahupua'a* is the appropriate geographical unit of study. With this in mind, and for the purpose of this preliminary assessment of potential cultural impacts, the broader region of influence (ROI), hereafter referred to as the "study area", will be considered to identify any potential impacts to traditional cultural practices that may result from the proposed project. The study area for this report consists of the entire *ahupua'a* of Olowalu (Figure 4) including the off-shore reef area which may have supported traditional fisheries associated with Olowalu Ahupua'a.

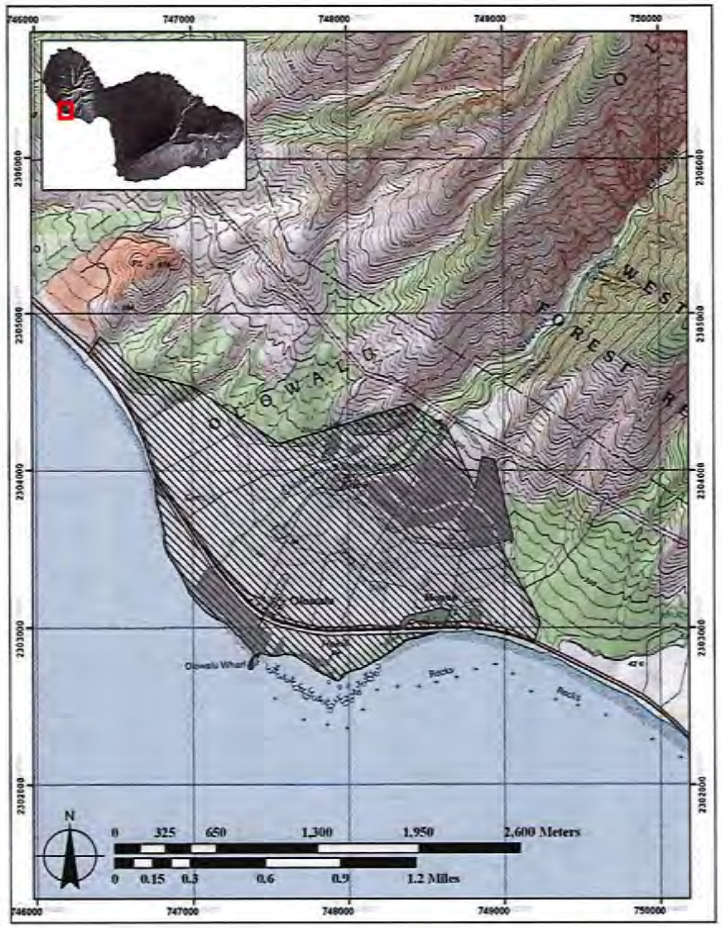

Figure 1. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

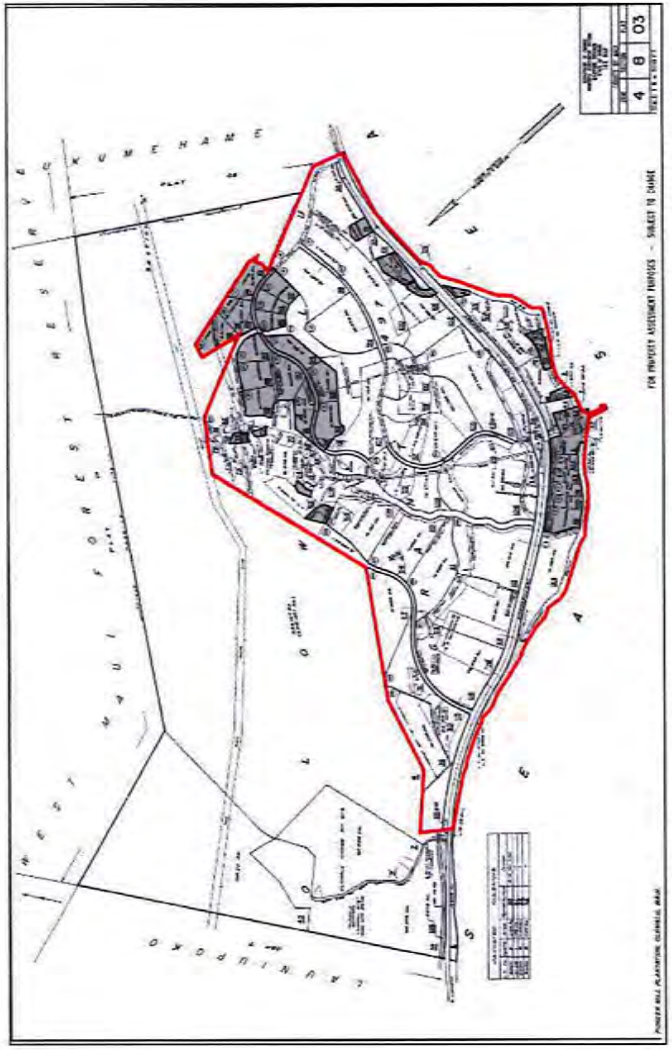

Figure 2. TMK (2) 4-8-03 showing the location of the current project area outlined in red, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

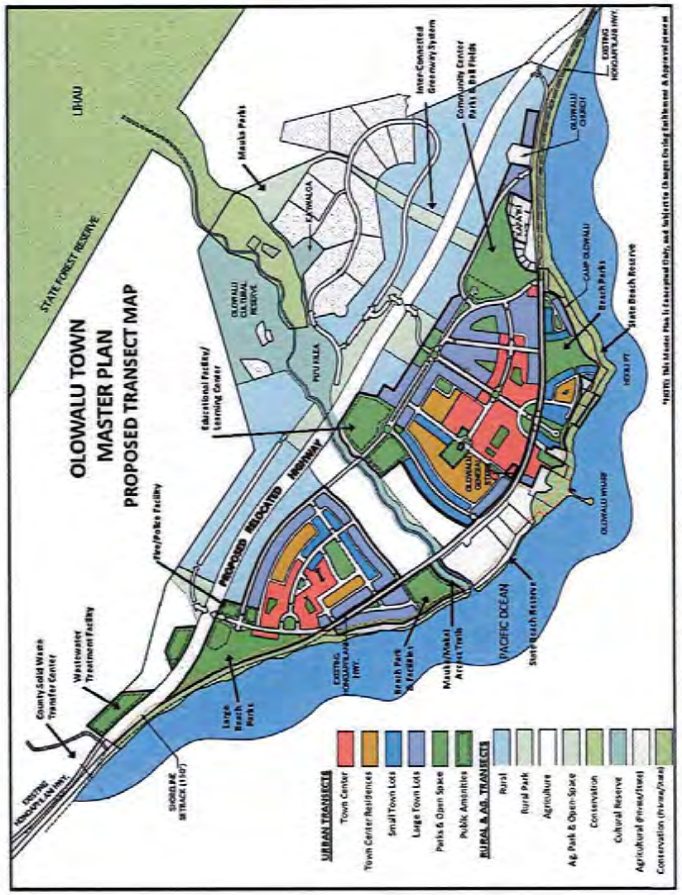

Figure 3. Conceptual drawing for the Proposed Olowalu Town Master Plan (figure courtesy of Olowalu Town, LLC.)

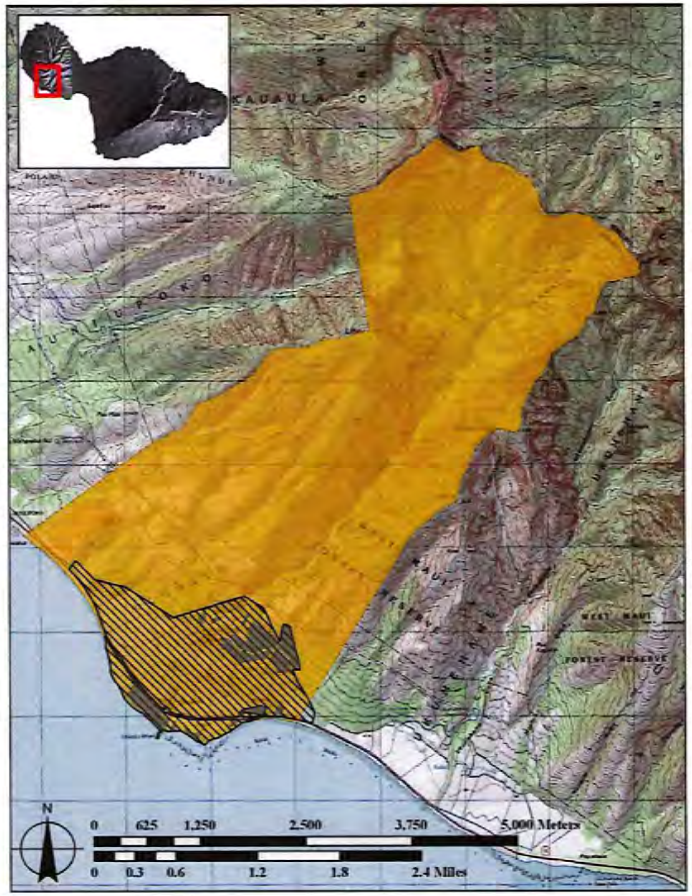

Figure 4. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, the study area and Olowalu Ahupua'a shaded in orange, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

1.2 Environmental Setting

1.2.1 Natural Environment

The current study area extends from the located on the broad alluvial plain of Olowalu Ahupua'a where the principle geologic features consists of the Olowalu Gulch and Stream. Other contributing physical features of the landscape include smaller stream systems and their resulting gulches along the northern and southern flanks of Olowalu Gulch.

The general soils of the project area are of the Pulehu-Ewa-Jaucus Association and are largely dominated by the Pulehu Soil Series which comprises the majority of the alluvial fan of Olowalu Ahupua'a. Other soils types include sediments associated with the Jaucus Series and Beaches that are found along the southern coastal reaches of the *ahupua'a*, patches of soils that fall into the Kealia Series and Ewa Series occur *mauka* of Honoapi'ilani Highway, soils of the Wainee and Ewa Series comprises the southern flank of Olowalu Gulch, and rocky soils are found along the streambed of Olowalu Gulch (Figure 5). The Pulehu Soil Series consists of well-drained soils that developed in alluvium washed from basic igneous rock (Foote, et al. 1972:115). Pulehu clay loam, 0 to 3 percent slopes, consists of a surface layer of dark brown clay loam approximately 21 inches thick that is underlaying by stratified loam, loamy sand, fine sandy loam and silt loam that is approximately 39 inches thick (Foote, et al. 1972:115-116). The permeability of this soil type is moderate with a slow runoff rate and slight erosion hazard. Low areas characterized by PsA soils can be subject to flooding (Foote, et al. 1972:116). Pulehu cobbly clay loam, 0 to 3 percent slopes (PtA), is similar to PsA soils except that it is cobbly. The underlying parent material consists of coarse, gravelly or sandy alluvium. Pulehu cobbly clay loam, 3 to 7 percent slopes (PtB), also has slow runoff with a slight erosion hazard. Pulehu silt loam, 0 to 3 percent slopes, (PpA) are also similar to PsA soils except that the texture is silt loam. At the time of the USDA soil survey, PtA and PtB soils were used for sugarcane cultivation and pasture, PsA soils included some acreage that was used for truck crops, and finally PpA soils were noted as used for house sites (Foote, et al. 1972:115, 116).

Beaches (BS) occur as sandy, gravelly, or cobbly areas that are derived from coral and seashells and are washed and rewashed by ocean waves (Foote, et al. 1972:28). In the case of the current project area however, beach sediments are dark in color as the sands are derived from from basalt and andesite parent material (Foote, et al. 1972:28). The USDA, at the time of the soil survey determined that soils associated with this series had no value for farming and were better suited for recreational use and resort development (Foote, et al. 1972:28). It should be noted that pre-contact human burial interments are commonly found in beach sand deposits.

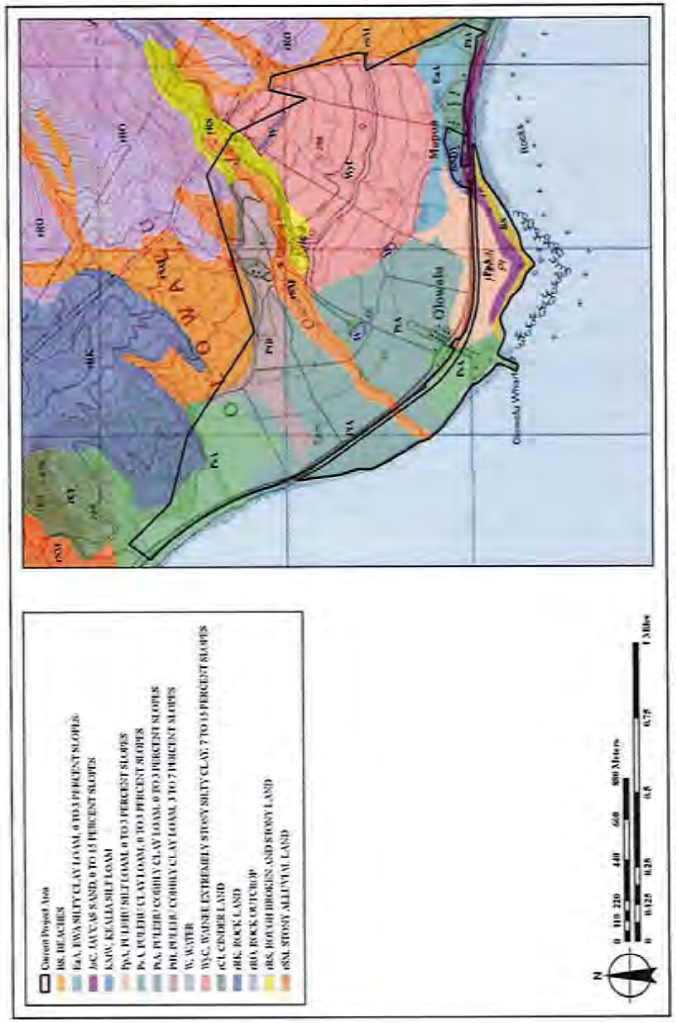

Figure 5. . Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the current project area relative to the local soil series (U.S. Department of Agriculture 2001).

The Jaucas Series consists of excessively drained, calcareous soils that are developed in wind and water deposited sand from coral and seashells and occur as narrow strips on coastal plains adjacent to the ocean (Foote, et al. 1972:48). Normally pale brown to very pale brown in color, within Olowalu Ahupua'a, the surface layer is dark brown as a result of the accumulation of organic matter and alluvium (Foote, et al. 1972:48). Jaucas sand, 0 to 15 percent slopes (JaC), is neutral to moderately alkaline throughout. Permeability of JaC soils is rapid and runoff is slow to very slow. The general erosion hazard is slight, but wind erosion poses a severe hazard where vegetation has been cleared. At the time of the USDA survey, JaC soils were used for pasture, sugarcane, truck crops, and urban development (Foote, et al. 1972:49). Like beach sand deposits, pre-contact human burial interments are commonly found in Jaucas sand deposits.

The Kealia Soil Series consists of rather poorly drained and poorly drained soils on coastal flats, and are geographically associated with Jaucas, Mala, and Pulehu soils. Kealia silt loam (KMW) is a poorly drained soil with a high salt content. Ponding often occurs in low areas after heavy rains and when the soil dries, salt crystals accumulate on the surface. This soil has an underlying brackish water table that fluctuates with the tides. As the occurrence of the KMW soils within the project area are near the coastline, it is important to note that the water table is nearer to the surface along the shoreline than in inland areas. Permeability of KMW soil is moderately rapid with a slow to very slow runoff. The hazard of water erosion is no more than slight, but the hazard of wind erosion is severe when the soil is dry and the surface layer becomes loose and fluffy (Foote, et al. 1972:67). At the time of the USDA survey, KMW soils were used only for wildlife habitat and occasional pasturage as the high salt content and poordrainage was not suitable for agriculture (Foote, et al. 1972:68).

Wainee soils are generally well-drained soils that have developed on alluvial fans. Unlike the Pulehu Series, which is found in similar geologic environments throughout Maui County and on the island of O'ahu, Wainee soils are found only on Maui Island. Wainee extremely stony silty clay, 7 to 15 percent slopes (WyC) occur on smooth alluvial fans with a moderately rapid permeability rate and slow to medium run off rate. The erosion hazard is slight to moderate and stones cover three to 15 percent of the surface. At the time of the USDA soil survey, WyC soils were used primarily for sugarcane with small acreages used for pasture and home sites (Foote, et al. 1972:134).

The Ewa Soil Series is generally characterized by well-drained soils in basins and on alluvial fans that have developed in alluvium derived from basic igneous rock (Foote, et al. 1972:29). Ewa silty clay loam, 0 to 3 percent slopes (EeA) has very slow runoff rate and the erosion hazard is no more than slight. At the time of the USDA soil survey, EeA soils were used for sugarcane and homesites (Foote, et al. 1972:30).

Finally, Rough, Broken and Stone Land (rRS) and Stony Alluvial Lands (rSM) characterizes the soils at the base of Olowalu Gulch and adjacent soils of Olowalu Streambed respectively. Rough, Broken and Stone Land (rRS) consists of very steep, stony gulches where the local relief is generally between 25 and 500 feet with soil material general less than 20 inches deep over saprolite or bedrock (Foote, et al. 1972:119). Stony Alluvial Lands (rSM) soils consist primarily of stones, boulders, and silt deposited by streams along the bottoms of gulches and on alluvial fans (Foote, et al. 1972:120). At the time of the USDA soil survey, rRS soils was used for

pasture, wildlife habitat, and watershed (Foote, et al. 1972:119) while rSM soils were suited to pasture in dry areas and woodland in wet areas (Foote, et al. 1972:120).

The average annual rainfall accumulation within the entire project area averages from 15 to 20 inches (Giambelluca and Schroeder 1998:56) per year, with the heaviest rainfall occurring during the winter months (December through February) and little to no rainfall during the summer months (June through August) (Giambelluca and Schroeder 1998:56). This pattern of rainfall and low annual precipitation rate may have once sustained a lowland, dry shrubland and grassland native ecosystem (Pratt and Gon 1998) with some wetland environments in areas of the Kealia soil type. The landscape and watershed of the project area, however, has been heavily modified by sugarcane cultivation and supporting irrigation development from the early historic period up until modern times, with only small stands of native plants remaining. The current vegetation consists of thick *kiawe* (*Prosopis pallida*), *klu* (*Acacia farnesiana*), *koa haole* (*Leucaena leucocephala*), australian salt bush (*Atriplex semibaccata*), and pickleweed (*Batis maritime*) adjacent to the Honoapi'ilani Highway, as well as, small stands of *niu* (*Cocos nucifera*), *kou* (*Cordia sebestena*), and other introduced plant species. Inland of the highway the natural environment is dominated by fallow sugar cane fields with vegetation that can be characterized as grasslands and shrublands.

1.2.2 Built Environment

The most prominent feature of the modern built environment within the current project area consists of the two-lane Honoapi'ilani Highway. Other features include residential homes and associated infrastructure both *mauka* and *makai* of the Honoapi'ilani Highway, the Olowalu General Store, and unimproved cane haul access roads.

Section 2 Summary of Background Research

The division of Maui's lands into political districts occurred during the rule of Kaka'alaneo, under the direction of his *kahuna*, Kalaiha'ōhi'a (Beckwith 1970:383). This division resulted in the creation of twelve districts or *moku* during traditional times: Kula, Honua'ula, Kahikinui, Kaupō, Kīpahulu, Hāna, Ko'olau, Hāmākua Loa, Hāmākua Poko, Na Poko (Wailuku), Kā'anapali, and Lāhainā (Alexander 1890:106; Sterling 1998). The *moku o loko*, or *moku* as it is most commonly called, literally means "to cut across, divide, separate" (Lucas 1995:77). When used as a term of traditional land tenure, a *moku* is similar to a modern political district. Within these *moku* are smaller units of land termed the *ahupua'a*, the name of which is derived from the Hawaiian term *ahu* (altar), which was erected at the point where the boundary of land was intersected by the *alaloa* (main road encircling the island), upon which a *pua'a* (hog) image, carved of kukui wood and stained with red ochre, was and placed along with the tax of food items from that particular land unit, paid to the *ali'i* (chief) (Alexander 1890:105). The typical configuration of the *ahupua'a* extends from the sea to the mountain, and while the boundary generally followed prominent landforms (i.e. ridge lines, the bottom of a ravine, or defined by a depression) there were times where a stone or rock that was notable from a tradition or sacred uses would mark a corner or determine a line (Alexander 1890:105-106). Similarly, the line of a growth of a certain kind of tree, herb or grass, or the habitat of a certain kind of bird would sometimes define a division (Alexander 1890:105-106).

The present study area includes the entire *ahupua'a* of Olowalu, a land division located on the leeward slopes of Mauna Kahalawai (West Maui Mountains) (Figure 6) in the traditional *moku* of Lāhainā (Figure 7). The boundary of Olowalu Ahupua'a, along the most *mauka* extent, follows the ridge separating the headwall of Iao Valley from that of Olowalu Valley and extends *makai* touching the landforms of Helu and Lihau, ending at Awalua on the Launiupoko side and incorporates the landforms of Halepohaku and Ulaula, ending at Mōpua on the Ukumehame side (see also Figure 4).

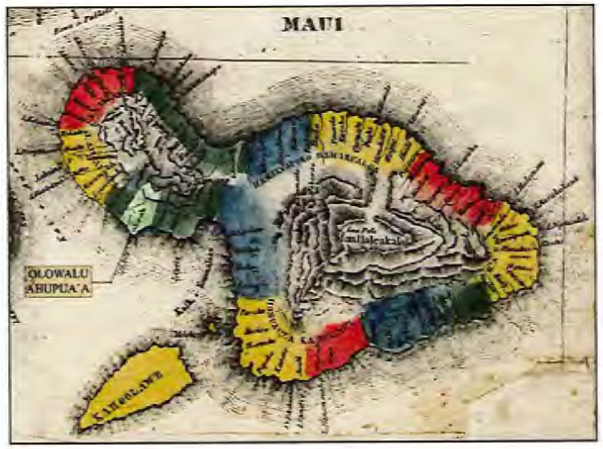

Figure 6. A portion of the S.P. Kalama Map (1837) showing the location of Olowalu Ahupua'a in relation to the *moku* of Maui Island.

Figure 7. A portion of the F.S Dodge map (1885) showing Olowalu Ahupua'a in relation to the traditional *moku* of Lāhainā (crown lands in yellow).

2.1 Traditional and Historical Background

In the preface of *Place Names of Hawaii* (Pukui, et al. 1974:x), Samuel Elbert states that:

> Hawaiians named taro patches, rocks and trees that represented deities and ancestors, sites of houses and heiau, canoe landings, fishing stations in the sea, resting places in the forests, and the tiniest spots where miraculous or interesting events are believed to have taken place.
>
> Place names are far from static ... names are constantly being given to new houses and buildings, land holdings, airstrips, streets, and towns and old names are replaced by new ones ... it is all the more essential, then to record the names and the lore associated with them (the ancient names) now.

Inherent in the statements of Elbert is the knowledge that the oldest place names held meaning and told the story of an area prior to European contact. A study of the place name meanings for the study area may yield some insight into the stories, patterns of life and land use within Olowalu Ahupua'a. The place names listed below are for land areas, fisheries, land divisions, markers, and other resources identified through research of available historic literary resources like the Hawaiian Government and Territorial Survey Maps (Dodge 1885; Kalama 1837), and USGS Topographic 7-Minute and 15-Minute Series Maps (1925, 1997), as well as consultation with *kama'āina* and *kūpuna* of Olowalu. Unless indicated otherwise, the spelling and translations presented below are taken from Pukui and others (1974). Alternate spellings are provided where multiple translations were noted from different sources and cited in text.

Lāhainā (*moku*)	*hainā* literally translated as "cruelty" and *la* as "day "or, alternatively, *haina* that translates literally as "merciless" and *lā* as "sun" (Sterling 1998:16-17);"land [of] prophesy" (Ashdown 1970:10)
Awalua	Literally translates as "double harbor" (p.15)
Halepohaku	Literally, "stone house" (p.38-39)
Hawaiikekee (*'ili*[1])	*keke'e*: a redup of *ke'e* (Pukui and Elbert 1986:143) which means crookedness (Pukui and Elbert 1986:141), possibly a reference to the distinctive bend in the *'ili* boundary, an *'ili* name associated with LCA 5829E: Apana 1 and 2 to Kawehena located within Olowalu Valley;
Hekili Point	*hekili* is literally translated as "thunder" (p.44)
Kaluaaha (*'ili*)	Literally, "the gathering pit" (p. 78); an *'ili* of LCA 1742: Apana 2 to Z. Kaauwai and LCA 5829H: Apana 1 to Nahue located in the area of the former Olowalu Mill Site.
Kamani (*'ili*)	A large tree (*Calohpyllum inophyllum*) which produced a hard wood that was formerly made into calabashes (Pukui and Elbert 1986:125); An *'ili* name associated with LCA 6728: Apana 1 to Mahulu, LCA 1742 Apana 1 to A Kaauwai, LCA 5829E: Apana 3 to Kawehena, LCA 8573: Apana 1 to Kailiula, LCA 8817: Apana 1 to Kanakaole , LCA 6058: Apana 3 to Peekauai, LCA 5829: Apana 3 to Haole
Kapaiki	Translated as "the small enclosure" a section or *mo'o* of *ali'i* lands at Olowalu Ahupua'a (Mr. Hinano Rodrigues in Lee-Greig and Hammatt 2006)
Kaunukukahi (*'ili*)	An *'ili* name associated with LCA 8817: Apana 2 and 3 to Kanakaole, LCA 5952: Apana 1 and 2 to Minamina, LCA 6728: Apana 2 to Mahulu, LCA 6058: Apana 4 to Peekauai
Kuekue (*'ili*)	An *'ili* name associated with LCA 8573: Apana 2 to Kailiula
Līhau	literally, "a gentle cool rain", a gentle rain considered favorable for the work of fishermen (Emerson 1909:241)
Maomao (*'ili*)	literally a type of fish, a variation of *mamao* or far, calm, clear (Pukui and Elbert 1986:241); An *'ili* name associated with LCA 7719: Apana 1 to Haia
Mōpua	a traditional village at Olowalu and translates literally as "melodious" (p.158); currently a popular snorkeling spot
'Ōhi'a (*'ili*)	Two kinds of trees, *'ōhi'a'ai* (*Eugenia malaccensis* mountain apple) (Pukui and Elbert 1986:277) and *'ōhi'a lehua* (*Metrosideros macropus, M. collina polymorpha*) (Pukui and Elbert 1986:199). Found in the forested regions, the fruit of the *'ōhi'a'ai* was prepared by splitting and drying it in the sun (Pukui and Elbert 1986:277). The wood of the *'ōhi'a lehua* is hard and once used for images, spears, and mallets (Pukui and Elbert 1986:199). An *'ili* name associated with LCA 6058: Apana 1 to Peekauai and claim 10127 by Makanialoha.
Olowalu (*ahupua'a*)	literally, "many hills" (p.170)
Pākalā	literally translates as the "sun shines" (p.174), a place located just after Mōpua and before Kapaiki
Paumaumau (*'ili*)	An *'ili* name associated with LCA 9906: Apana 1 to Pikao and LCA 8546: Apana 1 to Kaawili
Pu'u Kīlea	literally, "small but conspicuous hill" (p.111), a cemetery
Ulaula	Literally, "red" (p.214)
Wailoa (*'ili*)	literally, "long water" (p.224); An *'ili* name associated with LCA 5829: Apana 4 to Haole

[1] a land subdivision of an *ahupua'a* with its own name and defined boundary

Alexander, William DeWitt

1890 A Brief History of Land Titles in the Hawaiian Kingdom. In *Hawaiian Almanac and Annual for 1891*, edited by T. G. Thrum. Press Publishing Company Print, Honolulu, HI.

2.1.1 He Mo'olelo no Olowalu

Handy and others (1991) summarize the relationship that traditional Hawaiians have with the natural environment best in the following passage:

> The sky, sea, and earth, and all in and on them are alive with meaning indelibly impressed upon every fiber of the unconscious as well as the conscious psyche. Hawaiian poetry and folklore reveal this intimate rapport with the elements, (Handy, et al. 1991:23-24)
>
> (T)he relationship which existed from very early times between the Hawaiian people ... is abundantly exemplified in traditional mele (songs), in pule (prayer chants), and i genealogical records which associate the ancestors, primordial and more recent, with their individual homelands, celebrating always the outstanding qualities and features of those lands. (Handy, et al. 1991:42)

At Olowalu the *mo'olelo* (traditions) revolve around the surrounding mountains and the elemental characteristics of this *'aina* (land) which has been known as a *pu'uhonua* or refuge of Maui since ancient times (Ladana 1858). The winds of Maui, as named and described in the story of Paka'a, is recounted by J.H. Kanepu'u (in Sterling 1998:7) and mentions the strong wind of Olowalu in the following excerpt:

> The house breaking wind is at Olowalu,
>
> The kilihau is also there.

The strength and prominence of this wind at Olowalu is additionally described in Hawaiian Proverbs and Poetical sayings gathered by Mary Kawena Pukui (1983) and related below:

> *'Ōlelo No'eau 215*
>
> *'A'ohe umu mo'a i ka makani.*
>
> No *umu* can be made to cook anything by the wind.
>
> (Talk will not get the umu lighted and the food cooked. This saying originated in Olowalu, Maui, where it was very windy and hard to light an umu.)
>
> *'Ōlelo No'eau 1457*
>
> *Ka makani ha'iha'i lau hau o Olowalu.*
>
> The hau-leaf tearing wind of Olowalu. (A gust wind.)
>
> *'Ōlelo No'eau 2502*
>
> *Olowalu ihu pāpa'a.*
>
> Crusty-nosed Olowalu.
>
> (Disparaging expression for the people of Olowalu, Maui, where the wind is said to blow into the nostrils, drying the mucus into crust.)

While not all proverbs were complimentary, as illustrated by 'Ōlelo No'eau 2502 above, it is clear that the wind of Olowalu Ahupua'a was a significant element for the *kama'aina* of this land and well known by others who did not reside there.

Tempering the "house breaking" wind of Olowalu, is the presence of the *kilihau* (J.H. Kanepu'u in Sterling 1998:7). Defined by Pukui and Elbert (1986:151), *kilihau* translates as ice-cold shower; cold drizzle; to rain thus. It is possible that this particular rain is a rain that falls at the higher elevations and may possibly be linked with the following 'saying (Pukui 1983:246):

> *'Ōlelo No'eau 2250*
>
> *Na lehua o Līhau i pehia e ka noe.*
>
> The lehua blossoms of Līhau, weighted by the mist.
>
> (Līhau, a mountain of Maui, was noted for its beautiful lehua blossoms.)

At Olowalu, Līhau is a prominent and picturesque mountain peak located toward the back of the valley. So prominent were the *ohi'a lehua* blossoms of Līhau that it was said the rich color of the blossoms would reflect onto to the waters of Ka Lae Hekili and turn the water red (Mr. Hinano Rodrigues in Lee-Greig and Hammatt 2006:59).The *lehua* of Līhau also figures prominently in a set of *mele inoa*, or name chants, known as "*He lei no ka Moi Wahine Kapiolani*" (A Wreath for Queen Kapiolani) that were composed for the queen at her coronation and represented each island (Stillman 1996). The following *mele, Aia i Lihau ko lei nani*, written by a Mrs. Paupau, and translated by Mary Kawena Pukui, was the *mele* for Maui (Stillman 1996):

Aia i Lihau ko lei nani	At Lihau is your beautiful lei,
O ka ao lehua i poe i ka manu	Made of the full blown lehua loved by birds,
Ke haku a mai la e ka lau makani	It is braided together by the wind's deft fingers
a hono o Lele ua lai lua	On the calm and peaceful realm of Pi'ilani
Luana i Hauola kahi manao	Two thoughts enter the mind
I ka lai huli o ka Maaa	With the conflicting blowing of the Maaa
Hanohano ka opua i ka malie	Proudly appear the clouds in the calm
I ke kau a ke ao i Maunalei	As they gather on Maunalei
He lei hoi no ua lai nei	The lei is to be worn by you on a calm day
No ka nalu haihai maka a Uo	On the rolling surf of Uo
Ke noho nei no au i ka lulu	The sea dwells there before the calm
Me na lai elua a ka manu	Beside the pleasant haunts of birds.
Alia oe la e Haleakala	Wait there, Haleakala,
E alai nei ia Kauiki	Before you hide Ka'uiki from view.
Ua maikai ke alo o Piiholo	Beautiful is the face of Pi'iholo
I ka noho a ka ua ulalena	Fore there dwells the 'ulalena rain.
Haina ka wahine nona ka lei	This is in praise of the chiefess whose lei chant this is,
O Kapioloni i ka iu o ka moku	Kapi'olani, so high above.

2.1.1.1 The Origins of Pu'ulaina at Wahikuli and the Role of Līhau

Prior to her current incarnation as a mountain peak, Līhau was once a woman who had a child with Eeke named Pu'ulaina, a now prominent landform in Wahikuli Ahupua'a. Fornander (1919b) recounts the following regarding the birth of Pu'ulaina and the transformation of Līhau to a hill at Olowalu:

> ...some say it was begotten by two mountains, Eeke (the summit crater of the West Maui Mountains) and Lihau (the mountain top back of Olowalu). Eeke was the husband and Lihau was the wife. They were real persons, but it will be shown later the reason for their being changed to mountains. After they had lived as man and wife, a child was born to them, a son, the subject of this story which we are considering. But after some time Eeke became entangled, for he saw a beautiful woman, Puuwaiohina from Kauaula, and they committed adultery. Because of this, Lihau thought to choke the child to death, so that the two of them could go and do mischief; this caused them to quarrel. Eeke took the child to his mother, Maunahoomaha, and left him with her. After that their god, Hinaikauluau, placed a restriction over them; they were not to live together, nor were they to have any intercourse with others; but ten days after this order, Eeke again committed adultery with Puuwaiohina above referred to, who was a younger sister to Lihau. Because of this their god punished them by making Eeke a mountain and Puuwaiohina a mountain ridge; that is the ridge prominent at Kauaula.
>
> After that, Lihau was possessed with love for their child, so she asked Maunahoomaha for permission to meet her son, that was agreeable to her mother-in-law, and when she met her child she was glad. When she realized what a handsome man her favorite son had grown to be, she gave him for husband to Molokini, one of the noted beauties of that time, because she was the wife intended for him ...
>
> However, arriving on Maui, this was one of Pele's (the fire goddess) cruel deed; one of her younger sisters saw how handsome Puulaina was, so she asked Molokini to let her have him for husband. The other refused, for she was greatly in love with her own husband; so she (Molokini) was changed into a little island, and she has remained so to this day.
>
> When Lihau heard of this, she grieved for her daughter-in-law, so she went to consult Pele on the matter. But Pele replied gruffly: "If that is the case, then I say to you that you will die; also your son." Lihau was there and then changed into a hill where Pele resided for some time; the son also died. But the one whose was the desire, earnestly entreated and begged that her husband be spared. But the red-bleary-eyed (Makole-ulaula, an epithet applied to Pele) did not wish it that way. That was how the son became a hill and has remained such until this day.

2.1.1.2 Drought and the Lesson of Hua

There is an ancient proverb, or *'olelo no'eau*, that warns others to not talk too much of one's king and is a reminder that trouble will follow those who destroy the innocent (Pukui 1983:194 [1811]):

> *Ko'ele na iwi o Hua i ka lā.*
>
> The bones of Hua rattled in the sun.

According to the story of Hua, retold by Fornander (1919a:514-516), he was a chief of Lāhainā who had forsaken his *kahuna*, or priest, Luaho'omoe and caused a drought throughout the Hawaiian Islands. The mountains of Olowalu and *ua'u* (Hawaiian Petrel [*Pterodroma sandwichensis*] that nest there are central to the story:

> There lived here in Lahaina a chief named Hua ... he desired to get some ua'u squabs to eat; he sent some men up to the mountains above Oloalu [sic] to get some ua'u squabs to satisfy his desire. He did not wish for birds from the beach. When the birds were obtained, they were to be taken to the priest for him to ascertain where the birds came from; if he should give out the same information as the men had given to the chief as to the source of the birds, then he would be safe; if he should give a contrary answer, he would be killed. The name of this priest was Luahoomoe and he also had children. When the men went up, they could not find any mountain birds at all, so they decided to get some shore birds. When they caught some, they daubed the feathers red with dirt so that the chief would think the birds came from the mountain. When they returned and handed the birds to the chief, he was exceedingly glad because he thought the birds came from the mountain. The chief told the men to take them to the priest for his inspection. The priest perceived, however, that the birds came from the seashore. Then the chief said to the priest: "You shall not live, for you have guessed wrongly. I can very well see that these are mountain birds." Then and there an imu was prepared in which to bake the priest.
>
> Before he was placed in the imu, however he said to his children: "You two wait until the imu is lighted, and when the smoke ascends, should it break for the Oloalu mountains, that indicates the path; move along; and where the smoke becomes stationary, that indicates where you are to reside ... Then the priest was cast into the oven and the opening closed up tightly. The smoke arose and darkened the sky ... after the priest had been in the imu for two days, he reappeared and sat by the edge of the imu unknown to any one; the chief thinking all the time that he was dead; but it was not so.
>
> When the smoke ascended and leaned towards the Oloalu mountains, the two sons went off in that direction; the cloud pointed towards Hanaula, and there it stood still, so the two sons ascended to the place and resided there...
>
> Then the whole of Maui became dry; no rain, not even a cloud in the sky, and people died from lack of water. The smoke that hung over Hanaula became a cloud, and rain fell there.
>
> Hua, the chief, lived on, and because of the lack of water and food he sailed for Hawaii, the home of his elder brother; but because Hawaii also suffered from lack of water and food he came back and lived at Wailuku. Wailuku also did not have any water, and that caused the chief to be crazed, so he leaned against the edge of the precipice and died, and that was the origin of the saying "The bones of Hua rattle in the sun."

Fornander further notes that the saying, "The bones of Hua rattle in the sun," refers to the chief whose wickedness won him the ire of his people. In an ultimate show of disregard, they let his body lie where he fell so that his bones bleached in the sun and rattled in the wind. Hence the above proverb warning others to not destroy the innocent as Hua had destroyed Luaho'omoe and in that caused great suffering to people of Hawai'i and ultimate desecration of his bones by his own people.

2.1.2 Traditional Hawaiian Period prior to Western Contact

2.1.2.1 Traditional Settlement and Subsistence

As emphasized by Handy and others in the following summary, the *ali'i* and *maka'āinana* were attracted to the Lāhainā District by its natural resources and geographic position:

> Lāhainā District was a favorable place for the high chiefs of Maui and their entourage for a number of reasons: the abundance of food from both land and sea; its equable climate and its attractiveness as a place of residence; it had probably the largest concentration of population, with its adjoining areas of habitation; easy communication with the other heavily populated areas of eastern and northeastern West Maui, 'The Four Streams,' and with the people living on the western, southwestern and southern slopes of Haleakala; and its propinquity to Lanai and Molokai. (Handy, et al. 1991:492)

They further indicate that Olowalu, along with the three other major waterways of the Lāhainā District (Ukumehame, Launiupoko, Kaua'ula), provided a productive leeward environment for the cultivation of a wide range of agricultural goods:

> Southeastward along the coast from the *ali'i* settlement were a number of areas where dispersed populations grew taro, sweet potato, breadfruit and coconut on slopes below and in the sides of valleys which had streams with constant flow. All this area, like that around and above Lāhainā, is now sugar-cane land ... Olowalu, the largest and deepest valley on southwest Maui, had ... extensive *lo'i* lands both in the valley and below. Just at the mouth of the valley we found in 1934 a little settlement of five *kauhale* (family homes) surrounded by their flourishing *lo'i*. There are said to be abandoned *lo'i* far up in the valley. (Handy, et al. 1991:492)

Winslow Walker of the Bishop Museum corroborated the writings of Handy and others during an island-wide archaeological inventory survey where he notes the presence of *lo'i* and ancient house sites within Olowalu Ahupua'a (Walker 1931):

> "Terraces for the cultivation of taro were seen on West Maui in the vicinity of... Lāhainā, Olowalu, and Ukumehame" [p.71]
>
> Above Mrs. Naho'oikaika's house (at Olowalu), old taro patches and house sites, old *auwai* (traditional Hawaiian irrigation ditches) were used for sugarcane ditches...at the edge of a house platform (15 by 28 feet) there is a large red stone used as a *papamu* for *konane* [p.77]

While the upland areas provided a good environment for agricultural crops, the coastal reaches, were rich in marine resources. Most of the fishing grounds lying between Lāna'i, Kaho'olawe, Ukumehame, and Lāhainā were only one to two miles apart (Daniel Kahā'ulelio in Maly and Maly 2003:22). *'Ō'io*[2] fishing, using a method referred to as *mamali 'ō'io*, was done just beyond the reef and in places close to shore from the steamer landing of Ma'alaea to the cape of Kunounou at Honokapohau, in the district of Lāhainā. These were the places in which fishing was done by those of Olowalu, Lāhainā, Ka'anapali, Honolua, and Honokohau (Kahā'ulelio 2006:141).

[2] Adult ladyfish, bonefish (*Albula glossodonta*)

As the coastal environs were intensively used for gathering marine resources, it should follow that the existence of permanent or re-current seasonal habitations would be present along the coastline. *Kuleana* claims for *pahale* or house lots along the Olowalu coastline reflects a picture of settlement in the coastal environs (see Section 2.1.4 and Figure 7).

A basic comparative picture of the pre-western contact population of Olowalu Ahupua'a is suggested by figures in nineteenth century missionary censuses (Schmitt 1973). Results of the 1832 census, in which the total population of Maui is 35,062, give the following populations: for Lāhainā, 4028; for Ukumehame, 573; and for Olowalu, 832. These three figures, when combined, represent 15 percent of the total Maui population. Allowing for post-contact distortions (e.g., disease and commercially-inspired population shifts), the population totals suggest that this portion of Maui accommodated a substantial portion of the island's pre-western contact population.

An "overland" trail system allowed pedestrian access between Lāhainā and the north coast of West Maui, as well as into the upper forests for bird-catching and the collection of wild plant resources. According to Handy and others (1991:490), the trail extended *mauka* in Olowalu Valley to the highest point of the West Maui summit at Pu'u Kukui, then descended to Waiehu on the northern side ui (Handy, et al. 1991:490; Sterling 1998:26).

Kealaloloa, located within the modern boundaries of Ukumehame Ahupua'a, is a broad ridge of the southeast flank of West Maui which ascends *mauka* of a traditional Hawaiian coastal settlement (Walker 1931:43). Following this ridge *mauka* provides a direct and easily navigated route (now a jeep road) to the West Maui summit area, at the headwaters of Pohakea stream on the east and Ukumehame stream on the west. From this point, at Hana'ula, the trail likely continued along the summit ridge to intersect the inland Olowalu-Pu'u Kukui-Waiehu "overland" trail (Handy, et al. 1991:490).

2.1.2.2 Politics and Warfare

The Mokupuni of Maui, being the second largest island in the Hawaiian island chain, was a major center for political development during pre-contact and early historic times (Kirch 1985:135). Many battles were fought between the Maui Island and Hawai'i Island polities, with the earliest conflicts primarily centered on the east coast of Maui.

During the reign and following the death of Maui ruler Kekaulike in the early 1700's, the chiefs of Maui and Hawai'i were once again at war, this time bringing the battles closer to the present study area. After Kamehameha-nui, the original successor of Kekaulike, was defeated in battle at Lāhainā by his older brother Kauhi, Alapa'i (ruling chief of Hawai'i) brought Kamehameha-nui back to Hawai'i and began making plans for battle against Kauhi. Around 1738 Alapa'i and his Hawaiian forces occupied the Lāhainā region, holding the lands from Ukumehame to Māla and employed the following wartime tactics to keep the subjects of Lāhainā under control:

> A whole year Alapa'i spent in preparation for the war with Maui. It was in 1738 that he set out for the war in which he swept the country. What was the war like? It employed the unusual method in warfare of drying up the streams of Kaua'ula, Kanaha, and Mahoma (which is the stream near Lāhaināluna). The wet taro patches and the brooks were dried up so that there was no food for the forces of Ka-uhi or for the country people. Alapa'i's

> men kept close watch over the brooks Olowalu, Ukumehame, Wailuku, and Honokowai. (Kamakau 1992:74)

This tactic, along with a day of hard fighting at Pu'unene near Mailepai, won this war for the forces of Alapa'i and Kamehameha-nui, the latter of whom became the ruling chief of Maui (S. Kamakau 1992:75).

Kamehameha, future *Mō'ī* (King) who unites the Hawaiian Islands under a single ruler, finds himself at the *pu'uhonua* of Olowalu following the great battle of Kakanilua, a battle fought on the sand hills of Kalua where Kalaniopu'u of Hawai'i lost to Kahekili of Maui (S. Kamakau 1992:85-88). Joseph Mokuohai Poepoe (inSterling 1998:24) relates the story of Kamehameha at Olowalu:

> Four days after the battle of Kakanilua the chiefs of hawaii received a kind of welcome from King Kahekili of Maui. Kahekili told the Hawaii chiefs to pause awhile on Maui and rest. The land which Kahekili gave them is the place where they stayed. It was Puuokapolei at Olowalu. Their division of land reached as far as Lahaina.

Kahekili, who rose to power following the passing of Kamehameha-nui, was one of the more powerful and ambitious chiefs of Maui who, by 1786, ruled O'ahu, Moloka'i and Lāna'i (Daws 1968:31). During the later years of Kahekili's reign and the early years of Western contact, the traditional Hawaiian lifestyle changed rapidly, as western goods, particularly weapons and metals became obtainable through either trade or theft. Daws comments that several of the early traders "saw nothing wrong in arming one Hawaiian chief against another as they sold guns to as many factions as they could find and then encouraged them to fight" (Daws 1968:32).

The "Olowalu Massacre," one of the more infamous events immediately following European contact reveals how conflicts between early western traders and native Hawaiians were easily provoked as western goods became the focus of Hawaiian needs. On February 1790, the Eleanora arrived from Liverpool, England captained by Simon Metcalfe, and anchored off of Honua'ula (S. M. Kamakau 1992:145). Kalola, the widow of Kalaniopu'u, was residing at Honua'ula at the time of the arrival of the ship with her new husband Ka'opuiki when the following events occurred:

> ... Ka-'opu-iki was glad to go on board to trade for iron, muskets, and red cloth; but muskets were the objects he most desire. The people brought in exchange hogs, chickens, potatoes, bananas, and taro. Night fell before they had finished their bargaining, and the next day Ka-'opu-iki and others went out again to trade further; but the strangers were unfriendly and beat them off with ropes. When Ka-'opu-iki heard from the people of Honua'ula about the small boat which it was customary to keep tied to the back of the ship, he determined to steal the boat at night. At midnight when the guard on the skiff and the men of the ship were sound asleep, Ka-'opu-iki and his men cut the rope without being seen from the ship. As they were towing it along, the guard awoke and called out to those on board the ship, but he was too far away to be heard; he was killed and his body thrown into the sea. The boat was taken to Olowalu and broken up, and the iron taken for fishhooks, adzes, drills, daggers, and spear points.
>
> The next morning when the men on the ship awoke and found both skiff and watchman missing and realized that the boat had been stolen and the watchman killed, they shot off the cannon upon Honua'ula and killed some men, among them a peddler from Wailuku, named Ke-aloha, who had come to Honua'ula to peddle his wares. Two men were held

> on board the ship, one from Honua'ula and one from Olowalu, perhaps because these men had given information about the theft or perhaps because the foreigners suspected that Ka-'opu-iki and the others ... said they were from Olowalu, were responsible for the theft. That evening they sailed to Olowalu, and in the morning Ka-lola declared a tabu restricting canoes from going out to the ship on pain of being burned to death of they disobeyed. "Withered grass" (Mau'uae) was the name of this law...on the fourth the tabu was ended, and canoes in great numbers went out to trade with the foreigners ... Little did they suspect the terrible carnage that was to follow, a carnage without any effort to apprehend and punish the offenders or any pity for the innocent. So these Christians murdered the Hawaiian people without any more mercy than cannibal Nukuhivans show, or people of pagan lands. ... At noon that day the *Eleanor* sailed, and the people went out and brought the dead shore ... and the dead were heaped on the sands at Olowalu. Because the brains of many were oozing out where they had been shot in the head, this battle with the ship *Eleanor* and her captain was called "The spilled brains" (Kalolopahu). It was a sickening sight ... (S. M. Kamakau 1992:145-146)

The arrival of the Eleanora plays significantly into the history of Hawai'i not only for the atrocity that was the Olowalu Massacre, but for the shipboard presence of John Young who, along with Isaac Davis, would become a favorite of Kamehameha I and instrumental as leaders in the wars of unification which would bring all of the islands under a single ruler. This push for unity would shift the traditional sociopolitical system from a Chiefdom hierarchy to a Kingdom under the Kamehameha line and make way for rapid changes in the islands.

2.1.3 Early Post-Contact Period

The nineteenth century brought to Lāhainā, and the surrounding lands which include the study area, a multitude of commercial, demographic, social, and religious changes that were encouraged by the burgeoning foreign influx. During the year 1819 the first whaling ships arrived in Hawaiian waters and Lāhainā Harbor became a primary port of call for provisioning ships in the islands. Closely following the arrival of the first whaling ships, thefirst Protestant missionaries and their families arrived in Lāhainā in 1823. The missionary William Ellis, who visited Lāhainā during the 1820's, described the landscape that had entranced both the Hawaiians themselves and the nineteenth century newcomers:

> The appearance of Lāhainā from the anchorage is singularly romantic and beautiful. A fine sandy beach stretches along the margin of the sea, lined for a considerable distance with houses and adorned with shady clumps of kou-trees, or waving groves of cocoa-nuts. . .The level land of the whole district, for about three miles, is one continued garden, laid out in beds of taro, potatoes, yams, sugar-cane, or cloth-plants. The lowly cottage of the farmer is seen peeping through the leaves of the luxuriant plantain and banana tree, and in every direction white columns of smoke ascend, curling up among the wide-spreading branches of the bread-fruit tree. The sloping hills immediately behind, and the lofty mountains in the interior, clothed with verdure to their very summits, intersected by deep and dark ravines, frequently enlivened by waterfalls, or divided by winding valleys, terminate the delightful prospect. (Ellis 1826:76-77)

Specific to Olowalu was an excursion around part of the island beginning at Lāhainā by the Rev. Hiram Bingham and Rev William Richards. In a letter to the American Board of Commissioners for Foreign Missions, Mr. Bingham describes their journey and overall impressions:

> Day before yesterday, Mr. Richards and I set off on an excursion to explore a part of the Island, and to visit the king, now on the other side. By the favor of the king's mother and her husband we obtained a good double canoe to facilitate our progress. We sailed along the shore in the direction of Maurakea (Mow-rah-ka-ah) [Mauna Kea] on Owhyhee, [Hawaii] of which we had a view among the clouds. Seven or eight miles from Lahinah we alighted on shore, and walked a mile or two through a pleasant plantation called Oroaru (O-ro-ah-roo) [Olowalu] belonging to the king's mother and containing 128 houses; then joined the canoe again. We found that some of the people had attended divine worship. As I was giving them a few words of instruction, I heard a lad pronounce the name of JESUS CHRIST. I asked him by whom he had heard the name of our Savior; he replied, "By the missionaries at Lahinah." We proceeded sailing along the shore, several miles passed [sic] several plantations belonging to Urumaheihei (Oo-roo-mah-ha-ee-ha-ee) [Ukumehame] and containing about 80 houses ... (Bingham 1824)

The whaling trade flourished until the 1860's and gave impetus to the development and growing population of Lāhainā. Between 1824 and 1861, 4747 whale ship arrivals were recorded for Lāhainā, representing 47 percent of the total arrivals in all ports of the Hawaiian Islands. Figures from an 1846 census of Lāhainā documents the following changes brought to the area midway through the nineteenth century: 3,445 Hawaiians, 112 foreigners, 600 seamen, 155 adobe houses, 822 grass houses, 59 straw and wooden houses and 529 dogs (Jarves 1847:240). With an increasing population of foreigners entering Lāhainā, there was a need to increase the traditional agricultural surplus, primarily under the control of the *ali'i* class, for economic trade. Henry Whitney, editor for The Pacific Commercial Advertiser, implies that western vegetables became a common and abundant constituent of the Hawaiian gardens in the following excerpt about Maui Island:

> ...Fruits are generally abundant. The grape seems to luxuriate in the rich soil, and the sunny, clear weather of Lāhainā is, par excellence, the fruit of this place or Islands. Figs, bananas and melons are produced in abundance, and pumpkins enough for all New England to make pies for a general Thanksgiving (Whitney 1858)

After the consolidation of the rulership of the Hawaiian Islands by Kamehameha I early in the nineteenth century, Lāhainā became the "capitol" of the kingdom until the 1840's when the government moved to Honolulu. The sugar cane Ellis observed in the environs of Lāhainā in the 1820's would become, during the second half of the nineteenth century, the basis for a commercial venture that would reshape the landscape within much of the present study area.

2.1.4 Mid- 1800s and the Great Māhele

With the unification of the Hawaiian Islands in 1791(Andrews 1865:556) and the arrival of the first Missionaries in 1820 (American Board of Commissioners for Foreign Missions 1832; Andrews 1865:556), western commerce and the Christianization of the Native Hawaiian people swept across Lāhainā Moku. The lands surrounding Lāhainā town were cultivated in commercial sugar (Gilmore 1936:198-203), while the whale trade (Graves, et al. 1998), the Irish potato trade in response to the California Gold Rush (Gilman 1906:177), and the establishment of the Lahaina Mission Station and Lahainaluna High School, drew people to the waterfront areas as well as the town itself. This trend made Lāhainā town one of the main religious and educational centers for the entire island chain (S. Kamakau 1992:304) and strongly influenced the religious and economic development of adjacent land divisions.

2.1.4.1 Religious Development

The Reverend Richard Williams established the Olowalu Mission of the Lāhainā Station between around 1829, and provided Christian meetings for the people there. In a letter written October 2, 1830, by Richard Williams and Jonathan S. Green, a review of the status of public worship on the Sabbath was reported thus:

> In every considerable village from one end of the island to the other, the people have erected a house for the worship of God ... At Olualu [sic], a village eight miles distant from Lāhainā, we have preached during the season, nearly thirty sermons to a congregation of five to six hundred. This and a single Sabbath at Kanepale, a village equally distant from Lāhainā in another direction, is all that we have been able to do for the people on this side of the island ... The congregation at Olualu [sic] listen with seriousness to the preaching of the gospel. A few teachers of schools there have formed themselves into a Bible class, who have been instructed in the interval between the services of the Sabbath. (Richards and Green 1831)

In an 1837 report to the American Board of Commissioners for Foreign Missions, a review of meeting-house construction in the Hawaiian Islands was presented with the following comment on progress at Olowalu:

> A *doby* meeting-house, or one the walls of which are of clay hardened in the sun ... has been built at Oloalu [sic], on Maui. (American Board of Commissioners for Foreign Missions 1837)

Mr. Hinano Rodrigues (in Lee-Greig and Hammatt 2006:A-32) offered the following description of the effort that went into building the Olowalu Church (see Figure 8):

> The church was founded in 1835 ... what happened is that my *tutu* folks formed a human line from the church up the mountain, and then they passed the stones down to the church, then they went across the street and got the coral and ground the coral to make cement yeah? And they built the church.

Figure 8. General Interior View of the Olowalu Church, photographed by Jack E. Boucher in 1966 for the Historic American Buildings Survey (HABS), and the Historic American Engineering Record (HAER) (National Park Service).

By the mid 1800's Hawai'i, the Lāhainā area in particular, was infiltrated by a growing community of foreign business entrepreneurs, transient whalers, and Calvinist-minded missionaries; all of whom had personal interests to protect and virtues to impress upon the traditional Hawaiian people. Encouraged by these foreign factions, the western-like land divisions of the Māhele were instigated under Kamehameha III (Kauikeaouli). The series of acts to "Organize the Executive Ministry" known commonly as the Organic Acts of 1845 and 1846, initiated the process of the Māhele, or division of Hawaiian lands, which would introduce private property ownership into Hawaiian society, as well as, transform the governance of the Kingdom from a full monarchy to a constitutional monarchy (Van Dyke 2008:32-33). Beginning in 1848, the Land Commission oversaw land divisions of three groups: Crown Lands (for the King); Konohiki or Ali'i Lands; and Government Lands, all of which were "subject to the rights of native tenants" (Wong Smith in Graves and Goodfellow 1991).

In 1848 the crown and the *ali'i* (royalty) received their land titles and *kuleana* awards for individual parcels within the *ahupua'a* were subsequently granted in 1850 (Alexander 1890:114). Crown Lands are lands defined as follows:

> ... lands reserved by Kamehameha III, March 8, 1848, "for himself, his heirs and successors forever", as his private property.

At the death of Kamehameha IV, it was decided by the Supreme Court that ...under the confirmatory Act of June 7th, 1848, "the inheritance is limited to the *successors* to the *throne*," "the wearers fo the crown which the conqueror had won," and that at the same time "each successive possessor my regulate and dispose of the same according to his will and pleasure as private property, in the manner as was done by Kamehameha III." (Alexander 1890:121)

As illustrated above, in designations of lands as Crown, and through all awards of whole *ahupua'a* and *ili* to specific *ali'i*, the rights of the native tenants were expressly reserved, "*Koe na Kuleana o Kanaka*" (Reserving the Rights of Native Tenants) (Alexander 1890:114). In an Act ratified on August 6th, 1850, the gathering rights of the common people for personal use, which included the gathering of both terrestrial and marine resources, in addition to the right to water and the right of way on the lands of the Konohiki, were guaranteed and embodied in Section 10477 of the Civil Code (Alexander 1890:114-115). By this same Act, resolutions passed by the Privy Council granted fee simple titles, free of all commutation, with the exception of awards granted within the towns of Honolulu, Lāhainā, and Hilo, to all native tenants for their cultivated lands and house lots, (Alexander 1890:115). *Kuleana* awards were presented to tenants of the land, native Hawaiians, naturalized foreigners, non-Hawaiians born in the islands, or long-term resident foreigners, who could prove occupancy on the parcels prior to 1845. Despite the effort to allocate lands to the *maka'āinana*, the *ali'i* control of the majority of lands persevered and, as the future would indicate, much of these lands were ultimately obtained by foreigners for sugarcane enterprises.

The majority of Olowalu Ahupua'a was retained by Kamehameha III as Crown Lands. Within these lands, most of the *kuleana* claims where concentrated along Olowalu Stream in the *mauka region* and along the coastline of the *ahupua'a* in the *makai* areas. The primary uses of the *kuleana* claims in the upper environs and along the stream bed were for agricultural pursuits, with some used as house lots, while the claims along the coastal regions consisted primarily of house sites with home gardens. Again, these land claim testimonies affirm that the *kuahiwi* or upper forested regions were a focus of gathering or maintaining household plant resources such as *wauke*, *hala*, and *'ohi'a* while the watered valley bottom was good for *lo'i kalo* (pondfield taro) with cultivation of *kula* crops (e.g. sweet potatoes and dryland taro) or *kihapai* presumably along the dryer upper alluvial plains (Table 1 and Figure 9 through Figure 10).

References to adjunct *po'alima*, or agricultural lands tended for the *ali'i*, and *konohiki* lands are accounted in the native or foreign testimonies as well. Of note, one of the testimonies given during the Mahele claims that the *konohiki*, had three *lo'i* plots in the middle of his land. Following the Mahele, in 1871, surveyors noted that "140 konohiki lois" were present on one side of Olowalu stream (Letter to J.O. Dominis from Nahaolelua, September 14, 1871-State Archives files).

Table 1. Sample of Land Commission Awards within Olowalu Ahupua'a

Helu	Royal Patent Number	Claimant	'Ili	Award Details
01742:02	2154	Kaauwai, Z.	Kailoaiki/ Wailoanui	*kula* land adjacent to Olowalu Stream
0240	None	Clark, John	Kaluakanaka	House lot
04376:01	6267	Keahi	Puukoloohilo	25 *mo'o* of *kula* (pasture) land
05620:01, 04	5477	Kehele	Maomao, Wailoa	Section 1 is *kalo* land adjacent to Olowalu Stream, Section 4 is 2 *lo'i* adjacent to Olowalu Stream
05829:H	4840	Nahue,	Kaluaha	2 *lo'i* and 1 house lot adjacent to Olowalu

Helu	Royal Patent Number	Claimant	'Ili	Award Details
		wahine		Stream
05952:01	5181	Minamina	Kaunukukahi	A house lot adjacent to the government road
06728:2	4952	Mahulu	Kaunakukahi	1 house lot and *kula*; referred to as "School Building" in boundary description
07719	7209	Haia	Maomao	15 *lo'i*, 1 *kula*, and 1 house lot adjacent to Olowalu Stream and the government road
08573:1	3810	Kailiala	Kuekue	A house lot
08817:01	7572	Kanakaole	Kaunukukahi	1 house lot
10128:05	4041	Maui, E	Kamani 3	small salt land
8546	3353	Kaawili	Paumaumau Kapaikoa Pu'uhilili'ole	One parcel of dry taro land near Pu'u hilili'ole and Kapaikoa. One piece of *Kalo* land in the three *ili* of Pulaia, Pu'ukoliolio and Hawaiikekee. 16 *lo'i*, a *pahale* (houselot) with a *wauke* patch, a banana orchard in Paumaumau, a *wauke* forest in Pualaia, another banana orchard in Pahua, and 11 *lo'i* in Pu'ukoleaohilo
6058	5468	Peekauai	Kamani & Kaunukukahi	2 pieces of forest 'ohi'a land, *kalo* in Kamani (10 *lo'i*) and one in Kaunukuhahi
4376	6267	Keahi	Pu'ukoliohilo Launukukahi Pualaia	Apana 1 – kula land in the *'ili* of Puukoliohilo. Apana 2 is *kalo* and *kula* in Pu'ukoliohilo. Keahi's testimony states: I tell you of my *kuleana* of 58 *lo'i*, 5 *puhala lei* and *lauhala* factories and the wood upland from the *mo'o* lands from my father. I am his heir. From Pikai is our *kuleana* and living compound and the *kula*. There was never any dispute up to this time. And three patches of *wauke*, one located in Pualaia, several stands of *wauke*, 2 more stands, 2 dryland taro gardens--they are in the *kuahiwi* (uplands/forest).

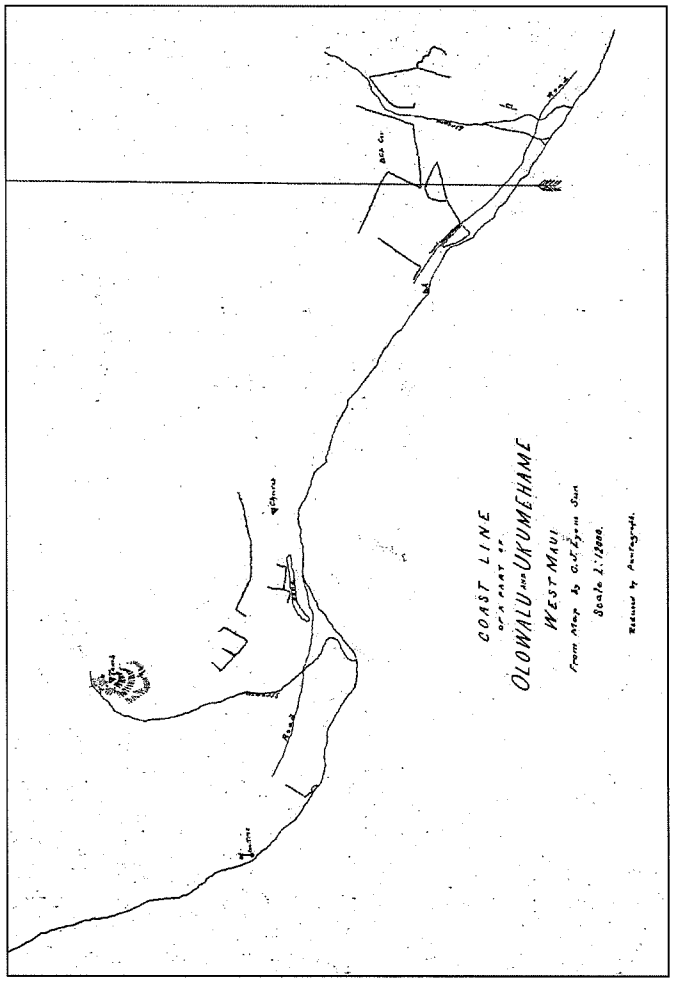

Figure 9. Original route of Olowalu Stream, as surveyed by C.J. Lyons (Dodge 1879), as opposed to the rerouted stream of modern day Olowalu (see Figure 1).

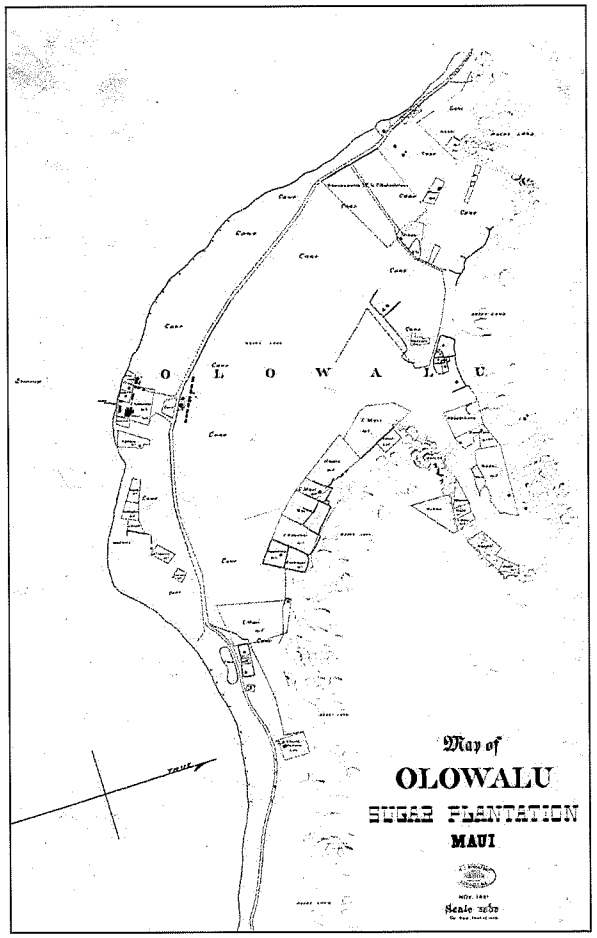

Figure 10. Distribution of *kuleana* awards within Olowalu Ahupua'a, note concentration along the base of Olowalu Valley and former location of Olowalu Stream bed (Monsarrat 1881).

2.1.5 Development of the Sugar Industry in Olowalu Ahupua'a (Mid-1800 to Mid-1900s)

The Lāhainā area was the location of some of the earliest sugarcane ventures in Hawai'i. The earliest reference to sugar grown in the Lāhainā area is credited to G. W. Wilfong, the manager of the Hana Plantation in 1851. In his 1882 writings, Wilfong made note of the various sugar enterprises established on Maui during his first tour of the island in 1849, and described the early sugar operations in Lāhainā. He noted that cane trash was an inefficient fuel for the boiling down of the juice extract into syrup, and that a large supply of indigo (*Indigofera suffruticosa*) was cut down for firewood in Lāhainā. "The area cleared by this means was subsequently used for the first planting of a supply of seed brought by Captain Edwards, of the whale ship George Washington. This cane was called Lāhainā" (Wilfong 1882). '

Captain Pardon Edwards had brought samples of two varieties of sugarcane to Hawaii in 1854: one variety from Tahiti, and one from Cuba. Both varieties flourished, but the Tahitian variety excelled, and was named "Lāhainā" (Dorrance and Morgan 2000). The first Lāhainā mill was operated by Judge A.W. Parsons in 1849. This mill plus 1000 acres of land was subsequently auctioned to O.H. Gulick. The Lāhainā Sugar Company was established in 1859, under the direction of Henry Dickenson (Wong-Smith in Graves and Goodfellow 1991:A6). The primary sugarcane enterprises developed during the mid to late 1800's along the alluvial plains of the West Maui Mountains were the Olowalu Sugar Company and Pioneer Mill Company.

Seeking to capitalize on the sugar industry, King Kamehameha V (Lot Kamehameha) leased the Crown Lands of Olowalu and Ukumehame to a new venture, the West Maui Sugar Association, in1871. One of 32 plantations that existed in Hawai'i and one of 12 on Maui listed in an 1872 report, this sugar venture produced an average yearly crop of 600 tons, though its mill had a capacity of 1,200 tons. By comparison, Pioneer Mill produced an average of 1,000 tons for its 1,200-ton capacity mill. Both plantations were hindered by lack of labor. (Ainsworth 2011)

The owners of the West Maui Sugar Association needed to concentrate on the difficult task of growing sugar so they turned to an agent, also called a factor, to handle the sale and shipping of their product. C. Brewer & Co. acted as agent for the yearly crop in the 1870s. Unfortunately, the sugar industry slumped in the 1870s. The Olowalu venture, struggling to survive, received a major blow when Lot Kamehameha died in 1872. Two years later, the West Maui Sugar Association sold both its plantation and mill in 1874 to James C. Campbell and Henry Turton, owners of what was by then called the Pioneer Mill Plantation, for $38,000. (Ainsworth 2011)

When the sugar industry rebounded, as a result of a reciprocity treaty with the United States that went into effect in 1876, and in anticipation of a boom in sugar, Milton Philip, a Lāhainā businessman, started to acquire land in Olowalu and Ukumehame in 1875. Another Maui resident, Goodale Armstrong, also acquired Olowalu property and together they formed what they called the Olowalu Plantation. (Ainsworth 2011)

2.1.5.1 The Olowalu Sugar Company

Utilizing former crown and *kuleana* lands, Phillip and Armstrong started growing sugar in 1876 (Ainsworth 2011) and formally organizing the Olowalu Sugar Company in 1881 on lands given up by the West Maui Plantation. The sugar venture was originally represented by the agency of McFarlane & Co., with shares in the plantation purchased by Theophilus Harris Davies, who became the agent for the enterprise in the late 1880's.

The history of the Olowalu Sugar Company included the construction of a mill and wharf development at Olowalu prior to 1884 (Wright 1974a). In addition processing cane harvested from the fields of Olowalu and Ukumeham, the mill was also contracted to process the cane harvested by Maunalei Sugar Company, a Lāna'i Island enterprise. Cane harvested by the Maunalei Sugar Company in Keōmuku was shipped from Halepalaoa to be processed at Olowalu beginning with the 1899 crop. Processing of the Lāna'i cane continued until 1901with the closing of the Maunalei Sugar Company(Conde and Best 1973:206).

The lands of the Olowalu Sugar Company lie on the lee side of the west Maui Mountains, where the rainfall is low, but the streams behind the plantation reach back to the crest of the mountains and are supplied chiefly by trade-wind rainfall. Heavy "kona" rains augmented the water supply during years of low trade-wind rainfall. It is estimated that the first well drilled at Olowalu for the plantation was sunk in 1905, a single shaft with 670 feet of lateral tunnels designed to skim 3 million gallons of fresh irrigation water per day from sources beneath the Olowalu plains. It was drilled vertically approximately 20 feet through the Wailuku basalts, at an elevation of 20 feet (Stearns and MacDonald 1942). A second well was drilled in Ukumehame around 1908, which consisted of a pit five feet deep, with a 6-inch drilled well 12-feet deep in the bottom. This arrangement was able to pump 1.25 million gallons per day (Stearns and MacDonald 1942).

In the 1920's, the Olowalu Sugar Company drilled an additional Maui-Type well at 165 feet of elevation, which consisted of a 30° inclined shaft measuring 300 feet long. This became known as well site no. 12, and replaced the Ukumehame well, which was subsequently filled in (Stearns and MacDonald 1942). In the early 1930's, the Olowalu Plantation merged with the Pioneer Mill Company, bringing along its two small and relatively crude systems. The Ukumehame Ditch system had a capacity of 15.5 mgd, and a median flow of 3.30 mgd. The Olowalu system had a capacity of 11 mgd and a median flow of 4.08 mgd.

Table 2. Sugar Crop figures for the Olowalu Plantation are listed as follows for the years leading up to Annexation with the United States: (listed as tons)

1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
760	859	702	937	905	1,163	1,112	1,425	1,502	1,480

At its operating peak in the 1920's, the plantation was divided into thirty-three fields, of an average size of twenty acres. The fields were named either for plantation employees ("Yoshino 15.75 acres", "Santiago 15.0 acres"), or for geographic locations ("Church 22.5 acres", "Olowalu Gulch 9.75 acres"). The Olowalu Sugar Company field map, drawn by F.W. Broadbent in 1924 for the Hawaiian Sugar Planter's Association, also shows the location of the Olowalu mill, the school, and the "old church". Production of about 2,000 tons of sugar per year was maintained until the plantation was purchased by the Pioneer Mill Company in May 1930 (Pioneer Mill Company 1931). In 1932, according to the records of the Pioneer Mill Company, the mill at Olowalu was dismantled and shipped to the Philippine Islands.

2.1.5.1.1 Railway Operations

The first reference regarding the use of a railroad at Olowalu Plantation to transport cane to the mill was found in the *Planter's Monthly* for April, 1882. The use of a "Fowler Railroad Plant" at the Olowalu plantation was considered by historian Jesse "Jay" Conde to mean that the

track had been installed, and the cane cars in operation utilized "mule power" until the enterprise could afford to order a locomotive (Conde and Best 1973). By November of 1882, according to the *Hawaiian Gazette*, the Olowalu railroad had completed the two-mile section of track to Ukumehame, for a total of three miles of fixed track.

The order for a Baldwin locomotive named "Olowalu" was placed late in 1889 by the firm of W.G. Irwin. The two-foot gauge plantation engine arrived on Maui just after the turn of the century. By September of 1905, a second locomotive was ordered from the Baldwin Locomotive Works, for a new boiler ("B") version of the same type of 2-foot gauge locomotive; also to be named "Olowalu". By 1918, new steel rails were being installed to replace the existing layout.). The 2-foot gauge track for the Olowalu Plantation Company railroad was built to the same specifications as the railway linking the HC&S mill at Spreckelsville to its fields; and to the sugar warehouses at the Kahului wharf. The uses of the railroad at Olowalu had made it possible to harvest and transport over six thousand tons of sugar in a single year (Gilmore 1936)

2.1.5.2 Pioneer Mill Company

The Pioneer Mill Company was established as a partnership in 1862, between James Campbell, Henry Turton, and Benjamin Pittman. The first Pioneer Mill plantation lands were deeded to the partners by Benjamin Pittman for the price of $30,000 (Condé and Best 1973:252.). How Pittman obtained such a sizable piece of land is unknown, however, one may posit that the first Pioneer Mill lands were in Launiupoko Ahupua'a which was acquired by Thomas Phillips in 1840 (Wong-Smith in Graves 1991:A6).

Using gravity flow water from mountain streams, the Pioneer Mill Company produced 500 tons of sugar in 1866. Production reached 1,000 tons annually by 1872, and the viability of the enterprise was assured when H. Hackfield was appointed sugar factor in 1877. By the turn of the century, the Pioneer Mill Company was producing over 10,000 tons of sugar a year (Thrum 1901).

In 1877, the entire Pioneer Mill plantation holdings were evaluated as being worth $500,000 (Wong-Smith in Graves 1991:A6-7). Henry Turton is credited during the early 1880's with planning construction of the first railway in Lāhainā to facilitate cane hauling from the cane fields in Kā'anapali to the Lāhainā-based mill. The Pioneer Mill was incorporated in 1885 and sold to H. Hackfeld & Company, the predecessor of Amfac, Inc. (Wilcox n.d.:, Wong-Smith in Graves 1991:A9). In order to maintain production and the successful growing of sugar cane along the west coast of Maui required further development of water resources.

The Pioneer Mill installed a simple galvanized iron flume in the Honokowai Stream in 1898, but the mechanism by which arid coastal lands could receive mountain waters was not to be perfected on Maui's western coastline until the building of the Honokohau Ditch in 1904. With the construction of Honokohau Ditch, the Pioneer Mill Company was able to reach back into the mountain valleys and obtain water in a system developed by the Honolua Ranch, effectively delivering about 20 million gallons per day to the Pioneer Mill fields. This main ditch was augmented over the years with seven additional ditches.

General reorganization of the Pioneer Mill Company began around the turn of the 20th century. A prospectus for change describes assets of the four main cane fields composing the company at that time (Conde and Best 1973:253):

Lāhainā - 1,000 acres of land on the flat and outside of small kuleanas, (land areas claimed by the Hawaiians under Royal grants), the land is fee simple (could be deeded).

Launiupoko - 2,900 acres of fee simple land, lying between Lāhainā and Olowalu.

Wahikuli - A tract of government land of 5,000 acres, under lease for eighteen years, lies between Lāhainā and Kaanapali.

Kaanapali - Some 3,600 acres at various levels, fee simple land, beyond Wahikuli.

An immediate result of the reorganization was the construction of "twenty miles" of new railroad, replacing old lines and extending the entire length of the plantation, with branches emanating *mauka* into the upper elevations of the cane fields (Condé and Best 1973:253.). By the late 1920's, the Pioneer Mill Company developed a complex of irrigation systems including flumes used to transport cane to railroad "car loading stations" (Condé and Best 1973:254). As suggested by archaeological evidence and respective cane maps, the Pioneer Mill may have developed irrigation canals and flumes at an earlier time in Launiupoko where the examination of an un-labeled Pioneer Mill map (possibly titled: *Canefield Map - 1918 MC-10 to 33*) differentiates the irrigation canal and flume as the "new flume" and "old flume, respectively. Thus, suggesting that both structures are not contemporaneous in origin.

In May of 1931 the Pioneer Mill Company expanded their cane enterprise as far as Ukumehame to the east through the purchase of Olowalu Sugar Company (Conde and Best 1973:264). During this same period, less lucrative cane fields, specifically in upper Launiupoko, were abandoned for the most part due to labor shortages "imposed by World War II" (Graves 1991:5). During the 1930's the Pioneer Mill Co. also began cattle ranching in the abandoned cane fields of Launiupoko. According to Herbert Kinores, Pioneer Mill Co. ranch foreman, ranching infrastructure including walls, fences, and wooden and stone-walled corrals were constructed in the Launiupoko region above the cultivated cane fields (Graves 1991:7).

A dramatic technological change to cane production of the Pioneer Mill occurred in 1946 when it became more economical to use trucks to transport the harvested cane instead of railroad carts. As reported in a Pioneer Mill Co. annual, the year of 1953 marked the final elimination of railroad use in the Pioneer Mill Company (in Conde and Best 1973:255). Changes in the operation, as a result of an exhaustive study by the combined staffs of Pioneer Mill Company, and American Factors, Ltd., Plantation Division, resulted in the elimination of the railroad system altogether. All sugarcane would be hauled by trucks, with the ability to haul 45-65 tons per load, on a shift basis.

2.1.6 Late 1900s to Modern Era

In the late 1900s and toward the end of the Sugar Era in Lāhainā, small scattered residential lots were present within the current project area along the shoreline at Olowalu and in the upper reaches of the valley. These isolated house lots are referred to as *kuleana* (Kimo Falconer, in Robins et al. 1994) and likely represent original boundaries of land claims made during the Māhele.

The intensive sugarcane agriculture under the direction of Pioneer Mill continued operations from Ukumehame to Launiupoko until 1998. With the final harvest and closure of Pioneer Mill in 1999 (Kubota 1999) lands that were formerly cultivated in sugarcane were either left fallow, in pasturage, or have been subdivided out of larger landholdings for development of agricultural

estates. During the 1970s Maui Electric installed a power line between Mā'alaea and the town of Lāhainā. The existing line stretches over elevations of between roughly 600 and 2600 feet above mean sea level. A *pu'u*, commonly referred to as "cut mountain", is located between Olowalu and Launiupoko presently being used as a quarry or "borrow pit". Immediately west of the *pu'u* is an old landfill site.

2.2 Previous Archaeological Research within Olowalu Ahupua'a

In 1916, John F. Stokes of the Bishop Museum performed the first systematic reconnaissance of monumental, pre-contact architecture as a part of an archaeological reconnaissance of *heiau* on Maui Island. At Olowalu, Stokes recorded Kaiwaloa Heiau with the following notation:

> ... on a hill near power line. Large, walled heiau in fair condition. Many graves inside. (Stokes 1916:5)

Between 1928 and 1929 Winslow Walker, also of the Bishop Museum, conducted an island-wide systematic archaeological survey that built upon the initial work carried out by Stokes. Like Stokes, the primary focus of the Walker Survey, was on the identification of monumental architecture and ceremonial structures in the form of *heiau* (temples) and *ko'a* (shrines). At Olowalu Walker re-identified Kaiwaloa Heiau and recorded a smaller unnamed *heiau* below the ditch. The following descriptive information from Walker's survey (1931) for both *heiau*, with a notable variation in the spelling of the name from Kaiwaloa (Stokes 1916:5) to Kawaialoa (Walker 1931:108) and Kawailoa (Walker 1931:109 map illustration), is offered below:

Table 3. Walker Sites within Olowalu Ahupua'a, adapted from Walker (1931)

Walker Site	Name	Location	Description
4	Kawaialoa Heiau Kawailoa Heiau	On the rising ground south of Kilea Hill above the ditch	Measures approximately 156' by 110'. The walls range in thickness from 8 ½ feet on the west to 12 feet on the south and east where it is composed of two terraces. The highest part is 10 feet high. The north wall is lower and ranges from 5 to 6 feet thick. Several low terraces and enclosures are found inside. The low platforms in the western part are probably graves of recent date. The entrance evidently was the the north. At a point on the west wall and at two points on the south wall are piles of stones cone-shaped whose use or purpose could not be determined. Rough red vesicular basalt is the material used in the heiau construction and no coral is found. Nor artifacts were found there.
5	Unknown	In the cane lands below the ditch	Measures 40 x 60 feet but all interior structures have been destroyed.

While Walker was primarily concerned with the identification of ceremonial sites, he made survey notations of house and village sites within the regions that he visited. At Olowalu, Walker corroborated the later observation of Handy and Handy (1991) regarding the prominence of *lo'i* agriculture and permanent habitation within Olowalu Ahupua'a by noting that:

> Terraces for the cultivation of taro were seen on West Maui in the vicinity of ... Lāhainā, Olowalu, and Ukumehame (Walker 1931:71).

> Above Mrs. Naho'oikaika's house are evidences of old taro patches and house sites. The site of the ancient ditch bringing down water from Olowalu Gulch is now used for the modern ditch supplying the cane fields. At the edge of a house platform measuring 15 x 28 feet, is a large flat stone of red basalt used as a *papamu* for the game of *konane*. It has 9 rows of holes ½ inch deep, and 12-15 holes in a row (Walker 1931:77).

In 1973 the Department of Land and Natural Resources, State Parks Division conducted a similar island-wide archaeological survey, as a follow-up to Winslow Walker's study. As a result of the 1973 survey, Kaiwaloa/Kawaialoa Heiau was thoroughly documented and the site was given State Inventory of Historic Property (SIHP) number 50-50-08-00004 (Connolly 1973a) (Appendix A). While an attempt to re-identify Walker Site 5 (50-50-08-00005) was made at this time, it was determined that the *heiau* was destroyed by sugar cane cultivation (Hawai'i Department of Land and Natural Resources State Historic Preservation Division 1974). Other historic properties that were identified during the State sponsored survey included the Olowalu Petroglyph Complex (50-50-08-01200 and -01201) (Connolly 1973b), features associated with the Olowalu Mill District (50-50-08-01602) (Wright 1974a), and the Olowalu Stone Church at Mōpua (50-50-08-01603) (Wright 1974b) (Appendix A).

Robins and others (1994) conducted an archaeological inventory survey of a power transmission line from Ma'alaea to Lāhainā within the upper reaches of the current project area. During the survey 34 sites and site complexes were identified throughout their project corridor. The archaeological sites that were identified consisted of a wide range of formal pre-contact site types that included agricultural features characteristic of intensive non-irrigated agriculture, temporary and permanent habitation sites, major *heiau* and shrine sites, a travel route, a marker site, possible human burials, historic ranching walls, in addition to, irrigation canals, flumes and a possible railroad bed associated with large-scale, historic sugarcane cultivation. The traditional Hawaiian sites that were identified during the survey, however, were clustered in the Ukumehame and Launiupoko valley regions, with more isolated pre-contact historic properties located near Kaua'ula Stream and in the upland alluvial plains of Ukumehame Ahupua'a. Within Olowalu Ahupua'a, two historic properties (50-50-08-03172 and -03180) primarily associated with the historic sugar industry were identified adjacent to the Olowalu Stream (Robins, et al. 1994:37 and 83). The scarcity of traditional Hawaiian sites within the project corridor as it crossed the Olowalu valley area was attributed to the destructive nature of large-scale cane agriculture that encompassed nearly all of Olowalu lands within the project corridor (Robins, et al. 1994:99).

Two separate studies, specific to the current project area, were conducted by Xamanek Researches along a section *makai* of Honoapi'ilani Highway (approximately 73-acres) (D. L. Fredericksen and Fredericksen 2000a) and a section *mauka* of Honoapi'ilani Highway (approximately 662-acres) (D. L. Fredericksen and Fredericksen 2000b) for an overall 735-acre project area. Both sections of the project area were covered by cultivated sugarcane lands at the time of the archaeological inventory survey. Seven historic properties consisting of pre-contact and early post-contact traditional Hawaiian habitation and burial sites, as well as, historic era features associated with commercial sugar cane cultivation and government infrastructure were identified within the *makai* section of the *makai* section of the current project area (D. L. Fredericksen and Fredericksen 2000a) (SHPD LOG NO: 24957; DOC. NO: 000RC39 – see also Appendix B). Six of these historic properties were newly identified (50-50-08-4693 through -4698 and -4822) while one, the Olowalu Mill District (50-50-08-01602), was previously

recorded during the State of Hawaii sponsored inventory survey (see Section 2.2.1 Table 4 for summary historic property information).

A total of 31 sites, both pre-contact and historic, were identified within the *mauka* portion of the current project area (D. L. Fredericksen and Fredericksen 2000b) (SHPD: LOG NO: 25237; DOC. NO: 0004RC1O – see also Appendix B). Three historic properties were previously identified and recorded (50-50-08-00004, -01200, -01201 and -01603) while 27 were newly identified (50-50-08-04699 through -04721, -04758, and -04820 through -04823) (see Section 2.2.1 Table 4 for summary historic property information). Pre-contact sites recorded in the *mauka* section include habitation sites (walls, enclosures, and rock shelters), ceremonial and religious sites (*heiau* and burials), and agricultural sites (terraces and modified outcrops); as well as, rock art features. Historic era properties identified within the *mauka* study were associated with the sugar industry and subsequent historic era settlement of the area. These features include the remnants of a church, a cemetery, and sites related to historic agriculture. Radio carbon dates from four rockshelters and a permanent habitation site (D. L. Fredericksen and Fredericksen 2000b:66) indicates that settlement of Olowalu Ahupua'a was chronologically established during the middle of the time period that Kirch (1985:Figure 239) identifies as the "Expansion Period" (A.D. 1100-1650). Throughout this 550-year time span, the Hawaiian population expanded to several hundred thousand; economic production intensified through the development of large irrigation works and dryland field systems as well as aquaculture methods and new fishing technology; and social and political organization became highly stratified (Kirch 1985:303-306).

Archaeological monitoring for the installation of a septic tank within an approximate 1.3 acre project area along the coastal boundary of the current project area was carried out by Xamanek Researches (E. M. Fredericksen 2003). While no significant historic properties were identified within a subsurface context, the excavation did encounter coastal sand deposits. As sensitive historic properties are often found in these types of environments, continued archaeological monitoring within adjacent areas was recommended and approved (SHPD LOG NO: 2003.0954; DOC. NO: 0306MK31 – see also Appendix B).

An archaeological field inspection of a residential parcel (TMK [2] 4-8-004:010) within the current project area was carried out by CRM Solutions Hawai'i (Conte 2007) (SHPD LOG NO: 2008.0957; DOC. NO: 0802TD16-- Appendix B). The field inspection resulted in no new or previously recorded historic properties being identified. It was further noted that the property had been previously grubbed and graded on several occasions and, due to proposed method of dwelling construction (post and pier over imported fill), no further archaeological work was recommended.

Finally, following the large brush fires of 2007, Scientific Consultant Services was contracted by the current project applicant to conduct a field inspection of approximately 500-acres that had been cleared by fire (Shefcheck and Dega 2007). One new historic property, consisting of agricultural terraces, was identified during the course of the field inspection. Due to the horizontal proximity and morphological similarities of these terraces to Feature B of previously recorded SIHP 50-50-08-04708, the newly identified historic property was designated as Feature C of Site -04708. Additionally, two historic properties (SIHP 50-50-08-04758 and -01200) were noted as adversely impacted by the fire. Several headstones of Site -04758, historic Awalua Cemetery, had cracked and spalled as a result of the heat of the fire. Similarly, thermal damage

was also noted at Site -01200, the Olowalu Petroglyph Complex, where smoke damage and spalling of some of the petroglyphs panels were noted.

2.2.1 Historic Properties Identified within the Current Project Area

A total of 41 historic properties, some consisting of multiple features, were identified and recorded during previous archaeological studies within the current project area (Connolly 1973a; D. L. Fredericksen and Fredericksen 2000a, b; Robins, et al. 1994; Shefcheck and Dega 2007; Stokes 1916; Walker 1931). The following section provides a summary of all known historic properties that have been identified along with recommended significance evaluations by the recording archaeologists (Table 4 and Figure 11).

Table 4. Summary of Historic Properties Identified and Recorded within the Current Project Area (SIHP Prefix 50-50-80-), see also Figure 11

SIHP No	Formal Type	Probable Function	Age[3]	Significance	Brief Description
00004[4 5 6]	Heiau (Kaiwaloa/Kawaiaoa Heiau)	Ceremonial	P	C,D,E	Site consists of "...[L]arge walled heiau...156 x 110 feet..." interior features include: "... terraces and enclosures...graves...piles of stones cone-shaped
01200[7]	Olowalu Petroglyph Complex	Rock Art	P	C,D,E	Petroglyph panels (2): Area 1 = minimum of 37 petroglyphs, Area 2 = minimum of 31 petroglyphs. Some are badly vandalized; Shefcheck and Dega (2007) noted fire damage.
01201[8]	Rock Shelter	Temporary Habitation	P	D	Rock shelter associated with Area 1 of SIHP -01200
01602[9] [10]	Olowalu Mill District	Habitation/Mill/ Wharf	H	A,D	Historic District: structures, sugar mill, wharf, manager's house.

[3] P=Pre-contact; H=Historic; U=Undetermined (used where the archaeological report indicated a "?" in age determination)

[4] **Stokes, John F. G.**
1916 Maui Heiau. December 1916. (typeset notes). Unpublished Bernice Pauahi Bishop Museum, Honolulu, HI.

[5] **Walker, Winslow M.**
1931 Archaeology of Maui. Manuscript. Bernice Pauahi Bishop Museum. Honolulu, HI.

[6] **Connolly, Robert D. III**
1973a *50-50-08-00004 Kawaiaoa Heiau.* Hawaii Register of Historic Places Archaeological Forms. Hawai'i Department of Land and Natural Resources State Historic Preservation Division. Kapolei, HI

[7] 1973b *50-50-08-01200 Olowalu Petroglyphs.* Hawaii Register of Historic Places Archaeological Forms. Hawai'i Department of Land and Natural Resources State Historic Preservation Division. Kapolei, HI

[8] **Fredericksen, Demaris L. and Erik M. Fredericksen**
2000b *Archaeological Inventory Survey of Alaika Portion of Olowalu Development Parcel Phase 2, Olowalu Ahupua'a, Lahaina District, Maui Island (TMK 4-8-3:10).* Prepared for Olowalu Elua Associates. Kahului, Maui. Xamanek Researches. Pukalani, HI

[9] **Wright, J.C.**
1974a *50-50-08-01602 Olowalu Mill District.* Hawaii Register of Historic Places Archaeological Forms. Hawai'i Department of Land and Natural Resources State Historic Preservation Division. Kapolei, HI

[10] **Fredericksen, Demaris L. and Erik M. Fredericksen**
2000a *Archaeological Inventory Survey of Alaika Portion (Phase 1) of Olowalu Development Parcel, Olowalu Ahupua'a, Lahaina District, Maui Island (TMK 4-8-3:por.3).* Prepared for Olowalu Elua Associates. Kahului, HI. Xamanek Researches. Pukalani, HI

SIHP No	Formal Type	Probable Function	Age[3]	Significance	Brief Description
01603[11]	Lanakila Hawaiian Protestant Church	Church/Cemetery	H	D,E	Historic church and graveyard.
03172[12 8]	Concrete Irrigation Ditch	Agriculture	H	D	Site consists of a historic irrigation ditch constructed of cement and boulders.
03180[12 8]	Historic Cattle Wall	Ranching	H	D	Site consists of a wall located on west side of Olowalu Stream; 234 x .85 x 1.45m; an alternative interpretation of function was as an *ahupua'a* boundary wall.
04693[10]	Burial Complex	Burial	P	D,E	Site consists of 6 *in situ* burials ranging from .05 to .80-.85cmbs; burials 1 thru 5 were articulated, burial 6 interpreted as scattered
04694[10]	L-Shape	Habitation	P	D	Site consists of an L-shape wall, 10m long (E/W) and 9.5m long (N/S) x 1.2 m wide x 0.3-0.6m high; located on Hekili Point.
04695[10]	Wall/terrace	Erosion Control	H	D	Site consists of retaining wall segment, 10 x 4.5 x 1.1m
04696[10]	Old Government Road	Transportation	H	D	Site consists of an old road segment that follows a traditional trail, 100m long x 15m wide;; located 15-18m northeast of SIHP -4695.
04697[10]	Subsurface Cultural Deposit	Habitation	U	D	Site consists of a possible historic dog burial, possibly associated with nearby kuleana house lots; and a subsurface cultural deposit, 6 x 3-4 x .12m deep.
04698[10]	Subsurface Cultural Deposit	Habitation	P	D	Site consists of subsurface cultural deposit, 35 x 50m (depth and thickness not provided).
04699[8]	Habitation Complex	Habitation/Burial/ Possible Boundary	U	D,E	Habitation Complex located along S-SE side of ridge: 8 rock shelters (Features A-H) with one containing a probable burials (Feature D); and a modified outcrop (Feature I), 12.6 x 0.8 x 0.75m; overall site complex dimensions = 155 x 30m.

[11] **Wright, J.C.**
1974b *50-50-08-01603 Olowalu Stone Church Ruins*. Hawaii Register of Historic Places Archaeological Forms. Hawai'i Department of Land and Natural Resources State Historic Preservation Division. Kapolei, HI

[12] **Robins, Jennifer J, William H. Folk and Hallett H. Hammatt**
1994 *An Archaeological Inventory Survey of an Approximately 14.7 Mile Proposed Transmission Line, from Ma'alaea to Lahaina, Maui, Hawai'i*. Prepared for Dames & Moore. Cultural Surveys Hawai'i Inc. Kailua, HI

SIHP No	Formal Type	Probable Function	Age[3]	Significance	Brief Description
04700[8]	Habitation Complex	Habitation/Undetermined	P	D	Habitation Complex: 7 rockshelters: (Features A and C-I); one C-shape (Feature B), 1.7 x 2 x 0.5m; and a wall segment (Feature J), 2.3 x 0.8 x 0.7m; overall site complex dimensions = 55 x 40m.
04701[8]	Possible Ko'a	Ceremonial	P	D,E	Site consists of a platform, 15 x 11 x 0.3m and paved area; overall site area = 33 x 27m.
04702[8]	L-Shape	Boundary	H	D	Site consists of L-shape wall, 47 x .75 x 1.2m; 6 x 0.75 x 1.2m and an inactive historic concreted ditch.
04703[8]	Complex	Boundary	U	D	Site complex consisting of features of an indeterminate age: enclosure/alignment/uprights (Feature A), 4 x 3 x 0.7m; wall remnant (Feature B), 5.5 x 0.65 x 0.65m; alignment (Feature C), 3 x 1 x .6m; overall site complex dimensions = 30 x 8m.
04704[8]	Habitation Complex w/Petroglyphs	Habitation	P	C,D,E	Habitation Complex: 27 individual petroglyphs (Feature A), 14 x 3.6m; terraces (Features B-G), 8.5 x 4 x 0.75m to 2.3 x 2.4 x .8m; overall site complex dimension = 61 x 23m.
04705[8]	Rock Shelters	Temporary Habitation	P	D	Site consists of 2 rock shelters: Feature A, 4.5 x 1.75 x 2m; Feature B, 2.5 x 1.3 x .9m.
04706[8]	Rock Shelter	Temporary Habitation	P	D	Rock shelter: 4.25 x 2.25 x 1.25m; located on west side of Olowalu Stream.
04707[8]	Wall and Mound	Marker/ Burial	U	D,E	Two features: wall or alignment (Feature A), 77 x 3.5 x .8m high; and a rock mound (Feature B), 5 x 2.7 x .85m; overall site dimensions = 77 x 5.5m.
04708[8 13]	Platform and Terrace Complex	Agriculture/ Ceremonial	P	D,E	Agricultural Complex: terrace/platform (Feature A), 19 x 8 x 2.6m; terrace complex (Feature B), 40 x 22m; terrace complex (Feature C[13]); overall site complex dimensions = 62 x 23m.
04709[8]	Historic Hydro-Electric Plant	Historic Agriculture	H	C,D	Site consists of foundation that formerly supported a hydro-electric plant measuring 29 x 23m.

[13] **Shefcheck, Donna and Michael F. Dega**
2007 *Letter Report: Field Inspection of Previously Identified Sites within a Burned Area (Approximately 500-acres of a Total 660 Acres) in Olowalu Ahupua'a, Lahaina District, Island of Maui [TMK: 4-8-3:10 por.]*. Prepared for Olowalu Town, LLC. Wailuku, HI. Scientific Constultant Services, Inc. Honolulu, HI

SIHP No	Formal Type	Probable Function	Age[3]	Significance	Brief Description
04710[8]	Habitation Complex	Agriculture/Burial	P	D,E	Habitation Complex: terrace w/ enclosure (L-shape alignment) (Feature A), 14.5 x 9 x .9m; four terraces (Features B and F-G); two enclosures (Features C and D); and an oval alignment indicating a possible burial (Feature E), 2.1 x 1.5 x 0.3m
04711[8]	Alignment and Terrace	Agriculture	P	D	Site consists of 2 features: alignment (Feature A), 5.5 x 2 x 0.6m; and a terrace (Feature B), 3.2 x 3.5 x 0.5m; overall site dimension = 16 x 6m.
04712[8]	Terrace and Mound	Agriculture/Burial	P	D,E	Site consists of 2 features: terrace and rock pile (Feature A), 14 x 3 x 1.3m; modified outcrop (Feature B), 1.8 x 0.8 x 0.6m; overall site dimensions = 30 x 6m.
04713[8]	Rock Shelter	Temporary Habitation	P	D	Site consists of rock shelter, 6 x 3.5 x 2.4m; located on east slope of Pu'u Kilea.
04714[8]	Rock Shelter	Temporary Habitation	P	D	Site consists of rock shelter, 2 x 2.4 x 0.7m; located on northwest side of Pu'u Kilea.
04715[8]	Cemetery	Burial	P/H	D,E	Site consists of cemetery containing minimum of 33 graves; located on the summit of Pu'u Kilea; overall site dimensions = 38 x 20m.
04716[8]	Terrace and Wall	Boundary/Habitation	P	D	Site consists of 2 features: terrace/platform (Feature A), 5 x 3.5 x 2.3m; wall (Feature B), 22 x 1 x 1m.
04717[8]	Retaining Walls	Historic Agriculture	H	D	Site consists of 5 retaining wall segments: Feature A, 15 x 4 x 2.6m; Feature B, 25 x 2.5 x 2.9m; Feature C, 20 x 2.7 x 0.9m; Feature D, 51 x 3.3 x 1.3m; and Feature E; 12 x 1.8m.
04718[5 8]	Heiau Complex	Ceremonial	P	C,D,E	Site is believed to be the "unnamed heiau" identified by Walker 1931 (SIHP 50-50-08-00005) and documented as destroyed during the 1973 inventory (Hawai'i Department of Land and Natural Resources State Historic Preservation Division 1974); Complex consists of 3 features: an enclosure (Feature A), 12 x 6 x 0.7m; and two burials (Features B and C); overall site complex dimensions = 21 x 12 x 0.7m.
04719[8]	Rock Wall	Boundary	H	D	Site consists of a dry-stacked wall, 8 x 0.8 x 0.9m.
04720[8]	Retaining Wall	Transportation	H	D	Site consists of a retaining wall.
04721[8]	Rectangular Platform	Habitation	H	D	Site consists of a small rectangular platform with a retaining wall on the western side. Historic era artifacts found.

SIHP No	Formal Type	Probable Function	Age[3]	Significance	Brief Description
04758[8]	Historic Cemetery	Burial	H	D,E	Site is historic Awalua Cemetery containing a minimum of 60 graves, 80 x 30m; Shefcheck and Dega (2007) noted fire damage to some of the headstones.
04820[8]	Surface Scatter Human Skeletal Remains	Burials	P	D,E	Surface scatter of human skeletal remains; overall site area: 100m sq; located in cane field; no indication of an *in situ* burial..
04821[8]	Surface Scatter Human Skeletal Remains	Burial	P	D,E	Surface scatter of human skeletal remains; overall site area: 50-60m sq; no indication of an *in situ* burial..
04822[8]	Kaloko o Kapa'iki Pond?	Pond	P	D	Site consists of probable fishpond sediments; located between shoreline and Olowalu Subdivision in eastern section of Olowalu Subdivision.
04823[8]	Marsh/Lagoon, Olowalu	Lagoon	P	D	Site consists of gleyed deposits.

2.3 The Project Area within the Context of Ahupua'a System

The arrangement of a typical Hawaiian *ahupua'a* extended from the coastline to the upland forest areas. Depending on the location within this broad *makai* to *mauka* context, a wide variety of cultural practices and resources within the *ahupua'a* could be found. The central idea behind the *makai* to *mauka* configuration was to take advantage of the variety resources within that land division. Such resources and rights would include marine resources and fishing rights in the coastal area, arable lands for crop cultivation, as well as, water and timber rights in the planting and upland zones, and valuable bird catching privileges at the higher elevations (Handy, et al. 1991:48). Based on the land commission award distribution in the *mauka* and *makai* sections of the current project area, as well as, the stories and information gathered during the background research for this study, it is apparent that settlement and land use within Olowalu Ahupua'a functioned in the traditional sense.

The general pattern was to maintain two residences, a *makai* residence that could take advantage of the marine resources and a *mauka* residence to maintain the staple taro crops and other agricultural pursuits. The waters of Olowalu Stream were perennial and would have supported *lo'i* agriculture all the way down to the coast. Some freshwater aquatic resources were also likely available along the lower reaches of the stream system. As a whole, the primary traditional activities within the area would have centered on marine resource gathering, domestic activities during the hottest times of the day, and agricultural pursuits associated with maintaining a home garden and the *mauka lo'i* and *kula* agricultural lands.

2.3.1 Traditional Trails

Trails served to connect the various settlements within and between the *ahupua'a* and districts of the Hawaiian Islands in traditional times. While the Alaloa, or foot trail, that encircled the coastline likely existed along the coast, the preferred mode of inter-*ahupua'a* travel for leeward environs of West Maui was through an upland route and/or major valleys of the West Maui Mountains, where the temperatures were cooler and more tolerable. Traditional trails along the coast were more frequently used for intra-*ahupua'a* travel between the coastal reaches and permanent habitation locations to the upland agricultural area. Mr. Hinano Rodrigues (in Lee-Greig and Hammatt 2006) indicated that these trails generally followed the course of each major stream and were more often than not marked by petroglyphs along the trails as evidenced along the bedrock exposures of Olowalu Gulch (Olowalu Petroglyph Complex [50-50-08-01200 and -01201] [See also Section 2.2]).

2.3.2 Traditional Hawaiian Habitation and Agriculture

Land commission awards for the *makai* region of Olowalu Ahupua'a show small scattered house lots with associated agricultural plots along the coastline, while *mauka* awards along the former stream route and valley bottom show larger lots for more extensive agricultural endeavors. The smaller agricultural plots were presumably used for home gardens, *kula* agriculture or dryland crop cultivation occurred at *kuleana* lots situated further away from the primary stream, and *lo'i* agriculture occurred at *kuleana* lots situated closer to the stream outlets and along the valley bottom (see also Section 2.1.4 Mid- 1800s and the Great Māhele).

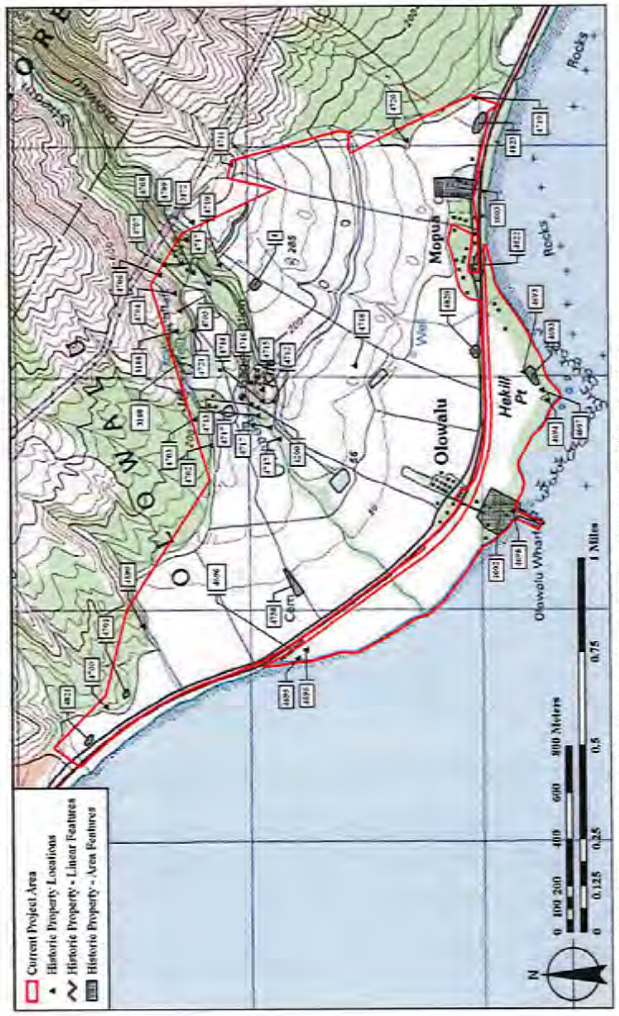

Figure 11. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the locations of historic properties within the current project area

2.3.3 Gathering for Plant Resources

Based on the early historic literature and testimony to the Land Commissioners during the Mahele, most plant gathering occurred at the upper elevations and within the gulches. Such plants included *wauke* (paper mulberry, *Broussonetia papyrifera*), *hala* (*Pandanus tectorius*), and *'ōhi'a* (likely *'ōhi'a lehua*, *Metrosideros polymorpha*) (see also Section 2.1.4 Mid- 1800s and the Great Māhele). Plant gathering along the coast was likely for the different *limu* species such as *limu līpoa*, *limu kohu*, *lipe'ep'e*, *māne'one'o*, and *manauea*. .

2.3.4 Aquatic Resources

The coastal reaches of Olowalu Ahupua'a were noted as rich with marine resources and is distinguished as the traditional fishing grounds for the people of the Lahaina District. Noted resources include *pāpio*, mullet, *moi*, *'ōpelu*, *akule*, *ū'ū*, *opihi*, *ha'uke'uke*, *wana*, *he'e*, *ula*, and *loli*. Fishing methods included spear fishing, pole fishing, *paea ea*, and *ho'omoemoe*. *Paea ea* fishing is generally a low-impact type method that was carried out from the shoreline using a straight pole or bamboo. Commonly practiced in Olowalu during the traditional time period, this type of fishing was only conducted on nights of the new moon, a phase of the moon that is often referred to as "dark night" or "pitch dark night".

Moemoe net is a rectangular type of gill of net, with floats on one edge and weights on the opposite edge. The floats and weights keep the lay net suspended vertically while in the water. The net is "set" and left in place for several hours and later retrieved. The name *moemoe* net comes from the Hawaiian word *moe* meaning "to sleep". The method involved setting the net, going home to sleep, and returning later to retrieve the net. The set begins when the net first touches the water and ends when the net is completely removed. This method of fishing is highly efficient at catching a larger volume of fish.

The presence of Kaloko O Kapaiki, the *ali'i* fishpond at Kapaiki also indicates that marine resource based subsistence for Olowalu also relied on aquaculture. Gley deposits at SIHP 50-50-08-4823 may indicate an additional fishpond feature.

2.3.5 Traditional Hawaiian Archaeological Sites

Previous cultural resource management investigations within the current project area have documented the area's rich cultural resources (see Section 2.2 Previous Archaeological Research within Olowalu Ahupua'a); however, historic and modern sugar cane cultivation have greatly modified the traditional landscape. Such activities have largely removed any surface remnant of cultural resources that may have been present along the alluvial plains of the current project area. Lessons learned along Hekili Pt. indicate that subsurface deposits can be found in a disturbed context within the plow zone and an intact context below the plow zone. Therefore, the fact that there was extensive ground disturbance associated with sugar cane cultivation from the historic era up until modern times does not preclude the presence of historically significant cultural deposits within former habitation areas at subsurface level.

2.3.6 Traditional Burial Practices and Ceremony

SIHP # 50-50-08-4693, a pre-contact burial ground consisting of a minimum of six individuals is dedicated to passive preservation (see Section 2.2.1 Historic Properties Identified within the Current Project Area). The preserve area for this burial site is situated adjacent to the campgrounds of Camp Olowalu.

Other burial sites include the known cemeteries at Awalua, SIHP 50-50-08-4758, Pu'u Kilea SIHP 50-50-08-4715, and Lanakila Hawaiian Protestant Church SIHP 50-50-08-1603. There is some concern with regards to the boundaries of the Church graveyard in that the graves extend beyond the recorded metes and bounds for the cemetery. Mr. Rodrigues (in Lee-Greig and Hammatt 2006) indicated that the:

> Territory of Hawai'i decided that they were gonna give all the churches their property and so they decided to draw the map and give the churches two acres. The plantation jumped in and said "Oh but no, we want the original two acres because we want to grow the sugar cane". So when they drew the map they shoved us two acres forward toward the ocean which left the graves in the back and they grew the sugar cane on our graves.

This fact was verified during an inventory survey conducted by Xamanek Researches(D. L. Fredericksen and Fredericksen 2000b) when conducting backhoe testing behind the church beyond the recorded boundaries of the church yard.

Kaiwaloa Heiau, SIHP 50-50-08-0004, and what is believed to be a smaller *heiau* complex, SIHP 50-50-08-4718, is also located within the current project area, both of which have been noted as having associated burial interments (D. L. Fredericksen and Fredericksen 2000b). Based on the construction style of Kaiwaloa Heiau, it is thought that the *heiau* was a *luakini* type *heiau* (H. Rodrigues in Lee-Greig and Hammatt 2006:Appendix A pA-46). According to the writing of Malo (1951:212), the right to build a *luakini* belonged only to the king. This particular type of temple was dedicated Kū and built as a war temple when one sovereign sought to make war upon another, or in a reaction to a declaration of war (1951:210-212). Construction of a *luakini* required *'ōhi'a* for the both the idols and structure timber, *loulu* (native fan palm, *Pritchardia* sp.) or *'uki* (*Machaerina angustifolia*) for the thatch and *'ōhi'a* that had been stripped of bark for the fence (1951:211).

Section 3 Assessment of Cultural Impacts

Act 50 of the Session Laws of Hawaii 2000 amended Chapter 343, of the Hawaii Revised Statutes, to require that environment impact statements assess the effects of a proposed action on the cultural practices of the community and State, specifically acknowledging the State's responsibility to protect native Hawaiian cultural practices:

> The legislature also finds that native Hawaiian culture plays a vital role in preserving and advancing the unique quality of life and the "aloha spirit" in Hawaii. Articles IX and XII of the state constitution, other state laws, and the courts of the State impose on government agencies a duty to promote and protect cultural beliefs, practices, and resources of native Hawaiians as well as other ethnic groups.
>
> Moreover, the past failure to require native Hawaiian cultural impact assessments has resulted in the loss and destruction of many important cultural resources and has interfered with the exercise of native Hawaiian culture. The legislature further finds that due consideration of the effects of human activities on native Hawaiian culture and the exercise thereof is necessary to ensure the continued existence, development, and exercise of native Hawaiian culture.

While a requirement for a Cultural Impact Assessment exists as a part of the environmental review process, the *Guidelines for Assessing Cultural Impacts* (hereafter referred to as "Guidelines") originally adopted in 1997 by the Hawai'i State Department of Health, Office of Environmental Quality Control (OEQC) were suspended in 2008. Suspension of these Guidelines notwithstanding, the following plan for assessing the potential for cultural impacts will utilize the general framework as outlined in the Guidelines for consistency in content and methods. In the Guidelines, the following protocol was recommended for preparers of assessments analyzing a proposed projects potential for cultural impact:

1. identify and consult with individuals and organizations with expertise concerning the types of cultural resources, practices and beliefs found within the broad geographical area, e.g., district or *ahupua'a*;
2. identify and consult with individuals and organizations with knowledge of the area potentially affected by the proposed action;
3. receive information from or conduct ethnographic interviews and oral histories with persons having knowledge of the potentially affected area;
4. conduct ethnographic, historical, anthropological, sociological, and other culturally related documentary research;
5. identify and describe the cultural resources, practices and beliefs located within the potentially affected area; and
6. assess the impact of the proposed action, alternatives to the proposed action, and mitigation measures, on the cultural resources, practices and beliefs identified.

To accomplish the above in the context of the proposed Olowalu Town Master Plan, the analysis of potential impacts will incorporate the methods in the following section.

3.1 Document Review and Research

The traditional and historic background presented above was developed through research of published and unpublished accounts, land and archaeological survey reports and maps, as well as, photographs found in public and private collections pertaining to Olowalu Ahupua'a and the study area. English language historical documents, maps, and archaeological studies were researched at the DLNR/SHPD library, the Survey Office of the Department of Accounting and General Services (DAGS), the Lahaina Restoration Foundation Archives at the Hale Pa'i, the Maui County Planning Department, and the Cultural Surveys Hawai'i (CSH) library; in addition to private collections held by others in the community.

The sample of *Kuleana* claims and testimony presented in Section 2.1.4 Mid- 1800s and the Great Māhele were studied using historic maps and cross referenced with the Māhele 'Aina data compiled in the online Papakilo Database (Office of Hawaiian Affairs 2011) and Waihona 'Aina (Waihona 'Aina 2002). Native register documents, as well as, native and foreign testimony that were recorded in Hawaiian language were translated by Ms. Katherine Kama'ema'e Smith.

Hawaiian newspaper resources and other Hawaiian language documents were researched using *Ulukau: The Hawaiian Electronic Library* (www.ulukau.org) and translated by Ms. Katherine Kama'ema'e Smith and Ms. Cori-Ann Lorenzo, B.A. The final Cultural Impact Assessment for the proposed project will continue to build upon the cultural and historic background information presented in Section 2.1 Traditional and Historical Background as a means to provide a comprehensive historic narrative for Olowalu Ahupua'a.

3.2 Scoping and Community Outreach

3.2.1 Government Agencies, Advisory Councils, and Local Community Organizations

In order to cast a wide net in identifying individuals with knowledge of traditional cultural practices and gathering cultural recommendations for the cultural impact assessment study for the proposed project, government agencies, advisory councils, and local community organizations identified in Table 5 will be contacted.

Table 5. 3.2.1 Government Agencies, Advisory Councils, and Local Community Organizations

Name	Affiliation
Mr. Hinano Rodrigues	Department of Land and Natural Resources State Historic Preservation Division -- Maui Annex, Cultural Historian
Mr. Matthew Erickson	Lāhainā Hawaiian Civic Club
Ms. Hokulani Holt	Maui Arts and Cultural Center, served as a member of the Olowalu Cultural Reserve Committee
Ms. Nicole McMullan	Bailey House Museum

Name	Affiliation
Mr. Kamana'opono Crabbe	Office of Hawaiian Affairs, Chief Executive Officer
Ms. Thelma Shinnaoka	Office of Hawaiian Affairs, Maui Community Affairs Coordinator
Mr. Stan Solamillo	Maui County Cultural Resources Commission, Planner
Ms. Pua Aiu	Department of Land and Natural Resources State Historic Preservation Division, Administrator
Mr. Ke'eaumoku Kapu	Maui/Lanai Islands Burial Council, Burial Council Chair
Ms. Patty Nishiyama	Na Kupuna O Maui
Ms. Uilani Kapu	Kuleana Ku'ikahi LLC
Ms. Rose Marie Duey	Olowalu Cultural Reserve, Executive Director
Mr. Albert Lagunero	Olowalu Cultural Reserve, President of the Board of Directors

To initiate consultation with these organizations, a scoping letter along with project area maps showing the proposed project footprint, as well as the overall region of influence will be mailed out with the following text (see Appendix A for the letter and attachments):

> At the request of Olowalu Town, LLC and Olowalu Ekolu, LLC., Cultural Surveys Hawai'i (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed Olowalu Town Master Plan Project. The Olowalu Town Master Plan will serve as a guide for the establishment of a small-scale "mixed-use" community with land uses that will vary from urban neighborhood town centers to rural and agricultural areas within the 636-acre project area (Attachment 1). Overall, the master plan proposes the development of 1,500 residential units along with civic structures (educational facilities, community and cultural centers, and emergency worker facilities), park and gathering facilities, greenways, bikeways, and trails all of which would be constructed concurrently with the appropriate infrastructure over an approximate 10 year period.
>
> The area of direct effect for the proposed undertaking, here after referred to as the "current project area", is considered as the footprint of the proposed 636-acre footprint of the Olowalu Town Master Plan (Attachement x). When assessing the presence or absence of direct, indirect, and cumulative effects of the proposed project on the traditional cultural practices of this region, traditional use and access to resources from the mountains to ocean, or *mauka* to *makai*, must be taken into consideration. As such, the Region of Influence (ROI), hereafter referred to as the "study area" for this CIA is defined as the geographic area encompassed by the known traditional boundaries of Olowalu Ahupua'a which includes any offshore traditional fisheries that may have been associated with Olowalu Ahupua'a. (Attachments 2 and 3)
>
> We are seeking your *kōkua* or help and guidance regarding the following aspects of our study:
>
> - **General history and present and past land use of the project area.**
> - **Knowledge of cultural resources which may be impacted by the proposed Olowalu Town Master Plan - for example, traditional plant gathering areas, traditional fishing areas, historic sites, archaeological sites, and burials (see also Attachment 4).**
> - **Knowledge of traditional gathering practices in the area – both past and ongoing.**
> - **Cultural associations of the project area, such as legends and traditional uses.**
> - **Referrals of *kūpuna* or elders who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.**
> - **Any other cultural concerns the community might have related to Hawaiian cultural practices within Olowalu Ahupua'a and/or in the vicinity of the proposed Olowalu Town Master Plan area.**
>
> I invite you to contact me, Tanya Lee-Greig at 1-808-242-9882. You may also contact me by e-mail at leegreig@culturalsurveys.com if you have any mana'o or information you would like to share.

3.2.2 Individuals and Families with Generational Knowledge and Lineal Ties to the Lands of the Current Study Area

As a result of the initial community outreach by Olowalu Town, LLC. and their intensive work with the community during the Olowalu Talk Story Community-Based Planning Workshop, families and individuals with lineal ties to the lands and generational knowledge of the history and traditional cultural practices within the current study area have been identified. The cultural impact assessment study will look to these families and individuals for their knowledge of current traditional cultural practices and *mana'o* (thought, idea, opinion) on the potential for either positive or adverse effects to such practices in the context of the proposed project.

3.3 Group Consultation, Informal Interviews, and Formal Interviews

Interviews will be conducted in either a group setting, informally via telephone, or as a part of a formal sit-down interview between the researcher and participating individual. Handwritten notes of all consultations will made by the researcher, and with the permission of the participant, formal interviews will be recorded using either a Sony ICD-SX25 or Olympus VN-4100PC Digital Voice Recorder.

Verbatim transcriptions of recorded interviews will be completed using the Sony Digital Voice Editor Software. All formal and informal interview notes, along with the verbatim transcriptions where applicable will submitted to each participant for clarification and accuracy prior to inclusion in cultural impact assessment. Transcripts from formal interviews will only be included in the study upon written consent from the interviewee (see Appendix B for the consent form).

3.4 Final Report Preparation

A Cultural Impact Assessment report will be prepared and include the findings from Sections 3.1, 3.2, and 3.3 above and consist of the following as suggested by the Guidelines:

1. An explanation of confidential information that has been withheld from public disclosure in the assessment.
2. A discussion concerning any conflicting information with regard to identified cultural resources, practices and beliefs.
3. A discussion concerning the cultural resources, practices and beliefs identified:
   a. for resources and practices, their location within the broad geographical area in which the current project is proposed.
   b. their direct or indirect significance or connection to the proposed project area footprint.
4. A discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area that may be affected directly or indirectly by the proposed project.
5. An analysis of the potential effect of any proposed physical alteration on cultural resources, practices or beliefs which may include:
   a. the potential of the proposed action to isolate cultural resources, practices or beliefs from their setting.
   b. and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place.

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Appendix A Scoping Letter

CULTURAL SURVEYS HAWAI'I
ARCHAEOLOGICAL, CULTURAL, AND HISTORICAL DOCUMENTATION SERVICES - SINCE 1982

CSH Job Code: **OLOWALU 3**

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Fax: (808) 262-4950

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Wailuku, Hawai'i 96793
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Fax: (808) 244-1994

Branch Offices:
Hilo, Hawai'i
Kona, Hawai'i
Lāwai, Kaua'i

Thursday, January 19, 2012

Addressee:

Subject: Cultural Impact Assessment for the Proposed Olowalu Town Master Plan in Olowalu Ahupua'a, Lāhaina District, Island of Maui.

Dear Recipient:

At the request of Olowalu Town, LLC and Olowalu Ekolu, LLC., Cultural Surveys Hawai'i (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed Olowalu Town Master Plan Project. The Olowalu Town Master Plan will serve as a guide for the establishment of a small-scale "mixed-use" community with land uses that will vary from urban neighborhood town centers to rural and agricultural areas within the 636-acre project area (Attachment 1). Overall, the master plan proposes the development of 1,500 residential units along with civic structures (educational facilities, community and cultural centers, and emergency worker facilities), park and gathering facilities, greenways, bikeways, and trails all of which would be constructed concurrently with the appropriate infrastructure over an approximate 10 year period.

The area of direct effect for the proposed undertaking, here after referred to as the "current project area", is considered as the footprint of the proposed 636-acre footprint of the Olowalu Town Master Plan (Attachement x). When assessing the presence or absence of direct, indirect, and cumulative effects of the proposed project on the traditional cultural practices of this region, traditional use and access to resources from the mountains to ocean, or *mauka* to *makai*, must be taken into consideration. As such, the Region of Influence (ROI), hereafter referred to as the "study area" for this CIA is defined as the geographic area encompassed by the known traditional boundaries of Olowalu Ahupua'a which includes any offshore traditional fisheries that may have been associated with Olowalu Ahupua'a. (Attachments 2 and 3)

Thursday, January 19, 2012

We are seeking your *kōkua* or help and guidance regarding the following aspects of our study:

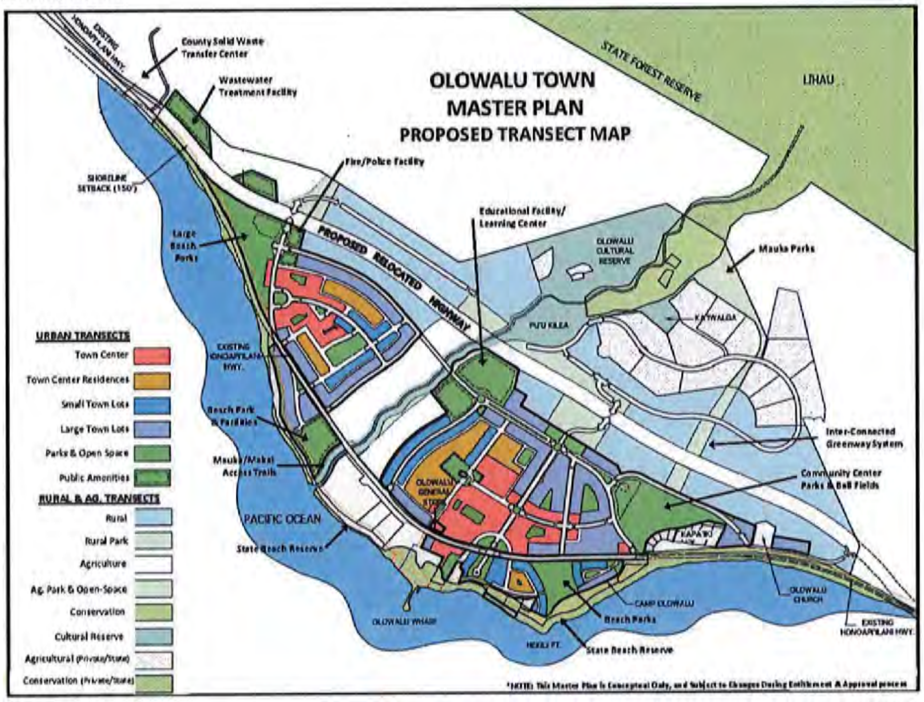
- **General history and present and past land use of the project area.**
- **Knowledge of cultural resources which may be impacted by the proposed Olowalu Town Master Plan - for example, traditional plant gathering areas, traditional fishing areas, historic sites, archaeological sites, and burials (see also Attachment 4).**
- **Knowledge of traditional gathering practices in the area – both past and ongoing.**
- **Cultural associations of the project area, such as legends and traditional uses.**
- **Referrals of *kūpuna* or elders who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua*]*a* lands.**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within Olowalu Ahupua'a and/or in the vicinity of the proposed Olowalu Town Master Plan area.**

I invite you to contact me, Tanya Lee-Greig at 1-808-242-9882. You may also contact me by e-mail at leegreig@culturalsurveys.com if you have any mana'o or information you would like to share.

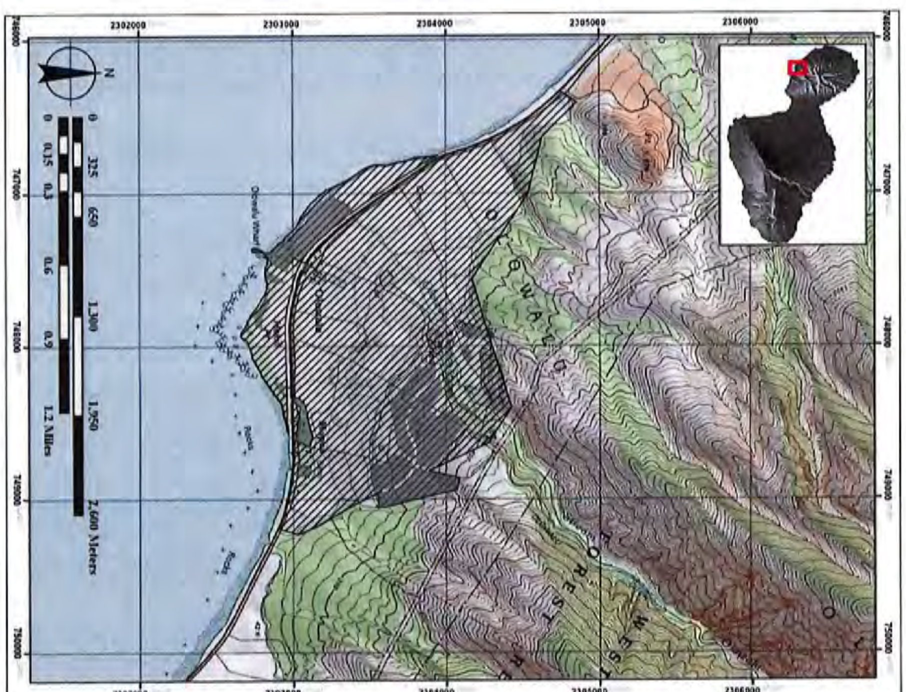
Mahalo a nui,

Tanya L. Lee-Greig

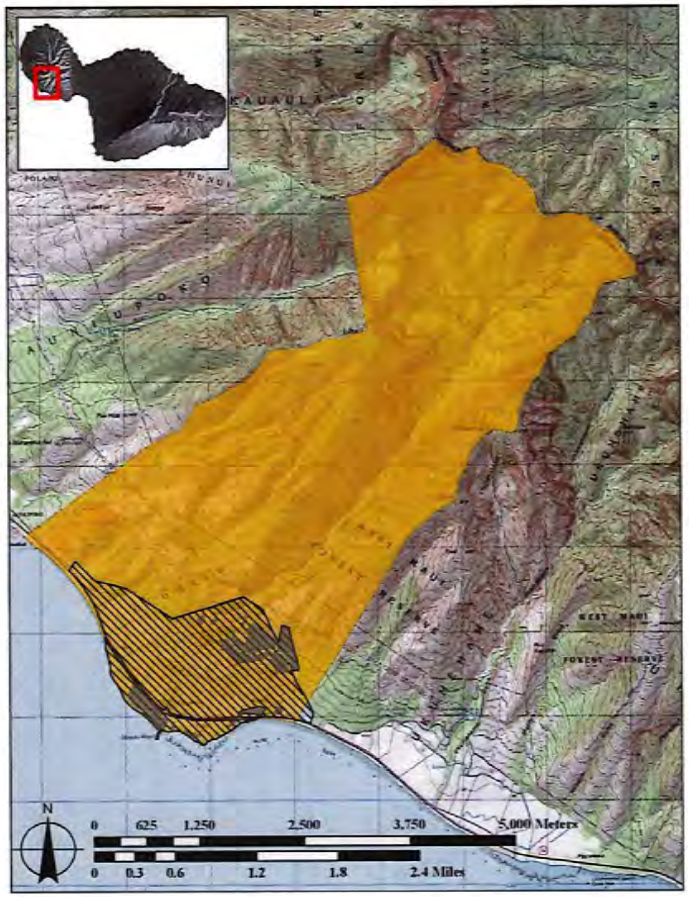
Cultural Surveys Hawai'i, Inc.



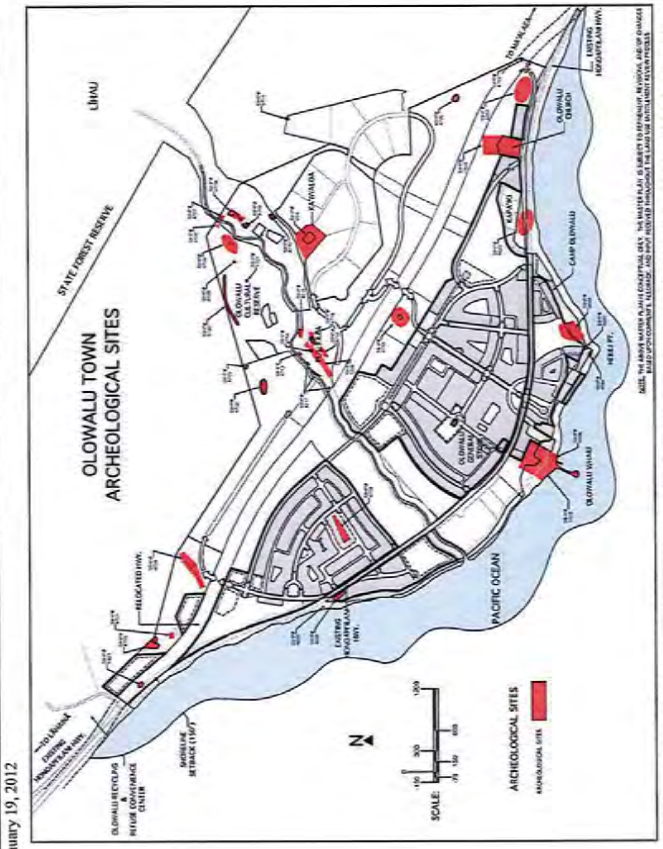
Conceptual drawing for the Proposed Olowalu Town Master Plan (figure courtesy of Olowalu Town, LLC.)



Portion of the 1992 7.5-minute USGS topographic map, Olowalu Quadrangle showing the location of the current project area in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray



Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, the study area and Olowalu Ahupua'a shaded in orange, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.



Location of known archaeological sites with preservation buffers (in orange) in relation to the proposed Olowalu Town Master Plan (figure courtesy of Olowalu Town, LLC).

Appendix B Transcript Release Form

Ethnographic Interview Authorization and Release Form

Cultural Surveys Hawai'i (CSH) is grateful for the generosity of the Kūpuna and Kama'aina who have willingly shared their knowledge and experiences for the preparation of a cultural impact assessment for the proposed Olowalu Town Master Plan project.

We understand our responsibility in respecting the wishes and concerns of the interviewees participating in our assessment. Here are the procedures we promise to follow:

1. You will have the opportunity to review the written transcription of our interview with you. At that time, you may make any additions, deletions, or corrections you wish.
2. You will be given a copy of the interview transcript you have approved for your records.

For our records and yours, we humbly request your confirmation that:

1. You were given the opportunity to review the transcript of the interview.
2. You consent to the use of the interview with any revisions specified by you for historic documentation and academic purposes.
3. You consent to the interview being made available to the public.

I, _____, agree to the procedures outlined above and by my
(Please print your name)
signature, given my consent and release for this interview to be used for historic documentation and academic purposes.

Additional Comments and Clarifications:

_____
(Signature)

_____
(Date)

APPENDIX H-1.

A Cultural Impact Assessment for the Proposed Olowalu Town Master Plan in Olowalu Ahupua`a, Lāhainā District, Island of Maui

A Cultural Impact Assessment for the Proposed Olowalu Town Master Plan in Olowalu Ahupua'a, Lāhainā District, Island of Maui TMK: (2) 4-8-003: 84, 98, through 118, and 124

Prepared for

Olowalu Town, LLC

and

Olowalu Ekolu, LLC

Prepared by

Tanya L. Lee-Greig, M.A.

and

Hallett H. Hammatt, Ph.D.

with contributions by

Ms. Katherine Kama'ema'e Smith

Cultural Surveys Hawai'i, Inc.

Wailuku, Hawai'i

(Job Code:OLOWALU 3)

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Acknowledgements

Many thanks go out to the various individuals who shared their personal life experiences and traditional knowledge for this study. Information shared by these people helps tremendously in reconstructing the way life was lived at different phases in history and also shows how lifestyles, particularly relating to Hawaiian traditions and cultural practices, have evolved. Mahalo nui to Katherine Kama'ema'e Smith for compiling and translating the Native Register claims for Olowalu Ahupua'a, a snapshot in time which allowed the voices of the *kūpuna* to speak to the resources and agricultural traditions through their own writings.

Most important it is with our sincerest gratitude and fondest aloha that we thank the following *kūpuna* and individuals who have contributed greatly to our understanding of traditional cultural practices related to the lands and waters of Olowalu Ahupua'a: Mrs. Adeline Rodrigues, Mr. Hinano Rodrigues, Mr. Al Lagunero, Mr. Stanley Okamoto, Mr. Ke'eamoku Kapu and Mrs. Ui'lani Kapu, and Mr. Daniel Nahina. Mahalo also to the members of Pola Nui Hiu, and in particular Mrs. Roselle Bailey, Mr. Charlie Lindsey, Mr. Ekolu Lindsey, Mr. Scott Fisher, and Mr. Mark Hecht for sharing their *mana'o* and concerns for the marine and coastal resources of Olowalu for this study.

Management Summary

Reference	A Cultural Impact Assessment for the Proposed Olowalu Town Master Plan in Olowalu Ahupua'a, Lāhaina District, Island of Maui TMK: (2) 4-8-003: 84, 98, through 118, and 124.
Date	March 2015 (Revised)
Project Number (s)	Cultural Surveys Hawai'i (CSH) Job Code: OLOWALU 3
Project Location	Olowalu Ahupua'a, Lāhainā District, Maui Island, TMK: [2] 4-8-003: multiple parcels as depicted on the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) (see Section 1.1 Project Description and Background)
Land Jurisdiction	Private: Olowalu Town, LLC. and Olowalu Ekolu, LLC.
Agencies	State: Hawai'i Department of Health/Office of Environmental Quality Control (DOH/OEQC) Hawai'i Department of Land and Natural Resources/State Historic Preservation Division (DLNR/SHPD)
Project Description	The Olowalu Town Master Plan seeks to combine conservation, agricultural, rural, and urban land uses to re-establish a small-scale and mixed-use community. Approximately 1,500 residential units, ranging from single-family to multi-family dwellings, are proposed with appropriate infrastructure to be built concurrently.
Region of Influence (ROI)	The area of direct effect for the proposed undertaking is considered as the footprint of the proposed 636-acre footprint of the Olowalu Town Master Plan When assessing the presence or absence of direct, indirect, and cumulative effects of the proposed project on the traditional cultural practices of this region, traditional use and access to resources from the mountains to ocean, or *mauka* to *makai*, must be taken into consideration. As such, the ROI for this undertaking is defined as the geographic area encompassed by the known traditional boundaries of Olowalu Ahupua'a.
Regulatory Context	With regard to State of Hawai'i Environmental Regulations, this undertaking is subject to Hawai'i Administrative Rules (HAR) Title 11 Chapter 200-4(a) and Chapter 343 of the Hawai'i Revised Statutes (HRS) which requires consideration of a proposed project's effect on traditional cultural practices. CSH undertook this cultural impact assessment to provide information pertinent to the assessment of the proposed project's cultural impacts. This document is intended to facilitate the project's state environmental review and provides documentation of the project's consultation efforts.

Results	Background research as well as community consultation identified both past and current traditional cultural practices centered on the gathering of marine resources, agricultural pursuits within the valley and adjacent to the stream, and gathering of forest resources. Central to this is the potential disruption of *mauka* to *makai* access to coastal and upland resources. In an effort to address this potential effect and preserve the more pristine historic properties within Olowalu Ahupua'a, the Olowalu Cultural Preserve (OCR), consisting of a corridor along the current route of Olowalu Stream and area covering the floor of the gulch to the *mauka* boundary of the current project area, has been set aside for preservation in perpetuity. It is envisioned that the OCR will ensure that access between the mountains and ocean is maintained and preserved along Olowalu Stream, and that the re-opening of the *lo'i kalo,* restoration of native plants and historic properties, and development of educational and outreach programs by the OCR will safe guard the natural resources in the Olowalu Ahupua'a for future generations. Concerns regarding the preservation of the *mauka* to *makai* viewshed, adverse effects to the marine resources of the coastal environment, access to fresh water resources for both traditional agricultural purposes and the maintenance of a healthy near shore ecosystem, and the effects of light pollution on the night sky were identified. Community and *kama'aina* recommendations on how to minimize such effects, as well as, details on how the Olowalu Town Master Plan plans are addressing such concerns are presented in Section 6 Traditional Cultural Practices and Section 7.1 Project Effect and Proposed Recommendations.

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Section 1 Introduction

At the request of Olowalu Town, LLC and Olowalu Ekolu, LLC., Cultural Surveys Hawai'i (CSH) has prepared an assessment of potential impacts to traditional cultural practices within Olowalu Ahupua'a that may result from the proposed Olowalu Town Master Plan Project. The location of the proposed project is bound by the Pacific Ocean to the west and lands currently under the jurisdiction of State of Hawai'i to the north, south and east at Olowalu Ahupua'a and a portion of Ukumehame Ahupua'a, Lāhainā District, Maui Island (TMK [2] 4-8-003:84, 98, through 118, and 124).

1.1 Project Description and Background

The Olowalu Town Master Plan will serve as a guide for the establishment of a small-scale "mixed-use" community with land uses that will vary from urban neighborhood town centers to rural and agricultural areas within the 636-acre project area (Munekiyo & Hiraga 2010:7 and Table 2). Overall, the master plan proposes the development of 1,500 residential units along with civic structures (educational facilities, community and cultural centers, and emergency worker facilities), park and gathering facilities, greenways, bikeways, and trails all of which would be constructed concurrently with the appropriate infrastructure over an approximate 10 year period (Munekiyo & Hiraga 2010:10).

The area of direct effect, or area that may be physically altered by the proposed project, consists of the entire 636-acre project footprint as described above (hereafter referred to as the "project area"). To ensure that potential impacts to traditional cultural practices which may not occur within the area of direct effect, but may nonetheless be adversely affected by the proposed project are identified, where a proposed action that may not physically alter subsistence and medicinal gathering resources but may affect either access to such gathering areas or the integrity of the resource used, the *ahupua'a* is the appropriate geographical unit of study. With this in mind, and for the purpose of this assessment, the broader region of influence (ROI), hereafter referred to as the "study area", will be considered to identify any potential impacts to traditional cultural practices that may result from the proposed project. The study area for this report consists of the entire *ahupua'a* of Olowalu including the off-shore reef area.

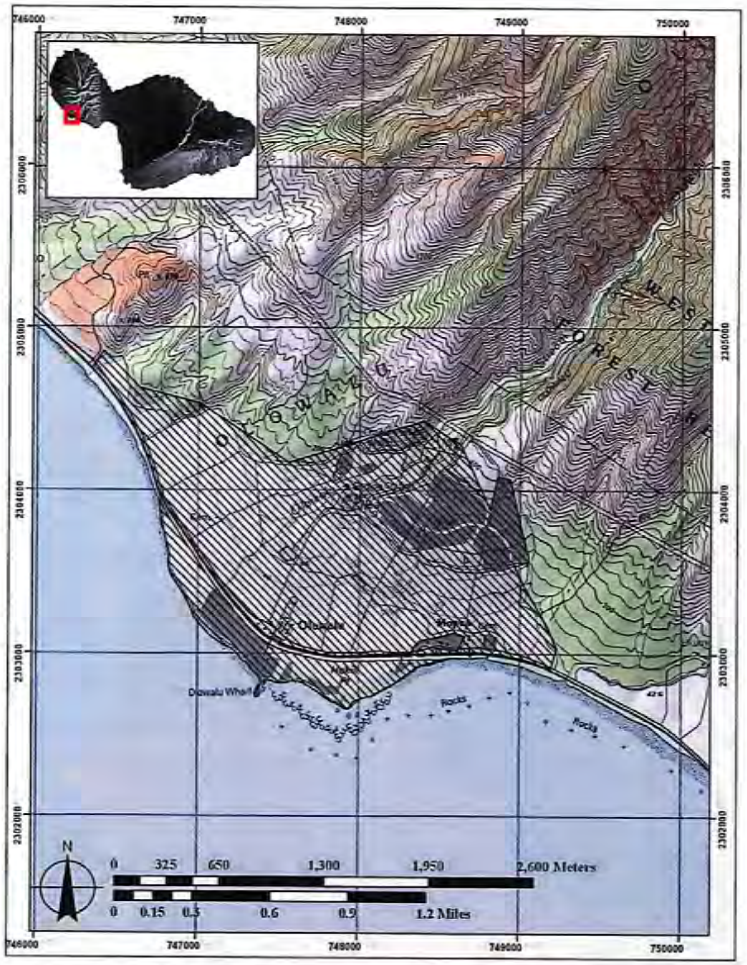

Figure 1. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

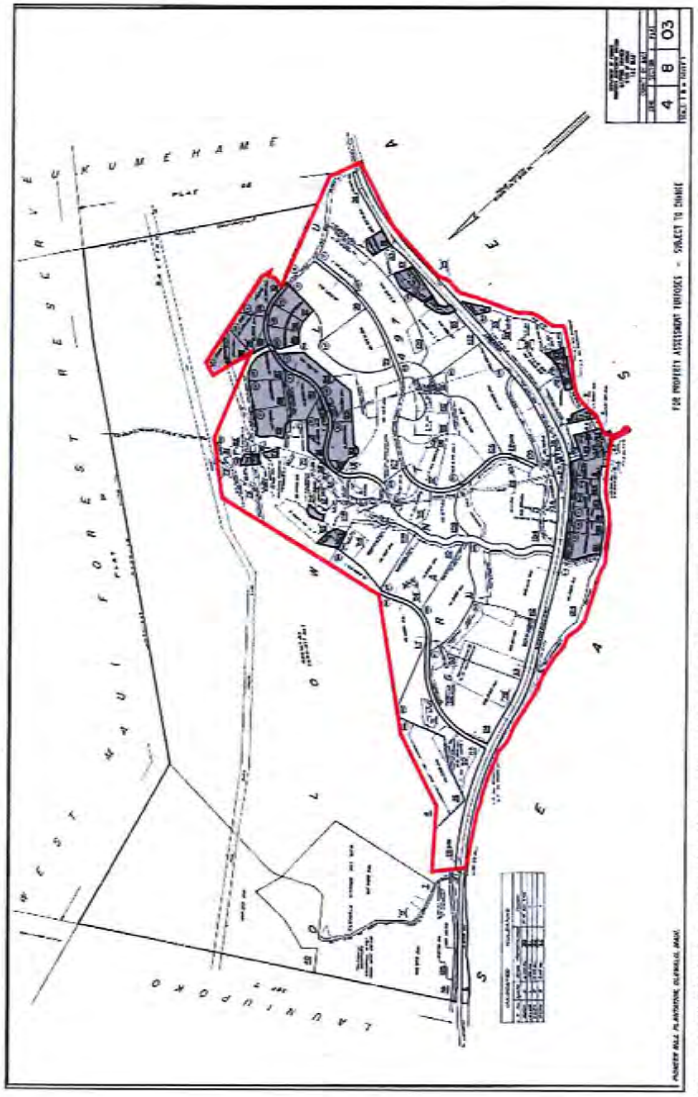

Figure 2. TMK (2) 4-8-03 showing the location of the current project area outlined in red, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

Figure 3. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, the study area and Olowalu Ahupua'a shaded in orange, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

1.2 Scope of Work

The scope of work for this preliminary study is summarized as follows:

1. Examination of historical documents, Land Commission Awards, historic maps, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal and other resources or agricultural pursuits as may be indicated in the historic record.
2. A review of the existing archaeological information pertaining to archaeological sites within the study area to reconstruct traditional land use activities and to identify and describe the cultural resources, practices, and beliefs associated with the parcel and identify present uses, if appropriate.
3. Preparation of a preliminary report on items 1-2 summarizing the information gathered related to traditional cultural practices and land use.

1.3 Environmental Setting

1.3.1 Natural Environment

The current study area extends from the located on the broad alluvial plain of Olowalu Ahupua'a where the principle geologic features consists of the Olowalu Gulch and Stream. Other contributing physical features of the landscape include smaller stream systems and their resulting gulches along the northern and southern flanks of Olowalu Gulch.

The general soils of the project area are of the Pulehu-Ewa-Jaucus Association and are largely dominated by the Pulehu Soil Series which comprises the majority of the alluvial fan of Olowalu Ahupua'a. Other soils types include sediments associated with the Jaucus Series and Beaches that are found along the southern coastal reaches of the *ahupua'a*, patches of soils that fall into the Kealia Series and Ewa Series occur *mauka* of Honoapi'ilani Highway, soils of the Wainee and Ewa Series comprises the southern flank of Olowalu Gulch, and rocky soils are found along the streambed of Olowalu Gulch (Figure 4). The Pulehu Soil Series consists of well-drained soils that developed in alluvium washed from basic igneous rock (Foote et al. 1972:115). Pulehu clay loam, 0 to 3 percent slopes, consists of a surface layer of dark brown clay loam approximately 21 inches thick that is underlaying by stratified loam, loamy sand, fine sandy loam and silt loam that is approximately 39 inches thick (Foote et al. 1972:115-116). The permeability of this soil type is moderate with a slow runoff rate and slight erosion hazard. Low areas characterized by PsA soils can be subject to flooding (Foote et al. 1972:116). Pulehu cobbly clay loam, 0 to 3 percent slopes (PtA), is similar to PsA soils except that it is cobbly. The underlying parent material consists of coarse, gravelly or sandy alluvium. Pulehu cobbly clay loam, 3 to 7 percent slopes (PtB), also has slow runoff with a slight erosion hazard. Pulehu silt loam, 0 to 3 percent slopes, (PpA) are also similar to PsA soils except that the texture is silt loam. At the time of the USDA soil survey, PtA and PtB soils were used for sugarcane cultivation and pasture, PsA soils included some acreage that was used for truck crops, and finally PpA soils were noted as used for house sites (Foote et al. 1972:115, 116).

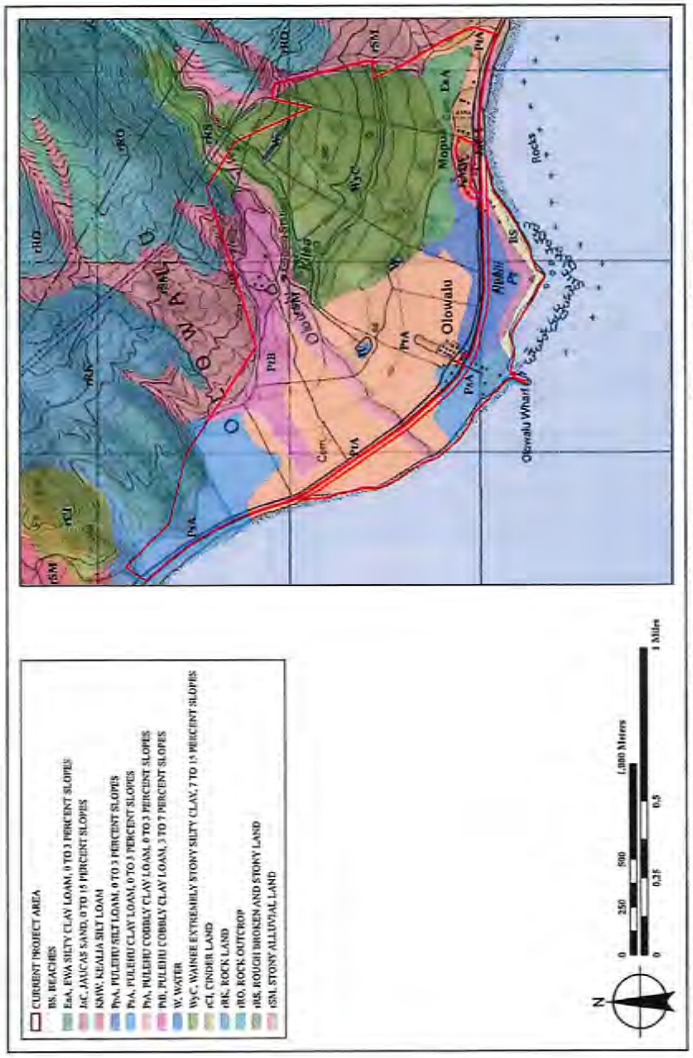

Figure 4. . Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the current project area relative to the local soil series (U.S. Department of Agriculture 2001).

Beaches (BS) occur as sandy, gravelly, or cobbly areas that are derived from coral and seashells and are washed and rewashed by ocean waves (Foote et al. 1972:28). In the case of the current project area however, beach sediments are dark in color as the sands are derived from from basalt and andesite parent material (Foote et al. 1972:28). The USDA, at the time of the soil survey determined that soils associated with this series had no value for farming and were better suited for recreational use and resort development (Foote et al. 1972:28). It should be noted that beach sand deposits are considered highly sensitive with regard to cultural concersn as pre-contact human burial interments are commonly encountered in such deposits.

The Jaucas Series consists of excessively drained, calcareous soils that are developed in wind and water deposited sand from coral and seashells and occur as narrow strips on coastal plains adjacent to the ocean (Foote et al. 1972:48). Normally pale brown to very pale brown in color, within Olowalu Ahupua'a, the surface layer is dark brown as a result of the accumulation of organic matter and alluvium (Foote et al. 1972:48). Jaucas sand, 0 to 15 percent slopes (JaC), is neutral to moderately alkaline throughout. Permeability of JaC soils is rapid and runoff is slow to very slow. The general erosion hazard is slight, but wind erosion poses a severe hazard where vegetation has been cleared. At the time of the USDA survey, JaC soils were used for pasture, sugarcane, truck crops, and urban development (Foote et al. 1972:49). Like beach sand deposits, Jaucus Sands are considered highly culturally sensitive as pre-contact human burial interments are commonly encountered in these deposits.

The Kealia Soil Series consists of rather poorly drained and poorly drained soils on coastal flats, and are geographically associated with Jaucas, Mala, and Pulehu soils. Kealia silt loam (KMW) is a poorly drained soil with a high salt content. Ponding often occurs in low areas after heavy rains and when the soil dries, salt crystals accumulate on the surface. This soil has an underlying brackish water table that fluctuates with the tides. As the occurrence of the KMW soils within the project area are near the coastline, it is important to note that the water table is nearer to the surface along the shoreline than in inland areas. Permeability of KMW soil is moderately rapid with a slow to very slow runoff. The hazard of water erosion is no more than slight, but the hazard of wind erosion is severe when the soil is dry and the surface layer becomes loose and fluffy (Foote et al. 1972:67). At the time of the USDA survey, KMW soils were used only for wildlife habitat and occasional pasturage as the high salt content and poordrainage was not suitable for agriculture (Foote et al. 1972:68).

Wainee soils are generally well-drained soils that have developed on alluvial fans. Unlike the Pulehu Series, which is found in similar geologic environments throughout Maui County and on the island of O'ahu, Wainee soils are found only on Maui Island. Wainee extremely stony silty clay, 7 to 15 percent slopes (WyC) occur on smooth alluvial fans with a moderately rapid permeability rate and slow to medium run off rate. The erosion hazard is slight to moderate and stones cover three to 15 percent of the surface. At the time of the USDA soil survey, WyC soils were used primarily for sugarcane with small acreages used for pasture and home sites (Foote et al. 1972:134).

The Ewa Soil Series is generally characterized by well-drained soils in basins and on alluvial fans that have developed in alluvium derived from basic igneous rock (Foote et al. 1972:29). Ewa silty clay loam, 0 to 3 percent slopes (EeA) has very slow runoff rate and the erosion hazard is no

more than slight. At the time of the USDA soil survey, EeA soils were used for sugarcane and homesites (Foote et al. 1972:30).

Finally, Rough, Broken and Stone Land (rRS) and Stony Alluvial Lands (rSM) characterizes the soils at the base of Olowalu Gulch and adjacent soils of Olowalu Streambed respectively. Rough, Broken and Stone Land (rRS) consists of very steep, stony gulches where the local relief is generally between 25 and 500 feet with soil material general less than 20 inches deep over saprolite or bedrock (Foote et al. 1972:119). Stony Alluvial Lands (rSM) soils consist primarily of stones, boulders, and silt deposited by streams along the bottoms of gulches and on alluvial fans (Foote et al. 1972:120). At the time of the USDA soil survey, rRS soils was used for pasture, wildlife habitat, and watershed (Foote et al. 1972:119) while rSM soils were suited to pasture in dry areas and woodland in wet areas (Foote et al. 1972:120).

The average annual rainfall accumulation within the entire project area averages from 15 to 20 inches (Giambelluca and Schroeder 1998:56) per year, with the heaviest rainfall occurring during the winter months (December through February) and little to no rainfall during the summer months (June through August) (Giambelluca and Schroeder 1998:56). This pattern of rainfall and low annual precipitation rate may have once sustained a lowland, dry shrubland and grassland native ecosystem (Pratt and Gon 1998) with some wetland environments in areas of the Kealia soil type. The landscape and watershed of the project area, however, has been heavily modified by sugarcane cultivation and water development for irrigation from the early historic period up until modern times, with only small stands of native plants remaining. The current vegetation consists of thick *kiawe* (*Prosopis pallida*), *klu* (*Acacia farnesiana*), *koa haole* (*Leucaena leucocephala*), australian salt bush (*Atriplex semibaccata*), and pickleweed (*Batis maritime*) adjacent to the Honoapi'ilani Highway, as well as, small stands of *niu* (*Cocos nucifera*), *kou* (*Cordia sebestena*), and other introduced plant species. Inland of the highway the natural environment is dominated by fallow sugar cane fields with vegetation that can be characterized as grasslands and shrublands.

1.3.2 Built Environment

The most prominent feature of the modern built environment within the current project area consists of the two-lane Honoapi'ilani Highway. Other features include residential homes and associated infrastructure both *mauka* and *makai* of the Honoapi'ilani Highway, the Olowalu General Store, as well as, roughly paved and unimproved cane haul access roads.

Figure 5. Aerial photograph (Microsoft Corporation and ESRI 2010) showing the overall built environment in relation to the current project area.

Section 2 Methods

2.1 Document Review and Research

Numerous published and unpublished accounts, surveys, reports, maps and photographs found in public and private collections pertaining to Olowalu Ahupua'a were investigated by Cultural Surveys Hawai'i Inc. English language historical documents, maps, and archaeological studies were researched at the DLNR/SHPD library, the Survey Office of the Department of Accounting and General Services (DAGS), the Lahaina Restoration Foundation Archives at the Hale Pa'i, the Maui County Planning Department, and the Cultural Surveys Hawai'i (CSH) library; in addition to private collections held by others in the community. Land Commission Award Claims were studied using historic maps and cross referenced with the Papakilo Database compiled under the auspices of the Office of Hawaiian Affairs (2011) and the Waihona 'Aina online database (Waihona 'Aina 2002). Hawaiian language newspaper resources and other Hawaiian language documents were researched using both *Ulukau: The Hawaiian Electronic Library* (www.ulukau.org) and the Papakilo Database with Hawaiian Language translations provided by Ms. Katherine Kama'ema'e Smith and Ms. Cori-Ann Kaipolani Lorenzo, B.A.

2.2 Scoping and Community Outreach

2.2.1 Government Agencies, Advisory Councils, and Local Community Organizations

In order to identify individuals with knowledge of the traditional cultural practices of the area of potential effect for the proposed project as it relates to this study, contact was initiated with government agencies, advisory councils, and local community organizations (See). Follow up attempts were then made to all contacts on the initial mailing list in a good-faith effort to make contact. Letters and project area maps showing the location of the proposed Olowalu Town Master Plan project area and was mailed out with the following accompanying text:

> Subject: Cultural Impact Assessment for the Proposed Olowalu Town Master Plan in Olowalu Ahupua'a, Lāhainā District, Island of Maui.
>
> At the request of Olowalu Town, LLC and Olowalu Ekolu, LLC., Cultural Surveys Hawai'i (CSH) is conducting a Cultural Impact Assessment (CIA) for the proposed Olowalu Town Master Plan Project. The Olowalu Town Master Plan will serve as a guide for the establishment of a small-scale "mixed-use" community with land uses that will vary from urban neighborhood town centers to rural and agricultural areas within the 636-acre project area (Attachment 1). Overall, the master plan proposes the development of 1,500 residential units along with civic structures (educational facilities, community and cultural centers, and emergency worker facilities), park and gathering facilities, greenways, bikeways, and trails all of which would be constructed concurrently with the appropriate infrastructure over an approximate 10 year period.
>
> The area of direct effect for the proposed undertaking, here after referred to as the "current project area", is considered as the footprint of the proposed 636-acre footprint of the Olowalu Town Master Plan (Attachment 1). When assessing the presence or absence of direct, indirect, and cumulative effects of the proposed project on the traditional cultural practices of this region, traditional use and access to resources from the mountains to ocean, or *mauka* to *makai*, must be taken into consideration. As such, the Region of Influence (ROI), hereafter referred to as the "study area" for this CIA is defined as the geographic

area encompassed by the known traditional boundaries of Olowalu Ahupua'a which includes any offshore traditional fisheries that may have been associated with Olowalu Ahupua'a. (Attachments 2 and 3)

We are seeking your *kōkua* or help and guidance regarding the following aspects of our study:

- General history and present and past land use of the project area.
- Knowledge of cultural resources which may be impacted by the proposed Olowalu Town Master Plan - for example, traditional plant gathering areas, traditional fishing areas, historic sites, archaeological sites, and burials (see also Attachment 4).
- Knowledge of traditional gathering practices in the area – both past and ongoing.
- Cultural associations of the project area, such as legends and traditional uses.
- Referrals of *kūpuna* or elders who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.

Any other cultural concerns the community might have related to Hawaiian cultural practices within Olowalu Ahupua'a and/or in the vicinity of the proposed Olowalu Town Master Plan area.

I invite you to contact me, Tanya Lee-Greig at 1-808-242-9882. You may also contact me by e-mail at leegreig@culturalsurveys.com if you have mana'o or information you would like to share.

Mahalo a nui,

Tanya L. Lee-Greig

Cultural Surveys Hawai'i, Inc.

Surveys Hawai'i, Inc.

Section 3 Background Research

The division of Maui's lands into political districts occurred during the rule of Kaka'alaneo, under the direction of his *kahuna*, Kalaiha'ōhi'a (Beckwith 1970:383). This division resulted in the creation of twelve districts or *moku* during traditional times: Kula, Honua'ula, Kahikinui, Kaupō, Kīpahulu, Hāna, Ko'olau, Hāmākua Loa, Hāmākua Poko, Na Poko (Wailuku), Kā'anapali, and Lāhainā (W. D. Alexander 1890:106; Sterling 1998). The *moku o loko*, or *moku* as it is most commonly called, literally means "to cut across, divide, separate" (Lucas 1995:77). When used as a term of traditional land tenure, a *moku* is similar to a modern political district. Within these *moku* are smaller units of land termed the *ahupua'a,* the name of which is derived from the Hawaiian term *ahu* (altar), which was erected at the point where the boundary of land was intersected by the *alaloa* (main road encircling the island), upon which a carved *pua'a* (hog) image, made of kukui wood and stained with red ochre was placed along with the tax of food items from that particular land unit as payment to the *ali'i* (chief) (W. D. Alexander 1890:105). The typical configuration of the *ahupua'a* extends from the sea to the mountain, and while the boundary generally followed prominent landforms (i.e. ridge lines, the bottom of a ravine, or defined by a depression) there were times where a stone or rock that was notable from a tradition or sacred use would mark a corner or determine a line (W. D. Alexander 1890:105-106). Similarly, the line of a growth of a certain kind of tree, herb or grass, or the habitat of a certain kind of bird would sometimes define a division (W. D. Alexander 1890:105-106).

The present study area includes the entire *ahupua'a* of Olowalu, a land division located on the leeward slopes of Mauna Kahalawai (West Maui Mountains) (Figure 6) in the traditional *moku* of Lāhainā (Figure 7). The boundary of Olowalu Ahupua'a, along the most *mauka* extent, follows the ridge separating the headwall of 'Īao Valley from that of Olowalu Valley and extends *makai* touching the landforms of Helu and Līhau, ending at Awalua on the Launiupoko side and incorporates the landforms of Halepohaku and Ulaula, ending at Pākala on the Ukumehame side (see also Figure 3).

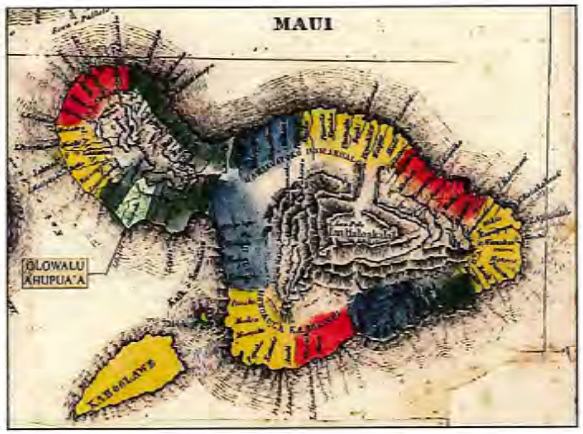

Figure 6. A portion of the S.P. Kalama Map (1837) showing the location of Olowalu Ahupua'a in relation to the moku of Maui Island.

Figure 7. A portion of the F.S Dodge map (1885) showing Olowalu Ahupua'a in relation to the traditional *moku* of Lāhainā (crown lands in yellow , approximate location of the current project area cross-hatched in black).

3.1 Traditional and Historical Background

In the preface of *Place Names of Hawaii* (Pukui et al. 1974:x), Samuel Elbert states that:

> Hawaiians named taro patches, rocks and trees that represented deities and ancestors, sites of houses and heiau, canoe landings, fishing stations in the sea, resting places in the forests, and the tiniest spots where miraculous or interesting events are believed to have taken place.
>
> Place names are far from static ... names are constantly being given to new houses and buildings, land holdings, airstrips, streets, and towns and old names are replaced by new ones ... it is all the more essential, then to record the names and the lore associated with them (the ancient names) now.

Inherent in the statements of Elbert is the knowledge that the oldest place names held meaning and told the story of an area prior to European contact. A study of the place name meanings for the study area may yield some insight into the stories, patterns of life and land use within Olowalu Ahupua'a. The place names listed below are for land areas, fisheries, land divisions, markers, and other resources identified through research of the Māhele 'Āina at Olowalu and other available historic literary resources which include the Hawaiian Government and Territorial Survey Maps (Dodge 1885; Kalama 1837), the USGS Topographic 7-Minute and 15-Minute Series Maps (1925, 1997), as well as, consultation with *kama'āina* and *kūpuna* of Olowalu. Unless indicated otherwise, the spelling and translations presented below are taken from Pukui and others (1974). Alternate spellings are provided where multiple translations were noted from different sources and cited in text.

Lāhainā (*moku*)	*hainā* literally translated as "cruelty" and *la* as "day "or, alternatively, *haina* that translates literally as "merciless" and *lā* as "sun" (Sterling 1998:16-17);"land [of] prophesy" (Ashdown 1970:10)
Awalua	Literally translates as "double harbor" (p.15)
Halepohaku	Literally, "stone house" (p.38-39)
Hawaiikekee ('ili[1])	*keke'e*: a redup of *ke'e* (Pukui and Elbert 1986:143) which means crookedness (Pukui and Elbert 1986:141), possibly a reference to the distinctive bend in the *'ili* boundary, an *'ili* name associated with LCA 5829: Apana 1 and 2 to Kawehena (see also Section 3.1.4 Mid- 1800s and the Great Māhele) located within Olowalu Valley;
Hekili Point	*hekili* is literally translated as "thunder" (p.44)
Kaluaaha ('ili)	Literally, "the gathering pit" (p. 78); an *'ili* of LCA 1742: Apana 2 to Z. Kaauwai and LCA 5829: Apana 1 to Nahue located in the area of the former Olowalu Mill Site.

[1] a land subdivision of an *ahupua'a* with its own name and defined boundary

Alexander, William DeWitt
1890 A Brief History of Land Titles in the Hawaiian Kingdom. In *Hawaiian Almanac and Annual for 1891*, edited by T. G. Thrum. Press Publishing Company Print, Honolulu, HI.

Kaluakanaka	*Kalua* is translated as "the pit" and *kanaka* is translated as "human being" (Pukui and Elbert 1986:127). Place name of where John Clark resided (LCA 240) and potentially the location of the burial ground of those slain during the Metcalf Massacre (Mr. Hinano Rodrigues, personal communication, September 24, 2012; see also Section 3.1.2.3 Politics and Warfare)
Kamani (*'ili*)	A large tree (*Calohpyllum inophyllum*) which produced a hard wood that was formerly made into calabashes (Pukui and Elbert 1986:125); An *'ili* name associated with LCA 6728: Apana 1 to Mahulu, LCA 1742 Apana 1 to A Kaauwai, LCA 5829: Apana 3 to Kawehena, LCA 8573: Apana 1 to Kailiula, LCA 8817: Apana 1 to Kanakaole , LCA 6058: Apana 3 to Peekauai, LCA 5829: Apana 3 to Haole
Kapāiki	Translated as "the small enclosure" a section or *mo'o* of *ali'i* lands at Olowalu Ahupua'a (Mr. Hinano Rodrigues in Lee-Greig and Hammatt 2006)
Kaunukukahi (*'ili*)	An *'ili* name associated with LCA 8817: Apana 2 and 3 to Kanakaole, LCA 5952: Apana 1 and 2 to Minamina, LCA 6728: Apana 2 to Mahulu, LCA 6058: Apana 4 to Peekauai
Kuekue (*'ili*)	An *'ili* name associated with LCA 8573: Apana 2 to Kailiula
Līhau	Literally, "a gentle cool rain", a gentle rain considered favorable for the work of fishermen (Emerson 1909:241)
Maomao (*'ili*)	Literally a type of fish, a variation of *mamao* or far, calm, clear (Pukui and Elbert 1986:241); An *'ili* name associated with LCA 7719: Apana 1 to Haia
Mōpua	A traditional village at Olowalu and translates literally as "melodious" (p.158), located between Mile Marker 14 and the current location of Olowalu Church (Mr. Hinano Rodrigues, personal communication, September 24, 2012).
'Ōhi'a (*'ili*)	Two kinds of trees, *'ōhi'a'ai* (*Eugenia malaccensis* mountain apple) (Pukui and Elbert 1986:277) and *'ōhi'a lehua* (*Metrosideros macropus, M. collina polymorpha*) (Pukui and Elbert 1986:199). Found in the forested regions, the fruit of the *'ōhi'a'ai* was prepared by splitting and drying it in the sun (Pukui and Elbert 1986:277). The wood of the *'ōhi'a lehua* is hard and once used for images, spears, and mallets (Pukui and Elbert 1986:199). An *'ili* name associated with LCA 6058: Apana 1 to Peekauai and claim 10127 by Makanialoha.
Olowalu (*ahupua'a*)	Literally, "many hills" (p.170)
Pākala	A place located just after Mōpua from Mile Marker 14 to the boundary between Olowalu and Ukumehame Ahupua'a (Mr. Hinano Rodrigues, personal communication, September 24, 2012)
Pa'apa (*'ili*)	An *'ili* and stream name associated with LCA 9906: Apana 2 to Pikao

Paumaumau (*'ili*)	An *'ili* name associated with LCA 9906: Apana 1 to Pikao and LCA 8546: Apana 1 to Kaawili
Pu'u Kīlea	Literally, "small but conspicuous hill" (p.111), a cemetery
Ulaula	Literally, "red" (p.214)
Wailoa (*'ili*)	Literally, "long water" (p.224); An *'ili* name associated with LCA 5829: Apana 4 to Haole

3.1.1 He Mo'olelo no Olowalu

Handy and others (1991) summarize the relationship that traditional Hawaiians have with the natural environment best in the following passage:

> The sky, sea, and earth, and all in and on them are alive with meaning indelibly impressed upon every fiber of the unconscious as well as the conscious psyche. Hawaiian poetry and folklore reveal this intimate rapport with the elements, (Handy et al. 1991:23-24)
>
> (T)he relationship which existed from very early times between the Hawaiian people … is abundantly exemplified in traditional mele (songs), in pule (prayer chants), and in genealogical records which associate the ancestors, primordial and more recent, with their individual homelands, celebrating always the outstanding qualities and features of those lands. (Handy et al. 1991:42)

At Olowalu the *mo'olelo* (traditional knowledge) revolve around the surrounding mountains and the elemental characteristics of this *'āina* (land) which has been known as a *pu'uhonua* or refuge of Maui since ancient times (Ladana 1858). The winds of Maui, as named and described in the story of Paka'a, is recounted by J.H. Kanepu'u (in Sterling 1998:7) who mentions the strong wind of Olowalu in the following excerpt:

> The house breaking wind is at Olowalu,
>
> The kilihau is also there.

The strength and prominence of this wind at Olowalu is additionally described in the following Hawaiian Proverbs and Poetical sayings gathered by Mary Kawena Pukui (1983):

> *'Ōlelo No'eau 215*
>
> *'A'ohe umu mo'a i ka makani.*
>
> No *umu* can be made to cook anything by the wind.
>
> (Talk will not get the umu lighted and the food cooked. This saying originated in Olowalu, Maui, where it was very windy and hard to light an umu.)
>
> *'Ōlelo No'eau 1457*
>
> *Ka makani ha'iha'i lau hau o Olowalu.*
>
> The hau-leaf tearing wind of Olowalu. (A gust wind.)

'Ōlelo No'eau 2502

Olowalu ihu pāpa'a.

Crusty-nosed Olowalu.

(Disparaging expression for the people of Olowalu, Maui, where the wind is said to blow into the nostrils, drying the mucus into crust.)

The force of the wind at Olowalu and its destructive nature was also described in a Hawaiian language newspaper article dated February 19, 1894 (Kalei 1894a):

E oluolu mai, ma ko oe poli aku au, a nau ia e hoomahana iho i na anoai o kahi i haiia maluna ae.

He mau la makani heleululu keia o na aina nei a na Alii i aloha ai o ke au i hala aku. He mau makahiki i hala ae nei, akahi no a wehe hou mai ke Kuahiwi o Lihau i na kikiao makani ikaika e naka ai na hale me ka haalulu, me he la ua eehia i keia mea hou i loaa ia lakou. Hoomanao ae la kou mea kakau i ke mele a ke keiki o ka Malu Ulu o Lele, i mioia ai ka pilialo e ka oiopapio i ke Kula o Kamaomao:

"Olowalu ka leo a ka makani ia Ukumehame, Pohapoha ka ihu o ka waa i na ale a ke Kaumuku, Huleilua i na nalu o Launiupoko, Keikei Lahaina, i ka Ua Paupili."

Ua pa ikaika iho iloko o na la eono e hoomaka ana i ka Poakolu, Jan. 31, a e hoomaha ana i ke ahiahi o ka Poakahi, Feb. 5. Ua lilo na kumulaau kiawe i mea ole i kona ikaika hoonee, o na pou uweaolelo, ua unuaia iho a ahua mokaki ilalo, mawaena o Olowalu a me Lahaina. A no ia ino huhu ua hiki ole i ka mokuahi Malulani ke ku ae i ke awa o Kamaalaea i ka po o ka Poalima, Feb. 2 nei, a ua hiu loa aku oia no na Kona i ka pohu maokioki. Oehuehu no keia kaeaea a ka poe kahiko e kanaenae ai:

"Mana ekeeke i ka ipu a ka makani, Hiololua i na pali o Laniha, O Waokila ua haakulou wale, Ua makapehu inai ole Mana."

Please, my arms extend out to you, and it is for you to rest in the news of the place that is told here. These are days with violent wind on this land of the chiefs that were loved just before this. Some years have passed, the mountains of Lihau just opened for the first time again with strong sudden gusts of wind that shake the houses with a tremble, as if it was terrifying the people. My writer remembers the song that children would sing called "Malu ulu O Lele," where a beloved wife was stolen by a young man at Kula Kamaomao:

"Olowalu is the voice of the wind to Ukumehame, The nose of the canoes burst through the waves of the Kaumuku wind, Tossing in the waves of Launiupoko, Lahaina in glory, In the Pa'upili rain

It blew strong for 6 days starting on Wednesday, January 31st, and came to rest on the evening of February 5th. Kiawe trees were nothing to it's movable strength, the telegraph wires, they were moved and piled up on the ground, between Olowalu and Lahaina. And because of that violent storm, the Malulani steamboat couldn't port at Kama'alaea pier on the night of February 2nd, it was thrown violently towards the leeward side of the streaked calmness. The expertise of the ancestors was straight to the point chanting:

"The container of wind with little strength, Tumbling down the cliffs of Laniha, Waokila the rain that makes one bow, Suffering power without seasoning."

Within a *kanikau*, or lamentation, for a *kupuna* of Olowalu that was published in the Hawaiian language newspaper *Ka Makaainana*, the writer recounts the prominent places and natural elements that are revered at Olowalu (Kalei 1894b):

E oluolu oe e hookomo aku i ka'u wahi ukana ma kahi kowa iki o ka kakou papa konane, i ike mai ai na hoa'loha a me na makamaka o Ioane Kalili Nahina. Ma ka la 16 o Ianuari, hora 11 a. m. i haalele mai ai ka uhane o ka mea nona ke kino i haiia maluna iho, ma kona wahi noho ma kukui o Malulani, Olowalu, Maui.

He kupa nana makani oia no Lihau, a he kamaaina hoi no ua aina nei nona na Konohiki elua, a'u e kanaenae nei, "Hoomanua i ke one o Awalua, konohikilua ka la ia Olowalu, I ka la i ka makani kahi aoao, Na Ukumehame ka nau o ka makani."

O kona ma'i i waiho loihi iho nei a hala aku la, he mimihai. Ua imi ia no ke ola e hiki ai ke hala kekahi manawa, ua lawelaweia e ke Kauka o ka apana o Lahaina nei, a ua ike oia, ua loihi loa ka manawa o ka loaa ana o keia mai iaia he 30 makahiki a oi ae. "O ka mea i hanau ia e ka wahine he hapa kona mau la, ua piha i ka popilikia."

Ua komo oia i ke Kula Nui o Lahainaluna i ka makahiki 1858, aole nae i loihi loa a hoi mai oia. Mai ka makahiki 1890 a 1893 i oni ikaika mai ai oia i na hana o ka Ekalesia o kona Haku aloha ma Olowalu nei, a moe malie aku la kona kino me kela inoa koikoi he Lunakahiko. He wahine mare e uwe nei nona, na keiki hanai, na kaikuahine elua a me kona mau hoa'loha a pau. Ua malama ia kona halawai hope me ka ohana ma ka hora 3 p.m. o ka la 17, a moe aku la ke kino i ka lepo. "Waiho kahelahela na kaha i ka malie."

Please put my things in the little space beside our checker board, so all the friends and acquaintances of Ioane Kalili Nahina can see. On January 16th, at 11 a.m. is when he passed in the light of Malulani, Olowalu, Maui.

He was a wind watcher from Lihau, and a native to this land, the two konohiki were his, I am chanting his eulogy, "Gathered on the sand of Awalua, sun shining on Olowalu, in the sun, and the wind blowing on one side. Ukumehame is the reason for the wind coming."

His sickness was not looked at for a very long time. A urination problem? Becoming better is what was wanted after some time, he was taken to the doctor of Lahaina, and he saw, he had this sickness for 30+ years. "What was given birth by the woman only had half of it's days, it was filled with hardship."

He went to Lahainaluna School in 1858, but not after long, he returned. From 1890 to 1893, he did a lot of work for the church of his loving maker in Olowalu, and his body lay calmly with that important name of Lunakahiko. A married woman crying for him, his adopted children, his two sisters, and all his friends. His last meeting was held with his family at 3 p.m., on the 17th, and then his body was laid to rest. "The strips of cloth were left spread out in the calmness."

Malulani, according to Pukui and Elbert (1986:234), is the name of a star that literally translates to mean "celestial shade". The *konohiki*, or chiefs, in which the author speaks of in the *kanikau* are the sun and the wind as these are the elements that dictate life within Olowalu Ahupua'a (Mr. Hinano Rodrigues, personal communication, September 27, 2012). Finally, the wind of the area is recalled by Lāhainā area fishermen during a fishing trip for *opelu* (Ka Nupepa Kuokoa 1865):

No na waa lawaia & na kanaka maluna i puhiia e ka makani

For the fishing canoes and the people in it who were blown away by the wind

I ka po o ka Poalima, oia hoi ka la 9 o Dekemaba, hoo ekolu mau waa i ka lawaia opelu, a i ka wanaao o ua po nei, hoomaka ka ikeia o ka i-a e ke kolu o ka waa, a o na kanaka maluna oia waa, o Hoonuu a me Kauwahi, a oia wahi hoi a laua i ike ai i ka i-a, a lawaia ai hoi, mawaho ae no ia o Kahea, Olowalu Maui.

On Friday night, December 9th, three canoes went opelu fishing until dawn, the fish started to be seen by the 3rd canoe, and on this canoe were Ho'onu'u and Kauwahi, and that is where they seen the fish and went fishing outside Kahea, Olowalu, Maui.

O ka lua o na waa, he mau elemakule na kanaka maluna o ia waa, o Naholowaa a me Kamohomoho, mawaho ae o Keonepohuehue ko laua wahi i lana'i, aole laua i ike i ka i-a, a puhi waleia ai e ka makani.

The second canoe had old men, Naholowa'a and Kamohomoho, and outside Keonepohuehue was the place they floated, they didn't see any fish, the wind was the only thing blowing.

A o ka waa akolu hoi, o Nika a me Keola, na kanaka maluna o ia waa, mawaho ae o Kaheki ko laua wahi i lana'i, a i ko laua ike ana i ka i-a, oia paha ka hora 6 o kakahiaka Poaono, la 10 o Dekemaba, ia wa no, pa mai la ka makani mauka pono mai o lakou. I aku la o Nika ia Keola, "e! ka makani! no ka mea, he kamaaina no wau no keia wahi, akahi no wau a ike i ka makani ikaika." Ia wa, o ke kuu pau mai la no ia o ka makani, o ka hao mai la no ia o na ale weliweli o ka moana, i hoihoi mai ka hana i ka ihu o ka waa iuka, aole wahi mea a noi ae, i ka ua mea he ikaika o ka makani.

And the 3rd of those canoes, Nika and Keola were on that canoe, just outside Kaheki is where they floated, and by the time they saw the fish it was 6 a.m. on Saturday, December 10th. At that time, the mauka wind blew towards them. Nika said to Keola, "E, the wind! I am a commoner here and I know this strong wind." At that time, the wind blew very strongly, the scary waves of the ocean picked up. Returning to land was to be done by making the nose of the canoe face inland, no one asked or said anything because of the strength of the wind.

Ke puhi aku la no ia o ka makani iwaho loa, i kahi aole aina, hemo ae la ke ama mai ka iako ae, lele no o Keola iloko o ke kai e naki ai ana, i ka hoi ana mai iluna o ka waa, o ka hemo mai la no ia, lele no i ke kai e hoopaa mai i ke ama, a pau loa ae la, o ka lanalana o ka waa i ka mokumoku, pau ka pono o ka waa, o ka waiho no o ka upena, ko Kaola mokumoku no ia, a a-u hou no iloko o ke kai e nakii ai ke ama a paa ke ama, o ka hoi mai la no ia a kau iluna o ka waa, hele mai la a anu i ka makani a me na ale o ka moana, o ke ku ae la no ia o Keola iluna, a ike ia Nahienaena i Lanai mawaho ae, kahea ana la

The wind blew so strong out there, where there was no land, the 'ama (outrigger float) broke loose from the outrigger boom, Keola jumped into the ocean to tie it back together, when he got back into the canoe, it broke off again, and he jumped again back into the ocean to tie up the 'ama, only to return to put it in the canoe. The coldness of the wind arrived along with the splashing of the ocean waves, that's when Keola stood right up and saw Nahi'ena'ena on the outside of Lāna'i. Keola called out to the ship to come and get them, but no one on the ship heard him. It took the wind and their swimming to get to Nahi'ena'ena and climb on board, except for their fishing gear, the net, the paddles, the canoe.

o Keola i kanaka o ka moku e kii mai ia laua, aole nae he lohe mai o kanaka o luna o ka moku, na ka makani a me ke a-u laua nei i lawe a hiki ia Nahienaena, a kau laua maluna o ka moku, koe ko laua mau mea lawaia, o ka upena, o na hoe, o ka waa.

The one thing that Nika wanted when he got to the ship was to lie down and go to sleep. Because of the cold wind and becoming sick was what was bothering him, but no clothes, it got shredded into bits by the ocean, the people on the ship gave them clothes.

Hookahi nae mea pilikia loa o Nika, i ke kau ana no iluna o ka moku, o ka hoi no ia a lalo moe, no ke anu a me ka mai kona mea i pilikia ai, aole wahi kapa, he mau wahi kapa no, ua weluwelu loa i ke kai, no ka poe m-- o luna o ka moku ko laua wahi kapa.

Here is what they told them: Life is blessed by God. And the other canoes, what happened to them, did they make it to land or not.

Eia ka laua olelo: pomaikai ke ola na ke Akua." A o kekahi mau waa, pehea la, ua pae paha, aole paha.

For Capt. Helm (Capt. of Nahi'ena'ena), all the blessings for the generous act, for rescuing these people that were talked about above, on board Nahi'ena'ena.

No Capt Helm, (Kapena o Nahienaena) ka hoomaikai ia e na mea a pau loa, i hoomaopopo i keia hana lokomaikai, i ka hoopakele ana i keia mau kanaka i oleloia ae nei maluna o ka Nahienaena.

It is clear from the above *mo'olelo* and historical accounts that the wind and constant sun of Olowalu Ahupua'a were significant in the lives of the *kama'āina* of this land and well known by others who resided elsewhere. Tempering the "house breaking" wind and blazing sun of Olowalu, is the presence of the *kilihau* (J.H. Kanepu'u in Sterling 1998:7). Defined by Pukui and Elbert (1986:151), *kilihau* translates as ice-cold shower; cold drizzle; to rain thus. It is possible that this particular rain describes the rain that falls at the higher elevations which may possibly be linked with the following saying (Pukui 1983:246):

> *'Ōlelo No'eau 2250*
>
> *Na lehua o Līhau i pehia e ka noe.*
>
> The lehua blossoms of Līhau, weighted by the mist.
>
> (Līhau, a mountain of Maui, was noted for its beautiful lehua blossoms.)

At Olowalu, Līhau is a prominent and picturesque mountain peak located toward the back of the valley. So prominent were the *ohi'a lehua* blossoms of Līhau that it was said the rich color of the blossoms would reflect onto to the waters of Ka Lae Hekili and turn the water red (Mr. Hinano Rodrigues in Lee-Greig and Hammatt 2006:59). The *lehua* of Līhau also figures prominently in a set of *mele inoa*, or name chants, known as "*He lei no ka Moi Wahine Kapiolani*" (A Wreath for Queen Kapiolani) which represented each island and were composed for the queen at her coronation (Stillman 1996). The following *mele, Aia i Lihau ko lei nani*, written by a Mrs. Paupau and translated by Mary Kawena Pukui, was the *mele* for Maui (Stillman 1996):

Aia i Lihau ko lei nani	At Lihau is your beautiful lei,
O ka ao lehua i poe i ka manu	Made of the full blown *lehua* loved by birds,
Ke haku a mai la e ka lau makani	It is braided together by the wind's deft fingers
a hono o Lele ua lai lua	On the calm and peaceful realm of Pi'ilani
Luana i Hauola kahi manao	Two thoughts enter the mind
I ka lai huli o ka Maaa	With the conflicting blowing of the Maaa
Hanohano ka opua i ka malie	Proudly appear the clouds in the calm
I ke kau a ke ao i Maunalei	As they gather on Maunalei
He lei hoi no ua lai nei	The lei is to be worn by you on a calm day
No ka nalu haihai maka a Uo	On the rolling surf of Uo
Ke noho nei no au i ka lulu	The sea dwells there before the calm
Me na lai elua a ka manu	Beside the pleasant haunts of birds.
Alia oe la e Haleakala	Wait there, Haleakala,
E alai nei ia Kauiki	Before you hide Ka'uiki from view.
Ua maikai ke alo o Piiholo	Beautiful is the face of Pi'iholo
I ka noho a ka ua ulalena	Fore there dwells the 'ulalena rain.
Haina ka wahine nona ka lei	This is in praise of the chiefess whose lei chant this is,
O Kapioloni i ka iu o ka moku	Kapio'olani, so high above.

3.1.1.1 The Origins of Pu'ulaina at Wahikuli and the Role of Līhau

Prior to her current incarnation as a mountain peak, Līhau was once a woman who had a child with E'eke named Pu'ulaina, a now prominent landform in Wahikuli Ahupua'a. Fornander (1919b) relates the following regarding the birth of Pu'ulaina and the transformation of Līhau to a mountain at Olowalu:

> ...some say it was begotten by two mountains, Eeke (the summit crater of the West Maui Mountains) and Lihau (the mountain top back of Olowalu). Eeke was the husband and Lihau was the wife. They were real persons, but it will be shown later the reason for their being changed to mountains. After they had lived as man and wife, a child was born to

> them, a son, the subject of this story which we are considering. But after some time Eeke became entangled, for he saw a beautiful woman, Puuwaiohina from Kauaula, and they committed adultery. Because of this, Lihau thought to choke the child to death, so that the two of them could go and do mischief; this caused them to quarrel. Eeke took the child to his mother, Maunahoomaha, and left him with her. After that their god, Hinaikauluau, placed a restriction over them; they were not to live together, nor were they to have any intercourse with others; but ten days after this order, Eeke again committed adultery with Puuwaiohina above referred to, who was a younger sister to Lihau. Because of this their god punished them by making Eeke a mountain and Puuwaiohina a mountain ridge; that is the ridge prominent at Kauaula.
>
> After that, Lihau was possessed with love for their child, so she asked Maunahoomaha for permission to meet her son, that was agreeable to her mother-in-law, and when she met her child she was glad. When she realized what a handsome man her favorite son had grown to be, she gave him for husband to Molokini, one of the noted beauties of that time, because she was the wife intended for him ...
>
> However, arriving on Maui, this was one of Pele's (the fire goddess) cruel deed; one of her younger sisters saw how handsome Puulaina was, so she asked Molokini to let her have him for husband. The other refused, for she was greatly in love with her own husband; so she (Molokini) was changed into a little island, and she has remained so to this day.
>
> When Lihau heard of this, she grieved for her daughter-in-law, so she went to consult Pele on the matter. But Pele replied gruffly: "If that is the case, then I say to you that you will die; also your son." Lihau was there and then changed into a hill where Pele resided for some time; the son also died. But the one whose was the desire, earnestly entreated and begged that her husband be spared. But the red-bleary-eyed (Makole-ulaula, an epithet applied to Pele) did not wish it that way. That was how the son became a hill and has remained such until this day.

3.1.1.2 Drought and the Lesson of Hua

There is an ancient proverb, or *'ōlelo no 'eau*, that warns others to not talk too much of one's king and is a reminder that trouble will follow those who destroy the innocent (Pukui 1983:194 [1811]):

> *Ko 'ele na iwi o Hua i ka lā.*
>
> The bones of Hua rattled in the sun.

According to the story of Hua as , retold by Fornander (1919a:514-516), he was a chief of Lāhainā who had forsaken his *kahuna*, or priest, Luaho'omoe and caused a drought throughout the Hawaiian Islands. The mountains of Olowalu and the *ua'u* (Hawaiian Petrel [*Pterodroma sandwichensis*]) that nest there are central to the story:

> There lived here in Lahaina a chief named Hua ... he desired to get some ua'u squabs to eat; he sent some men up to the mountains above Oloalu [sic] to get some ua'u squabs to satisfy his desire. He did not wish for birds from the beach. When the birds were obtained, they were to be taken to the priest for him to ascertain where the birds came from; if he should give out the same information as the men had given to the chief as to the source of the birds, then he would be safe; if he should give a contrary answer, he would be killed. The name of this priest was Luahoomoe and he also had children. When the men went up, they could not find any mountain birds at all, so they decided to get some shore birds. When they caught some, they daubed the feathers red with dirt so that the chief would think the

> birds came from the mountain. When they returned and handed the birds to the chief, he was exceedingly glad because he thought the birds came from the mountain. The chief told the men to take them to the priest for his inspection. The priest perceived, however, that the birds came from the seashore. Then the chief said to the priest: "You shall not live, for you have guessed wrongly. I can very well see that these are mountain birds." Then and there an imu was prepared in which to bake the priest.
>
> Before he was placed in the imu, however he said to his children: "You two wait until the imu is lighted, and when the smoke ascends, should it break for the Oloalu mountains, that indicates the path; move along; and where the smoke becomes stationary, that indicates where you are to reside ... Then the priest was cast into the oven and the opening closed up tightly. The smoke arose and darkened the sky ... after the priest had been in the imu for two days, he reappeared and sat by the edge of the imu unknown to any one; the chief thinking all the time that he was dead; but it was not so.
>
> When the smoke ascended and leaned towards the Oloalu mountains, the two sons went off in that direction; the cloud pointed towards Hanaula, and there it stood still, so the two sons ascended to the place and resided there...
>
> Then the whole of Maui became dry; no rain, not even a cloud in the sky, and people died from lack of water. The smoke that hung over Hanaula became a cloud, and rain fell there.
>
> Hua, the chief, lived on, and because of the lack of water and food he sailed for Hawaii, the home of his elder brother; but because Hawaii also suffered from lack of water and food he came back and lived at Wailuku. Wailuku also did not have any water, and that caused the chief to be crazed, so he leaned against the edge of the precipice and died, and that was the origin of the saying "The bones of Hua rattle in the sun."

Fornander further notes that the saying, "The bones of Hua rattle in the sun," refers to the chief whose wickedness won him the anger of his people. In an ultimate show of disregard, they let his body lie where he fell so that his bones bleached in the sun and rattled in the wind. Hence the above proverb warning others to not destroy the innocent as Hua had destroyed Luaho'omoe and in that caused great suffering to people of Hawai'i and resulted in the ultimate desecration of his bones by his own people.

3.1.2 Traditional Subsistence and Land Use

3.1.2.1 Ka 'Oihana Mahi'ai no Olowalu – Traditional Hawaiian Agriculture at Olowalu

As emphasized by Handy and others in the following summary, the *ali'i* and *maka'āinana* were attracted to the Lāhainā District by its natural resources and geographic position:

> Lāhainā District was a favorable place for the high chiefs of Maui and their entourage for a number of reasons: the abundance of food from both land and sea; its equable climate and its attractiveness as a place of residence; it had probably the largest concentration of population, with its adjoining areas of habitation; easy communication with the other heavily populated areas of eastern and northeastern West Maui, 'The Four Streams,' and with the people living on the western, southwestern and southern slopes of Haleakala; and its propinquity to Lanai and Molokai. (Handy et al. 1991:492)

They indicate further that Olowalu, along with the three other major waterways of the Lāhainā District (Ukumehame, Launiupoko, Kaua'ula), provided a productive leeward environment for the cultivation of a wide range of agricultural goods:

> Southeastward along the coast from the *ali'i* settlement (the *kalana* of Lāhainā) were a number of areas where dispersed populations grew taro, sweet potato, breadfruit and coconut on slopes below and in the sides of valleys which had streams with constant flow. All this area, like that around and above Lāhainā, is now sugar-cane land ... Olowalu, the largest and deepest valley on southwest Maui, had ... extensive *lo'i* lands both in the valley and below. Just at the mouth of the valley we found in 1934 a little settlement of five *kauhale* (family homes) surrounded by their flourishing *lo'i*. There are said to be abandoned *lo'i* far up in the valley. (Handy et al. 1991:492)

Claims for traditional resources and agricultural areas at the time of the Māhele also provide insight to the traditional subsistence practices of Olowalu Ahupua'a prior to western contact (see also Section 3.1.4.2 The Great Māhele). *Kuleana* for *lo'i kalo* (wetland or pond field taro patches), *kalo malo'o* (dry land taro), *'uala* (sweet potato), *mai'a* (banana), *wauke* (paper mulberry), *'ulu* (breadfruit), and other land and garden areas (e.g. *kula, mo'o, pā, la'au, mala, mahina*); as well as explicit claims for *hala* or *pūhala* (Screwpine), *hau, niu* (coconut trees), *kou*, and *kukui* were presented to the Land Commission. Of particular interest are *kuleana* claims for *pūhala* were related to specific uses such as *pūhala lei* for *lei* making or *pūhala* (also *lauhala*) *moena* for the manufacture of sleeping mats (Helu [Claim Number] 3726 to Malaea, 3772 to Alapa'i, 3811 to Lupe, 3877 to Pikao, 3934 to Ni'au, and 4376 to Keahi, see also Figure 8) and thus distinguishing a preference for certain areas of *hala* growth for specific tasks.

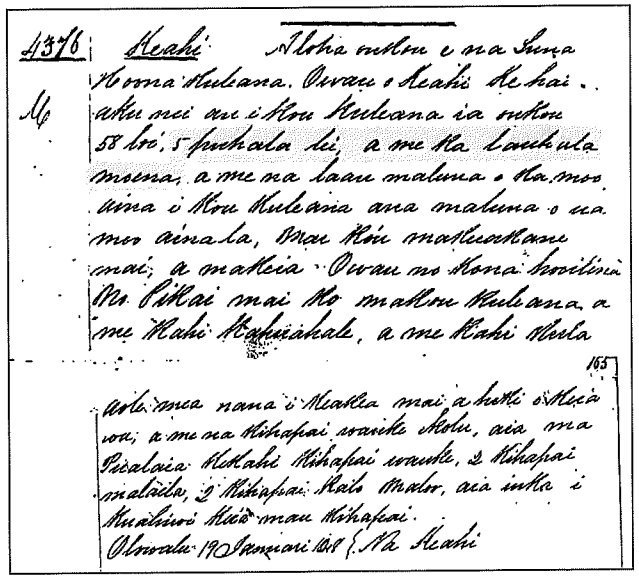

Figure 8. Helu 4376, *kuleana* claim at Olowalu distinguishing between *pūhala lei* and *lauhala moena* (highlighted in yellow) (Office of Hawaiian Affairs 2011:86624 Native Register Volume 6, Reel 3, Image 01326).

The results of one of the first archaeological surveys of Maui Island, conducted by Winslow Walker of the Bishop Museum, identifies the extensive presence of *lo'i* and ancient house sites within Olowalu Ahupua'a and completes the picture of traditional agriculture and settlement by identifying the physical remains of terraces and house sites within the valley in the following narrative (Walker 1931):

> "Terraces for the cultivation of taro were seen on West Maui in the vicinity of... Lāhainā, Olowalu, and Ukumehame" [p.71]
>
> Above Mrs. Naho'oikaika's house (at Olowalu), old taro patches and house sites, old *auwai* (traditional Hawaiian irrigation ditches) were used for sugarcane ditches...at the edge of a house platform (15 by 28 feet) there is a large red stone used as a *papamu* for *konane*. [p.77]

3.1.2.2 Ka 'Oihana Lawai'a no Olowalu – Traditional Hawaiian Fishing and Other Aquatic Cultural Resources of Olowalu

Most of the fishing grounds lying between Lāna'i, Kaho'olawe, Ukumehame, and Lāhainā were only one to two miles apart (Daniel Kahā'ulelio in Maly and Maly 2003:22).Therefore, while the

upland areas provided a good environment for agricultural endeavors, the coastal reaches supplemented the livelihood of those who resided at Olowalu with the rich in marine resources available in the near shore and off shore areas. Notable for an accessible low coastline and well developed reef system, Olowalu would have provided excellent opportunities for fishing and *limu* (seaweed) gathering.

Hawaiian Fishing Traditions (Kahā'ulelio 2006), a compilation of newspaper articles about traditional Hawaiian fishing methods written by Daniel Kahā'ulelio for *Ka Nupepa Kuokoa* in 1902, presents the most detailed account of Hawaiian fishing practices at the turn of the 19th Century. At Olowalu, Kahā'ulelio notes his experiences with *'ō'io*, *aku*, and *akule* fishing. *'Ō'io* fishing, using a method referred to as *mamali 'ō'io*, was carried out just beyond the reef and in places close to shore from the steamer landing of Ma'alaea to the cape of Kunounou at Honokapohau, in the district of Lāhainā. These were the places in which fishing was done by those of Olowalu, Lāhainā, Ka'anapali, Honolua, and Honokohau (Kahā'ulelio 2006:141). *Aku* fishing for those of Lāna'i, Ukumehame, Olowalu and all of Lāhainā, prior to the arrival of the missionaries, was carried out five to seven miles from the coast with the *pā* hook and a bait carrier (*malau*) filled with *'iao* (Kahā'ulelio 2006:25). *Akule* fishing, which is a type of endeavor that requires a communal effort was also practiced at Unahi in Olowalu (Kahā'ulelio 2006:201):

> They [the *akule*] remain several days or weeks at a place ... [w]hen the fishermen who are all-supplied with *papa* (bag) and *pākū* (curtain) nets see the fish, they call for their canoes and go out to surround the fish with the nets. Two canoes would go ahead and they carried the curtain nets. The head fisherman watches from the shore and when he sees that they have reached the right places, he makes signs by waving his hands. The curtain nets are lowered and every effort is made to draw them shoreward. If the fish are surrounded in this time that the net is lowered, then the bag net is quickly set in place, for the fish are excited then. At this time, no is allowed to speak nor to make a noise on the canoe until the space in the net begins to decrease.
>
> ...
>
> If by next June the *konohiki* or the land owners who hold the fishing rights do no sue, then the channel of Pu'uloa will be clear of all obstruction and Ka'ahupāhau (the shark goddess) will have a clear sailing, all will be well.

In addition to being a reliable subsistence resource, the waters of Olowalu along Hekili Point are also a well known black tip reef shark nursery, as well as an area that is frequented by tiger sharks just off of the fringing reef. The following newspaper account speaks to a shark encounter incident at Olowalu just off shore, and while the incident occurred in 1876, the author speculates that the shark involved was the guardian Ka'alamikihau whose territory runs from Honua'ula to Waianu'ukolu in Lāhainā:

MOKU I KA MANO.—	MOKU I KA MANO (Cut by the Shark)
Ma ka la 24 o Iulai iho nei; ma Olowalu, apana o Lahaina, mokupuni o Maui, ua pakele iho la o Papu (w.,) mai pau poo i ka Ia ilikani o ka moana. A penei ke ano: Ua hele aku la o Papu (w.) a me Kalani (w.,) i ka luu Wana ma ke kai o kahi i haiia maluna ae, a i ko laua luu hele ana a hiki ma kekahi wahi ku ae la ka lima o Papu i ka wana, a lilo iho la oia ilaila e wehe ai; a aole no hoi oia i	On the 24th of July is when this took place; in Olowalu, a piece of Lahaina, island of Maui, Papu, a woman was saved by being consumed by the tough skin sun of the ocean (shark). It happened like this: Papu and Kalani went to dive for wana in the ocean at the place that is mentioned above. They were diving until they came to this one place where Papu's hand got

ike aku i ka mano, he mau ana no kona wawae kana i ike, a manao hewa iho la oia he Puhi, a kahea aku la ia Kalani kona hoa: "E! Pau au i ka puhi e!!" Nana aku kahi wahine e kahe ana ke koko, a ike pu aku la no hoi i ka mano e holapu ana. O ko laua hoomaka aku la no ia i ka au wikiwiki a pae iuka, a i ke hiki ana i kaha one, maule iho la ka mea i moku a hehee iho la ilalo; a mahope iho ua pohala ae la, a eia oia ke ola nei. Aloha.
S. P. KEALIIAHONUI.
Olowalu, Maui, Aug. 24, 1876.

[Ua manao wale o Huaa, i moku au la no paha ia Kaalamikihau, no ka mea, wahi ana, oia ka mano nana e kiai mai ka Lae o Pohakueaea ma Honuaula, a hiki i ka wai o Waianuukolu ma Lahaina; mai hilinai na makamaka i ka ia nei, oiai o ko Huaa mau no ia o ka maha, aia no a wini oluolu iho la keia. L. H.]

poked by the wana, and she stayed in place to remove it, however she didn't see the shark, her feet were measuring what she saw, and she wrongfully that it was an eel, and Kalani called out to her friend, "E! I am going to get killed by the eel!!" The girl looked at the blood flowing, and saw the shark becoming angry. They immediately began to swim quickly to shore. When they reached the sand, the thing that poked her fell out, and she was relieved that here she is, living.
S. P. KEALIIAHONUI.
Olowalu, Maui, Aug. 24, 1876.

[Hua'a just a thought, she possibly go cut by Ka'alamikihau because according to him/her, that is the shark that guards Pohakueaea Point in Honua'ula until the waters of Waianu'ukolu in Lahaina; don't trust the fish here]
(Kealiiahonui 1876)

An "overland" trail system allowed pedestrian access between Lāhainā and the north coast of West Maui, as well as into the upper forests for bird-catching and the collection of wild plant resources. According to Handy and others (1991:490), the trail extended *mauka* in Olowalu Valley to the highest point of the West Maui summit at Pu'u Kukui, then descended to Waiehu on the northern side (Handy et al. 1991:490; Sterling 1998:26).

Lo'i agriculture within the watered areas of Olowalu Ahupua'a, supplemented by *kula* or dry land crop staples as well as coastal resources would have undoubtedly supported a significant population. With regard to census counts, results of the 1832 missionary census, shows the total population of Maui as 35,062, and gives the following population counts: Lāhainā, 4028; Ukumehame, 573; and Olowalu, 832 (Schmitt 1973). These three figures, when combined, represent 15 percent of the total Maui population, and allowing for post-contact distortions (e.g., disease and commercially-inspired population shifts), the 1832 population totals along with the above claims for arable agricultural plots suggest that this portion of Maui likely accommodated a substantial portion of the island's population prior to western contact.

3.1.2.3 Politics and Warfare

The Mokupuni of Maui, being the second largest island in the Hawaiian island chain, was a major center for political development during the pre-contact and early historic time period (Kirch 1985:135). Many battles were fought between the Maui Island and Hawai'i Island polities, with the earliest conflicts primarily centered on the east coast of Maui. During the reign of Kekaulike there appears to hav been relative peace; however, following the death of this Maui ruler in the early 1700's, the chiefs of Maui and Hawai'i would find themselves at conflice once again, this time bringing the battles closer to the present study area.

3.1.2.3.1 The Role of Olowalu in the Battles of Kamehameha-nui and Kahekili

After Kamehameha-nui, the original successor of Kekaulike, was defeated in battle at Lāhainā by his older brother Kauhi, Alapa'i (ruling chief of Hawai'i) brought Kamehameha-nui back to Hawai'i and began making plans for retaliation against Kauhi. Around 1738 Alapa'i and his Hawaiian forces occupied the Lāhainā region, holding the lands from Ukumehame to Māla and employed the following wartime tactics to keep the subjects of Lāhainā under control:

> A whole year Alapa'i spent in preparation for the war with Maui. It was in 1738 that he set out for the war in which he swept the country. What was the war like? It employed the unusual method in warfare of drying up the streams of Kaua'ula, Kanaha, and Mahoma (which is the stream near Lāhaināluna). The wet taro patches and the brooks were dried up so that there was no food for the forces of Ka-uhi or for the country people. Alapa'i's men kept close watch over the brooks Olowalu, Ukumehame, Wailuku, and Honokowai. (Kamakau 1992:74)

This tactic, along with a day of hard fighting at Pu'unene near Mailepai, won this battle for the forces of Alapa'i and ultimately the war when Kamehameha-nui became the ruling chief of Maui (Kamakau 1992:75).

Kahekili, who rose to power following the passing of Kamehameha-nui, was one of the more powerful and ambitious chiefs of Maui who, by 1786, ruled O'ahu, Moloka'i and Lāna'i (Daws 1968:31). Following the great battle of Kakanilua, a battle fought on the sand hills of Kalua where the army of Kalaniopu'u of Hawai'i was defeated by the warriors of Kahekili, Kamehameha, future *Mō'ī* (King) who would unite the Hawaiian Islands under a single ruler, found himself at the *pu'uhonua* of Olowalu (Kamakau 1992:85-88). Joseph Mokuohai Poepoe (in Sterling 1998:24) relates the story of Kamehameha at Olowalu:

> Four days after the battle of Kakanilua the chiefs of hawaii received a kind of welcome from King Kahekili of Maui. Kahekili told the Hawaii chiefs to pause awhile on Maui and rest. The land which Kahekili gave them is the place where they stayed. It was Puuokapolei at Olowalu. Their division of land reached as far as Lahaina.

During the later years of Kahekili's reign and the early years of Western contact, the traditional Hawaiian lifestyle changed rapidly, as western goods, particularly weapons and metals became obtainable through either trade or theft. Daws comments that several of the early traders "saw nothing wrong in arming one Hawaiian chief against another as they sold guns to as many factions as they could find and then encouraged them to fight" (Daws 1968:32).

3.1.2.3.2 The Eleanora and the Incident that Led to the Olowalu Massacre

Over a period of five years, from the time of Cook's landing at Hawai'i to the incident that would lead to the Olowalu Massacre, the waters of the islands were busy with ships, some of which were "friendly" and others that were "bent on destroying men and governments" (Kamakau 1992:144). On February 1790, the Eleanora arrived from Liverpool, England captained by Simon Metcalfe, and anchored off of Honua'ula (Kamakau 1992:145). Kalola, the widow of Kalaniopu'u, was staying at Honua'ula at the time of the arrival of the ship with her new husband Ka'opuiki when the following events occurred:

> ... Ka-'opu-iki was glad to go on board to trade for iron, muskets, and red cloth; but muskets were the objects he most desired. The people brought in exchange hogs, chickens, potatoes, bananas, and taro. Night fell before they had finished their bargaining, and the next day Ka-'opu-iki and others went out again to trade further; but the strangers were

unfriendly and beat them off with ropes. When Ka-'opu-iki heard from the people of Honua'ula about the small boat which it was customary to keep tied to the back of the ship, he determined to steal the boat at night. At midnight when the guard on the skiff and the men of the ship were sound asleep, Ka-'opu-iki and his men cut the rope without being seen from the ship. As they were towing it along, the guard awoke and called out to those on board the ship, but he was too far away to be heard; he was killed and his body thrown into the sea. The boat was taken to Olowalu and broken up, and the iron taken for fishhooks, adzes, drills, daggers, and spear points.

The next morning when the men on the ship awoke and found both skiff and watchman missing and realized that the boat had been stolen and the watchman killed, they shot off the cannon upon Honua'ula and killed some men, among them a peddler from Wailuku, named Ke-aloha, who had come to Honua'ula to peddle his wares. Two men were held on board the ship, one from Honua'ula and one from Olowalu, perhaps because these men had given information about the theft or perhaps because the foreigners suspected that Ka-opu-iki and the others ... said they were from Olowalu, were responsible for the theft. That evening they sailed to Olowalu, and in the morning Ka-lola declared a tabu restricting canoes from going out to the ship on pain of being burned to death of they disobeyed. "Withered grass" (Mau'uae) was the name of this law...on the fourth the tabu was ended, and canoes in great numbers went out to trade with the foreigners ... Little did they suspect the terrible carnage that was to follow, a carnage without any effort to apprehend and punish the offenders or any pity for the innocent. So these Christians murdered the Hawaiian people without any more mercy than cannibal Nukuhivans show, or people of pagan lands. ... At noon that day the *Eleanor* sailed, and the people went out and brought the dead shore ... and the dead were heaped on the sands at Olowalu. Because the brains of many were oozing out where they had been shot in the head, this battle with the ship *Eleanor* and her captain was called "The spilled brains" (Kalolopahu). It was a sickening sight ... (Kamakau 1992:145-146)

The arrival of the Eleanora plays significantly into the history of Hawai'i not only for the atrocity that was the Olowalu Massacre, but also for the shipboard presence of John Young who, along with Isaac Davis, would become a favorite of Kamehameha I and instrumental as leaders in the wars of unification that brought all of the islands under a single ruler. This push for unity would shift the traditional sociopolitical system from a Complex Chiefdom to a Monarchy under the Kamehameha line and make way for rapid changes in the islands.

3.1.2.3.3 The Battle of Kepaniwai and the Escape of Keōpuōlani through Olowalu Valley

One of the most distinguished battles during the rise of Kamehameha I was fought between the warriors of Hawai'i Island and Maui at 'Īao Valley in Wailuku in the Battle of Kepaniwai. While the fierce battle that occurred between the warriors within this valley is the most widely recounted story, the small pass between 'Īao and Olowalu Valleys played an important role in the escape of Keōpuōlani who would later become the Sacred Wife to Kamehemameha I and Queen Mother to his ruling heirs, as well as an instrumental figure in overturning the *'ai kapu* and future convert and advocate for Christianity in Hawai'i (Mookini 1998). Fornander details the following:

... Kamehameha moved his fleet to Kahului, and hauled up his canoes from there to Hopukoa without opposition. After two days of preparation he marched on to Wailuku, where Kalanikupule awaited him with such forces as he had been able to collect. This battle was one of the hardest contested on Hawaiian record. We have no detailed account of the disposition of the forces on either side; we only know that the battle commenced at Wailuku and thence spread up the Iao valley, the Maui army defending valiantly every foot of the

ground, but being continually driven farther and farther up the valley, Kamehameha's superiority in the number of guns, and the skilful management of the same under the charge of Young and Davis, telling fearfully upon the number of his foes, and finally procuring him the victory. ... The Maui troops were completely annihilated, and it is said that the corpses of the slain were so many as to choke up the waters of the stream of Iao, and that hence one of the names of this battle was "Kepaniwai" (the damming of the waters).

Kalanikupule, his brother Koalaukani, Kamohomoho, and some other chiefs escaped over the mountain and made their way to Oahu. Kalaniakua, Kekuiapoiwa Liliha, and her daughter Keopuolani, crossed over to Olowalu, where they joined their mother, Kalola, and after a hurried preparation they all left for Molokai, and took up their residence with Kekuelikenui at Kalamaula. (Fornander 1880:237)

3.1.3 Early Post-Contact Period

The nineteenth century brought to Lāhainā, and the surrounding lands which include the study area, a multitude of commercial, demographic, social, and religious changes that were encouraged by the burgeoning foreign influx. During the year 1819 the first whaling ships arrived in Hawaiian waters and Lāhainā Harbor became a primary port of call for provisioning ships in the islands. Closely following the arrival of the first whaling ships, the first Protestant missionaries and their families arrived in Lāhainā in 1823. The missionary William Ellis, who visited Lāhainā during the 1820's, described the landscape that had entranced both the Hawaiians themselves and the nineteenth century newcomers:

The appearance of Lāhainā from the anchorage is singularly romantic and beautiful. A fine sandy beach stretches along the margin of the sea, lined for a considerable distance with houses and adorned with shady clumps of kou-trees, or waving groves of cocoa-nuts. . .The level land of the whole district, for about three miles, is one continued garden, laid out in beds of taro, potatoes, yams, sugar-cane, or cloth-plants. The lowly cottage of the farmer is seen peeping through the leaves of the luxuriant plantain and banana tree, and in every direction white columns of smoke ascend, curling up among the wide-spreading branches of the bread-fruit tree. The sloping hills immediately behind, and the lofty mountains in the interior, clothed with verdure to their very summits, intersected by deep and dark ravines, frequently enlivened by waterfalls, or divided by winding valleys, terminate the delightful prospect. (Ellis 1826:76-77)

Specific to Olowalu was an excursion around part of the island beginning at Lāhainā by the Rev. Hiram Bingham and Rev. William Richards. In a letter to the American Board of Commissioners for Foreign Missions, Mr. Bingham described their journey and overall impressions:

Day before yesterday, Mr. Richards and I set off on an excursion to explore a part of the Island, and to visit the king, now on the other side. By the favor of the king's mother and her husband we obtained a good double canoe to facilitate our progress. We sailed along the shore in the direction of Maurakea (Mow-rah-ka-ah) [Mauna Kea] on Owhyhee, [Hawaii] of which we had a view among the clouds. Seven or eight miles from Lahinah [sic] we alighted on shore, and walked a mile or two through a pleasant plantation called Oroaru (O-ro-ah-roo) [Olowalu] belonging to the king's mother and containing 128 houses; then joined the canoe again. We found that some of the people had attended divine worship. As I was giving them a few words of instruction, I heard a lad pronounce the name of JESUS CHRIST. I asked him by whom he had heard the name of our Savior; he replied, "By the missionaries at Lahinah." We proceeded sailing along the shore, several miles

> passed [sic] several plantations belonging to Urumaheihei (Oo-roo-mah-ha-ee-ha-ee) [Ukumehame] and containing about 80 houses ... (Bingham 1824)

The whaling trade flourished until the 1860's and gave impetus to the development and growing population of Lāhainā. Between 1824 and 1861, 4747 whale ship arrivals were recorded for Lāhainā, representing 47 percent of the total arrivals in all ports of the Hawaiian Islands. Figures from an 1846 census of Lāhainā documents the following changes brought to the area midway through the nineteenth century: 3,445 Hawaiians, 112 foreigners, 600 seamen, 155 adobe houses, 822 grass houses, 59 straw and wooden houses and 529 dogs (Jarves 1847:240). With an increasing population of foreigners entering Lāhainā, there was a need to increase the traditional agricultural surplus that fell primarily under the control of the *ali'i* class, for economic trade. Henry Whitney, editor for The Pacific Commercial Advertiser, implies that western vegetables became a common and abundant constituent of the Hawaiian gardens in the following excerpt about Maui Island:

> ...Fruits are generally abundant. The grape seems to luxuriate in the rich soil, and the sunny, clear weather of Lāhainā is, par excellence, the fruit of this place or Islands. Figs, bananas and melons are produced in abundance, and pumpkins enough for all New England to make pies for a general Thanksgiving (Whitney 1858)

After the consolidation of the rulership of the Hawaiian Islands by Kamehameha I early in the nineteenth century, Lāhainā became the "capital" of the kingdom until the 1840's when the government moved to Honolulu. The sugar cane Ellis observed in the environs of Lāhainā in the 1820's would become, during the second half of the nineteenth century, the basis for a commercial venture that would reshape the landscape along the alluvial plains of the present study area.

3.1.4 Mid- 1800s and the Great Māhele

With the unification of the Hawaiian Islands in 1791 (Andrews 1865:556) and the arrival of the first Missionaries in 1820 (American Board of Commissioners for Foreign Missions 1832; Andrews 1865:556), western commerce and the Christianization of the Native Hawaiian people swept across Lāhainā Moku. The lands surrounding Lāhainā town were cultivated in commercial sugar (Gilmore 1936:198-203), while the whale trade (Graves et al. 1998), the Irish potato trade in response to the California Gold Rush (Gilman 1906:177), and the establishment of both the Lahaina Mission Station and Lahainaluna High School, drew people to the waterfront areas as well as the town itself. This trend made Lāhainā town one of the main religious and educational centers for the entire island chain (Kamakau 1992:304) and strongly influenced the religious and economic development of adjacent land divisions.

3.1.4.1 Religious Development

The Reverend Richard Williams established the Olowalu Mission of the Lāhainā Station between around 1829, and provided Christian meetings for the people there. In a letter written October 2, 1830, by Richard Williams and Jonathan S. Green, a review of the status of public worship on the Sabbath was reported thus:

> In every considerable village from one end of the island to the other, the people have erected a house for the worship of God ... At Olualu [sic], a village eight miles distant from Lāhainā, we have preached during the season, nearly thirty sermons to a congregation of five to six hundred. This and a single Sabbath at Kanepale, a village equally distant from Lāhainā in another direction, is all that we have been able to do for the people on this side of the island ... The congregation at Olualu [sic] listen with seriousness to the preaching

> of the gospel. A few teachers of schools there have formed themselves into a Bible class, who have been instructed in the interval between the services of the Sabbath. (Richards and Green 1831)

In an 1837 report to the American Board of Commissioners for Foreign Missions, a review of meeting-house construction in the Hawaiian Islands was presented with the following comment on progress at Olowalu:

> A *doby* meeting-house, or one the walls of which are of clay hardened in the sun ... has been built at Oloalu [sic], on Maui. (American Board of Commissioners for Foreign Missions 1837)

Mr. Hinano Rodrigues (in Lee-Greig and Hammatt 2006:A-32) offered the following description of the effort that went into building the Olowalu Church (Figure 9 and Figure 10):

> The church was founded in 1835 ... what happened is that my *tutu* folks formed a human line from the church up the mountain, and then they passed the stones down to the church, then they went across the street and got the coral and ground the coral to make cement yeah? And they built the church.

By the mid 1800's, the Lāhainā area had been infiltrated by a growing community of foreign business entrepreneurs, transient whalers, and Calvinist-minded missionaries; all of whom had personal interests to protect and virtues to impress upon the traditional Hawaiian people. Encouraged by these foreign factions, the division of lands, based on a western model of fee simple land ownership, was instigated under Kamehameha III (Kauikeaouli). The series of acts to "Organize the Executive Ministry" known commonly as the Organic Acts of 1845 and 1846, initiated the process of the Great Māhele, or division of Hawaiian lands, which would introduce private property ownership into Hawaiian society, as well as, transform the governance of the Kingdom from a full monarchy to a constitutional monarchy (Van Dyke 2008:32-33).

Figure 9. Olowalu Church prior to the 1930 fire that took the wooden roof of the church (Date unknown, photo courtesy of Mr. Hinano Rodrigues)

Figure 10. General Interior View of the Olowalu Church, photographed by Jack E. Boucher in 1966 for the Historic American Buildings Survey (HABS), and the Historic American Engineering Record (HAER) (National Park Service).

3.1.4.2 The Great Māhele

In 1848 the crown and the *ali'i* (royalty) received their land titles and awards for both whole *ahupua'a* and individual parcels within an *ahupua'a* which were then subsequently granted in 1850 (W. D. Alexander 1890:114). Crown Lands were lands defined as:

> ... private lands of His Majesty Kamehameha III., to have and to hold for himself, his heirs and successors forever; and said lands shall be regulated and disposed of according to his royal will and pleasure subject only to the rights of tenants. (Kingdom of Hawaii 1848)

At the death of Kamehameha IV, it was decided by the Supreme Court that ...under the confirmatory Act of June 7th, 1848, "the inheritance is limited to the *successors* to the *throne*," "the wearers of the crown which the conqueror had won," and that at the same time "each successive possessor may regulate and dispose of the same according to his will and pleasure as private property, in the manner as was done by Kamehameha III" (W. D. Alexander 1890:121).

Lands were further partitioned and set aside as Government lands which were defined and managed as indicated below:

> ... those lands to be set apart as the lands of the Hawaiian Government, subject always to the rights of tenants. And we do hereby appoint the Minister of the Interior and his successors in office, to direct, superintend, and dispose of said lands, as provided in the Act ... (p)rovided, however, that the Minister ... shall have the power, upon the approval of the King in Privy Council, to dispose of the government lands to Hawaiian subject, upon such other terms and conditions as to him and the King in Privy Council, may seem best for the promotion of agriculture, and the best interests for the Hawaiian Kingdom ... (Kingdom of Hawaii 1848)

In 1850, most of the chiefs ceded a third of their lands to the Government in order to obtain an allodia title for the remainder and thus greatly increasing the Government land base (W. D. Alexander 1890:114). The designation of lands to be set aside as Government lands, paved the way for land sales to foreigners and in 1850 the legislature granted resident aliens the right to acquire fee simple land rights (Moffat and Fitzpatrick 1995:41-51).

In July of that same year, it was enacted that "one twentieth part of all the lands then belonging to the Government should be set apart for the general purposes of Education" and in December, certain lands and school sites were designated and set apart by the Privy Council for these purposes. In Section 749, of the Civil Code, which was approved in January 1865, the Board of Education was given the authority to "regulate the Bureau of Public Instruction", an authority under which most of the School lands had been sold in the same manner as other Government lands (W. D. Alexander 1890:121).

As illustrated above, in designations of lands as either Crown or Government, and through all awards of whole *ahupua'a* and *ili*, the rights of the native tenants were expressly reserved, "*Koe na Kuleana o Kanaka*" (Reserving the Rights of Native Tenants) (W. D. Alexander 1890:114). In an Act ratified on August 6th, 1850, the gathering rights of the common people for personal use, which included the gathering of both terrestrial and marine resources, in addition to the right to water and the right of way on the lands of the Konohiki, were guaranteed and embodied in Section

10477 of the Civil Code (W. D. Alexander 1890:114-115). By this same Act, resolutions passed by the Privy Council granted fee simple titles, free of all commutation, with the exception of awards granted within the towns of Honolulu, Lāhainā, and Hilo, to all native tenants for their cultivated lands and house lots (hereafter referred to as *kuleana* land) (W. D. Alexander 1890:115). Claims of the native tenants, or *kuleana* land claims, were presented to and heard by the Land Commission whose duty was to:

> ...ascertain the nature and extent to each claimant's rights in land, and to issue an Award for the same which is *prima facie* evidence of title "and shall furnish as good and sufficient a ground upon which to maintain an action for trespass, ejectment or other real action against any other person or persons whatsoever, as if the claimant, his heirs or assigns had received a Royal Patent for the same." (W. D. Alexander 1890:110)

Testimony for *kuleana* lands often included claims for multiple *'ili*, or *apana*, located both *mauka* and *makai*. These claims were recorded under a single *helu*, or case number, and brought before the Land Commission for consideration. *Kuleana* land awards, or *kuleana* claims that were approved by the Land Commission, were granted to tenants of the land, native Hawaiians, naturalized foreigners, non-Hawaiians born in the islands, or long-term resident foreigners, who could prove occupancy on the parcels prior to 1845 (hereafter referred to as Land Commission Awards [L.C.A.]).

While the majority of Olowalu Ahupua'a was retained by Kamehameha III as Crown Lands, this did not preclude the designation of a school lot within the *ahupua'a* (Grant 15 Apana 2, figure) or hearing of individual *kuleana* claims and issuance of subsequent awards. Within Olowalu, the majority of individual *kuleana* claims were concentrated within the upper valley, along the original route of Olowalu Stream (Figure 11), and lining the southeastern coastline near the mouth of the original stream location.

The primary land uses for the *kuleana* claims in the upper environs and along the stream bed focused on agricultural pursuits largely associated with *lo'i kalo* (pond field taro) cultivation followed by open *kula* (pastures or fields) and dry land agricultural practices centered on *mahi 'uala* (potato farming). In addition to agricultural claims, gathering rights for certain plant resources (e.g. different varieties or parts of *hala* along with claims for *wauke*) along with a few house lots in the *mauka* reaches were also specified.

Claims along the coastal regions consisted primarily of house sites with home gardens and one interesting claim for "*he wahi kaka pa'akai*" or a place to pound salt (Helu 10128, E. Maui). References to adjunct *poalima*, or agricultural lands tended for the *ali'i*, and *konohiki* lands are also accounted for in the native or foreign testimonies summarized in Table 1 (Helu 10128, Kaiwi).

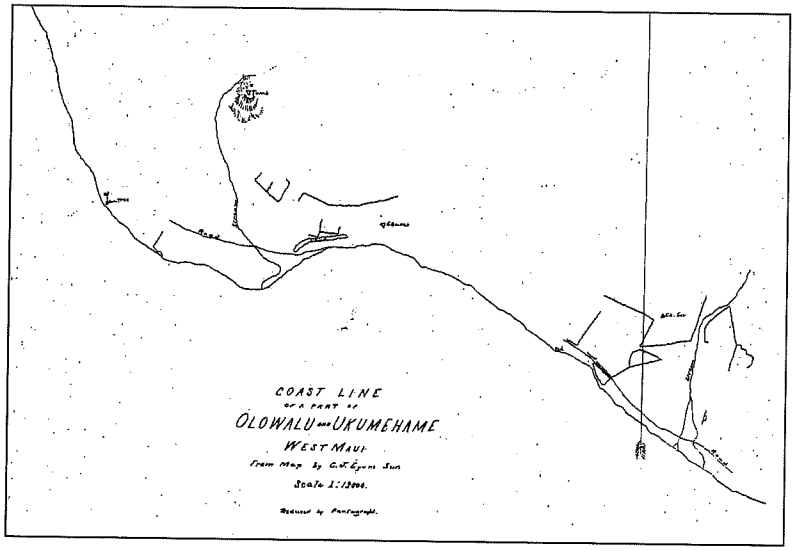

Figure 11. Original route of Olowalu Stream, as surveyed by C.J. Lyons (Dodge 1879), as opposed to the rerouted stream of present day Olowalu (see Figure 1).

Finally, two references to *loko* (ponds) (Helu 3877 claimed by Pikao and Helu 4376 awarded to Keahi) within Olowalu were noted. While the presence of Kalokoi'aokapāiki on the Ukumehame side of the *ahupua'a* and illustrated on maps up until 1906 (Figure 12), was well known, it appears that there was an additional inland pond located on the Launiupoko side of the *ahupua'a* boundary and depicted on a the metes and bounds map of Helu 4376, Apana 1 to Keahi (Figure 13, see also Figure 17).

Despite the effort to allocate lands to the *maka'āinana*, the *ali'i* control of the majority of lands persevered and, as the future would indicate, much of these lands would ultimately be obtained by foreigners for sugarcane enterprises. A total of 91 claims were presented to the Land Commission, of which only 13 were fully awarded, 17 were partially awarded, and the remaining 61 were not awarded at all. The following table summarizes both awarded and unawarded *kuleana* claims recorded in the Native Register for Olowalu Ahupua'a (Table 1) with locations of awarded claims graphically presented in Figure 14 through Figure 17.

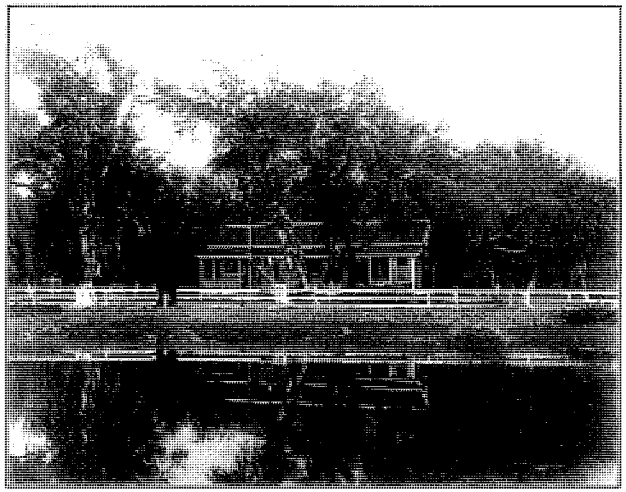

Figure 12. Historic photo of Kalokoi'aokapāiki (Date unknown, photo courtesy of Mr. Hinano Rodrigues)

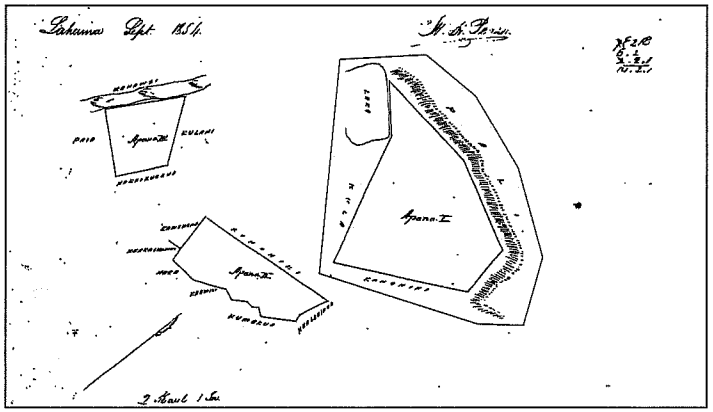

Figure 13. Sketch map of Helu 4376 and 4454 to Keahi, Apana 1 showing location of the *loko* in relation to the lot boundary (area shaded in gray) (Office of Hawaiian Affairs 2011:74370 Volume 74379 Reel 74311 Image 00235).

Table 1. *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
240	John Clark	Kaluakanaka	House lot, bordered to the south by the sea	House lot award (acreage not specified)
342	Kaauwai/E. Maui	Kaluaaha	3 *pā* (lots, no specific land use indicated) 2 roads form part of the boundary of this parcel: government road named "Kaluaaha" and a road leading towards the sea, called "Moanakai" Testimony refers to David Malo's *pā* in Olowalu	Not Awarded
358	Kawehena	--	Various farms for raising things at the request of the Konohiki	Not Awarded
386	Kaweawea	Honokawaikukui	1 house	Not Awarded
479	Peekauwai	--	House lot	Not Awarded
495[2]	Kauahuliwaa	Kamani 2	**Maui sworn**: No. 1 is *kalo* (taro) land	Awarded: acreage not specified
		Kamani	**Maui sworn**: No. 2 is a house lot	Awarded: acreage not specified
		Kamani 3	**Maui sworn**: No. 3 is *kula* (open pasture or field) land enclosed by a stone wall; No. 4 is *kula* land enclosed by a stone fence	Awarded: acreage not specified
1092	Paia	Kamani 3	*Kalo* land	Apana 2 (*kalo* land): 0.45 acres
		Kamani 2	*Kula* land	Not Awarded -- award for Apana 1 *kula* lands at Kamani 2 withdrawn (given to the *konohiki*?) (7.74 acres)
1742	Z. Kaawai	Kamani 1	Farmland	Apana 1 farmland (*pa mahi*): 2.975 acres
		Kaluaaha	Houselot, bordered to the south by the sea	Apana 2 *pahale*: 3.387 acres

[2] Land use from foreign testimony documents related to Helu 495

Table 1 (cont.). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
3726	Malaea	Pu'ukoliohilo	A farmer, with 24 *lo'i* (wetland taro), 2 *kula* fields,2 *puhalalei* (*hala* of the lei making variety) and 1 *kahua hale* (house site)	Not Awarded
3742	Waa (Kauahuliwa'a [w])	--	24 *lo'i*, 5 *mo'o mahi 'uala* (small lands section of potato farming), 1 house lot	Not Awarded
3772	Alapa'i	Pu'ukoliohilo	8 *lo'i*, 3 *mo'o 'uala* (small land section of potato), 4 *puhala moena* (*hala* of the sleeping mat making variety), some trees, 1 *kahua hale* that is bound to the west by the sea and to the east by the road (*alanui*)	Apana 1 (*pahale*): ~0.3 acres; Apana 2 (*kula* land [*aina kula*]): 0.91 acres; Apana 3 (*kula* land [*aina kula*]): 0.63 acres
3811	Lupe	Puukoliahi	28 *lo'i*, 1 *puhalalei*, 1 *kula* land	Not Awarded
3858	Piiku	--	25 *lo'i*, 10 *mo'o mahina 'uala* (potato gardens),	Not Awarded
3877	Pikao	Puukoliohilo	16 *lo'i*, 1 *loko* (pond), 1 *kula*, 1 *kulana hale* (house site) To the north is Launiupoko, to the east is kela kapa, to the south is Paumaumau, and to the west is the road (*ala loa*)	Not Awarded
		--	36 *lo'i*, 1 *kula* field for sweet potato and 1 *puhala lei* and *lauhala moena* (*hala* of the sleeping mat variety) Liliha died and passed kuleana to her sister Meawahine, then to Nahi'ena'ena. It was given to Pikolaa and then to Pikao.	Not Awarded
3888	Panioi	Kuekue	13 *lo'i*	Not Awarded
		Papa	2 *mo'o 'uala*	Not Awarded
		--	*Pahale* (houselot), Bordered to the west by the sea and to the east by the government road (*alanui*)	Houselot: 0.3 acres

Table 1 (cont.). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
3934	Niau	Paumaumau	7 *lo'i*	Not Awarded
		Puukoleohilo	1 *lo'i*, 1 *puhalalei*	Not Awarded
3935	Napooelua	Paumaumau	8 *lo'i*	Not Awarded
4376	Keahi	Puukoliohilo	58 *lo'i*, 5 *puhalalei* and 1 *lauhala moena, a me la'au* (and other plants), 1 *kauhale*, 2 *kihapai wauke* (*wauke* patch), 2 *kihapai* (no specific use indicated), 2 *kihapai kalo malo'o* (dryland taro patches) Apana 1 survey shows a *loko* (pond) along the north-northwest boundary and bordered the cliff side to the north and east	Apana 1 (*kula*): 7.5 acres; Apana 2 (*kula* and *kalo*): 6.5 acres
4453	Kaaihue	Pu'ukoliohilo	8 *lo'i*	Not Awarded
4454	Keahi	Kaumukukahi	23 *lo'i* Land received from Ka'aimanalo; Hoapiliwahine (Keopuolani) released it to Na'ea in 1842 and Ka'aimanalo got it from Na'ea. Hoapili land came from Nahi'ena'ena. Pahale name appears to be Kelakapu; bordered by the stream (*kahawai*) to the northwest	Apana 3 (*kalo*): 0.51 acres
4459	Kaumukalani	Kuekue	19 *lo'i*, 1 *kula*	Not Awarded
4462	Kauhena	Kamani	3 *lo'i*	Not Awarded
4878KK	Kelea	--	No specific land use information	Not Awarded
4878MM	Makanui	--	No specific land use information	Not Awarded
4878NN	Kapuhi	Kekio	No specific land use information	Not Awarded
4878OO	Kapuhi	Kekio	No specific land use information	Not Awarded

Table 1 (cont). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
5075	Haole	Kamani	1 *lo'i*	Not Awarded
		Kaumukukahi	4 *lo'i*	Not Awarded
		Wailoa	My path, my *hale*, and my garden	Not Awarded
5113	Kailaa	Kamani 1	*Pa*	Apana 1 (*kula*): 4.33 acres
5207B	Kalaipaihala	Maomao	8 *lo'i*, dryland taro fields Bordered to the east, south and west by the *kahawai* (stream) and to the north by the *pali* (cliff side)	Apana 1 (*kalo* section): 0.937 acres
5229	Kamana	--	23 *lo'i*	Not Awarded
5620	Kahele	Kaluaaha	1 *pahale* Bordered to the south by the sea	Apana 1 (*pahale*): 1.31 acres
		Maomao	*kalo* land Bordered to the south and east by the stream	Apana 2 (*kalo* land): 0.53 acres
		--	*kalo* land Bordered to the east by the stream (*kahawai*) and to the north by the cliff side (*pali*)	Apana 3 (*kalo* land): 0.61 acres
5620	Kahele	Kaunukukahi	*Pahale*	Apana 4 (*pahale*): 0.881 acres
5656B	Kekona	Puukoliohilo	19 *lo'i*	Not Awarded
5732	Kawaaiki	Pualaia	15 *lo'i*, 1 *kahua hale*, 1 *kula* field	Not Awarded
5737	Keakaikawae	Hawaiikekee	14 *lo'i*	Not Awarded
5740	Keawehena	Hawaiikekee	17 *lo'i*, 10 *lo'i* and 1 *kula* that has been fenced in (belonging to *kaikoeke* [brother-in-law]), 16 *lo'i* and 1 *kula* land (belonging to *makuahonowai* [parents-in-law])	Not Awarded
		Peekuuai	1 *hale* (houselot) and one kou tree	Not Awarded

Table 1 (cont.). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
5757	Kamakahiki	Kaunukahi	12 *lo'i*	Not Awarded
		Hawiikekee	1 *lo'i*	Not Awarded
		Kamani	1 *lo'i*	Not Awarded
		Wailoa	1 *lo'i*, 2 *mo'o e ae* (gardens?), 2 *pa* (enclosures) in the middle of the land, 1 *pa* makai	Not Awarded
		--	29 *lo'i* (very small), 1 houselot (the place of my mother; has been enclosed by a fence by new people)	Not Awarded
5829[3]	Kaaoaohema	Hawaiikeke`e	**Z. Kaauwai sworn**: No. 1 is a house lot, No. 2 is a section of 3 *lo'i*; No. 3 is one *lo'i*, No. 4 is 1 *lo'i* Located on Kahawai o Olowalu (Olowalu Stream)	Apana 1-3 (*pahale* and *lo'i kalo* surveyed as a single lot): 3 acres
5829[3]	Kawehena	Hawaiikeke`e	**Kauakahaole sworn**: 2 *kula* and *kalo* lands	Apana 1 (*pahale*) Apana 2 (section of *kalo* land [*pauku aina kalo*]): Apana 1 and 2 combined = 1 acre
5829	Kawehena	Kamani 2	**Kauakahaole sworn**: 1 *kula* lot	Apana 3 (*kula*): 1 acre
5829[3]	Haole	Kaumukukahi,	**Z. Kaauwai sworn**: No. 1 -- section of 2 *lo'i;* No. 2 -- is a section of 2 *lo'is*	Not Awarded
		Kamani 3	**Z. Kaauwai sworn**: No. 3 -- 1 *lo'i*	Apana 3 (*kalo* land [*aina kalo*]): 0.5 acre
		Wailoaiki	**Z. Kaauwai sworn**: No. 4 -- 11 *lo'i*, 1 *kula*	Apana 4 (*kalo* land [*aina kalo*]): 4.5 acres

[3] Land use information from foreign testimony documents, letter designations redacted

Table 1 (cont.). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
5829[3]	Nahue	Kaluaaha	**Kepaa sworn**: No. 1 -- section of *kula* land, No. 2 -- section of *kula* land, No. 3 -- houselot	Apana 1 (*pahale*): 0.86 acres
5832	Kaweawea	Honokawaikukui	23 *lo'i*, a *mo'o 'uala* and a *mo'o puhala* (section of *hala*). Several small *pahale* from Keopuolani, 2 of which I inherited. 2 *malo'o* (dry) taro fields and 6 *kahua hale*.	Not Awarded
5952	Minamina	Kaunukukahi	13 *lo'i*, bordered to the west by the *kahawai* (stream), 1 *pahale*	Apana 1 (*pahale*): 0.79 acres; Apana 2 (*kalo* land [*aina kalo*]): 0.38 acres
		Puuone	1 *pahale*	Not Awarded
6058	Peekauai	Kamani 1	*Pahale* (*kahakai*: by the sea); *la'au* (plants); 2 kou; 1 lot (no specific land use indicated); 1 *mahi'ai* (lot for farming) Initially awarded the farming lot (*pa kula mahi* -- 1.84 acres) as Apana 2 then retracted	Apana 1 (*pahale*): 0.19 acres; Apana 2 (*kula* land):1.75 acres
		Kanukukukahi 1	8 *lo'i*, Bordered to the east by the *pali* (cliffside)	Apana 4 (*kalo* land [*aina kalo*]): 0.23 acres
		Ohia	10 *lo'i*, Bordered to the east by the *kahawai* (stream) and to the north by the *pali*	Apana 1 (*kalo* land): 0.31 acres
6186	Pipipi	Ka'alaea	Potato fields	Not Awarded
		Kamani 2	11 *lo'i*, 1 *lo'i* owned by Mahulu, and one more by Keahi	Not Awarded
6187	Opunui	Kamani 1	A small parcel (*mo'o*)	Not Awarded
6188	Kamakahiki and Punia	Kaluaaha	*Pahale*, 1 *mo'o aina* (section of land) or *'ili*	Not Awarded

Table 1 (cont.). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
6189	Punia	Kukuialonokea	*kanu wauke iuka* (upland wauke farm)	Not Awarded
		Kamani	*Noho ana ma ka mo'o aina* (resides on a small land section)	
6190	Kahaule	Kaluaaha	First name is Bakaio	Not Awarded
6457	Hale	Kamani 2	2 *lo'i*, 1 house lot Bordered to the north by the *kahawai* (stream)	Section of *kalo* and *kula*: 0.58 acres
			21 *lo'i*, 1*kula* field, 1 *kulana hale*	Not Awarded
6544	Huihui	Puehuehu	18 *lo'i*, a few *puhala* (hala), and 1 *kulana kauhale*	Not Awarded
6728	Mahulu	Kamani	20 *lo'i*, 1 garden	Apana 1 (*kalo*): 0.78 acres
6728	Mahulu	Kaunukukahi	1 *kulana kauhale*, *makai* lot	Apana 2 (*pahale*): 0.91 acres
6852	Punahele	--	No specific land use information	Not Awarded
7719	Haia	Maomao	15 *lo'i*, 1 *kula* field, *pahale* Bound to the south by the sea and to the west by the *kahawai* (stream)	Apana 1 (*pahale*): 0.37 acres
8062	N. Hue	Paumaumau	1 *poho wauke* (*wauke* areas), called "Niniulapalapa"	Not Awarded
8191	Hilo	Ohia	5 *lo'i*, *kula* land in Pu'uone	Not Awarded
8238	Ihu	--	21 *lo'i*	Not Awarded
8545	Kaiehu	Pu'ukoliohilo	9 *lo'i*, 1 *pahale*, 3 *puhala*	Not Awarded
8546	Kaawili	Pahoa	*Mala mai'a* (garden of banana)	Not Awarded
		Pualaia	16 *lo'i*, 1 *pahale*, *kihapai wauke* (*wauke* section), *mala mai'a* (banana garden)	Not Awarded
		Pu'ukoliohilo	11 *lo'i*	Not Awarded
		Paumaumau	1 *kalo* land (*aina kalo*) Southern border is the *auwai* (irrigation ditch)	Apana 1 (*kalo* land): 0.7 acres

Table 1 (cont.). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
8573	Kailiiala	Kuekue	8 *lo'i*	Not Awarded
		Paumaumau	1 *lo'i*	Not Awarded
		Kamani	1 *pahale*	Apana 1 (*pahale*): 0.19 acres
8585	Kealoha	Honokowaikukui	29 *lo'i*	Not Awarded
		Papa	4 *puhala*	Not Awarded
		Puukoliohilo	1 *puhala*, 1 *hau*	Not Awarded
8651	Kealoaihue	Pualaia	2 *poho wauke* (*wauke* areas)	Not Awarded
8656B	Kekona	Puukoleohilo	19 *lo'i*, 1 *pahale*	Not Awarded
8656C	Kahooikaika	Kamani 2	1 *kula*, 19 *lo'i*	Not Awarded
8656	Kamakokalani	--	18 *lo'i*	Not Awarded
8657B	Amama	Kamani	11 *lo'i*, 1 *pahale*, 3 *puhala*	Not Awarded
8657	Kikau	Kamani 2	15 *lo'i* Bound to the north by Haole's stones (stone wall? [*pohaku* Haole])	Apana 1 (*kula* land, *lo'i*, and *pahale*): 3.45 acres
8668	Kaiwi	Kamani	26 *lo'i*, separated *kula* lands, 3 *poho wauke*, 1 *kauhale* Bordered to the north the stream (kahawai) to the south by an *auwai*. There is also a *poalima* section (*konohiki* or *ali'i* parcel) within this *apana* (section): 0.06 acres	*Kalo* and *kula*: 1.063 acres
8756	Kamakahiki	--	1 *pahale* called "Wehe ka Pilikia"	Not Awarded
8817	Kanakaole	Kamani	1 *pahale*	Apana 1 (*pahale*): 0.4 acres
		Kaumukukahi	10 *lo'i*	Apana 2 (one *lo'i*): 0.047 acres; Apana 3 (*kalo* land [*aina kalo*]): 0.17 acres

Table 1 (cont.). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
8828	Kauhiakalani	Honokawaikukui	28 *lo'i*,1 *mala* (garden)	Not Awarded
		Papa	1 *mo'o puhala*	Not Awarded
		Puukoliohilo	8 *puhala*	Not Awarded
8829	Mohaa	Honokawaikukui	10 *lo'i*	Not Awarded
		Papa	3 *puhala*	Not Awarded
8886	Kuewa	Kaumukukahi	18 *lo'i*	Not Awarded
		Kuekue	2 *lo'i*	Not Awarded
		Naupaipai	3 *lo'i*, *kahuahale*, and *kula*	Not Awarded
8887	Kaikuaana	Kaumukukahi	21 *lo'i*, 1 *kula* field, 2 *poho wauke*	Not Awarded
		Kamani	several more *poho wauke*, 1 *pa mahina 'uala* (potato garden lot), and 1 *pa kulana kauhale*	Not Awarded
9004	Kahale la'au	Pu'ukoliohilo	24 *lo'i*, 3 *puhala*	Not Awarded
9006	Kahananui	Kekio	22 *lo'i*, 2 *puhala*, 1 *pahale*	Not Awarded
9820	Paele	--	No land use details in record	Not Awarded
9821	Kaleiopu	--	No details in record	Not Awarded
9906	Pikao	Paumaumau	9 *lo'i*, 1 *pahale* *Poalima* is a separate section	Apana 1 (*pahale* and *lo'i kalo*): 2.70 acres
9907	Ka'ilimoku	Puolaia	15 *lo'i*, 1 *mo'o 'uala*	Not Awarded
9978	Leimakani	--	*Pahale*	Not Awarded
10127	Makanialoha	--	14 *lo'i*, 1 *kumu ulu* (ulu area?), 2 *puhala*, 1 *niu*	Not Awarded
10128	E. Maui	Kamani	many *lo'i* (1.5 Apana)	Apana 2 (*kalo*): 0.5 acres Apana 5 (*pahale* and *kula*): 8.64 acres
		Kahakeia	*kula* land, "*he wahi Kaka pa'akai*" a place to pound salt	Not Awarded

Table 1 (cont.). *Kuleana* claims within Olowalu Ahupua'a.

Helu	Claimant(s)	'Ili	Summary of Lands and Land Use of the Claimant(s)	Lands Awarded and Acreage
10128 (continued)	E. Maui	Kealualia	a storehouse	Not Awarded
		Kekaalaea	*paukū aina* (land section)	Not Awarded
		Wailoa	Many *'uala* farms, Kahawai 'O'opu (a claim for the stream?)	Apana 1 (*kula*): 1.25 acres Apana 3 (*kula ma kalo* [dry land taro]): 7 acres Apana 4 (*kula*): 1.187 acres
10592	Paia	Kamani3	19 *lo'i*, a few *kula 'uala* and 1 *pahale iuka* (*mauka* houselot)	Not Awarded
10673	Puhilaolao	--	1 houselot	Not Awarded
10714	Pohakunui	Kamani 2	24 *lo'i*, 1 *kula* field, 1 *kauhale* Bordered to the west by the stream	Section of dry land taro (*pauku aina kalo kula*): 0.86 acres
10807	Puuone	Kauhipoho	1 Kukui Grove	Not Awarded
10827	Puuone	Kealanui	27 *lo'i*, 1 *kula 'uala*, 2 dry taro	Not Awarded
10932	Ulili	Naupaipai	15 *lo'i*	Not Awarded
		Waiakamalii	1 *lo'i*, 2 *mo'o*	Not Awarded

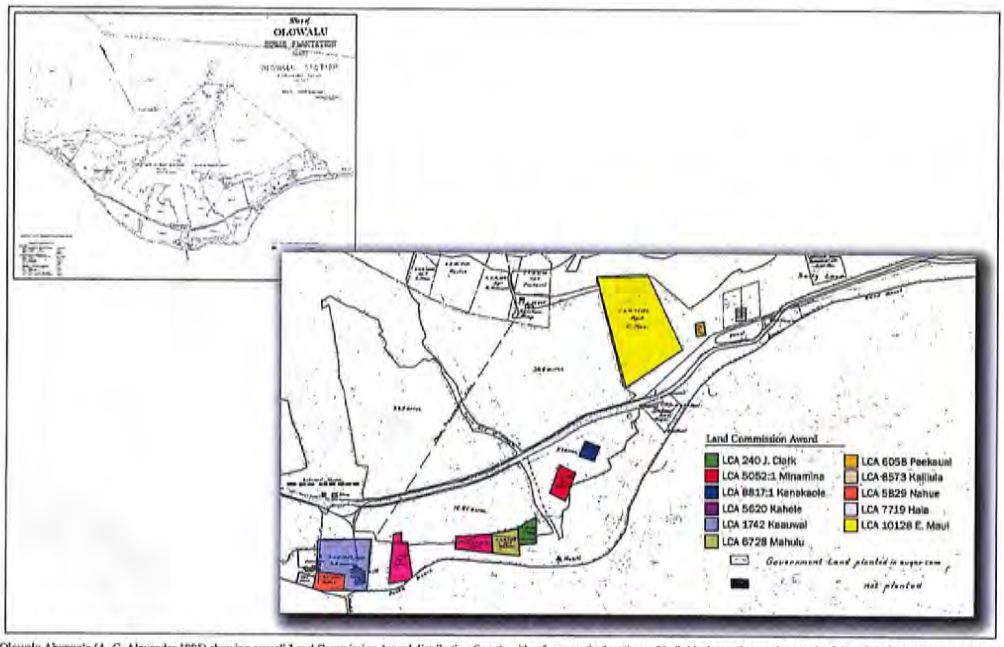

Figure 14. Map of Olowalu Ahupua'a (A. C. Alexander 1906) showing overall Land Commission Award distribution (inset), with a focus on the locations of individual awards near the mouth of the original stream route and southeastern coastline (focus frame).

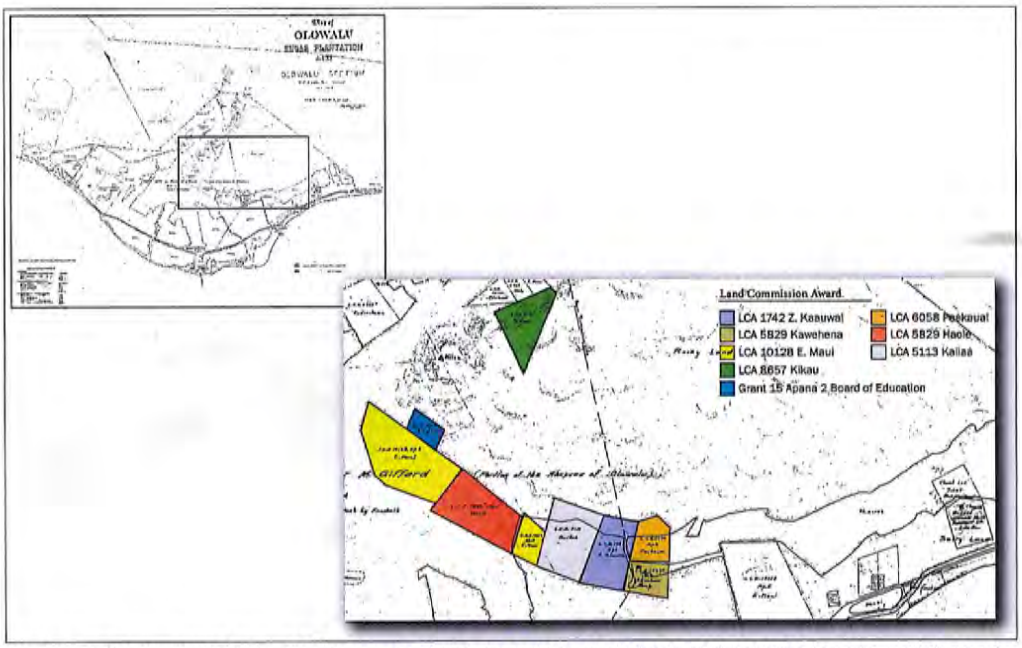

Figure 15. Map of Olowalu Ahupua'a (A. C. Alexander 1906) showing overall Land Commission Award distribution (inset), with a focus on the locations of individual awards following the original stream route (focus frame)[4].

[4] LCA 5829 letter designations reduced

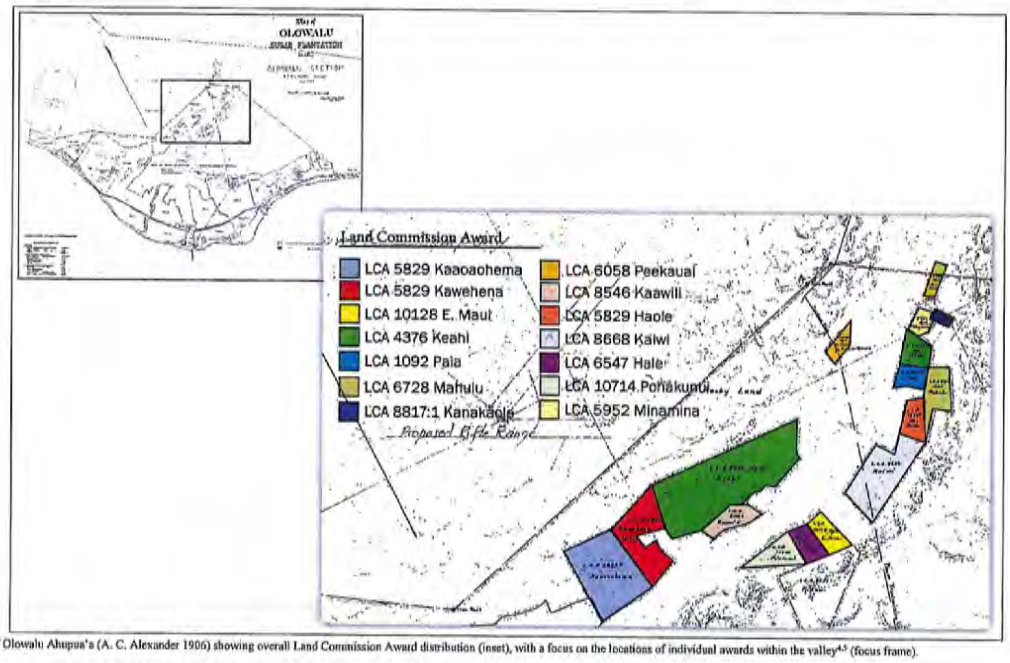

Figure 16. Map of Olowalu Ahupua'a (A. C. Alexander 1906) showing overall Land Commission Award distribution (inset), with a focus on the locations of individual awards within the valley[4,5] (focus frame).

[5] Unlocated LCAs: 5207B to Kalaipahoie (Taroland in valley – 0.89 acres); 10123:1 to E. Maui (Kula land in valley – 1.25 acres); 5620:2 and 3 to Kahale (Taro land in valley – Apana 2: 0.53 acres; Apana 3: 0.62 acres)

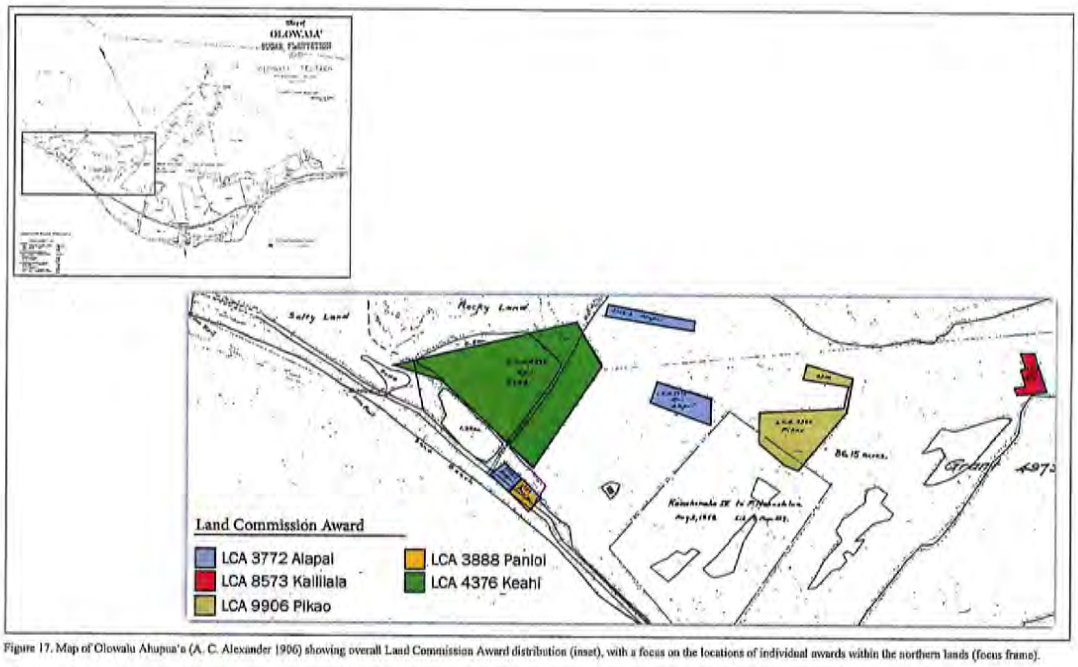

Figure 17. Map of Olowalu Ahupua'a (A. C. Alexander 1906) showing overall Land Commission Award distribution (inset), with a focus on the locations of individual awards within the northern lands (focus frame).

3.1.5 Development of the Sugar Industry in Olowalu Ahupua'a (Mid-1800 to Mid-1900s)

The Lāhainā area was the location of some of the earliest sugarcane ventures in Hawai'i. The earliest reference to sugar grown in the Lāhainā area is credited to G. W. Wilfong who was the manager of the Hana Plantation in 1851. During his first tour of the island in 1849, Wilfong made note of the various sugar enterprises that had been established on Maui, and described the early sugar operations in Lāhainā. He noted that cane trash was an inefficient fuel for the boiling down of the juice extract into syrup, and that a large supply of indigo (*Indigofera suffruticosa*) was cut down for firewood in Lāhainā. "The area cleared by this means was subsequently used for the first planting of a supply of seed brought by Captain Edwards, of the whale ship George Washington. This cane was called Lahaina" (Wilfong 1882).

Captain Pardon Edwards had brought samples of a Tahitian and Cuban variety of sugarcane to Hawaii in 1854, both of which flourished in the Hawaiian growing environment. The Tahitian variety, however, excelled, and was named "Lāhainā" (Dorrance and Morgan 2000). The first Lāhainā mill was operated by Judge A.W. Parsons in 1849. This mill plus 1000 acres of land was subsequently auctioned to O.H. Gulick. The Lāhainā Sugar Company was established in 1859, under the direction of Henry Dickenson (Wong-Smith in Graves and Goodfellow 1991:A6). The primary sugarcane enterprises developed during the mid to late 1800's along the alluvial plains of the West Maui Mountains were the Olowalu Sugar Company and Pioneer Mill Company.

Seeking to capitalize on the sugar industry, King Kamehameha V (Lot Kamehameha) leased the Crown Lands of Olowalu and Ukumehame in 1871 to a new venture identified as the West Maui Sugar Association. One of 32 plantations that existed in Hawai'i and one of 12 on Maui listed in an 1872 report, this sugar venture produced an average yearly crop of 600 tons, though its mill had a capacity was double that at 1,200 tons. By comparison, Pioneer Mill produced an average of 1,000 tons for its 1,200-ton capacity mill. While there appears to have been room for an increase in volume, both plantations were hindered by lack of labor to reach the maximum capacity (Ainsworth 2011).

Because owners of the West Maui Sugar Association needed to concentrate on the difficult task of growing sugar, they turned to an agent, or factor, to handle the sale and shipping of their product. C. Brewer & Co. acted as agent for the yearly crop in the 1870s and, unfortunately, the sugar industry slumped during this time. The Olowalu venture, struggling to survive, received a major blow when Lot Kamehameha died in 1872. Two years later, the West Maui Sugar Association sold both its plantation and mill in 1874 to James C. Campbell and Henry Turton, owners of what was by then called the Pioneer Mill Plantation, for $38,000. (Ainsworth 2011)

When the sugar industry rebounded, as a result of a reciprocity treaty with the United States that went into effect in 1876, and in anticipation of a boom in sugar, Milton Philip, a Lāhainā businessman, started to acquire leases in both Olowalu and Ukumehame in 1875. Another Maui resident, Goodale Armstrong, also acquired Olowalu property and together they formed what they called the Olowalu Plantation (Ainsworth 2011). The crown lands within the Olowalu section, approximately 6,025 acres was leased to the Olowalu Sugar Company at $800 per year with a lease contract dated October 5, 1875 that was set to expire on July 1, 1908 (Governer of the Territory of Hawaii 1904:52). The Ukumehame section consisted of approximately 11,000 acres of land originally leased to C.Brewer & Co. in a contract dated March 1, 1892 that was set to expire on November 1, 1906 for $250 per year (Governer of the Territory of Hawaii 1904:53).

3.1.5.1 The Olowalu Company

Utilizing former crown and *kuleana* lands, Phillip and Armstrong started growing sugar in 1876 (Ainsworth 2011) and began formally organizing the Olowalu Company in 1881. In 1884, the firm of William G. Irwin & Co. took over as sugar agent for the Olowalu Company and William G. Irwin, president of the company, became the majority stockholder (Ainsworth 2011). The history of the Olowalu Company included the construction of a mill and wharf at Olowalu prior to 1884 (Wright 1974a), which in addition to processing cane harvested from the fields of Olowalu and Ukumehame (Table 2), the mill was also contracted to process cane harvested by Maunalei Sugar Company, a Lāna'i Island enterprise. Cane harvested by the Maunalei Sugar Company in Keōmuku was shipped from Halepalaoa Landing to be processed at Olowalu beginning with the 1899 crop. Processing of the Lāna'i cane continued until 1901 when the Maunalei Sugar Company ceased operations (Conde and Best 1973:206).

Table 2. Sugar Crop figures for the Olowalu Plantation are listed as follows for the years leading up to Annexation with the United States (listed as tons) (Based on Figures reported in The Louisiana Planter And Sugar Manufacturer Weekly for the years indicated).

1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
760	859	702	937	905	1,163	1,112	1,425	1,502	1,480

In July 1906, all of the lands leased by the Olowalu Sugar Company was purchased at public auction from the Territory of Hawai'i for $37,750 by Walter M. Giffard, vice-president and corporation manager for Olowalu Company and recorded as Land Grant (LG) Number 4973 (Waihona 'Aina 2002) (Appendix B). With regard to Olowalu Ahupua'a, the total area purchased in fee simple consisted of approximately 684.7 acres exclusive of the L.C.A.s, School Lots and land sold by Kamehameha IV to Kahā'ulelio (Liber 87) (see also Appendix B). In 1908, it appears that the William G. Irwin & Co. exchanged lands with the Department of Public Instruction whereby the department gave Olowalu Company two School Lots at Ukumehame and Olowalu in exchange for a new school lot at Olowalu *makai* of the government road (Figure 18).

The lands of the Olowalu Company lie on the lee side of the West Maui Mountains, where the rainfall is low, but the streams behind the plantation reach back to the crest of the mountains and are primarily fed by trade-wind rainfall. Heavy "kona" rains augmented the water supply during years of low trade-wind rainfall. It is estimated that the first well drilled at Olowalu for the plantation was sunk in 1905 (Well 11), and conisisted of a single shaft with 670 feet of lateral tunnels designed to skim 3 million gallons of fresh irrigation water per day (mgd) from sources beneath the Olowalu plains. This well was drilled vertically approximately 20 feet through the Wailuku basalts, at an elevation of 20 feet (Stearns and MacDonald 1942:216). In around 1908, an additional well was drilled at Ukumehame at an altitude of 6 ft. which consisted of a 5 ft. deep pit with a 6-inch drilled well that extended for 12 feet and was equipped with a pump that had a capacity of 1 ¼ mgd (Stearns and MacDonald 1942:217).

Following the development of the water system, field production increased and by 1930 sugar yields rose from 1,480 tons to 2,966 tons (Haneberg 1931:1), improvements in sugar yields notwithstanding, Olowalu Company would continue to have difficulties and in May of 1931, the neighboring sugar company at Lāhainā, Pioneer Mill Company, purchased the assets of the Olowalu Sugar Company. On December 31, 1931, the company was dis-incorporated and placed within the holdings of Pioneer Mill Company (Burns 1932:15). The following year, according to the records of the Pioneer Mill Company, the mill at Olowalu was dismantled and shipped to the Philippine Islands (Gilmore 1936:198).

3.1.5.1.1 Railway Operations

The first reference regarding the use of a railroad at Olowalu Plantation to transport cane to the mill was found in the *Planter's Monthly* for April, 1882. The use of a "Fowler Railroad Plant" at the Olowalu plantation was considered by historian Jesse "Jay" Conde to mean that the track had been installed, and the cane cars in operation utilized "mule power" until the enterprise could afford to order a locomotive (Conde and Best 1973). By November of 1882, according to the *Hawaiian Gazette*, the Olowalu railroad had completed the two-mile section of track to Ukumehame, for a total of three miles of fixed track.

The order for a Baldwin locomotive named "Olowalu" was placed late in 1889 by the firm of W.G. Irwin. The two-foot gauge plantation engine arrived on Maui just after the turn of the century. By September of 1905, a second locomotive was ordered from the Baldwin Locomotive Works, for a new boiler ("B") version of the same type of 2-foot gauge locomotive; also to be named "Olowalu". By 1918, new steel rails were being installed to replace the existing layout.). The 2-foot gauge track for the Olowalu Plantation Company railroad was built to the same specifications as the railway linking the HC&S mill at Spreckelsville to its fields; and to the sugar warehouses at the Kahului Harbor. The uses of the railroad at Olowalu had made it possible to harvest and transport over six thousand tons of sugar in a single year (Gilmore 1936)

3.1.5.2 Pioneer Mill Company (PMCo)

The Pioneer Mill Company (PMCo) was established as a partnership in 1862, between James Campbell, Henry Turton, and Benjamin Pittman. The first Pioneer Mill plantation lands were deeded to the partners by Benjamin Pittman for the price of $30,000 (Conde and Best 1973:252). How Pittman obtained such a sizable piece of land is unknown, however, one may posit that the first Pioneer Mill lands were in Launiupoko Ahupua'a which was acquired by Thomas Phillips in 1840 (Wong-Smith in Graves 1991:A6).

Using gravity flow water from mountain streams, PMCo produced 500 tons of sugar in 1866. Production reached 1,000 tons annually by 1872, and the viability of the enterprise was assured when H. Hackfield was appointed sugar factor in 1877. By the turn of the century, the Pioneer Mill Company was producing over 10,000 tons of sugar a year (Thrum 1901).

In 1877, the PMCo plantation holdings were evaluated as being worth $500,000 (Wong Smith in Graves and Goodfellow 1991:A6-A7). Henry Turton is credited during the early 1880's with planning construction of the first railway in Lāhainā to facilitate cane hauling from the cane fields in Kā'anapali to the Lāhainā-based mill. The Pioneer Mill was incorporated in 1885 and sold to H. Hackfield & Company, the predecessor of Amfac, Inc. (Wong Smith in Graves and Goodfellow 1991:A9). In order to maintain production and the successful growing of sugar cane along the west coast of Maui further development of water resources was required.

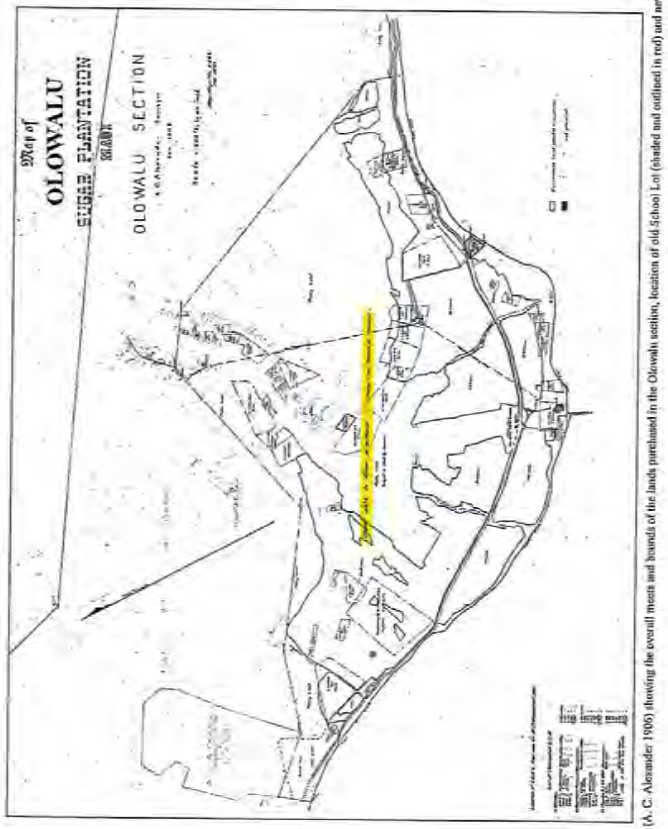

Figure 18. Map of Olowalu Ahupua'a (A. C. Alexander 1906) showing the overall metes and bounds of the lands purchased in the Olowalu section, location of old School Lot (shaded and outlined in red) and new School Lot (shaded and outlined in blue).

To this end, Pioneer Mill installed a simple galvanized iron flume in the Honokowai Stream in 1898, but the mechanism by which arid coastal lands could receive mountain waters was not to be perfected on Maui's western coastline until the building of the Honokohau Ditch in 1904. With the construction of Honokohau Ditch, PMCo was able to reach back into the mountain valleys and obtain water in a system developed by the Honolua Ranch, effectively delivering about 20 million gallons per day to the Pioneer Mill fields. This main ditch was augmented over the years with seven additional ditches.

General reorganization of the Pioneer Mill Company began around the turn of the 20th century. A prospectus for change describes assets of the four main cane fields composing the company at that time (Conde and Best 1973:253):

> Lāhainā - 1,000 acres of land on the flat and outside of small kuleanas, (land areas claimed by the Hawaiians under Royal grants), the land is fee simple (could be deeded).
>
> Launiupoko - 2,900 acres of fee simple land, lying between Lāhainā and Olowalu.
>
> Wahikuli - A tract of government land of 5,000 acres, under lease for eighteen years, lies between Lāhainā and Kaanapali.
>
> Kaanapali - Some 3,600 acres at various levels, fee simple land, beyond Wahikuli.

An immediate result of the reorganization was the construction of "twenty miles" of new railroad, replacing old lines and extending the entire length of the plantation, with branches emanating *mauka* into the upper elevations of the cane fields (Conde and Best 1973:253). By the late 1920's, PMCo developed a complex of irrigation systems which included flumes to transport cane to railroad "car loading stations" (Conde and Best 1973:254). As suggested by archaeological evidence and respective field maps, PMCo may have developed irrigation canals and flumes at an earlier time in Launiupoko where the examination of an un-labeled Pioneer Mill map (possibly titled: *Canefield Map - 1918 MC-10 to 33*) differentiates the irrigation canal and flume as the "new flume" and "old flume, respectively. Thus, suggesting that both structures are not contemporaneous in origin.

In May of 1931 the Pioneer Mill Company expanded their cane enterprise as far as Ukumehame to the east through the purchase of Olowalu Sugar Company, an expansion that was expected to bring an addition 3,000 tons of sugar per year (Pioneer Mill Company 1932:15). Following the acquisition of the Olowalu Sugar Company, Pioneer Mill Company invested in improvements to the two small and relatively crude water systems. In 1933, the first inclined shaft in the Territory of Hawaii was drilled at Olowalu (Well 10) under the direction of C.A. Brown which resulted in a yield of 5.25 mgd (Stearns and MacDonald 1942:192, 216). The following year, Well 12 was drilled at Ukumehame to replace the 1908 well. This well consisted of a 30° incline shaft with a yield of 4.75 mgd (Stearns and MacDonald 1942:216, 217).

During this same period, less lucrative cane fields, specifically in upper Launiupoko, were abandoned for the most part due to labor shortages "imposed by World War II" (Graves and Goodfellow 1991:5). At around this time, During the 1930's the Pioneer Mill Company also began cattle ranching in the abandoned cane fields of Launiupoko. According to Herbert Kinores, Pioneer Mill Company ranch foreman, ranching infrastructure including walls, fences, and wooden and stone-walled corrals were constructed in the Launiupoko region above the cultivated cane fields (Graves and Goodfellow 1991:7).

A dramatic technological change to cane production of the Pioneer Mill occurred in 1946 when it became more economical to use trucks to transport the harvested cane instead of railroad carts. As reported in a Pioneer Mill Co. annual, the year of 1953 marked the final elimination of railroad use in the Pioneer Mill Company (in Conde and Best 1973:255). Changes in the operation, as a result of an exhaustive study by the combined staffs of Pioneer Mill Company, and American Factors, Ltd., Plantation Division, resulted in the elimination of the railroad system altogether. All sugarcane would be hauled by trucks, with the ability to haul 45-65 tons per load, on a shift basis.

3.1.6 Late 1900s to Modern Era

In the late 1900s and toward the end of the Sugar Era in Lāhainā, small scattered residential lots were present within the current project area along the shoreline at Olowalu and in the upper reaches of the valley. These isolated house lots are referred to as *kuleana* (Kimo Falconer, in Robins et al. 1994) and likely represent original boundaries of land claims made during the Māhele.

The intensive sugarcane agriculture under the direction of Pioneer Mill continued operations from Ukumehame to Launiupoko until 1998. With the final harvest and closure of Pioneer Mill in 1999 (Kubota 1999) lands that were formerly cultivated in sugarcane were either left fallow, in pasturage, or have been subdivided out of larger landholdings for development of agricultural estates. During the 1970s Maui Electric installed a power line between Mā'alaea and the town of Lāhainā. The existing line stretches over elevations of between roughly 600 and 2600 feet above mean sea level. A *pu'u*, commonly referred to as "Cut Mountain", is located between Olowalu and Launiupoko that was once used as a quarry or "borrow pit". Immediately west of the *pu'u* is an old landfill site.

3.2 Previous Archaeological Research within Olowalu Ahupua'a

In 1916, John F. Stokes of the Bishop Museum performed the first systematic reconnaissance of monumental, pre-contact architecture as a part of an archaeological reconnaissance of *heiau* on Maui Island. At Olowalu, Stokes recorded Kaiwaloa Heiau with the following notation:

> ... on a hill near power line. Large, walled heiau in fair condition. Many graves inside. (Stokes 1916:5)

Between 1928 and 1929 Winslow Walker, also of the Bishop Museum, conducted an island-wide systematic archaeological survey that built upon the initial work carried out by Stokes. Like Stokes, the primary focus of the Walker Survey, was on the identification of monumental architecture and ceremonial structures in the form of *heiau* (temples) and *ko'a* (shrines). At Olowalu Walker re-identified Kaiwaloa Heiau and recorded a smaller unnamed *heiau* below the ditch. The following descriptive information from Walker's survey (1931) for both *heiau*, with a notable variation in the spelling of the name from Kaiwaloa (Stokes 1916:5) to Kawaialoa (Walker 1931:108) and Kawailoa (Walker 1931:109 map illustration), is offered below:

Table 3. Walker Sites within Olowalu Ahupua'a, adapted from Walker (1931)

Walker Site	Name	Location	Description
4	Kawaialoa Heiau Kawailoa Heiau	On the rising ground south of Kilea Hill above the ditch	Measures approximately 156' by 110'. The walls range in thickness from 8 ½ feet on the west to 12 feet on the south and east where it is composed of two terraces. The highest part is 10 feet high. The north wall is lower and

Walker Site	Name	Location	Description
			ranges from 5 to 6 feet thick. Several low terraces and enclosures are found inside. The low platforms in the western part are probably graves of recent date. The entrance evidently was the north. At a point on the west wall and at two points on the south wall are piles of stones cone-shaped whose use or purpose could not be determined. Rough red vesicular basalt is the material used in the heiau construction and no coral is found. Nor artifacts were found there.
5	Unknown	In the cane lands below the ditch	Measures 40 x 60 feet but all interior structures have been destroyed.

While Walker was primarily concerned with the identification of ceremonial sites, he made survey notations of house and village sites within the regions that he visited. At Olowalu, Walker corroborated the later observation of Handy and Handy (1991) regarding the prominence of *lo'i* agriculture and permanent habitation within Olowalu Ahupua'a by noting that:

> Terraces for the cultivation of taro were seen on West Maui in the vicinity of ... Lāhainā, Olowalu, and Ukumehame (Walker 1931:71).
>
> Above Mrs. Naho'oikaika's house are evidences of old taro patches and house sites. The site of the ancient ditch bringing down water from Olowalu Gulch is now used for the modern ditch supplying the cane fields. At the edge of a house platform measuring 15 x 28 feet, is a large flat stone of red basalt used as a *papamu* for the game of *konane*. It has 9 rows of holes ½ inch deep, and 12-15 holes in a row (Walker 1931:77).

In 1973 the Department of Land and Natural Resources, State Parks Division conducted a similar island-wide archaeological survey, as a follow-up to Winslow Walker's study. As a result of the 1973 survey, Kaiwaloa/Kawaialoa Heiau was thoroughly documented and the site was given State Inventory of Historic Property (SIHP) number 50-50-08-00004 (Connolly 1973a) (Appendix C). While an attempt to re-identify Walker Site 5 (50-50-08-00005) was made at this time, it was determined that the *heiau* was destroyed by sugar cane cultivation (Hawai'i Department of Land and Natural Resources State Historic Preservation Division 1974). Other historic properties that were identified during the State sponsored survey included the Olowalu Petroglyph Complex (50-50-08-01200 and -01201) (Connolly 1973b), features associated with the Olowalu Mill District (50-50-08-01602) (Wright 1974a), and the Olowalu Stone Church at Mōpua (50-50-08-01603) (Wright 1974b) (Appendix C).

Robins and others (1994) conducted an archaeological inventory survey of a power transmission line from Ma'alaea to Lāhainā within the upper reaches of the current project area. During the survey 34 sites and site complexes were identified throughout their project corridor. The archaeological sites that were identified consisted of a wide range of formal pre-contact site types that included agricultural features characteristic of intensive non-irrigated agriculture, temporary and permanent habitation sites, major *heiau* and shrine sites, a travel route, a marker site, possible human burials, historic ranching walls, in addition to, irrigation canals, flumes and a possible railroad bed associated with large-scale, historic sugarcane cultivation. The traditional Hawaiian sites that were identified during the survey, however, were clustered in the Ukumehame and Launiupoko valley regions, with more isolated pre-contact historic properties located near

Kaua'ula Stream and in the upland alluvial plains of Ukumehame Ahupua'a. Within Olowalu Ahupua'a, two historic properties (50-50-08-03172 and -03180) primarily associated with the historic sugar industry were identified adjacent to the Olowalu Stream (Robins et al. 1994:37 and 83). The scarcity of traditional Hawaiian sites within the project corridor as it crossed the Olowalu valley area was attributed to the destructive nature of large-scale cane agriculture that encompassed nearly all of Olowalu lands within the project corridor (Robins et al. 1994:99).

Two separate studies, specific to the current project area, were conducted by Xamanek Researches along a section *makai* of Honoapi'ilani Highway (approximately 73-acres) (D. L. Fredericksen and Fredericksen 2000a) and a section *mauka* of Honoapi'ilani Highway (approximately 662-acres) (D. L. Fredericksen and Fredericksen 2000b) for an overall 735-acre project area. Both sections of the project area were covered by cultivated sugarcane lands at the time of the archaeological inventory survey. Seven historic properties consisting of pre-contact and early post-contact traditional Hawaiian habitation and burial sites, as well as, historic era features associated with commercial sugar cane cultivation and government infrastructure were identified within the *makai* section of the *makai* section of the current project area (D. L. Fredericksen and Fredericksen 2000a) (SHPD LOG NO: 24957; DOC. NO: 000RC39). Six of these historic properties were newly identified (50-50-08-4693 through -4698 and -4822) while one, the Olowalu Mill District (50-50-08-01602), was previously recorded during the State of Hawaii sponsored inventory survey (see Section 3.2.1 Table 4 for summary historic property information).

A total of 31 sites, both pre-contact and historic, were identified within the *mauka* portion of the current project area (D. L. Fredericksen and Fredericksen 2000b) (SHPD: LOG NO: 25237; DOC. NO: 0004RC1O). Three historic properties were previously identified and recorded (50-50-08-00004, -01200, -01201 and -01603) while 27 were newly identified (50-50-08-04699 through -04721, -04758, and -04820 through -04823) (see Section 3.2.1 Table 4 for summary historic property information). Pre-contact sites recorded in the *mauka* section include habitation sites (walls, enclosures, and rock shelters), ceremonial and religious sites (*heiau* and burials), and agricultural sites (terraces and modified outcrops); as well as, rock art features. Historic era properties identified within the *mauka* study were associated with the sugar industry and subsequent historic era settlement of the area. These features include the remnants of a church, a cemetery, and sites related to historic agriculture. Radio carbon dates from four rock shelters and a permanent habitation site (D. L. Fredericksen and Fredericksen 2000b:66) indicates that settlement of Olowalu Ahupua'a was chronologically established during the middle of the time period that Kirch (1985:Figure 239) identifies as the "Expansion Period" (A.D. 1100-1650). Throughout this 550-year time span, the Hawaiian population expanded to several hundred thousand; economic production intensified through the development of large irrigation works and dry land field systems as well as aquaculture methods and new fishing technology; and social and political organization became highly stratified (Kirch 1985:303-306).

Archaeological monitoring for the installation of a septic tank within an approximate 1.3 acre project area along the coastal boundary of the current project area was carried out by Xamanek Researches (E. M. Fredericksen 2003). While no significant historic properties were identified within a subsurface context, the excavation did encounter coastal sand deposits. As sensitive historic properties are often found in these types of environments, continued archaeological monitoring within adjacent areas was recommended and approved (SHPD LOG NO: 2003.0954; DOC. NO: 0306MK31).

An archaeological field inspection of a residential parcel (TMK [2] 4-8-004:010) within the current project area was carried out by CRM Solutions Hawai'i (Conte 2007) (SHPD LOG NO: 2008.0957; DOC. NO: 0802TD16). The field inspection resulted in no new or previously recorded historic properties being identified. It was further noted that the property had been previously grubbed and graded on several occasions and, due to proposed method of dwelling construction (post and pier over imported fill), no further archaeological work was recommended.

Finally, following the large brush fires of 2007, Scientific Consultant Services was contracted by the current project applicant to conduct a field inspection of approximately 500-acres that had been cleared by fire (Shefcheck and Dega 2007). One new historic property, consisting of agricultural terraces, was identified during the course of the field inspection. Due to the horizontal proximity and morphological similarities of these terraces to Feature B of previously recorded SIHP 50-50-08-04708, the newly identified historic property was designated as Feature C of Site -04708. Additionally, two historic properties (SIHP 50-50-08-04758 and -01200) were noted as adversely impacted by the fire. Several headstones of Site -04758, historic Awalua Cemetery, had cracked and spalled as a result of the heat of the fire. Similarly, thermal damage was also noted at Site -01200, the Olowalu Petroglyph Complex, where smoke damage and spalling of some of the petroglyph panels were noted.

3.2.1 Historic Properties Identified within the Current Project Area

A total of 41 historic properties, some consisting of multiple features, were identified and recorded during previous archaeological studies within the current project area (Connolly 1973a; D. L. Fredericksen and Fredericksen 2000a, b; Robins et al. 1994; Shefcheck and Dega 2007; Stokes 1916; Walker 1931). The following section provides a summary of all known historic properties that have been identified along with recommended significance evaluations by the recording archaeologists (Table 4 and Figure 19).

The State Department of Land and Natural Resources (DLNR) Chapter 13-284, Hawai'i Administrative Rules (HAR), entitled "Rules Governing Procedures for Historic Preservation Review to Comment on Section 6E-42, Hawai'i Revised Statutes (HRS), Projects," Chapter 13-284-6, entitled "Evaluation of Significance", states that once a historic property is identified, an assessment of significance shall occur (Department of Land and Natural Resources 2002:12). To be significant, a historic property shall possess integrity of location, design, setting, materials, workmanship, feeling, and association and shall meet one or more of the following criteria (Department of Land and Natural Resources 2002:12- 13):

1. Criterion "a". Be associated with events that have made a significant contribution to broad patterns of our history;
2. Criterion "b". Be associated with the lives of persons significant in our past;
3. Criterion "c". Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possesses high artistic values;
4. Criterion "d". Have yielded, or is likely to yield, information important for research on prehistory or history; or
5. Criterion "e". Have an important value to the native Hawaiian people or to another ethnic group of the State due to associations with cultural practices once carried out, or still carried

out, at the property or due to associations with traditional beliefs, events, or oral accounts-these associations being important to the groups' history and cultural identity.

Table 4. Summary of Historic Properties Identified and Recorded within the Current Project Area (SIHP Prefix 50-50-80-), see also Figure 19

SIHP No	Formal Type	Probable Function	Age[6]	Significance	Brief Description
00004[7 8 9]	Heiau (Kaiwaloa/Kawaialoa Heiau)	Ceremonial	P	C,D,E	Site consists of "...[L]arge walled heiau...156 x 110 feet..." interior features include: "... terraces and enclosures...graves...piles of stones cone-shaped
01200[10]	Olowalu Petroglyph Complex	Rock Art	P	C,D,E	Petroglyph panels (2): Area 1 = minimum of 37 petroglyphs, Area 2 = minimum of 31 petroglyphs. Some are badly vandalized; Shefcheck and Dega (2007) noted fire damage.
01201[11]	Rock Shelter	Temporary Habitation	P	D	Rock shelter associated with Area 1 of SIHP -01200
01602[12 13]	Olowalu Mill District	Habitation/Mill/ Wharf	H	A,D	Historic District: structures, sugar mill, wharf, manager's house.
01603[14]	Lanakila Hawaiian Protestant Church	Church/Cemetery	H	D,E	Historic church and graveyard.

[6]P=Pre-contact; H=Historic; U=Undetermined (used where the archaeological report indicated a "?" in age determination)

[7] **Stokes, John F. G.**

1916 Maui Heiau. December 1916. (typeset notes). Unpublished Bernice Pauahi Bishop Museum, Honolulu, HI.

[8] **Walker, Winslow M.**

1931 Archaeology of Maui. Manuscript. Bernice Pauahi Bishop Museum. Honolulu, HI.

[9] **Connolly, Robert D. III**

1973a *50-50-08-00004 Kawaialoa Heiau*. Hawai'i Department of Land and Natural Resources State Historic Preservation Division, Kapolei, HI.

[10] 1973b *50-50-08-01200 Olowalu Petroglyphs*. Hawai'i Department of Land and Natural Resources State Historic Preservation Division, Kapolei, HI.

[11] **Fredericksen, Demaris L. and Erik M. Fredericksen**

2000b *Archaeological Inventory Survey of Mauka Portion of Olowalu Development Parcel Phase 2, Olowalu Ahupua'a, Lahaina District, Maui Island (TMK 4-8-3:10)*. Prepared for Olowalu Elua Associates, Kahului, Maui. Xamanek Researches, Pukalani, HI.

[12] **Wright, J.C.**

1974a *50-50-08-01602 Olowalu Mill District*. Hawai'i Department of Land and Natural Resources State Historic Preservation Division, Kapolei, HI.

[13] **Fredericksen, Demaris L. and Erik M. Fredericksen**

2000a *Archaeological Inventory Survey of Makai Portion (Phase 1) of Olowalu Development Parcel, Olowalu Ahupua'a, Lahaina District, Maui Island (TMK 4-8-3:por.5)*. Prepared for Olowalu Elua Associates, Kahului, HI. Xamanek Researches, Pukalani, HI.

[14] **Wright, J.C.**

SIHP No	Formal Type	Probable Function	Age[6]	Significance	Brief Description
03172[15 11]	Concrete Irrigation Ditch	Agriculture	H	D	Site consists of a historic irrigation ditch constructed of cement and boulders.
03180[15 11]	Historic Cattle Wall	Ranching	H	D	Site consists of a wall located on west side of Olowalu Stream; 234 x .85 x 1.45m; an alternative interpretation of function was as an *ahupua'a* boundary wall.
04693[13]	Burial Complex	Burial	P	D,E	Site consists of 6 *in situ* burials ranging from .05 to .80-.85cmbs; burials 1 thru 5 were articulated, burial 6 interpreted as scattered
04694[13]	L-Shape	Habitation	P	D	Site consists of an L-shape wall, 10m long (E/W) and 9.5m long (N/S) x 1.2 m wide x 0.3-0.6m high; located on Hekili Point.
04695[13]	Wall/terrace	Erosion Control	H	D	Site consists of retaining wall segment, 10 x 4.5 x 1.1m
04696[13]	Old Government Road	Transportation	H	D	Site consists of an old road segment that follows a traditional trail, 100m long x 15m wide;; located 15-18m northeast of SIHP -4695.
04697[13]	Subsurface Cultural Deposit	Habitation	U	D	Site consists of a possible historic dog burial, possibly associated with nearby kuleana house lots; and a subsurface cultural deposit, 6 x 3-4 x .12m deep.
04698[13]	Subsurface Cultural Deposit	Habitation	P	D	Site consists of subsurface cultural deposit, 35 x 50m (depth and thickness not provided).
04699[11]	Habitation Complex	Habitation/Burial/ Possible Boundary	U	D,E	Habitation Complex located along S-SE side of ridge: 8 rock shelters (Features A-H) with one containing a probable burials (Feature D); and a modified outcrop (Feature I), 12.6 x 0.8 x 0.75m; overall site complex dimensions = 155 x 30m.
04700[11]	Habitation Complex	Habitation/Undetermined	P	D	Habitation Complex: 7 rock shelters: (Features A and C-I); one C-shape (Feature B), 1.7 x 2 x 0.5m; and a wall segment (Feature J), 2.3 x 0.8 x 0.7m; overall site complex dimensions = 55 x 40m.

1974b *50-50-08-01603 Olowalu Stone Church Ruins*. Hawai'i Department of Land and Natural Resources State Historic Preservation Division, Kapolei, HI.

[15] **Robins, Jennifer J, William H. Folk and Hallett H. Hammatt**

1994 *An Archaeological Inventory Survey of an Approximately 14.7 Mile Proposed Transmission Line, from Ma'alaea to Lahaina, Maui, Hawai'i*. Prepared for Dames & Moore. Cultural Surveys Hawai'i Inc., Kailua, HI.

SIHP No	Formal Type	Probable Function	Age[6]	Significance	Brief Description
04701[11]	Possible Ko'a	Ceremonial	P	D,E	Site consists of a platform, 15 x 11 x 0.3m and paved area; overall site area = 33 x 27m.
04702[11]	L-Shape	Boundary	H	D	Site consists of L-shape wall, 47 x .75 x 1.2m; 6 x 0.75 x 1.2m and an inactive historic concreted ditch.
04703[11]	Complex	Boundary	U	D	Site complex consisting of features of an indeterminate age: enclosure/alignment/uprights (Feature A), 4 x 3 x 0.7m; wall remnant (Feature B), 5.5 x 0.65 x 0.65m; alignment (Feature C), 3 x 1 x .6m; overall site complex dimensions = 30 x 8m.
04704[11]	Habitation Complex w/Petroglyphs	Habitation	P	C,D,E	Habitation Complex: 27 individual petroglyphs (Feature A), 14 x 3.6m; terraces (Features B-G), 8.5 x 4 x 0.75m to 2.3 x 2.4 x .8m; overall site complex dimension = 61 x 23m.
04705[11]	Rock Shelters	Temporary Habitation	P	D	Site consists of 2 rock shelters: Feature A, 4.5 x 1.75 x 2m; Feature B, 2.5 x 1.3 x .9m.
04706[11]	Rock Shelter	Temporary Habitation	P	D	Rock shelter: 4.25 x 2.25 x 1.25m; located on west side of Olowalu Stream.
04707[11]	Wall and Mound	Marker/ Burial	U	D,E	Two features: wall or alignment (Feature A), 77 x 3.5 x .8m high; and a rock mound (Feature B), 5 x 2.7 x .85m; overall site dimensions = 77 x 5.5m.
04708[11 16]	Platform and Terrace Complex	Agriculture/ Ceremonial	P	D,E	Agricultural Complex: terrace/platform (Feature A), 19 x 8 x 2.6m; terrace complex (Feature B), 40 x 22m; terrace complex (Feature C[16]); overall site complex dimensions = 62 x 23m.
04709[11]	Historic Hydro-Electric Plant	Historic Agriculture	H	C,D	Site consists of foundation that formerly supported a hydro-electric plant measuring 29 x 23m.
04710[11]	Habitation Complex	Agriculture/Burial	P	D,E	Habitation Complex: terrace w/ enclosure (L-shape alignment) (Feature A), 14.5 x 9 x .9m; four terraces (Features B and F-G); two enclosures

[16] **Shefcheck, Donna and Michael F. Dega**
2007 *Letter Report: Field Inspection of Previously Identified Sites within a Burned Area (Approximately 500-acres of a Total 660 Acres) in Olowalu Ahupua'a, Lahaina District, Island of Maui [TMK: 4-8-3:10 por.].* Prepared for Olowalu Town, LLC, Wailuku, HI. Scientific Consultant Services, Inc., Honolulu, HI.

SIHP No	Formal Type	Probable Function	Age[6]	Significance	Brief Description
					(Features C and D); and an oval alignment indicating a possible burial (Feature E), 2.1 x 1.5 x 0.3m
04711[11]	Alignment and Terrace	Agriculture	P	D	Site consists of 2 features: alignment (Feature A), 5.5 x 2 x 0.6m; and a terrace (Feature B), 3.2 x 3.5 x 0.5m; overall site dimension = 16 x 6m.
04712[11]	Terrace and Mound	Agriculture/Burial	P	D,E	Site consists of 2 features: terrace and rock pile (Feature A), 14 x 3 x 1.3m; modified outcrop (Feature B), 1.8 x 0.8 x 0.6m; overall site dimensions = 30 x 6m.
04713[11]	Rock Shelter	Temporary Habitation	P	D	Site consists of rock shelter, 6 x 3.5 x 2.4m; located on east slope of Pu'u Kilea.
04714[11]	Rock Shelter	Temporary Habitation	P	D	Site consists of rock shelter, 2 x 2.4 x 0.7m; located on northwest side of Pu'u Kilea.
04715[11]	Cemetery	Burial	P/H	D,E	Site consists of cemetery containing minimum of 33 graves; located on the summit of Pu'u Kilea; overall site dimensions = 38 x 20m.
04716[11]	Terrace and Wall	Boundary/Habitation	P	D	Site consists of 2 features: terrace/platform (Feature A), 5 x 3.5 x 2.3m; wall (Feature B), 22 x 1 x 1m.
04717[11]	Retaining Walls	Historic Agriculture	H	D	Site consists of 5 retaining wall segments: Feature A, 15 x 4 x 2.6m; Feature B, 25 x 2.5 x 2.9m; Feature C, 20 x 2.7 x 0.9m; Feature D, 51 x 3.3 x 1.3m; and Feature E; 12 x 1.8m.
04718[8 11]	Heiau Complex	Ceremonial	P	C,D,E	Site is believed to be the "unnamed heiau" identified by Walker 1931 (SIHP 50-50-08-00005) and documented as destroyed during the 1973 inventory (Hawai'i Department of Land and Natural Resources State Historic Preservation Division 1974); Complex consists of 3 features: an enclosure (Feature A), 12 x 6 x 0.7m; and two burials (Features B and C); overall site complex dimensions = 21 x 12 x 0.7m.
04719[11]	Rock Wall	Boundary	H	D	Site consists of a dry-stacked wall, 8 x 0.8 x 0.9m.
04720[11]	Retaining Wall	Transportation	H	D	Site consists of a retaining wall.
04721[11]	Rectangular Platform	Habitation	H	D	Site consists of a small rectangular platform with a retaining wall on the western side. Historic era artifacts found.

SIHP No	Formal Type	Probable Function	Age[6]	Significance	Brief Description
04758[11]	Historic Cemetery	Burial	H	D,E	Site is historic Awalua Cemetery containing a minimum of 60 graves, 80 x 30m; Shefcheck and Dega (2007) noted fire damage to some of the headstones.
04820[11]	Surface Scatter Human Skeletal Remains	Burials	P	D,E	Surface scatter of human skeletal remains; overall site area: 100m sq; located in cane field; no indication of an *in situ* burial..
04821[11]	Surface Scatter Human Skeletal Remains	Burial	P	D,E	Surface scatter of human skeletal remains; overall site area: 50-60m sq; no indication of an *in situ* burial..
04822[11]	Kaloko o Kapā'iki Pond?	Pond	P	D	Site consists of probable fishpond sediments; located between shoreline and Olowalu Subdivision in eastern section of Olowalu Subdivision.
04823[11]	Marsh/Lagoon, Olowalu	Lagoon	P	D	Site consists of gleyed deposits.

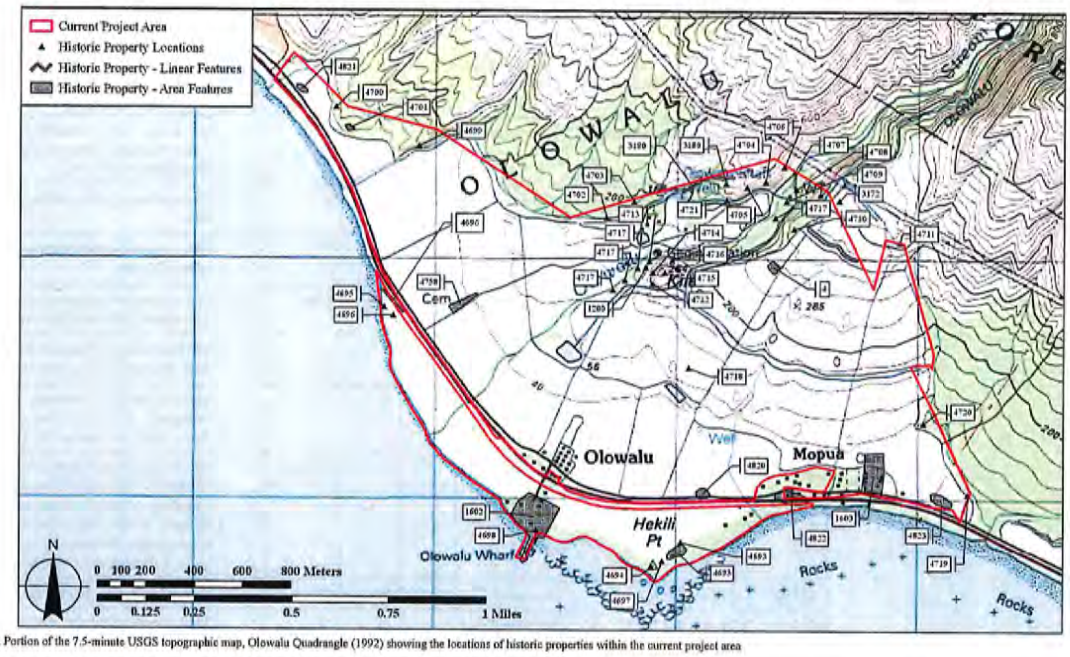

Figure 19. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the locations of historic properties within the current project area

Section 4 Community Consultations

Cultural Surveys Hawai'i Inc. contacted the following individuals and Hawaiian organizations requesting their *kōkua* and guidance regarding knowledge of traditional cultural practices and cultural resources of the study area. The following table represents the community consultation effort conducted with *kama'āina*, Hawaiian cultural advisors and Hawaiian organizations. Individuals who expressed personal knowledge of the study area and gave their consent to share their *mana'o* for this study, are presented in Section 5. Formal letters of response to the scoping letter sent out by CSH have been appended to this study as Appendix D.

Name	Affiliation	Contacted[17]	Personal Knowledge (Y/N/S)	Comments
Mr. Hinano Rodrigues	Cultural Historian – State Historic Preservation Division Lineal Descendent of Olowalu Ahupua'a	Y	Y	See Section 5.2.1.
Mr. Mathew Erickson	Lahaina Hawaiian Civic Club	A	--	--
Ms. Hokulani Holt-Padilla	Traditional Hawaiian Cultural Practitioner Director of Cultural Programs – Maui Arts and Cultural Center	A	--	--
Ms. Nicole McMullan (former) and Mr. Travis Schnepp (current)	Directors Bailey House Museum	Y	N	---
Ms. Thelma Shimaoka	Office of Hawaiian Affairs – Community Resources Coordinator for Maui	Y	S	Provided referral recommendations.
Mr. Kamana'opono Crabbe	Office of Hawaiian Affairs – CEO	A	--	--
Mr. Stanly Solamillo	Maui County Cultural Resources Commission	Y	--	Presented to the Maui County Cultural Resources Commission (see Section 5.3.2)
Ms. Pua Aiu	State Historic Preservation Division – Administrator	N	--	--

17

Y=Yes
N=No
A=Attempted (at least 3 attempts were made)
S=Some knowledge of project area
U=Unable to contact, i.e., no phone or forwarding address, phone number unknown

Name	Affiliation	Contacted[17]	Personal Knowledge (Y/N/S)	Comments
Mr. Ke'eaumoku Kapu	Maui/Lāna'i Islands Burial Council – Chair Caretaker – Kaiwaloa Heiau	Y	Y	See Sections 5.2.3 and 5.2.4
Mrs. Uilani Kapu	Kuleana Kuikahi, LLC. Aha Moku O Maui – Lahaina Representative	Y	S	See Section 5.2.3
Mr. Daniel Nahina	Caretaker – Kaiwaloa Heiau Lineal Descendant to Olowalu Ahupua'a	Y	Y	See Section 5.2.4
Ms. Patty Nishiyama	Na Kupuna o Maui	N	--	--
Ms. Rose-Marie Duey	Olowalu Cultural Reserve	Y	Y	See Section 5.2.2 and Appendix D
Mrs. Adeline Rodrigues	*Kupuna* and Lineal Descendant to Olowalu Ahupua'a	Y	Y	See Section 5.1.1 and Appendix E
Mr. Al Lagunero	Olowalu Cultural Reserve – President	Y	Y	See Section 5.1.2 and Appendix E
Mr. Stanley Okamoto	Former resident of Olowalu Ahupua'a	Y	Y	See Section 5.1.3 and Appendix E
Mr. Eddie Ka'aihue	*Kupuna* and Lineal Descendant to Olowalu Ahupua'a	A	--	--
Mr. Frank Silva	*Kama'aina* and Lineal Descendant to Olowalu Ahupua'a	A	Y	Initial consultation resulted in bad audio, attempted to reconnect
Mrs. Adelaide Silva	*Kupuna* and Lineal Descendant to Olowalu Ahupua'a	A	Y	Initial consultation resulted in bad audio, attempted to reconnect

Section 5 Summaries of Community Consultation and Kama'āina Interviews

The summaries presented in the section below consists of information that was shared during community consultations as well as informal and formal interviews related to past and present land uses and traditional Hawaiian cultural resources and traditional practices and beliefs of the study area. Interviews and consultation was conducted by Tanya L. Lee-Greig, M.A.

5.1 Formal Interviews

5.1.1 Mrs. Adeline Rodrigues

A formal interview with Mrs. Adeline Rodrigues was conducted for this study on August 27th, 2012 at the Olowalu Church hall (Appendix E). Mrs. Rodrigues was born Adeline Kamaileolihau Ka'ahui on December 21, 1929 in the old teacher's cottage at Olowalu. Her father worked for the Kahului Railroad while she was growing up, and although Mrs. Rodrigues was raised in Kahului, the family would go to Ukumehame every weekend to tend the *lo'i* (taro patches) and visit with her grandparents at Ukumehame and Olowalu.

So deep are the roots of her family in Olowalu that the *wahi pana* (storied places) of this *ahupua'a* also finds its way into their given names:

> My name is Kamaileolihau. That's the name of that mountain. On the left hand side is Lihau and on the right is the small Lihau... because there were *maile* growing up on Mount Lihau. And my daughter's name is Kapualehuaolihauulakalaeohekili, that means the Lehua blossoms that blooms on the Lihau, it's reflected in the water at Hekili point. It was before, when had all those Lehua blossoms blooming on Lihau ... white, pink and red ... my mom was the one that named her.

In a discussion about place names, Mrs. Rodrigues explains that she is most familiar with the places of Olowalu that are between Ukumehame and Kapāiki and give the following descriptions starting with the place name where her family home is situated:

> This place is really called Kapāiki. It's not called Olowalu. We always referred to this place as Kapāiki. Kapāiki starts from I think from this boundary of the church towards the last home here in Olowalu.
>
> ...
>
> (a)nd from that store (Olowalu General Store), that bridge, there was a bridge there, from there on, it was Olowalu, the people who lived in, who lived in that camp, always referred us, as we come from Kapāiki, we were always referred to coming from Kapāiki. We felt we were different from that Olowalu village, we were really Kapāiki.
>
> ...
>
> And Mōpua is going to that Hekili point. That is Mōpua. This is not Mōpua, but they refer to this place as Mōpua also, but this is called, really called Kapāiki. And the pond, there was a pond in front of our, of my home, and that was called the Kapāiki pond.
>
> ...
>
> I heard it as Kapāiki, but I don't know if I can say that 'cause I've (also) heard it as Kapiki, but when I ask Hinano he said, *kapāiki* means small gate. *Pā* is gate, *iki* is small, so the

> small gate, so we're thinking of the small gate to where? (West Maui)? Cause you know if you look at all the main names for each area, there it's somehow connected with each other. Like Pakala - Pakalā. Actually, we call it Pakala, but you know as the years go by Hawaii is kinda, you know Hawaii is kinda, I wouldn't say mispronounced or they just say it the way...but I always felt that it's not Pakala, its Pakalā. What does Pakalā mean? Pa is gate, kalā is the sun. The gate to the sun; to the sun, so Kapāiki is the small gate...

Mrs. Rodrigues also explains the connection between Kapāiki and the High Chiefess Kalola and in turn her connection her ancestral lands at Kapāiki:

> It's a fish pond (Kapāiki pond) ... and that pond and the fish, that was for the *Ali'i*, cause where my property is, that is where chief ... Kalola, that's where she lived. Kalola's property (is not) the Saffery's ... where the Saffery's lived. Where the Saffery's lived, is where the servants lived. So you guys gotta make some kinda correction.
>
> (Kalola's place) that's where I lived, that's where the pond is there, that fish pond.
>
> (M)y dad was *hānai* by William Ho'opi'i.
>
> ...
>
> My mom and dad were born in Ukumehame. And they moved here to Olowalu when they got married. They moved here, They met Ho'opi'i cause the home that I am living in now was his home, so when I was born, he told my dad, that the properties that I own were going to belong to the girl. I was always referred to as the girl. Yeah, I was the girl. After I was born, and anyway, my dad went to work for Kahului railroad in Kahului, my mom stayed here, in 1930 my mom and I and my dad got a home in Kahului. And we lived there until I got married. And then I moved back, we built a home here in 1966.

When asked about the water source for the pond, Mrs. Rodrigues stated that the spring water ran underneath the location of her house from Olowalu Valley. She went on to further explain that there was a *mo'o*, or lizard, that also lived in the pond.

Along these lines, Olowalu Ahupua'a is also noted as a very spiritual place where it is possible that fire can be controlled, *'uhane* (spirits) and *menehune* sightings are common, and the drums of the Night Marchers are heard on the Nights of Kane. Mrs. Rodrigues recounts the following:

> (A)s long as I remember, everyone would ask "where you come from?" and I would say Olowalu, and they would say "Olowalu, That's the most spookiest place." but I don't think so, I feel Olowalu that's where the heart and soul of Maui, the heart and soul of Maui is Olowalu. It's a spiritual place. You know when we had that first fire that started on the hill in I think 1990, I'm not sure, I guess the Maui electric line somehow had explosion. We heard the explosion, then we heard it when we were sleeping, but we didn't get up, we just slept because we thought what that, just an explosion, but we never knew where that explosion came from. Then later on, maybe could have been an hour later I heard my neighbor say fire, fire, there's a fire! And I think where is that fire, and I open I window and look up and there is the fire burning, the fire was huge and wind was blowing down ... there was a house where my brother Eddie use to live, but he sold his home and his home burnt. And the police came and told us we got to leave, and go down to the Olowalu store, I thought for real I'm not going have a home, but you know before I left, and my husband didn't want to go, he said he was going to stay, and I told him no we got to go. He said don't worry, don't worry the fire is not going to come, and we go down to Olowalu store, and I tell *tutu* take the fire away! You know the wind shifted, and I'm not kidding it only burnt my brothers house, but back behind my home ... and Eddie's son and his friend were

sitting on the roof and the police and the fire department didn't know these two guys were in the back there and hiding from the police watching the fire. So this boy, my nephew, Chris said look at that fire ball coming down the hill, it was a fire ball, it was something rolling, and it rolled down and hit my brother's house and the house exploded … It burnt that house, and I said tutu take the fire away! Go to Ukumehame, and it did! The wind switched, and the wind stopped, it didn't come down the mountain, it turned and the fire burnt two cottages on the church ground and then caught fire all on that side of Ukumehame. I'm not kidding! And I said tutu, tutu take this fire away!

Then had another fire! (B)ehind where Olowalu tomato farm was … So the fire burned behind Olowalu tomato farm, and the wind blew the fire ... And I was in Ukumehame, I was working with my daughter and husband working in the taro patch, and I saw smoke and I said oh we better go home, I think the fire is in Olowalu. I said oh come on, and you know what they tell me, oh no the fire is not there, it's in Launiupoko. And I said oh no that fire is in Olowalu and it's going to burn, so I tell Starla don't worry, the fire going Launiupoko; the fire going the other way now. The first fire went that way and the other one went this way. And it burnt a home in Launiupoko, one burned I think. I said don't worry the fire is not going down to our house. Not going to burn, because my husband refused to bring us home … we didn't come home till 5'o clock! (W)hen we came home, there was nobody there, no one in the community, because they told everybody to leave and it burnt and went towards Cut Mountain. So I said don't worry *tutu* going take care of us. That's why they quoted me two times for the two fires!

… (T)hat man came from Maui News and ask me "Hey, how come your guy's for the second time your house never burnt?" And I said "because this is one spiritual place! It's not going to burn! People that live here are not going to have their homes burnt!" So when I hear about people talking about fires in Olowalu, I'm not afraid, because our fires are not going to burn. Not here! Not in Kapaiki!

With regard to *menehune* at Olowalu, Mrs. Rodrigues recalls two separate instances where her husband and then her brother (Eddie Ka'ahui) both encountered the legendary figures:

(M)y husband saw *menehunes* right across our place … he use to work for the tire company … and he had to go to Lāhainā to deliver tires and everything, so one day he passed right in front our place, and he was looking at the beach before it had sand, and he saw two people running to the edge of the water and the water came up, and these two children, he thought they were children, and he thought those two children looked odd, because they were chunky and their hair was stuck to their head or something different about them, so then he passed looking at the two children, he thought oh, I wonder who my mother-in-law have at her house, because they get two children there and … my mom, (must have) had a guest, so he looked across to see who it was, *niele* yeah, and like I said didn't look like children, they looked odd. So he stopped to reverse, and when he reversed he looked across, and they disappeared. He said that was *menehune*.

Can you imagine that, 50 years ago, there was *menehunes* playing over here? (W)hen he told me that, I said ah you lying, you kidding. And he said no it was a *menehune*, because they look to mature to be children, and why they don't have parents with them. So that's why he looks across the street to see who my mom had her house, and you know he told my brother Eddie, and my brother Eddie, make fun yeah, so one day my brother Eddie was driving on the dirt road and his truck got stuck further down from this dirt road, so he had to walk home, that was night time because he was going to drive to Ukumehame, and so when he was walking home, there had a *menehune* run across the street, right on the dirt

road, right in front of him. So that's why he believed what my husband saw, can you imagine had that kind people before?

In a discussion about drums of the Night Marchers and their path, Mrs. Rodrigues recalled the following:

Funny kind music, it had no tune … like monotone, there was music but no tune to it, so you know, that's not real, it's not real. We use to hear that, and my husband and I would get up and go to the window and go listen and see what is that sound coming from, but we knew that it was *pō kane*, when they walk in with the drum, and even the drum there was no rhythm, you know but the warriors are walking at night.

…

I think the last time my husband and I heard that back here, was 1970's and get what you call that fire ball, *akua lele*…

I saw it, and when I looked at it and saw it the fire going across, it was going to go like this (demonstrating the path), and go oh, then it burst. Because when I told my dad, because my dad was still living at the time, and I told him hey I saw one *akua lele*.

With regard to the path of the night marchers, Mrs. Rodrigues recalled that the trail went from *heiau* to *heiau*, or from Kaiwaloa Heiau to Heki'i Heiau at Ukumehame. Another path in which the spirits would walk during certain times of the month was located between the school cottage and a fresh water well. A home was later built on this walking path that was often used by the great-grandmother and great-grandaunt of Mrs. Rodrigues:

(M)y mom went to Honolulu and my sisters were home and they had a party there and they slept there, and they went to work and these girls slept in that bedroom, and low and behold, that girl said she heard a lady saying what you doing in my bed? Get out of here! She did, she got up and cried and all the way to the beach and stayed at the beach until my sisters came home from work.

… and no matter how many Kahu's we ask to come and bless that area, Reverend Earl Kukahiko's father, John Kukahiko, told my mom and dad there is nothing he can do about it except move the house. Why you going to do that, what for its old already, but next time don't build a house on that walk way, that path, it goes right across the property, to the next property where they got the drinking water.

With regard to the subsistence resources of Olowalu, Mrs. Rodrigues recalled how her grandmother was the best at catching *he'e* (squid):

> And my grandmother was an ace at catching squid; she could catch fifty squid in one day if she had to. If she had to, but she's not going to do that as she would be taking everything out of the ocean. But sometimes we come to Olowalu and we see all the squid all hanging on the line, waiting to eat, and we just pull the leg, the dry spot.
>
> And my grandmother, that's her area, yeah, from Ukumehame to Cut Mountain. She use to go early in the morning, before the sun came out, she would go get squid, and she would end up at that S turn where Awalua is, you know they had families come from that side, and she would stop at every house and she give them something. I would go with her, and in my mind, I was like if she going to stop at every house and give everybody something I hope when we reach home we going get something. Even if only one left, that's what we going have, she would give everybody something. Don't have to be family; as long as she would just walk from the next house, to the next house.

Mrs. Rodrigues also explained the *limu* (seaweed) resources of Olowalu and also clarified that while *limu līpoa* could only be found at Papalaua Park at Ukumehame, *wawae'iole* was gathered at Kapāiki and *limu lipe'epe'e* was found around the wharf area. She further noted that each type of seafood would also have its own *limu* and *lipe'epe'e* was the one that was mixed with squid and raw *ake* (liver). Unfortunately, Mrs. Rodrigues also noted that she has not seen or smelled either type of *limu* in a while. In addition to the *he'e* and *limu* resources Mrs. Rodrigues recalled the presence of *loli*, or sea cucumber. When asked if she noticed a difference in the reef between then and now, Mrs. Rodrigues stated:

> No, no now what I know is we hardly have fish here, we use to have menpachi, moonlight Annie, used to have once in awhile we catch papio.
>
> … I haven't been bambooing lately but my husband and I use to go all the time. You know they the moonlight Annie. The small fish, it doesn't get bigger than this, it's always like this, but you catch it and clean it and you deep fry it, and you eat bone and all.
>
> And I know where the menpachi and the reef where the menpachi is on the reef cause me and my husband we try to beat each other, so If I catch one, I go some place and take off and go the other place, and I go and get the menpachi and when he see me catch one menpachi, he's not going go till he catch one. But I don't know if they still have, and what else they have out there, that pokey sea urchin. There's a lot.
>
> Sea urchin, sea urchin is at Ukumehame Park, and at the wharf, the Olowalu wharf on the left hand side. My husband use to catch and get it at the other end, but once that lady got killed and eaten; we no longer go on the other end. Kind of scared yeah.
>
> (There) had some kind of reef there before, we use to walk on that reef, my husband use to go *kukui hele pō*.
>
> My husband used to go on that reef, but now over there, there's no reef over there. It was a beautiful place. There was a reef on the right hand side. Where the weddings are held. Low tide, you could walk on the reef … It was a beautiful place.
>
> My husband, we used to put the light on him, because he was going spearing. They use to have a lot of fish there, but, now, you know when you go to the beach and catch something, people see you, they watching right?

> Then when you go home, they going over there, and they clean sweep the beach, no more nothing. So, now we don't say nothing, if we know where the *limu* is we go get that *limu*. And if somebody brings *limu* to me, and I say hey, where you get that *limu*? But, I'm not going to ask you. Thank you for giving me that *limu*. If you catch, bring, I don't want to know where you get it … because that's for you.

With regard to the proposed Olowalu Town Master Plan, Mrs. Rodrigues would like to see the project move forward. Mrs. Rodrigues sees this town concept, and availability of such services as a nearby grocery and emergency facilities as a positive thing for an otherwise fairly isolated community:

> I don't have anything, (laughing) I mean, you know, for, what do we have here nothing, nothing, just trees, what kinda trees we have here, Kiawe, and what do you call the other tree? I call it Camacellus or Opiuma. I don't know why they call it Opiuma but you know when you eat the fruit. Eat too much of it, your mouth get numb. Like Opium. Have you ever tried it?
>
> That's all we had here in Olowalu, just Mango, guava, what do you call that fruit, there's another fruit, we called it (Jakuro). I know it only as (Jakuro), but it is called Pomegranate.
>
> I am glad that we are going to have somebody that is going to build this town. And I've told every Hawaiian that I know, and a lot of Hawaiians they don't want Olowalu town. Oh, but it's such a nice place, but I tell them you folks is being mean. You folks live in the city, you can go shopping, what about me, I live here, I'm old already, so I need a town, but I know the town is not going to be here in 2 years, not going be here, but I'm thinking of my family. And I've heard them say that oh maybe we should all move home, and I said I wish you would move out of Wailuku heights, I have two girls live Wailuku heights, and I told them go sell your home and go buy a home in Olowalu.

5.1.2 Mr. Al Lagunero

A formal interview with Mr. Al Lagunero was conducted for this study on January 19, 2012, at the offices of Frampton and Ward, LLC (Appendix E). Born on October 19, 1945, Mr. Lagunero is a renowned artist and native Hawaiian cultural practitioner with family connections to Olowalu through the Kaumuali'i (Kekaulike) and Hale O Keawe lines. He is currently the President for the Olowalu Cultural Reserve, a 501c3 organization with an educational mission focused on learning opportunities where students can integrate and develop skills for either career or cultural re-growth with "the land as the teacher … the ocean as the mother teacher." Also present at the interview was Ms. Katherine Kama'ema'e Smith, author and volunteer with the Olowalu Cultural Reserve and Mr. Bill Frampton of Frampton and Ward, LLC.

When asked about the mission of the Olowalu Cultural Reserve, Mr. Lagunero shared:

> The mission is educational. It is a 501c 3 educational designation. Entwined with that is an opportunity to move back onto the land with the land as the teacher, the ocean as the mother teacher. So what we are looking at is the possibility of working the lands to have a place where learners can come integrate and then develop different kinds of such with regards to either career opportunity or cultural re-growth and all that's involved in re-growing and adding to culture. For example, contemporary works, contemporary writings, contemporary different kinds of things that have been left maybe not been taken in by Bishop Museum. The idea for the school, I feel should be, could be some kind of ambassadorship, training, where people not necessarily only elementary school children or

young people to come to school but also for the *kupuna* and the parents (intergenerational). I think, if we could look towards re-integrating our family systems by allowing education to come into play for that. So a child doesn't go home with just the homework, everyone shares in the homework. Everyone shares in the care.

So a lot of that *mana'o* although we just slightly talked about it here and there, I think comes together with some kind of consortium as to how that comes about. It is something that I've taken from conversations throughout my years with Maui and with other cultural areas. One of the big things I remember with Keali'i Reichel was that we have no place to present or to study without having to instruct others … So he was looking for a place where they could just be *hālau* and not worry about all those other things, to have interface with nature as it was, and to *kōkua* that whole area. Those kinds of conversations that come up over the years and I think I echo a lot of those. I collect in my thought, in my heart, my *na'au* the kinds of discussions that we have. I feel that many of the people who share that seem to have a certain kind of movement in themselves to keep that tie alive and interfacing cooperatively. If that is a start of an ambassadorship, I think that is wonderful. The other part of that is that we can have classrooms without walls which is a big part of the whole kind of exchange that we miss when we go into public forums. Exactly that word rather than a place where, you know, we could lay down, talk story and let it go without having all of that kind of confined space. We look forward to this *mauka* to *makai*. We have hope that the canoe that's being built for the Reserve will find a parking place down by the sea. Hopefully that can become very active in terms of returning the waters to proper use and access. Planting, you see people planting *limu*, little bays along the shore. Families come in, you park your car, you go over there, get on the canoe, take the *limu* and plant and go here and there and plant. I think much has been taken away from the waters and so it causes the water to do something else. I don't know what that ship can be like tide wise when it goes to other areas, if it becomes much more than just planting *limu*.

…

Limu brings the fish.

…

What I think is that we can allow the Cultural Reserve to walk in the footsteps of the ancestors. To allow that voice to be enjoyed, shared with people so that we can, from there become an ambassador just in place. That's some of the *mana'o* I think that has gone through our board and some of the people throughout maybe my 30 years.

When asked about the unique cultural resources of the Reserve and the role that these resources would have with achieving the mission of the Reserve, Mr. Lagunero explained:

The star that brings the canoes to Hawai'i, the star that is the tutelary star of West Maui is Rigel, Puanakau, is the constellation and in that comes the guide to Makali'i. In terms of the historic factor of that and having people look at *ahupua'a* different than just land marked by straight boundaries. We have at least that kind of thing, talking about walking in the steps of the ancestors. So when we come to realize the connections that way, *iluna*, *ilalo*, you can have a little bit. It continues to help to grow community awareness. The idea of experience is something that really is so important and I think the access to the land and ocean at Olowalu allows us an opportunity to bring that experience to both, you know those kinds of areas.

I think it's a very opportune situation when we can take any of the schools like Kamehameha and whoever goes out that they can touch and smell. When we talk about the

limu and stuff, all the links that we have in Hawai'i is so beautiful. Just in the art of *lei* making, if you making for Pele dances or if you making for ocean dances those kinds of links for the child who is taking *hula* could be a little bit more pronounced, you know, why do you wear those *leis*? Who made that lei, you or your grandparents? So what is the link, those kinds of things goes on and on. At the same time, we have new materials and things. So things like feather capes, Joanne Kahanamoku are very respected for their feather capes but their capes are a matter of contemporary material. Its contemporary feathers, dyed feathers and those kinds of things but the idea behind them, process of which it involves, really helps to instigate and maintain a sense of what that beauty is all about. This is why the Reserve, I feel is very important …

… I think that it's very exciting too is that we can deal with the new, old way now. And the new, old way has such to use what wisdoms we might experience from our *kupuna* and how we might adjust some of that for today.

With regard to Olowalu Ahupua'a as a *pu'uhonua* or place of refuge Mr. Lagunero shared:

.. that as people come into the area while you have your signage and stuff, "Welcome to this place." The idea of a *pu'uhonua* is a very strong one. And it could be something that moves into people's being quite differently than other places that seem to be more museum type situations. But we are coming into a living *pu'uhonua* again. And that possibility for that living *pu'uhonua* may not be necessarily this line.

So when you move along to where the surfer's, over there (Awalua), it's a really wonderful area in which people are entering into like a gateway. So when you enter into that gateway, your mind set could change when you come into this area. And when the dialogue of the *pu'uhonua* comes more in common, people begin to look at the islands as *pu'uhonua*. A different kind of way of looking at it. I think my *mana'o* goes in and out of care and PR.

In the recognition of this place as a *pu'uhonua*, in the constellation Puanakau is a star, at the lower bottom called Pu'u Honua. Then there's these other stars around it, the Cat's Cradle, Kahiehie

(Ms. Smith) Ka Heihei O Na Keiki

I think the stars have much information. Kaho'olawe with recognizing that maybe it is a training ground for the movements to the south and returning. I think we are looking at this star and this location as a part of the whole conversation. We began to look outside of the current realty of; you know, line like this and allow that conversation to maybe come in into this. The fact that the *pu'uhonua* goes back into this area is really very promising kind of thing to have the connection down here to Waihe'e with Kalola's Heiau to, at Pu'u, at Paukūkalo (Hale Ki'i Pihana. Pihanakalani).

… (T)hen she (Kalola) moves from Pihanakalani down into here quite with her presence then the land really becomes *kapu*, yeah. There's a *kapu* on it. I'm just kind of thinking those kinds of things are really important to know. How we relate to Haumea. How do the children show themselves when the sunlight comes up in the valley? What's there? When you look at the ridge of the mountain, not ridge but here's the mountain and then this layer like this sometimes especially in 'Īao when the light comes like this, then the shadows are cast this way and you begin to see them coming out like this. *Hiki no*, the formations of the stone people that kind of thing. The whole, that dialogue that informs us that informed our ancestors are all very important in the naming of the place. So that how we *pili* to one place, they always *pili*. They're always there. I think that kind of value is very strong and saying

> why the land is so important. The idea with Haumea and all of her children is that we are included. If we begin to understand that then the whole notion that we have is much more *pono*.

Turning to a discussion on the traditional structures, or archaeological resources, within the Olowalu Cultural Reserve Mr. Lagunero noted the presence of a Hale O Papa, or a women's *heiau*:

> Down here (pointing to the a map of Olowalu) is a structure that hasn't been identified in papers. It's a *heiau* like. I feel that heiau is the link of a *Hale O Papa*, the ladies *heiau*.
>
> Its location, some of the things that we see in the different way, that's the women's heiau and I think that's a very inportant part that it's not part of the paperwork that identifies that. Its location right below of this one is farmed. It's almost like Kawaihae with the men and then the women down below. At Kawaihae, I think it's like this, yeah, from the *heiau*, next to the ocean.
>
> (Ms. Smith) But this is next to the stream.
>
> Yeah, so I think the placement is traditional. And then the ridge, where's the ridge?
>
> Here, so this ridge, I think there's something up here or another kind of place where the men to gather before they come down to Kaiwaloa and then down here so women down there is really kind of nice. The men are up on the ridge and they're coming down. There's a flat land on the top of that ridge and I don't know if that was a lighthouse. Kind of a guide place for movement to Kaho'olawe and back. Signals.

Trails and the movement of the people were also discussed and both Mr. Lagunero and Ms. Smith talked of the *mauka* to *makai* trails. Mr. Lagunero goes into detail stating that the natural waterways were likely a part of the *mauka* to *makai* movement and historic waterways (irrigation ditches) that parallel the shoreline may have been an indicator of lateral movement between *ahupua'a* as those that built and engineered these waterways would have likely followed routes that they were already familiar with.

When discussing the flora of the valley, Mr. Lagunero stated that he would not be surprised if there were *tī* plants along the stream, *māmaki* were the water collected, and *ko 'oko 'olau* along the ledges. He further explained that when you start to think of those things in that way, then you can "begin to think about habitat." Mr. Lagunero also mentions the usefulness of *'uhaloa*, a plant that is often looked at as a weed, as an important tea. Additionally, Mr. Lagunero shared the multi-faceted usefulness of the *kūkui*:

> where the *kukui* nuts flow out and then they create a sediment in an area and the sediment helps create different habitats for fish. I think one of the board members mentioned that if we plant too much *kūkui*, it's *'a'ole maika'i* for the whole. I was thinking, "Oh, it's not only up there but down there by the ocean." You know when we go certain places and all those things are coming down from the mountain and creating that sediment.
>
> Yeah, so it's an important factor for those kinds of plants and we have plenty *kukui* trees or want to plant more kukui trees, keep the water cool in our area.
>
> (Ms. Smith) And that plant in the valley, in Handy and Handy, they mention the planting of the *kūkui* tree on the slope above the valley floor so that the nuts run down hill and then underneath the nuts and the leaves become the compost for the *'uala*.

In some final comments about the Olowalu Cultural Reserve and the importance of Olowalu Ahupua'a, Mr. Lagunero ties back to the previous discussion about having a place for the *wa'a* that is being built for the Reserve then looks forward and states:

> I think one of the original plans or *mana'o* that we had for that area was that Hawai'i doesn't have a welcoming place, traditional welcoming place for all of those coming up from the south especially to retain connections to the South Pacific cousins. So, if we had a place down at the point to receive the canoes that would come in, our canoe would be there to greet and then could walk up and then develop an arena in the mauka area to host the protocols that are necessary between us and have a place for these people to stay when they come.

5.1.3 Mr. Stanley Okamoto

A formal interview with Mr. Stanley Okamoto was held on January 13, 2012 at the offices of Frampton and Ward, LLC. Mr. Stanley Okamoto was born on December 12, 1926 in Wailuku, Maui (Appendix E). While Mr. Okamoto was not born in Olowalu, he noted that his father was born in Olowalu and lived there until 1925. As a child, Mr. Okamoto would visit his grandmother who remained at Olowalu Camp working for Olowalu Sugar Mill until she relocated to Wailuku in 1930. Mr. Okamoto also shared the name of his grandfather, Shirataro Okamoto, who was once buried at Awalua Cemetery until he (Stanley) moved the remains from Olowalu to the columbarium in Wailuku.

When recalling some of his earliest memories of Olowalu, Mr. Okamoto explained that the trips that he would take to visit his grandparents as a young boy was an all day endeavor and fondly remembered:

> (I)t was a twice a year trek to Olowalu … in the old Model-T that my dad had.
>
> And every time we came to Ukumehame, he says "Okay, all of you hang on to the roof!" So the wind don't blow it away! The wind at Ukumehame. The wind will come down, you know.
>
> …
>
> It gets—it gets windy. It's not a sustained wind, you know, it comes and goes, you know.
>
> (I)t (the road) was…a one lane road, you know. So you pull on the side when the traffic from the other side was coming. It was windy. And, I always marveled at the way the stone walls were made, along the *pali* highway … the cut—cut rock walls were built along the way and…just narrow enough for where two cars can go by.
>
> Yeah, that's the way it was. So it was an all day thing, yeah?

When asked where his grandmother lived, Mr. Okamoto noted that from Ichiki Store (Olowalu General Store) you would take the road going into the camp, and she was about the fourth house in. He noted further that Olowalu Camp was the just the plantation camp and that below the highway "were the supervisors, you know … The *haole* camp."

With regard to the operations of the Olowalu Company, Mr. Okamoto recalled the work that both his grandfather and grandmother for the mill, as well as the fond memories that his grandmother had of her time in Olowalu:

> Well, she had many fond memories. As I told you, she even came with the needle that they used to sew the sugar bags. Yeah, about this long, they was … and, when they sacked the sugar, and then they had to hand-sew the bags.
>
> Burlap bags, you know. Roll it over and then sew. And she came to Wailuku with the needle. And ...what we used it—the needle for, was when we grew eggplant, and then we would sell the eggplant we would sew the eggplant together and say, "Okay, four for a dollar."
>
> You know how odd-shaped the eggplant is. So, right at where it grows you sew it. Yeah, and that's what we'd use the needle for.
>
> …
>
> Grandpa was with the mill itself. I don't know whether it was boiler or whatever it was.

Mr. Okamoto also recalled that when they went to visit his grandparents and the main thing that they would do was to go to the beach by the old mill where the train track went into the ocean. He further explained that the swimming there was good because there was a clear, white sand beach.

Mr. Okamoto also remembered what Olowalu was like during the years leading up to and during U.S. participation in World War II, recalling that:

> During the war, Olowalu had military personnel there, on the beach side. But, ah, it wasn't…affected…affected very much. There were some camps…I mean military establishments along the way there.
>
> I was…I would have a tendency to say at the entrance here (pointing to the Awalua side of the peninsula). And then along this side, here, where now they plan to develop over there. That's about it. Very short…small … temporary…shelters.
>
> …our twice-a-year trek to visit the cemetery, and so forth, we did not have any problems (with military blocks), that I can recall. We were able to go and visit the cemetery. I know now they have a fence! I mean a gate.
>
> Yeah. And then, the military did have personnel along the shoreline. Because, you know, the shelter between Lanai, Molokai, Kahoolawe and Molokai, for enemy landing, is so easy, you know, coming in, and deep waters in Lahaina…when I grew up, you know, the entire pacific fleet used to be anchored in Lahaina.
>
> Every summer. It was my annual trip to go to Lahaina.
>
> You know, because, you know from Olowalu 'til Lahaina, Kaanapali, the entire pacific fleet used to come in. And then, when these people had liberty—shore leave, they would land right past Olowalu, because that area—where the rubbish dump is (Cut Rock)—
>
> You come in close, and then, they would have shore leave, and they would come in by boat, and then go—right there by Cut Rock, and then get off the boat. And so, we would see all nothing but whites, you know.
>
> They all came back and forth over there.
>
> But, it was a sight to behold here, the Lahaina Road, what they—was referred to the Lahaina Road, when the entire pacific fleet would be anchored there. And we would drive out at night to see, because, the entire ocean is lit with boats over there.

> And then you on the back side of Lanai, and Kahoolawe, so you can see all of this light. And then, ah…because very few taxis at the fort so you can see all of the white sailors walking back and forth.
>
> So, I remember the entire pacific fleet being—they congregated right there, you know.
>
> Well, it's not good naval strategy today, to congregate all you ships [laughter].
>
> Yeah, but, you see, that's the…that's all the maneuver for all the midshipmen and all of that…people, the navy personnel, so they would have maneuvers out in the Pacific ocean and then come back to Hawai'i, you see. Before Pearl Harbor.
>
> Yeah, and so Olowalu was big time, back then. Sugar mill…I wish my dad could be here to tell you about it, but ah...

5.2 Community Consultation and Informal Interviews

5.2.1 Mr. Hinano Rodrigues

Mr. Hinano Rodrigues was, for the most part, raised in Olowalu and traces his ancestral connection to Ukumehame and Olowalu through his maternal line (see also Section 5.1.1 interview with Mrs. Adeline Rodrigues). Born in Wailuku at Maui Memorial Hospital, Mr. Rodrigues, like his mother before him, spent every weekend and holiday with his grandparents at Olowalu. Mr. Rodrigues is currently the Maui Cultural Specialist for the Department of Land and Natural Resources/State Historic Preservation Division while raising taro part-time in Ukumehame. Mr. Rodrigues attended the May 3rd, 2012 Maui County Cultural Resources Committee (MCCRC) meeting regarding the Olowalu Town Master Plan as a resident and lineal descendant of Olowalu and Ukumehame Ahupua'a. In his testimony, Mr. Rodrigues presented his *mo'okū'auhau* demonstrating his link to Olowalu and relationship of Olowalu and Ukumehame as companion *ahupua'a*. He further notes that the property of his family home at Olowalu is located on the lands of Kalola and her husband Ka'opuiki. With respect to the shark nursery and overall presence near Olowalu Wharf, Mr. Rodrigues was taught to respect the sharks and related a story about when they were *keiki* they would go swimming in the area and when the sharks would come they would go back to the shore. He adds that his grandmother would ask why they were on shore, saying that they should be swimming and they, the *keiki*, would reply that the sharks came out so they got out of the water. At this point, his grandmother would tell them to get back in the water and that "the sharks are more afraid of you than you should be of them!" Mr. Rodrigues then told the story of how his Tutu Haehae, granddaughter to Chief Kamakakehau, had a brother who was stillborn without a spine. Following the birth of the baby, the mother, Kauakahiakua, put him in coconut husk at Punahoa (commonly referred to as Lone Pine Tree) and sent the baby out into the tide. The following day the mother went Punahoa to pick *limu* and as she bent down, a baby shark jumped for her breast and she said, "Ah this is our *aumakua*." Mr. Rodrigues further noted that although he is not able share the exact location, the cave of the *aumakua* is still at Olowalu and noted that the *aumakua* had been seen into the 1930s as it was during this time that his granduncles experienced problems with a swamped and fire destroyed Sanpan. Mr. Rodrigues mentions that as his granduncles were hanging on to the Sanpan waiting for help to arrive, the sharks showed up and rubbed against their thighs to help keep them afloat.

With regard to *hihimanu*, or the sting ray, Mr. Rodrigues told of the times that they would take his father's net and walk from mile marker 14 to lay the net by the wharf and watch the *hihimanu*

come in. Their biggest fear when that would happen was that the *hihimanu* would enter the net and *puka* or damage the net and result in them getting in trouble for taking the net.

Specific to the Olowalu Town Master Plan, Mr. Rodrigues asserted that the current planning model is outdated and conventional. He sees the overall master plan for Olowalu Town as a different way of planning a community that may serve as a prototype for future planning of the island. Mr. Rodrigues believes that there is a need to incorporate the *ahupua'a* management concept into planning.

During an informal talk-story session in September 2012, Mr. Rodrigues shared additional *mana'o* with regard to the place names of Olowalu explaining that Mōpua is also called Mo'opua, and that in Hawaiian language, sometimes two similar vowels that are separated by an *okina* are combined and pronounced as a long vowel (e.g. Mo'opua = Mōpua). This distinction is relevant as it relates to the route in which Kihawahine, the *mo'o* goddess would travel from the West Maui Mountains to Kalokoi'aokapāiki, the fishpond that once fronted their family home. Mōpua is located between Mile Marker 14 and the Olowalu Church. Pākala, another place that was mentioned by his mother, Mrs. Adeline Rodrigues (see also Section 5.1.1 interview with Mrs. Adeline Rodrigues) is located between Mile Marker 14 and the boundary between Olowalu and Ukumehame Ahupua'a. Mr. Rodrigues also shared that there is a place at Olowalu called Kaluakanaka (place name of where LCA 240 to John Clark is located) that literally translates as *kalua* = "the pit" and *kanaka* = "human being" (Pukui and Elbert 1986:127) and contemplates if this is the location where the victims of the Metcalf Massacre were laid to rest.

With specific regard to the Olowalu Town Master Plan, Mr. Rodrigues asserted at the MCCRC meeting that he would be keeping an eye on the progress and development of the town. In a separate consultation Mr. Rodrigues mentioned that when he goes to Olowalu on the weekends he sees the heavy use of the area, not only by tourists but *kama'āina* as well. With Olowalu Town, he sees an opportunity that would allow Hawaiians and long-time *kama'āina* to Maui to live at Olowalu, rather than just 35 or so, wealthy part-time residents. For Mr. Rodrigues, he hopes that by living in Olowalu the *kama'āina* of Maui would also then take ownership and *malama* the resources and the environment.

5.2.2 Mr. John Duey and Mrs. Rose-Marie Duey

Mr. John and Rose-Marie Duey are involved with, and a driving force behind, the Olowalu Cultural Reserve who are working very hard to return the *ahupua'a* of Līhau, Olowalu. In a letter response, Mr. and Mrs. Duey first and foremost wanted to state that they were neither for nor against the proposed Olowalu Town Master Plan and had not given testimony at anytime regarding the development of Olowalu. In their letter, Mr. and Mrs. Duey explains that the Olowalu Cultural Reserve is "74 acres of cultural lands and cultural sites (already documented and surveyed), from mauka to makai within Olowalu valley, and follows the streambed to the ocean" further stating that the lands were "generously set aside by Olowalu Elua Associates on a 99-year lease." They further note that those who are astute in Hawaiian history are well aware of the destruction of the Hawaiian cultural way of life, native areas of cultural habitat, and cultural practices by the plantations and modern development. Mr. and Mrs. Duey point out that efforts to protect, repair, and rebuild are required by committed people and that the developers need to be a part of this commitment in perpetuity.

Specific to Olowalu, Mr. and Mrs. Duey note that the reef of Olowalu is one of few pristine reefs with more than 29 species of coral. In order maintain a healthy and sustainable *ahupua'a* and reef system the following points where presented in order to address the needs of the *ahupua'a* (see also Appendix D):

- There should be an ample supply of fresh water in the stream from *mauka* to *makai* for sustainability of native flora and fauna within the stream and the ocean.
- There should be an ample supply of fresh water from the stream for growing *kalo* and other sustainable foods.
- There should be an ample supply of water for native plants and reforestation.
- There should be a greater setback from the ocean, beyond the 100 ft that is protected by state law. This setback would ensure protection from activities such as landscaping and associated chemical use and waste; in addition to stonewall and man-made pavements and structures.
- Swimming pools, as well as, dumping of other treated water of any sort into the ocean should not be allowed as chemical leaked or released in the ocean destroys sea life.
- Commercialized ocean activities form shore or ocean should be denied for preservation of these corals and reef life.
- There should be an avenue or process put in place between Olowalu Cultural Reserve and the project in perpetuity should mediation of future activities on adjoining lands impact the cultural sites, land, ocean and practices whereby the project's owners and developers should carry the buren or costs to mediate invasion of any type to Olowalu Cultural Reserve's intent to protect cultural sites, and practices of it *ahupua'a*.

5.2.3 Mr. Ke'eaumoku and Mrs. U'ilani Kapu

Mr. Ke'eaumoku and Mrs. U'ilani Kapu currently live in Kaua'ula Valley, *mauka* of Lāhainā Town, and are the Aha Moku o Maui representatives for Lāhainā Moku. Additionally, Mr. Kapu is also recognized as one of the caretakers for Kaiwaloa Heiau whose *kuleana* it is to *malama* (take care of) and preserve the integrity of this sacred site. In an informal meeting on May 3, 2012 at the Nā Aikane Facility, Malu-ulu-o-lele Park, Lāhainā, Mr. and Mrs. Kapu shared their *mana'o* and concerns about the proposed project.

With regard to Kaiwaloa Heiau, Mr. Kapu shared that he knew of at least 3-4 burials within the confines of the *heiau*. As a caretaker and with concerns about access to the *heiau*, he would like to see the access road or route be maintained along the cliffside rather than through the residential area. Along these lines, he felt that formal establishment of a community right-of-way was needed to ensure access to conduct yearly ceremonies at the *heiau* and for the families of the *ahupua'a* who wish to go up to the *heiau*. As a part of the maintenance of the *heiau*, Mr. Kapu had noted that they had begun re-vegetate with native plants outside of the *heiau* enclosure; however, the water that was used for vegetation maintenance at Kaiwaloa Heiau was discontinued by the current land owners. Mr. Kapu would like to regain water access for vegetation maintenance at the *heiau*.

The concerns of Mrs. U'ilani Kapu extended primarily to potential the impacts on the ocean resources and historic properties. Mrs. Kapu shared an apprehension about the location of the

sewage treatment facility in a low lying area and the potential for flood damage to the facility and resulting hazards. Of the potential hazards, Mrs. Kapu was most concerned with the size and depth of the sewer lines and the potential for leakage issues on the ocean resources of the area. When looking at the location of treatment facility in relation to nearby previously identified historic properties, Mrs. Kapu wanted to make sure that the facility was well away from known historic properties and that any utility installation would not adversely impact the sites. She further shared that the management responsibilities of the facility was of additional concern and inquired if that responsibility would fall to Maui County or a private entity. Finally, Mrs. Kapu noted the presence of a family farm nearby and wanted to know what would happen to the farmers in the area and make sure that they would not be adversely affected by the proposed project and placement of treatment facility.

5.2.4 Mr. Ke'eaumoku Kapu and Mr. Daniel Nahina

Mr. Ke'eaumoku Kapu and Mr. Daniel Nahina are both the caretakers of Kaiwaloa Heiau. An informal meeting with Mr. Kapu, Mr. Nahina, Mr. Bill Frampton of Frampton and Ward, LLC., and Tanya Lee-Greig of Cultural Surveys Hawai'i (CSH) was held at the Olowalu Plantation Manager's House on August 28, 2012 with a follow up field visit to Kaiwaloa Heiau (SIHP 50-50-08-0004).

Mr. Daniel Nahina, who has family ties to Olowalu Ahupua'a has long knowledge of the spirituality of this *ahupua'a*. Mr. Nahina shared the importance of the *mauka* to *makai* connection at Olowalu as it relates to the ceremonial practices once carried out at Kaiwaloa Heiau. He recalled that the warrior spirits, who are 10-15 feet tall, walk the road from *mauka* to *makai* during the rising of Kū. In the old days, the warriors would walk in the early morning to the ocean by torch light to *hi'uwai* (cleanse or purify) their weapons in the water and at the same time they would *hi'uwai* themselves. By carrying the torch light during the ceremony, the warriors would also let those at the *heiau* know that they are ready both physically and spiritually. Mr. Nahina also noted that the historic cemetery at Olowalu that is commonly referred to as the "Japanese" Cemetery and called Awalua Cemetery was also known as Puha Cemetery.

Mr. Ke'eaumoku Kapu expressed concerns that were raised by others in the community about the disposition of human remains identified and recorded as SIHP -4820 and -4821 (surface find of human remains). CSH advised that the remains were limited to a surface context that was possible present due to down slope erosion which resulted in their presence at the location where they were recorded. Mr. Kapu was reassured that during the archaeological inventory survey conducted by Xamanek Researches, the remains were collected and re-interred at Awalua Cemetery with the permission of the SHPD and the Maui/Lāna'i Islands Burial Council and a provision for archaeological monitoring at both locations. With regard to Kaiwaloa Heiau, Mr. Kapu also shared that this *heiau* is also connected to the *kahuna* of Kawailoa Ahupua'a on O'ahu.

Both Mr. Nahina and Mr. Kapu shared the stories of how *akua lele* (fireballs) at Olowalu would shoot straight up from Kaiwaloa Heiau. They explained that this is the tool of *'anā 'anā* practices or black magic and was used during fighting between *kahuna* or families much like the famous battles between Kawelo of Lāna'i and Lanikaula of Moloka'i (Beckwith 1970:110-111).

During the field visit to Kaiwaloa Heiau, both Mr. Nahina and Mr. Kapu felt that it was time to bring the *heiau* back and *malama* (take care of) the *heiau*. They shared that the Season of Kū and

Season of Kane are the two times in the year in which traditional Hawaiian ceremonial practices and protocols are carried out at the *heiau*. Mr. Kapu noted that the Season of Kū is longer so that is mainly the time that they would perform the ceremonies at Kaiwaloa.

As a part of the preservation plan for Kaiwaloa Heiau several conditions for maintenance, public interpretation and buffer requirements were put forward (E. M. Fredericksen and Fredericksen 2001:10-11). With regard to the position of the public viewing platform, as proposed by the preservation plan, Mr. Kapu had suggested that this platform could also be the foundation for the *lele* (altar) and positioned near the location of the existing *lele* at the southwest corner. The location of the viewing platform site would be well away from the entrance and was further envisioned as a way to discourage public traffic within the *heiau*. Mr. Kapu also suggested that the field boulders that were not a part of the original *heiau* construction, but rather a result of mechanical push into the area during former plantation field clearing activities, could be used for construction material.

Mr. Kapu also noted that he had some ideas about public interpretive signage and access trails based on previous work at Pu'ukohola Heiau. In reference to interpretive signage, he suggested that it would be okay to place the signs at the viewing platform and further noted that it would be appropriate to include a panoramic shot of the *makai* view shed from the *heiau* in its present condition. This panoramic shot would the highlight prominent landmarks in the distance (i.e. Pu'u Ō La'i to the south, Molokini, Kaho'olawe, and Lāna'i, along with an unimpeded view of Alalakeiki Channel and Auau Channel) that may have been important aspects of what was happening at the *heiau* prior to western contact.

Both Mr. Kapu and Mr. Nahina would like to begin restoration efforts to remove the plantation boulder push from the outer edges of the *heiau* to get to the original wall or *niho* stones. As Mr. Kapu shared in a previous meeting, he again relayed an early effort to plant gourds and *tī* leaf along the exterior of the *heiau* before the water was turned off by the landowners. He felt that drought resistant native plants would be the most appropriate type of vegetation for the proposed hedge that would delineate the permanent buffer between the *heiau* and the *mauka* subdivision and suggested *a'ali'i* as an appropriate plant species.

5.2.5 Community Field Trip to Olowalu – January 18, 2013

A site visit and informal meeting was conducted at Olowalu Ahupua'a to discuss traditional cultural practices and historic preservation concerns with regard to the proposed Olowalu Town Masterplan. More specifically, the goals of the meeting were to understand descendant concerns and hear recommendations from descendants and cultural practitioners for the preservation of and access to Kaiwaloa Heiau and Pu'u Kilea Cemetery, as well as, other traditional cultural resources and practices that may be impacted from the proposed project.

Present at this site visit were Uncle Jonah Keahi, Ms. Linda Nahina Maglianes, Uncle Ernest and Auntie Ona Naho'oikaika, Mr. Daniel Kahaiali'i, Mr. John Kaialu Haia, Aunty Laura and Mary Saffrey, Ms. Leona, Ms. Helen, Mr. Robert, and Mr. Aukahi, Ms. Haunani Teruya, Aunty Cathy, Mr. Al Lagunero, Mr. Ke'eaumoku and Ms. U'ilani Kapu, Uncle Leslie Kuloloia, Ms. Victoria Kalapaii, Ms. Elle Cochran, Mr. Michael Lee, Ms. Claire Apana, Ms. Lucienne de Naie, Mr. Mark Dekos, Mr. Bill Frampton, Ms. Noelani Hessler, and Ms. Tanya Lee-Greig.

Ms. Linda Nahina Magalianes shared her lineal connection to Olowalu through the Keao-Kawehana line on her mother's side, as well as a direct connection to Ioane Nahina who was a *konohiki* of Olowalu and known as the Wind Watcher. Ms. Nahina further shared that, while she grew up in the fourth house from the Olowalu Store, in a line of plantation homes that once fronted by the cane haul road where the fruit and smoothie stands are currently located, their original family property and home was situated where the former piggery was located. During the field trip to Olowalu, she noted that it was important to care for the frontage areas, the coastline and the ocean for traditional medicine. Ms. Nahina also shared that the buffer for Pu'u Kilea and Kaiwaloa should 100 feet and more if possible and there should be a locked gate when the areas are not in use. The protective buffer should be enforced so that it is safe for practitioners. She stressed that when the cultural practitioners come, they should feel the privacy. Ms. Nahina is very concerned about what would happen to the lineal descendants who either live elsewhere and come back to Olowalu to re-connect or are currently living in Olowalu if or when the development begins. She shared that these thoughts weigh heavily, and are painful, because she has had experience in Olowalu where she was told to leave. Ms. Natina stressed that Olowalu is a place of refuge, and to see it now, to see it developed is painful.

Mr. Ke'eaumoku Kapu shared that his first meeting here was in 1999 and stressed the need for the preservation protection of Kaiwaloa Heiau and all of the historic sites and burials. Mr. Kapu wanted to ensure that the *heiau* retain a "solemn dignity without cars going through." To this end, Mr. Kapu would prefer a vehicular pullout below Pu'u Kilea as the focal point for signage and public education with access to Kaiwaloa Heiau restricted to pedestrian access, which would eliminate vehicular traffic, and limit access to the *heiau* structure to ceremonial practices only. He further noted that as a part of the ceremonial practices of Kaiwaloa Heiau, the beginning would be at the ocean where those who are a part of the ceremony will *hi'uwai* (purify) and prepare to go to the *heiau*. With this in mind, Mr. Kapu stressed that pedestrian access to Kaiwaloa Heiau must extend from the ocean and would like the access route to the *heiau* proper include the current alignment of the maintenance road which could be planted with tall palms along the Ukumehame side of the road to shield the practitioners and maintain the necessary privacy of the procession to the *heiau* from the landownders of the lots that are adjacent to Kaiwaloa Heiau. With direct regard to the *heiau*, Mr. Kapu wanted to see the *lele* (altar) to become a more permanent fixture to stay up for years; it is falling apart and needs to be restored as well as be able to make amendments to the current preservation plans for the *heiau* so that the point of access location is placed in a way to keep those who would be *maha'oi* (rude, presumptuous) from impacting this ceremonial site and prevent it from become a "Tourist Mecca." Addressing the protective buffers, Mr. Kapu wanted believed that the *heiau* should also have an additional no build zone of an additional 20 ft.out side of the preservation area. Recognizing that this may be a hard request, Mr. Kapu noted that it would help delineate the area from the adjoining land owners and potentially crossing the preservation boundary and encroaching into the proective buffer. He noted the possibility that the property *mauka* of the *heiau* had encroached into the preservation buffer and with palm plantings and equipment and wanted to know if this had been resolved. Mr. Kapu shared the connection between Kaiwaloa Heiau and its *kahuna* (priest) Kaopulupulu who was sent to Oahu to *malama* (take care of) the *ahupua'a* of Kaiwaloa and Kuholowelowelo Heiau. In the larger picture, Mr. Kapu sees Kaiwaloa as a part of the restoration of the temples of Hawai'i in the example of Pu'ukoholā which serves as the central temple of government and the anchor. He wants Kaiwaloa to be a living place. Finally, Mr. Kapu inquired as to the possibilities of returning the exclusion

areas to the descendants of the original land commission awardee as these are the people who would be most connected to the land and could monitor, maintain, and be involved in the Olowalu Cultural Reserve (OCR) and caretakership of the traditional sites and resources. Finally, Mr. Kapu suggested drafting a memorandum of agreement between the project proponent and the families of Olowalu.

Mr. Michael Lee shared that he is involved with the restoration of Alamihi Fishpond and *limu* propagation for medicinal and subsistence purposes. As a *papakilo hoku* (Hawaiian astronomer) he has made recommendations for modern lighting to maintain the integrity of the night sky, asserting that viewplanes for cultural practices are related to the celestial observances. Mr. Lee noted that it is important to know what is seen from the horizon at the 10 degree angle, and shared that triangulation is determined by landmarks and modern building heights and utility poles can obstruct the celestial plane. Similar to Mr. Kapu, Mr. Lee suggested that an agreement between the descendants of Olowalu and the developer be drafted and as a means to sustain the OCR, suggested that fees be attached to each property sale that would go to the OCR. With regard to studies of ocean resources, Mr. Lee suggested that in addition to the scientific assessments, there should also be an assessment of *makai* resources by the Native Hawaiian cultural practitioners and referred to similar studies by cultural practitioners that were completed at Waihe'e for assessing the traditional resources from mountain to sea. To stress this need and the *mauka* to *makai* connection, Mr. Lee noted Kumulipo Chant 1 which names the 13 *limu* and states that what is in the mountain (*ma uka*) protects the *limu* in the ocean (*ma kai*).

With regard to Mr. Daniel Kahaiali'i recommended that there be a monitor or docent present to protect Pu'u Kilea and share *mana'o* of the *ahupua'a* with those who were visiting or present within Olowalu.

Mr. Al Lagunero shared that his mother would take him to the area near Napoepoe to get medicine, his mother would pray but never go to *heiau* (Kaiwaloa). With regard to traditional practices, Mr. Lagunero noted that only some women allowed near the *heiau* as *kokua* (assistance) as the place for women was the *Hale Papa*. He felt strongly that access to historic properties, particularly Kaiwaloa Heiau, be closed to the public during seasonal changes and potentially beginning with the rising of Makali'i. Mr. Lagunero goes on to note that with Kaopulupulu, the four walls all come together which can be interpreted as the return of Hawa'i. In connection with the traditions and cultural practices, Mr. Lagunero wanted to see the creation of a *mapele* within the 13 acres of the OCR that had been set aside as conservation lands, between the stream and the pali on the Ukumehame side of the valley, which was created to protect water resources and perhaps redirection during the time of plantation uses. This area would be a place dedicated for prayer and *na koa* (warrior) practice under Mr. Kapu. Mr. Lagunero noted that the OCR has an alliance with and honors the Kupuna Council requests for *kahu* and *kuleana* for the Kaiwaloa Heiau to be upon Ke'eaumoku Kapu and Daniel Nahina. To increase the understanding of Loina Kane and *na koa* led by Ke'eaumoku, Mr. Lagunero offered this area for the private use of the *na koa* and the *kahu* with *kuleana* for Kaiwaloa. The OCR would maintain insurance as is. With regard to potential restoration and maintenance of Kaiwaloa Heiau, Mr. Lagunero wanted to clarify where and how activities and machinery specifically related to maintenance and restoration would access the area of Kaiwaloa Heiau in order to carry out restoration work. As a part of an overall vision for Olowalu, Mr. Lagunero shared that Olowalu could also be a school for ambassadorship and communication with the cousins to the South and as a place to bring the *kūpuna* (elders) and

keiki (children) to educate in a open, outdoor classroom. In this manner we could have traditional knowledge guide resource management and propagation. To this end, Mr. Lagunero noted that he would like to see a section of *la'au lapa'au* (medicinal plants) set aside for continuous gathering and with that would be the access to water which also connects to the coast and medicines and resources of the ocean and maintains connectivity.

Mr. Leslie Kuloloia shared concerns about the preservation and protection of Pu'u Kilea, asserting that only lineal descendents should have rights of access. He inquired as to how we would get people to not scale the cliffs and asserted that the buffer for this *pu'u* extend to the base of the *pu'u* with the best protection being to have the families on the land again. Mr. Kulolia wanted to remind folks that the native tenants rights to access and gather were reserved and never extinguished, stressing that practitioners are gatherers. With regard to traditional cultural practices, Mr. Kuloloia shared that viewplane is also important to *lawai'a* (fishing) traditions as well, and that the landmarks as seen from the ocean, must also remain visible as teaching the *lawai'a* traditions can only be done through the use of the visual landmarks. To maintain the integrity of the fishing grounds and upland resources, Mr. Kuloloia suggested that water quality be monitored, as these resources are dependant on the waters of the *ahupua'a*. Finally, with regard to funding sources for the OCR, Mr. Kuloloia cautioned about seeking federal government money as it would involve people that are not lineal and encouraged a look at other non-monetary avenues by reaching out to the people of other *moku* for *kokua*.

Ms. Laura Saffrey wanted to note that simply notifying landowners that there was going to be a cultural access to certain areas, rather than asking for permission, should suffice. With regard to the Kaiwaloa Heiau, Ms. Saffrey stressed the need for access and advocated for the elimination of a viewing platform. She noted that there needed to be a change in linguistics, and perhaps, if a viewing platform was needed, the access to the platform be restricted and its utilization be at the discretion of the descendents and cultural practitioners.

5.3 Hawaiian and Local Community Organizations

5.3.1 Polanui Ahupua'a Community Managed Marine Area (Polanui Hiu, CMMA)

The mission of Polanui Hiu, CMMA (Polanui Hiu) is to "utilize traditional Hawaiian terrestrial and marine management strategies to improve the quality of these ecosystems, increase the abundance of keystone species and to improve the quality of life for the local community who depends on these marine resources" (Polanui Hiu CMMA 2012). A consultation meeting regarding the Olowalu Town Master Plan was held with Mr. Bill Frampton of Frampton and Ward, LLC. and Polanui Hiu at the Lindsey home on Front Street in Lāhainā on Saturday, August 4, 2012. At this meeting, the members of Polanui Hiu shared their *mana'o* on the traditional marine and coastal resources of Olowalu Ahupua'a and their concerns about the potential for adverse effects to these resources that may result from the development the proposed master plan.

Mrs. Roselle Bailey and her husband Mr. Jim Bailey once resided in Olowalu. Mr. Bailey worked for the Pioneer Mill Company at Olowalu and noted that part of the history of the Olowalu Mill included a connection to Lāna'i as the Olowalu Mill was responsible for processing the cane harvested by the Maunalei Sugar Company. Raised in Lāhainā, Mrs. Bailey is a Native Hawaiian cultural practitioner and renowned *kumu hula* in Hawai'i and abroad. Mrs. Bailey wanted to make clear that Hawaiians need open space; they need to be able to see *mauka* to *makai* and smell *mauka*

to *makai*. There is a distinct smell to the *makai* areas and she asserted that there is a noticeable difference in the smell of the ocean air around the current construction areas fronting Ukumehame. Mrs. Bailey went on to explain that after WWII, the ocean became a place for recreation and that this focus on recreation rather than subsistence caused changes in the sustainability of the ocean resources. She notes specifically that the *limu* resources were negatively affected by sunscreen lotions and residues from recreational ocean users. With regard to specific marine resources, Mrs. Bailey shared a story about a Makawao school teacher, who was also an avid diver, had noted that the *he'e* grounds of the area were beyond the sandy area in front of the pier. She further remarked that while residing at Olowalu she noticed that the reef created a lagoon in front of the Manager's house which resulted in the presence of schools of *nehu*. Additionally, Mrs. Bailey recalled a time when Russian shell collectors had studied Olowalu and noted the existence of rare marine shells along the coastline. Mrs. Bailey posed questions about a plan for the development of the Olowalu shoreline as a secondary harbor site in the event of failure at Kahului Harbor and expressed that she would like to see the plan prevented altogether.

With regard to coastal flora, Mrs. Bailey shared that while many view *hau* trees as troublesome, these trees were useful and planted along the shoreline to encourage shoreline retention and create shade. She then referenced an *olelo no'eau* about Olowalu that mentions the winds tearing at the *hau* trees. Mrs. Bailey also noted that *pōhuehue* also grew along the coast of Olowalu. In reference to the *mauka* areas, Mrs. Bailey noted that she had hiked into Olowalu Valley and recalled the presence of *lo'i* all the way to the valley headwall

Both Mrs. Roselle Bailey and her brother Mr. Charlie Lindsey would like to see a planned area for a *halau wa'a*; as well as a designated landing site for the voyaging canoe. They explained that in order for this to happen and be useful, a channel was needed and noted that there was a channel that would fulfill this purpose by the old pier. Mrs. Bailey and Mr. Lindsey indicated that this would be a more appropriate location due to the existing channel.

Mr. Charlie Lindsey was raised on Front Street in Lāhainā and currently works for the Kaho'olawe Island Reserve Commission as Maintenance and Vessel Specialist. Specific to the *halau wa'a* and landing site, Mr. Lindsey noted that it would make sense to make use of what was used historically. Building on Mrs. Bailey's comment about the usefulness of *hau* as an important traditional Hawaiian resource, Mr. Lindsey also noted that the wood from the *hau* tree was also used in the manufacture of canoe parts and net floats. With regard to the overall development plans of Olowalu Town, Mr. Lindsey expressed strong concerns about the building heights and their adverse effects on the view shed.

In addition to being a member of Polanui Hiu, Mr. Scott Fisher also works as the Director of Conservation for the Hawaii Island Land Trust. Mr. Fisher expressed a concern that sediment-laden freshwater discharging into the ocean would result in adverse impacts on the coral reef ecosystem. As a separate, but related, issue, Mr. Fisher advocated for the implementation of any measures that could be taken to enhance regulated (natural) stream flow into the near shore waters, an action which would enhance the quality of the reef. Mr. Fisher requested that the project proponents implement adequate measures to control excessive sedimentation into the near shore waters around Lāhainā in general and Polanui specifically. As it relates to the Olowalu Town Master Plan, Mr. Fisher feels that it is absolutely critical that comprehensive measures are implemented to avoid sediment and chemical laden discharge onto the reef. Along these lines, Mr.

Mark Hecht also a member of Polanui Hiu suggested the formation of an Olowalu Community Marine Management Group whereby this group could function as a shoreline monitoring check both during construction and periodically following construction.

Mr. Edwin "Ekolu" Lindsey, currently the President of Maui Cultural Lands and a founder of Polanui Hiu, presented the overall concerns of the organization. First and foremost, the health of the fringing reef off of the shores of Olowalu Ahupua'a remains a priority. Mr. Lindsey asserted that they would like to see the creation and implementation of shoreline restrictions, similar to traditional *kapu* seasons or periods, as a means to maintain the health of the environment and allow recovery. He further expressed concerns about potential impacts to the marine resources from increased recreational use. Finally, Mr. Lindsey noted that there should be an area that was specifically set aside for traditional cultural fishing practices.

5.3.2 Maui County Cultural Resources Commission (MCCRC)

5.3.2.1 May 3, 2012 – Request for Comments on the Cultural Impact Assessment for the Olowalu Town Masterplan

The MCCRC was consulted on the proposed project for the current study at their monthly meeting on May 3rd, 2012. The following concerns and recommendations regarding the cultural resources of Olowalu Ahupua'a were shared. Ms. Rhiannon Chandler, Wailuku Representative, was concerned that a project, on the scale of what is proposed for the Olowalu Town Master Plan, is going to have a negative impact on the watershed and, perhaps most importantly, the coral reefs. She went on to point out that the fringing coral reefs of Olowalu are the most beautiful reefs on Maui and not only a part of the traditional cultural resources for Olowalu Ahupua'a but the entire Lāhainā coastline. Ms. Chandler explained that these reefs also act as a breeding ground for the fish population which then replenishes the fisheries of the west side; further stating that "when there is no reef there are no fish." For Ms. Chandler, the most culturally important area is in the water. As a member of the Maui County Coral Reef Recovery Team she notes that there is great concern for reef decline of Maui Island in general; however, at Olowalu it is felt that this area is one of the last places for fringing coral reefs on the island. Ms. Chandler noted that the because the reefs of Olowalu are the best example of fringing reefs on Maui, this resource has been studied and documented by many scientists as well as DLNR, and goes on to state that the environmental resources are the cultural resources and along with the scientific information it is all a part of the cultural traditions of the past and the future. Ms. Chandler recommended further consultation with Puanani and Ekolu Lindsey, Rose Marie Duey, Roselle Bailey and Mary Helen (Roselle's sister). With regard to the archaeological resources of Olowalu, Ms. Chandler inquired if the historic properties that were identified during the archaeological work were going to be put forward for nomination to the State and National Registers of Historic Places.

Mr. Ray Hutaff, Chair of the MCCRC expressed a concern about water runoff and other effects of development noting that the Olowalu fishery is also a breeding ground for sharks. He further stated that any development within the area would have to be done so well that it would not impact the ocean at all. Mr. Hutaff also recalled surfing and diving in Olowalu and noted the presence of up to 200 sharks at night. With regard to the Olowalu Town Master Plan, Mr. Hutaff requested that the MCCRC be a part of the continuing process.

Mr. Gaylord Kubota, Kahului Representative to the MCCRC, also expressed concerns about the offshore fisheries of Olowalu, additionally noting that the area is also a known manta ray breeding ground. Mr. Kubota read from a letter to the editor, written by Dr. Mark Deakos of the Hawaii Association for Marine Education and Research, about concerns for the fringing reef at Olowalu in relation to the location of the proposed Olowalu Town and the potential effects that the project might have on the habitat of the giant manta rays which use the reef as an area for removing parasites and plays a role in their social and reproductive behavior (Deakos 2012). With this in mind, Mr. Kubota inquired about the management of wastewater and whether or not injection wells would be developed as a part of the proposed project.

Overall, the MCCRC requested future updates as well as inclusion the process with regard to Olowalu Town with additional opportunity to comment on the Final CIA and DEIS.

5.3.2.2 December 6, 2012 – Review and Comment on the Final Cultural Impact Assessment Report for the Draft Environemental Impact Statement for the Olowalu Town Master Plan

The MCCRC was approached for review and comment on the current study at their monthly meeting on December 6th, 2012. The following concerns and recommendations regarding the cultural resources of Olowalu Ahupua'a were shared during public testimony.

Ms. Haunani Teruya, though not currently living in Olowalu was raised in Olowalu and is a lineal descendant of Keaweikekahiali'iokamoku, Kalaninuiamamao, Kalani'opu'u, O Kalei'opu'u. Ms. Teruya expressed concerns about marine resources and the continuation of traditional fishing practices for the families of the area. She wanted to ensure that when plans are made, that the decisions and actions are *pono* (correct, just, moral) for the benefit of the future generations.

Ms. Linda Nahina Magalianes, a lineal descendant of Olowalu through the Kawehena line whose *kupuna* are buried within the cemetery at Pu'u Kilea. Ms. Magalianes shared concerns about not being directly contacted with regard to consultation as a lineal descendant and inquired as to the why the development of Olowalu was being put forward if the area is so sacred (spiritual). She further expressed specific concerns about the development of the area and the impact that it would have on the *heiau* (Kaiwaloa), perhaps not immediately but in generations to come. She noted that Kaiwaloa Heiau is the *piko* (center) fo the whole *ahupua'a*.

Mr. Ke'eaumoku Kapu of Lāhainā, and one of the caretakers of Kaiwaloa Heiau, expressed concerns about the images of the survey plans from the Land Commission Awards being included in the cultural impact assessment document and subsequently in the EIS. In consideration of issues with regard to title, exclusion areas, current ownership, and continuing issues, he felt that it was wrong to include the Land Commission Award survey plans in the document. Mr. Kapu also wanted to make clear that initial consultation (see also Section 5.2.4) was specifically to address Kaiwaloa Heiau and and ensure that impacts were minimized. As a part of the public testimony, Mr. Kapu also wanted to recommend that access to Olowalu Petroglyphs be discontinued in consideration of the fact that the petroglyphs are located at the base of Pu'u Kilea, the location of a family cemetery, and sensitive for the families of the area. He noted that he as observed whale watchers go up to the top of the *pu'u* to count whales, and wanted to see a strong recommendation to minimize access in the upper areas of the *pu'u* to provide the highest protection for the family burials of that area.

Ms. Katherine Smith, who assisted this study with translations of the testimonies, expressed that for those that had been displaced from Olowalu and opportunity might be presented to be able to come back to live in Olowalu with the plans for affordable housing within the proposed development. With the lineal descendents coming back to Olowalu there is a picture developed with the present descendents, the mahele 'aina records, the land use information, and this story of what was going on int eh *ahupua'a* can actually be put together.

Mr. Leslie Kuloloia spoke to three points concerning Olowalu where the MCRC could explore initiating recommendations with regard to cumulative impacts that would be seen 50 years down the line following the completion of the development. He expressed an appreciated fro the development of an Olowalu marine shoreline ocean management plan (see also Section 5.3.1). Mr. Kuloloia elaborated that the *ahupua'a* system includes the ocean, includes the access from the ocean to the *moku* (island, district, section), and from the *moku* to the ocean and so on. He asserted that it needed to be clear how *ahupua'a* and *moku* systems were described and that there would be no slow fragmentation of a traditional place. With that, Mr. Kulolia wanted to see the advisory (Olowalu marine shoreline ocean management plan) be put in place. He expanded on this and recommended that a protected zone to 20 fathoms be put in place, limit boat size, and create a grid system to monitor. Mr. Kulolia further recommended that the group that is developed engage other key agencies, including NOAA and the US. Army Corps of Engineers, further pointing out that such Federal agencies may have been involved in the plantation planning process during the 1800s with regard to the development of irrigation systems. In addition to developing the advisory group, as a part of a management plan, Mr. Kulolia recommended that a reef study be initiated to understand how the ocean resources have been impacted and the people will have a triggering account and at least a monitor station. He asserted that this could be a model to protect our resources, that Olowalu could be the first one, where this community, Olowalu community can pict their *kuleana* (responsibility), pick their voice so that they protect their *moku* in front, in the ocean, around and they have a voice in how the reefs should be protected and giving it the bes of help to get the best of marine life in that area.

Ms. Lucienne deNaie referred to her knowledge of the Olowalu area through *mana'o* passed down to her and others from *kūpuna* Renee Silva and Ed Lindsey in 1996 as they visited areas that they felt could be impacted by development. Ms. deNaie expressed concerns about lighting impacting the visibility of the night sky, even with shielded lightning. She further noted a conversation with Mr. Bob Hobdy, who she had interviewed for the Ocean Resources Management Plan, where he stated that an archaeological review of the offshore waters should occur. In this interview, Mr. Hobdy had stated that more than 40 traditional Hawaiian sinders for the *he'e* (octopus or squid) have been found off of the shores of Olowalu. Ms. deNaie further asserted, and looked for recognition that, there was no guarantee for the (Olowalu) Cultural Resource Preservation Area to exist in perpetuity, as there is a 99-year lease for the reserve which was created as an easement. She explained that there is language in the CC&Rs that states that any easement can be changed unilaterally by the primary property owners, and therefore the reserve does not have a secured future. Ms. deNaie asserted that a cultural preserve like the Olowalu Cultural Reserve should have a conseratin easement in perpetuity and reiterated the suggestion of Mr. and Mrs. Duey (see also Section 5.2.2) that a stewardship fund to be created to defend that easement. With regard to impacts, Ms. deNaie recognizes that there is going to be policies put in place for the development to deal with such impacts; however, she is concerned about the

enforcement of those policies. Examples such as road construction methods and potential impacts from construction related ground vibration near Pu'u Kilea and the smaller *heiau* downslope of Kaiwaloa Heiau where brought forward. She further elaborated that impacts to existing portions of the Alaloa should be made clearer as this would be a cultural impact were as the road goes away, all the memories of walking the road disappeard. Finally, Ms. deNaie expressed concerns about elaborating on the impacts to the marine environment, specifically the reefs, due to water runoff from lawn and green space watering in addition to rain water.

Mr. Clayton Naho'oikaika, who is a fourth generation lineal descendant living at Olowalu expressed that his mother was against the development of Olowalu and that he was expressing this *mana'o* (opinion). Mr. Naho'oikaika, asserted that the proposed development will impact him and his family, as well as the generations to come.

Mr. Kapali Keahi of Lāhainā, a lineal descendant of Olowalu who has family that currently resides in the *ahupua'a* was concerned about the ability for families that had been displaced to return to Olowalu and live. Mr. Keahi asserted that in his experience, and given the track record of the backers of the development, that there is no integrity for the people, especially the culture. He recalled the first time that he fished in Olowalu at age seven with a single-prong spear. Mr. Keahi noted that a single-prong spear was all you needed at that time, there was no need for a three-pronged spear out there because the *manini* (convict tang, *Acanthurus triostegus*) and *akole* (*kole*, yellow-eyed surgeon, *Ctenochaetus strigosus*) was so abundant. He stated that Olowalu was the place to go fishing, you didn't really need to hunt over there because the *manini* and *akole* were so thick underneath that reef that you can just stay in one place and get what you need, that is how abundant the place used to be and it's been impacted detrimentally. Mr. Keahi asserted given all the impacts, and even with promises to the people, he is of the belief that these promises will not be kept. He expressed that he wished that there was more time and that there would be more meetings concerning this project and many others because the processes that are available do not provide channels for the Hawaiian culture to ensure that things will be done for the benefit of the culture. He noted that many things happened in the past that are difficult to resolve because there is no place for resolution in the current discussions. Long standing issues with not just the current developer, but issues that date back to the plantation are still very real, and to Mr. Keahi and others the plantation was a thief. Mr. Keahi wants to ensure that none of the land is taken away from the families, which is in, and of itself, a cultural resource that they had been cut off from. Finally, Mr. Keahi wants to ensure that the families that have *kuleana* within Olowalu have support and are taken care of.

Ms. Elle Cochran of Lāhainā testified on her own behalf and expressed concerns about the families who had shared concerns and the fact that they had not been individually consulted noting the number consulted was very limited. Ms. Cochran further asserted that the CRC understand the importance of the *mana'o* and *'olelo* of the area and that there is much more of it out there.

Commissioner Bruce U'u wanted to recognize the recommendations put forward by Mr. Ke'eaumoku Kapu regarding minimization of access to sensitive areas, including ocean commercial activities. He asserted that if there was going to talk about sensitivities, then we needed to talk about the *ahpua'a* system. Commissioner U'u further recognized the recommendation from Mr. Leslie Kuloloio to conduct a reef study and the perhaps Olowalu Town can contribute or someone would take on the study to be used as a model for other areas. Finally, Commissioner

U'u wanted assurances that the families that currently live in Olowalu would not be removed from their lands.

Commissioner Makalapua Kanuha also reiterated the need to minimize access to the culturally sensitive areas in Olowalu. She questioned the impacts to families still living at Olowaly and those who want to return, how the proponents of the project would deal with these potential issues. Commissioner Kanuha wanted to further recognize the recommendation of the creation of an Olowalu marine ocean management team with regard to studying runoff and construction impacts in the marine environment. Finally, and perhaps most important, Commissioner Kanuha wanted to ensure that the project proponent commit to reaching out the *kanaka maoli*, the native Hawaiian people who still live there to get their input because it will impact their life at Olowalu.

Commissioner Warren Osako referred to his experiences on Lāna'i and expressed caution with regard to easements in perpetuity and memorandum of agreeements. Commissioner Osaka advised that prior to making agreements of that kind that there be some really good legal advice regarding enforceability.

Commissioner Gaylord Kubota expressed a particular concern regarding runoff and the implementation of best management practices. Commissioner Kubota wanted to see the details regarding what the best management practices would be and what kind of commitment would be put forward. Though the project proponents may form the Olowalu community marine management group, Commissioner Kubota wanted to see a more formal commitment, a stronger commitment to the marine resources, like the discussion on taking care of the *heiau*, be written into the document.

Commssioner Rhiannon Chandler reiterated Ms. Elle Cochran's concern on the low number of individuals consulted. Commissioner Chandler also noted the mention of native plants historically noted versus what is stated for the current environment in the document and requested that the potential presence of additional native plants within the *ahupua'a* be mentioned within the natural environment section. With regard to the destructive winds of Olowalu, Commissioner Chandler wanted to recognize the difficulty of working with the *makani* (wind) and was unsure that everyone knows that in order to work with the *makani* you need to yield to it. With regard to the place Kaluakanaka, Commissioner Chandler wanted to see further elaboration on Kaluakanaka in relation to the burial preservation areas or land commission awards. Commissioner Chandler also revisted concerns expressed by Mr. and Mrs. Duey regarding mitigation or prevention of swimming pools, swimming pool water, any type of treated water, or chemical leach leaking tht would destroy ocean life. She referred to issues that are occurring along these lines off of Front Street were individuals empty their chlorine into the ocean and devastating the adjacent area. Commissioner Chandler expressed concerns over the potential density of the project and potentially little control over certain actions, like swimming pools and the choices of individuals living in a place that they may not understand or have an attachment to referring to promises made in Kihei that the reefs would not be damaged and through the years they have been damaged, the *limu lipoa* grounds are gone. She asserted that the people who are saying things (about protecting the ocean resources) need to be heard. Commissioner Chandler read the following from her previous quote to amplify concerns regarding cumulative impacts and degradation of the marine environment:

> So I am concerned about the project and the scale of what is proposed for the Olowalu Town Master Plan. It's going to have a negative impact on the watershed. It's going to have a negative impact on the watershed. We don't know what that is. But I think it's safe to say that a project of this size, in an ahupua'a, developing pretty much the full extend of an ahupua`a cannot not have an impact on the watershed whether that's just concrete preventing absorption into the aquifer or anything if anything. The fringing coral reefs in Olowalu are the most important beautiful reefs on Maui and are not only a part of the traditional cultural resources for Olowalu ahupua'a, but the entire Lahaina coastline and the coastline of Lana`i and Moloka`i as well. The reef act as a breeding ground for the fish population that replenishes the fisheries of the west side and out into the channels. If we don't have a reef, we have no fish. We have no fish, we have no limu. We have no sharks. We have nothing. You know, I mean it's a big deal. [Minutes of the Cultural Resources Commission Regular Meeting, December 6, 2012]

She further expressed concerns regarding the scale of the project and referred to her time as a member of the Maui County Coral Reef Recovery Team where they have studied reef decline throughout the island change and the common pattern that is reflected is where there is development, there is reef decline. Commissioner Chandler asserted that some places are just special, while the development plan is grand and the ideas behind the plan have a beautiful intention, she believes that it would be best suited to a place other than Olowalu stating that she is not anti-development, she is just pro-Olowalu and pro-reef and finds the proposed development frightening because it is a plan to develop an *ahupua'a*, a watershed. So many of the chants included in the CIA document are so eloquent and mention the features of the land – they get lost under development. Finally, Commissioner Chandler believed the proposed plan to be beautiful in a place where there's no reefacross the street that threatens the future of our food security.

Commission Chair Hutaff addressed the winds of Olowalu and the best management practices as far as dust mitigation and soil runoff and the fact that it will be very challenging to manage or plan for in light of the changing direction of the winds and sporadic nature. Chair Hutaff expressed concerns about the failure of best management practices, as there are no 100% guarantees, and recommended that the best management practices be better management practices to understand the complexities of the winds. With regard to the water resources, Chair Hutaff wanted to ensure that the tributaries to the main stream remained as a pathway for the water to come down to the ocean. He wanted to further understand how impacts from inclement weather and extreme weather/geological events such as hurricanes or earthquakes would managed with regard to siltation and potential chemical runoff into the ocean. Chair Hutaff referred to impacts from the Polipoli forest fire and resulting effects on Kīhei from flooding, increased siltation, and movement of green waste from the gullies downstream. With regard to ocean management, Chair Hutaff expressed concern about increased pressure on the marine environment due to increased population density. He noted that as a commercial operator there were laws and rules that needed to be followed with regard to conduct and if they are not followed then the license to operate is revoked, so as a commercial operator they are bound to take care by law – not just by personal desire – but by law. In light of these rules on conduct for commercial operators within marine environments, Chair Hutaff suggested that use of the waters surrounding Olowalu be limited to cultural practitioners and commercial operators with qualifications who are trained in traditional fishing methods to perpetuate traditional knowledge. Finally, Chair Hutaff wanted to ensure that there were reforestation plans in areas that had experienced some environmental degradation in

order to maintain clean water and integrity of the relationship between the ocean, land, and humans.

Section 6 Traditional Cultural Practices

The arrangement of a typical Hawaiian *ahupua'a* extended from the coastline to the upland forest areas. When looking at the perceived boundaries of the *ahupua'a* Mr. Al Lagunero (see also Section 5.1.2 and Appendix E) encourages an effort to look beyond straight boundaries drawn on a map and with regard to Olowalu explains that:

> The star that brings the canoes to Hawai'i, the star that is the tutelary star of West Maui is Rigel, Puanakau, is the constellation and in that comes the guide to Makali'i. In terms of the historic factor of that and having people look at *ahupua'a* different than just land marked by straight boundaries. We have at least that kind of thing, talking about walking in the steps of the ancestors. So when we come to realize the connections that way, *iluna*, *ilalo*, you can have a little bit. It continues to help to grow community awareness. The idea of experience is something that really is so important and I think the access to the land and ocean at Olowalu allows us an opportunity to bring that experience to both, you know those kinds of areas.

Depending on the location within this broad *makai* to *mauka* context, and guided by knowledge of the natural environment, a wide variety of cultural practices and resources within the *ahupua'a* could be found. Such resources and rights would include marine resources and fishing rights in the coastal area, arable lands for crop cultivation, as well as, water and timber rights in the planting zones, and valuable bird catching privileges at the higher elevations (Handy et al. 1991:48). Based on the land commission award distribution in the *mauka* and *makai* sections of the current project area as well as the stories and information gathered during the background research for this study, it is apparent that settlement and land use within Olowalu Ahupua'a functioned in the typical traditional sense.

The general pattern here was to maintain two residences, a *makai* residence that could take advantage of the vast marine resources and a *mauka* residence to maintain the staple taro crops and other supplemental crops that would be used for both dietary and utilitarian needs. The waters of Olowalu Stream were perennial and would have supported *lo'i* agriculture all the way down to the coast with some freshwater aquatic resources that were also likely available along the lower reaches of the stream system. As a whole, the primary traditional activities within the coastal area would have centered around marine resource exploitation, domestic activities during the hottest times of the day, and agricultural pursuits associated with maintaining a home garden.

Discussions on specific aspects of traditional Hawaiian cultural resources and practices, as they may relate to the current study area, are presented below.

6.1 The Mauka Environment of Olowalu Ahupua'a and Traditional Hawaiian Agricultural Practices

Based on the testimony for *kuleana* claims during the Great Māhele, the writings of both Handy and others (1991) and Winslow Walker (1931), in addition to the findings of the archaeological inventory survey conducted for the *mauka* lands of the proposed project (D. L. Fredericksen and Fredericksen 2000b) it is clear that within Olowalu Valley and along the original stream route, traditional Hawaiian agricultural practices were fairly intensive and based primarily on *lo'i* agriculture followed by dry land cultivation (see also Section 3.1.2.1 Ka 'Oihana Mahi'ai no Olowalu – Traditional Hawaiian Agriculture at Olowalu). In all, there were *kuleana* claims for a minimum of 1124 *lo'i kalo* (pond field taro patches), 28 *'uala* (potato) patches, 27 *kula* (open field or pasture), and 31 plots of land with unspecified land uses (e.g. *mo'o, pā, mala, mahina*) (see also Table 1). When examining this level of agricultural intensity during the mid-1800s, and what it might mean in terms of population, Marion Kelly presents missionary estimates for the productivity of *lo'i kalo* or pond field agriculture as a minimum of 10 individuals to a maximum of 30 individuals per acre of *lo'i* (Kelly 1989). This range in productivity would be been dependent on the topography, sunlight, and soil. The qualitative implication here, is that even following a likely decline in population due to the introduction of Western disease, the horrific results of the Olowalu Massacre (see also 3.1.2.3.2 The Eleanora and the Incident that Led to the Olowalu Massacre), and shifts to a commercial economy, the above claims indicate that a sizeable settlement remained at Olowalu.

Other resources that appear to have been maintained and cultivated in addition to those listed above include *kalo malo'o* (dry land taro), *mai'a* (banana), *wauke* (paper mulberry, *Broussonetia papyrifera*), and *'ulu* (breadfruit, *Artocarpus spp.*); as well as explicit claims for *hala* or *pūhala* (Screwpine, *Pandanus tectorius*), *hau* (*Hibiscus tiliaceaus*), *niu* (coconut, *Cocos nucifera*), *kou* (*Cordia subcordata*), and *kukui* (*Aleurites molucanna*) (see also Section 3.1.4.2 The Great Māhele and Appendix A). The cultivation and maintenance of plant resources such as *wauke, pūhala, hau, kou, and kukui*, along with certain parts of the *niu* would have provided a more utilitarian purpose rather than dietary.

A total of eight individual *kuleana* claims were made for *wauke* (Helu [Claim Number] 4376 to Keahi, 6189 to Punia, 8062 to Hue, 8546 to Kaawili, 8651 to Kealoaihue, 8668 to Kaiwi, and 8887 to Kaikuaana). Though not the only fiber source for *kapa* making, *wauke* was a common *kapa* plant that was usually cultivated around the *pāhale* (house site) or *lo'i* by both men and women (Abbott 1992:51). *Kapa* making for clothing was a labor intensive task, the work of which was divided between women and men where the women were largely responsible for the production and finish of the cloth and the men were largely responsible for finding the plants for the dyes and making the tools (i.e. beaters, anvils, and stamps) (Abbott 1992:51).

Hala or *pūhala* was a versatile plant whose parts were useful in a variety of ways, from making household items (i.e. cordage mats, baskets, and sleeping pillows) (Abbott 1992:63, 71-74), for use in personal adornment (i.e. paint brushes for *kapa* and *lei* making) (Abbott 1992:54-55, 128), and as thatch finish (Abbott 1992:69); as well as serving medicinal and minor dietary needs (Abbott 1992:43, 99). Kuleana claims for *pūhala* were sometimes further noted as *pūhala lei* for *lei* making or *pūhala* (*lauhala*) *moena* for the manufacture of sleeping mats (Helu 3726 to Malaea, 3772 to Alapa'i, 3811 to Lupe, 3877 to Pikao, 3934 to Ni'au, and 4376 to Keahi, see also Figure

8) thus distinguishing a preference for certain areas of *hala* growth for specific tasks or uses. According to Isabella Abbott (1992:128), the *lei* of *hala* fruits were made only for personal use and never presented to others except with malice. She goes on to say that the reason for this is that *hala* also means "death," and in traditional Hawaiian culture, even the hint of such a double meaning would be avoided.

Hau is noted in the *mo'olelo* associated with Olowalu, the *kuleana* claims of the Māhele (Helu 8585 by Kealoha), and the traditional practices and sustainable conservation efforts noted by participants in this study. Mrs. Roselle Bailey recalled the *'olelo no'eau* that tells of the winds tearing at the *hau* trees in Olowalu (Pukui 1983, 'Ōlelo No'eau 1457) (see also Sections 3.1.1 He Mo'olelo no Olowalu and 5.3.1 Consultation with Polanui Ahupua'a Community Managed Marine Area (Polanui Hiu, CMMA)) and how the *hau* plant, though often seen as a nuisance when growing wild, was also useful for encouraging shoreline retention and creating shade in an environment where the sun is notably fierce. Though not water resistant or very durable, cordage produced from *hau* was a simple type of cordage that could be made with little training and likely put into service on a daily basis, from *lei* making to hauling dugout *koa* logs from the mountain to the shoreline (Abbott 1992:62). Mr. Charlie Lindsey also noted that *hau* was used for making net floats and along similar lines and due to the properties that made *hau* useful for floats, the wood of the *hau* tree was also used in the manufacture of the outrigger for the canoe (Abbott 1992:82).

Kou is considered a Polynesian introduction, or canoe plant, to Hawai'i. The wood of the *kou* tree is used in the construction of *'umeke lā'au* (wooden containers) (Abbott 1992:87) and the leaves provided a light tan dye that was used as a background color in *kapa* making (Abbott 1992:57). *Kuleana* claims for *kou* were presented by Keawehena in the *'ili* of Hawaiikekee (Helu 5740) and Peekauai in the *'ili* of Kamani 1 (Helu 6058).

Niu, a versatile resource that finds the history of its origins rooted in legend (Abbott 1992:33-34), was specifically claimed by Makanialoha (Helu 10127) and Maui (Helu 10128). Like *hala*, *niu* was used for both dietary needs as well as utilitarian purposes. As a food source, *niu* was *kapu* to women, thus limited to consumption only by men and used in one of two ways, either as an added ingredient in cooked dishes or processed to make "coconut cream" (Abbott 1992:35). With regard to the utilitarian uses of this resource, the different parts of the tree and fruit were used for household items (i.e. containers, utensils, mortars, thatching, and fan material) (Abbott 1992: 69-70, 76, 96, 95, 103), musical instruments (Abbott 1992:119), fish bait (Abbott 1992:85), and in place of human sacrifice (Abbott 1992:17).

Mr. Al Lagunero also points out the *kūkui* (*Aleurites moluccana*), *māmaki* (*Pipturus albidus*), *ko'oko'olau* (*Bidens spp.*), *'uahloa* (*Waltheria indica*), and *tī* (*Cordyline fruticosa*) would also have been present in the valley of Olowalu. According to Mr. Lagunero, and though *'uhaloa* is often dismissed as a weed, this plant has important medicinal value when ingested as a tea. With regard to native plant habitat, Mr. Lagunero states that *tī* would have been found along the stream course, *māmaki* would have been found where the water collected, and *ko'oko'olau* would have been found along the ledges. The presence of *kūkui*, was not only important for the commonly known domestic uses but for the *mahi'ai* aspect of traditional culture as well. Mrs. Katherine Smith explains that from her recollection of the writings of Handy and Handy, the plant was purposefully planted "on the slope above the valley floor so that the nuts run down hill and then underneath the nuts and the leaves become the compost for the *'uala*." Mr. Lagunero also points out that the *kūkui* also played a role in not only keeping the water cool but also as mechanism for creating a fish

habitat *makai* and further illustrating the link between *iluna* (up), *ilalo* (down), *mauka* (inland), and *makai* (sea):

> where the *kukui* nuts flow out and then they create a sediment in an area and the sediment helps create different habitats for fish. I think one of the board members mentioned that if we plant too much *kūkui*, it's *'a'ole maika'i* for the whole. I was thinking, "Oh, it's not only up there but down there by the ocean." You know when we go certain places and all those things are coming down from the mountain and creating that sediment.
>
> Yeah, so it's an important factor for those kinds of plants and we have plenty *kukui* trees or want to plant more kukui trees, keep the water cool in our area.

6.2 The Marine Environment of Olowalu Ahupua'a and the Traditional Cultural Resources of the Shoreline and Off Shore Area

Notable for an accessible low coastline and well developed reef system, Olowalu would have provided excellent opportunities for fishing and *limu* (seaweed) gathering. With regard to *limu* varieties that were present on the Olowalu shoreline, Mrs. Adeline Rodrigues recalled that while *wawae'ole* (*Huperzia mannii*) once grew along the shoreline fronting Kapāiki, she now notes that this type of *limu* is no longer present (Section 5.1.1 Mrs. Adeline Rodrigues and Appendix E). Mrs. Rodrigues also remembered the presence of *lipe'epe'e* (*Lawrencia succisa*) near the wharf. This type of *limu* was specifically mixed with raw *he'e* (squid) and *ake* (pork liver). Finally, *limu līpoa* (*Dictyopteris plagiogramma*) was noted as being present at Papalaua in Ukumehame and though not directly in Olowalu Ahupua'a, may have been important to those that lived in Olowalu given the companion relationship between the two lands (Section 5.2.1Mr. Hinano Rodrigues). Mrs. Rodrigues then goes on to mention that she had not smelled *limu līpoa* or *lipe'epe'e* in while and speculated that the cause may be related to "what we are putting in the water. The thing(s) they are putting on their body (sunscreen)." Mrs. Roselle Bailey also states that there is a "noticeable difference in the smell of the ocean air around the current construction areas fronting Ukumehame." Mrs. Bailey explained that after WWII, the ocean became a place for recreation and that this focus on recreation rather than subsistence caused changes in the sustainability of the ocean resources. Like Mrs. Rodrigues, Mrs. Bailey also notes that the *limu* resources were negatively affected by sunscreen lotions and residues from recreational ocean users. To balance the environment, Mr. Al Lagunero (Section 5.1.2 Mr. Al Lagunero and Appendix E) would like to see the *limu* come back to the shoreline and suggested that families could begin to plant *limu* at the little bays along the shore as a way to replace what "has been taken away from the waters" and when the is *limu* healthy, then the fish population is healthy.

With regard to traditional fishing practices, such methods included *paea ea*, *kukui hele pō*, and *ho'omoemoe*. *Paea ea* fishing, or bambooing, is generally a low-impact fishing method that was carried out from the shoreline using a straight pole or bamboo. Commonly practiced in Olowalu, during traditional times up until the present, this type of fishing was only conducted on nights of the new moon, a phase of the moon that is referred to as "dark night" or "pitch dark night". Although they have not done it in a while, Mrs. Rodrigues recalled a time when she and her husband would have *paea ea* fishing contests for *ū'ū* (menpachi) or *papio* (*Caranx spp.*) along the fishing grounds between Olowalu and the Pali. Mrs. Rodrigues also noted that her husband would practice *kukui hele pō*, also called *lamalama*, a fishing method that was conducted at night by torch light and spear. She explained that the reef in front of the wharf was where her husband would go

out. In testimony shared at the December 6, 2012 MCCRC meeting, Mr. Kapali Keahi (see also Section 5.3.2.2) shared that Olowalu was well known for the abundance of *manini* (convict tang, *Acanthurus triostegus*) and *akole* (*kole*, yellow-eyed surgeon, *Ctenochaetus strigosus*), noting that the schools were so thick that only a single pronged spear was necessary to catch what you needed. Other reef resources noted by Mrs. Rodrigues included *loli* (sea cucumber, Holothuroidea), *wana* (black sea urchin, *Echinothrix diadema*), and *he'e* (squid). According to both Mrs. Adeline Rodrigues and Mrs. Roselle Bailey (Section 5.3.1 Polanui Ahupua'a Community Managed Marine Area (Polanui Hiu, CMMA)), the reef between Ukumehame and "Cut Mountain" also provided one of the best *he'e* grounds on Maui. Mrs. Rodrigues recalled that her grandmother was an "ace" at catching *he'e* and remembers seeing the clothes line at her grandmother's house filled with drying *he'e*. Mrs. Rodrigues also remembered accompanying her grandmother *makai* when she would collect enough *he'e* to give to each resident along the coastline of Olowalu and still be able to have some left over for her family. Mrs. Bailey mentioned a conversation with a Makawao school teacher, an avid diver who noted that the *he'e* grounds of Olowalu that were located beyond the sandy area in front of the pier was an excellent area for *he'e*.

The sheltered reef of Olowalu is also a well known site of a nursery for *manō lālākea* (blacktip reef shark, *Carcharhinus melanopterus*) and home to the family *aumakua* of Mrs. Rodrigues and her son Mr. Hinano Rodrigues. *Manō lālākea*, would sometimes follow the fishermen around the reef and was thought to be harmless by Hawaiians (Titcomb 1972:107) as is evident when Mr. Rodrigues retold the story of how his grandmother would admonish them for being scared of the sharks and instruct them to get back in the water (Section 5.2.1 Mr. Hinano Rodrigues). With regard to the shark nursery, at the monthly meeting of the Maui County Cultural Resources Commission, Mr. Raymond Hutaff explained that as a surfer and diver, he was familiar with the area and once noted the presence of up to 200+ sharks. In addition to the shark nursery, the reef area is also an important breeding ground and habitat for *hihimanu*, or the manta ray, which plays an important role in the social and reproductive behavior of these creatures (Deakos 2012). Mr. Rodrigues states that as lineal descendents of the Olowalu, he and his *ohana* (family) have always known about the presence of *manō* (sharks) and *hihimanu* in this area.

Beyond the reef, Daniel Kahā'ulelio writes of fishing for *akule* (bigeye scad, *Selar crumenophthalmus*) off of a place called Unahi at Olowalu (Kahā'ulelio 2006:201) (see also Section 3.1.2.2 Ka 'Oihana Lawai'a no Olowalu – Traditional Hawaiian Fishing and Other Aquatic Cultural Resources of Olowalu). *Akule* ran in large schools and catching this type of fish could only be accomplished through the combined efforts of the community. *Akule* fishing would require at least two manned canoes and a *kilo* (spotter), who was either stationed on the prominent headland or in a canoe, to guide the fishermen toward the grounds where they would surround the fish with curtain nets and draw them toward the shore to those who waited to help with the catch (Kahā'ulelio 2006:201).

Finally, the presence of Kalokoi'aokapāiki, the *ali'i* fishpond at Kapāiki and an unnamed fishpond near Awalua (see Figure 13 and Figure 17) also indicates that aquaculture, though reserved for the *ali'i*, was also a part of the traditional subsistence of Olowalu. Mrs. Rodrigues explains that at Kalokoi'aokapāiki, the remnant of which is located in front of her home belongs to the Chiefess Kalola, sister to Kahekili and wife to both Kalaniopu'u and Ka'opuiki:

> It's a fish pond (Kapāiki pond) ... and that pond and the fish, that was for the *Ali'i*, cause where my property is, that is where chief ... Kalola, that's where she lived. Kalola's

property (is not) the Saffery's ... where the Saffery's lived. Where the Saffery's lived, (that) is where the servants lived.

During the archaeological inventory survey conducted for the *makai* lands of Olowalu for the then proposed Olowalu Elua development project, Xamanek Researches identified an area that was likely associated with Kalokoi'aokapāiki and documented it as SIHP 50-50-08-4822 (D. L. Fredericksen and Fredericksen 2000a:57). As noted in the literature review and field inspection conducted by Cultural Surveys Hawai'i (Lee-Greig 2012:71), SIHP -4822 currently functions as a drainage basin between the present alignment of Honoapi'ilani Highway and the access road to Kapa'iki Village; however, it is clear when looking at the historic maps in relation the approximate location of the site that this location as documented by Xamanek Researches is consistent with the location of the *loko* (Figure 20).

Figure 20. A portion of the 1881 Olowalu Sugar Plantation map (Monsarrat 1881) showing the former pond location and *kuleana* parcels of Kapa'iki Village in approximate relation to current historic property boundaries (shaded in blue), current built environment (outlined in red) and proposed Olowalu Town plans (outlined in black).

With regard to the marine resources of Olowalu and the proposed project, Ms. Haunani Teruya (see also Section 5.3.2.2) was concerned about the ability to continue traditional fishing practices for the families of the area. Mr. Leslie Kulolia is expressly concerned about the potential impacts to the marine resources and continuation of *lawai'a* traditions and maintenance of the integrity of the fishing grounds (Section 5.2.5 and 5.3.2.2). Ms. Rhiannon Chandler states that "the environmental resources are the cultural resources" (see also Sections 5.3.2.1 and 5.3.2.2) and pointed out that the fringing coral reefs of Olowalu are the most beautiful reefs on Maui and not only a part of the traditional cultural resources for Olowalu Ahupua'a but the entire Lāhainā coastline. She further explained that these reefs also act as a breeding ground for the fish population which then replenishes the fisheries of the west side; further stating that "when there is no reef there are no fish." In her capacity as a member of the Maui County Coral Reef Recovery Team,

Ms. Chandler noted that a pattern emerged throughout there studies that wherever there is development, there is subsequent reef decline (see also Section 5.3.2.2). Mr. Ekolu Lindsey points to work and research into coral larvae drift which shows that larvae spawned off of West Maui have successfully crossed the channel between Maui and the north Lāna'i reef flat, therefore illustrating that interisland "larval seeding" is feasible and that what happens to the reef on one island may have unanticipated effects on the reefs of neighboring islands (Hatcher 2003). Mr. Lindsey, points out that research such as this brings the importance of the health of the Olowalu reef system into a broader perspective.

With regard to the pristine quality of the fringing reef of Olowalu in the context of the current project area, those consulted for this study expressed their concerns for the possibility of adverse impacts to this resource. Both Mr. Scott Fisher (see also Section 5.3.1) and Mr. Hutaff (see also Sections 5.3.2.1 and 5.3.2.2) shared a concern that sediment-laden discharge into the ocean would result in adverse impacts on the coral reef ecosystem. As a separate, but related, issue, Mr. Fisher advocated for the implementation of any measures that could be taken to enhance regulated (natural) stream flow into the near shore waters, an action that would enhance the quality of the reef. Along similar lines, Mr. Hutaff wanted to ensure that the tributaries to the main stream that run intermittently during the wet season remained intact as a pathway for the water to enter the ocean (see Section 5.3.2.2). Mrs. U'ilani Kapu (see Section 5.2.3), Mr. Gaylord Kubota (Section 5.3.2.1), Ms. Rhiannon Chandler (Section 5.3.2.2), and Mr. and Mrs. Duey (Section 5.2.2 and Appendix C) expressed concerns about how the project proponents planned to manage sewage and chemical laden water (e.g. chlorinated swimming pool water) associated with the development of the proposed project in terms of whether or not injection wells were planned as a means to deal with such issues. Those who expressed concerns about the presence of injection wells noted that any "dumping" into the ocean would cause severe harm to the coastal and offshore resources. Mrs. Kapu shared additional apprehension about the planned location of the sewage treatment facility in a low lying area and the potential for flood damage to the facility and the resulting hazards. Of the potential hazards, Mrs. Kapu was most concerned with the size and depth of the sewer lines and the potential for leakage issues on the ocean resources of the area. Finally, concern was expressed about the cumulative affects of heightened utilization of the coastal reaches on the marine resources resulting from increased population density within Olowalu Ahupua'a as a result of the scale and final build out of the proposed project that cannot be currently accounted for.

6.3 Traditional Hawaiian Trails and Access Routes

Trails served to connect the various settlements within and between the *ahupua'a* and districts of the Hawaiian Islands in traditional times. While the Alaloa, or foot trail, that encircled the coastline certainly existed along the coastline Olowalu, the preferred mode of inter-*ahupua'a* travel for leeward environs of West Maui was through an upland route and/or major valleys of the Mauna Kahalawai (West Maui Mountains) (see also Section 3.1.2.3.3 The Battle of Kepaniwai and the Escape of Keōpuōlani through Olowalu Valley), where the temperatures were cooler and more tolerable. Traditional trails along the coast were more frequently used for intra-*ahupua'a* travel between the coastal reaches and permanent habitation locations to the upland agricultural area. Both Mr. Hinano Rodrigues (in Lee-Greig and Hammatt 2006) and Mr. Al Lagunero indicated that these trails generally followed the course of each major stream and Mr. Rodrigues noted that such trails were more often than not marked by petroglyphs along the trails as evidenced along the bedrock exposures of Olowalu Gulch (Olowalu Petroglyph Complex [50-50-08-01200

and -01201] [See also Section 3.2]). Mr. Lagunero further noted that there may be a possibility that the historic waterways, or plantation irrigation systems, that parallel the coastline may also share the same route as traditional trails that moved laterally. He points out that those who would have engineered and build these waterways may have followed routes that they were already familiar with. Ms. Lucienne deNaie expressed concern over potential impacts to the Alaloa, asserting that if the road goes away then, to the detriment of the continuous traditional knowledge, the memories of walking the road would also fade (see Section 5.3.2.2).

6.4 Traditional Hawaiian Sites

Past cultural resource management investigations have documented the archaeological resources of the area (see Section 3.2 Previous Archaeological Research within Olowalu Ahupua'a); and while the sites within Olowalu Valley remain, for the most part, intact and under preservation, activities associated with historic and modern era sugar cane cultivation have greatly modified the traditional landscape along the alluvial plain *mauka* of the highway and shoreline areas *makai* of the highway. Such activities have largely removed any surface sites that may have represented traditional Hawaiian habitation or agricultural practices that existed prior to Western contact along the alluvial plains and historic route of Olowalu Stream within the current project area (see also Figure 14, Figure 15, and Figure 17). Lessons learned along Hekili Pt. indicate that subsurface deposits can be found in a disturbed context within the plow zone and an intact context below the plow zone. Therefore, the fact that there was extensive ground disturbance associated with sugar cane cultivation from the historic era up until modern times does not preclude the presence of historically significant cultural deposits nearer to the coastline at a subsurface level (Lee-Greig 2012).

6.5 Traditional Hawaiian Burials and Historic Cemeteries

SIHP 50-50-08-4693, a pre-contact burial ground consisting of a minimum of six individuals is dedicated to passive preservation (see Section 3.2.1 Historic Properties Identified within the Current Project Area). The preserve area for this burial site is situated adjacent to the campgrounds of Camp Olowalu (Figure 19). When looking at the approximate location of this burial ground in relation to placenames gathered through research of the *kuleana* claims and land commission awards (LCA.), the proximity of the burial ground to LCA 240 to John Clark at Kaluakanaka (Figure 21) is compelling with regard to the literal translation of the name when analyzed in its component parts where *Kalua* can be translated as "the pit" and *kanaka* translated as "human being" (Pukui and Elbert 1986:127) (see also Section 3.1). Mr. Hinano Rodrigues has also indicated that the place, Kaluakanaka, may potentially be of particular significance as the possible location of the burial ground of those slain during the Olowalu Massacre given the descriptions in historical accounts of the event (see also Sections 3.1 and 3.1.2.3.2).

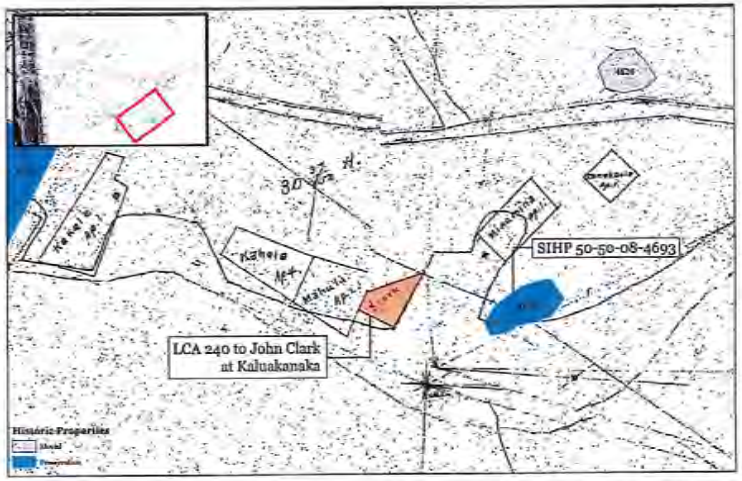

Figure 21. Map of Olowalu Ahupua'a (A. C. Alexander 1906) showing the location of LCA 240 at Kaluakanaka (shaded in orange) in relation to the approximate location of SIHP 50-50-08-4693 (shaded in blue).

Other known burial sites include Pu'u Kilea Cemetery (SIHP 50-50-08-4715), a pre-contact to post-contact cemetery situated atop the summit of Pu'u Kilea; Awalua Cemetery (SIHP 50-50-08-4758), a historic plantation era cemetery which included Hawaiian and Japanese burial interments; and the Olowalu Church cemetery (SIHP 50-50-08-1603), all of which are currently under preservation in perpetuity (E. M. Fredericksen and Fredericksen 1999, 2001). There is some concern with regards to the boundaries of the Olowalu Church graveyard in that the graves extend beyond the recorded metes and bounds for the currently known boundaries of the cemetery. Mr. Rodrigues (in Lee-Greig and Hammatt 2006) indicated that the:

> Territory of Hawai'i decided that they were gonna give all the churches their property and so they decided to draw the map and give the churches two acres. The plantation jumped in and said "Oh but no, we want the original two acres because we want to grow the sugar cane". So when they drew the map they shoved us two acres forward toward the ocean which left the graves in the back and they grew the sugar cane on our graves.

This fact was verified during an inventory survey conducted by Xamanek Researches (D. L. Fredericksen and Fredericksen 2000b) when conducting backhoe testing behind the church beyond the recorded boundaries of the church yard. In discussing the unmarked graves behind the church sanctuary, Mrs. Rodrigues asserted the following (Appendix E):

> ... this church ground there are burials on the side, but these people are only buried there from maybe 1910, anything else is all in the back (of the sanctuary), but what they planted sugar cane on that land before, and Hawaiians didn't say anything, why, because they are

> afraid of the Big Five. So they just take over that land, plant cane, and everything, cause the people who use to plow, they would see bones.
>
> I know more or less where my own tutus were buried in later years. But for the one in the back of the church and up I wouldn't know, so I'm wondering how the heck is Olowalu Elua going to get rid of those trees (behind the sanctuary)...

Traditional Hawaiian burials are also present within the enclosing walls of Kaiwaloa Heiau (SIHP 50-50-08-0004) (Stokes 1916:5) (see also Section 5.2.3 Mr. Ke'eaumoku and Mrs. U'ilani Kapu) as well as an unnamed *heiau* identified by Winslow Walker (SIHP 50-50-08-0005) (1931). These traditional burials are also currently protected as a part of the preservation plan and measures for each *heiau* (E. M. Fredericksen and Fredericksen 2001).

At the December 6, 2012 meeting of the MCCRC, Ms. Linda Nahina Magalianes expressed concern over the protection of Pu'u Kilea cemetery as her *kupuna* are interred within the cemetery (see Section 5.3.2.2). At the same meeting, Mr. Ke'eaumoku Kapu shared his observation that he has seen whale watchers go up to the top of the *pu'u* to count whales and strongly recommended that access to the top of the *pu'u* be limited to families that had *kupuna* interred within the cemetery. During the community field trip to the known historic properties within the current project area, Mr. Leslie Kulolia also expressed concerns with regard to the protection of Pu'u Kilea, asking how the project proponents could ensure that no one would attempt to hike the slopes of the *pu'u* (see Section 5.2.5) and wanting to make sure that the families are continuously consulted with regard to protection of the cemetery. Mr. Kulolia proposed that the preservation buffer for Pu'u Kilea be extended to the base of the *pu'u*.

6.6 Traditional Hawaiian Spirituality and Ceremony

Based on the design, Kaiwaloa Heiau (Figure 22) is believed to have been a *heiau* of the *luakini*, or sacrificial, type (Mr. Hinano Rodrigues in Lee-Greig and Hammatt 2006:A-46). In *Mo'olelo Hawai'i*, David Malo (1951:159, 160) writes that when the king wished to worship under the ritual of Kū, the *luakini heiau*, a war temple, was built for this rite. The Kū ritual was *'o'ole'a* (very rigid or strict) and the priests of this order, also called the priests of the order of Kanalu (the first priest of the order of Kū), were distinct from the other priests who they outranked (Malo 1951:159). Regarding the specifics of the *luakini* Malo records the following:

> ... The timbers of the house would be of *ohia*, the thatch of *loulu* palm or of *uki* grass. The fence about the place would be of *ohia* with the bark peeled off.
>
> The *lananuu-mamao* [offering altar] had to be made of *ohia* timber so heavy that it must be hauled down from the mountains. The same heavy *ohia* timber was used in the making of the idols for the *heiau*.
>
> The tabu of the place continued for ten days and then was *noa* [freed of tabu]; but it might be prolonged to such an extent as to require a resting spell, *hoomahanahana*, and it might be fourteen days before it came to an end. It all depended on whether the *aha* was obtained. If the *aha* was not found the *heiau* would not soon be declared *noa*.
>
> The body of priests engaged in the work stripped down the leaves form a banana stalk as a sign that the tabu was relaxed; and when the Ku tabu of the next month came round, the tabu of the *heiau* was again imposed. Thus it was then that, if the *aha* was procured, the services of prayer came to an end; otherwise people and chiefs continued indefinitely under tabu and were not allowed to come to their women folk.

> The tabu might thus continue in force many months, possibly for years, if the *aha* were not found. It is said that Umi was at work ten years on his *heiau* before the *aha* was found, and only then did they again embrace their wives ... it was *noa* only when the *aha* had been found.
>
> It was indeed an arduous task to make a *luakini*; a human sacrifice was necessary; and it must be an adult, a law-breaker (*lawe-hala*). (Malo 1951:159-160)

Figure 22. The *lele* (altar) at Kaiwaloa Heiau (SIHP 50-50-08-0004) in the middle ground, Līhau in the background. View to north.

Mrs. Rodrigues recalls hearing the drums from the *heiau* on the Nights of Kane or Pō Kane (Section 5.1.1 Mrs. Adeline Rodrigues and Appendix E), when the moon rises only as dawn breaks on the 27th and 28th night of lunar calendar. Mrs. Rodrigues further described the sounds of the drums as being "monotone" with "no tune to it". When the drums would sound during the night, she knew that "it was pō kane, when they walk in with the drum ... there was no rhythm ... but the warriors are walking at night." Mrs. Rodrigues goes on to say that on these nights, the spirits or Night Marchers would walk from *heiau* to *heiau*, from Kaiwaloa in Olowalu to Heki'i in Ukumehame.

When describing the ancient ceremonies, Mr. Daniel Nahina retold the following tradition of how the warriors would walk from the *heiau* to the ocean in preparation for war (see also Section 5.2.4 Mr. Ke'eaumoku Kapu and Mr. Daniel Nahina and Section 5.2.5):

> In the old days, the warriors would walk in the early morning to the ocean by torch light to *hi'uwai* (cleanse or purify) their weapons in the water and at the same time they would *hi'uwai* themselves. By carrying the torch light during, the warriors would also let those at the *heiau* know that they are ready both physically and spiritually.

He goes on to say that today, the spirits of these 10 to 15 foot tall warriors would manifest during the Rising of Kū and walk *mauka* to *makai*, between the *heiau* and the sea. Those nights that are sacred to Kū fall on the 3rd to 6th night of the lunar calendar.

Both Mr. Nahina and Mr. Ke'eaumoku Kapu; as well as, Mrs. Rodrigues shared the stories of how *akua lele* (fireballs) at Olowalu would shoot straight up from Kaiwaloa Heiau. Mr. Nahina and Mr. Kapu explained that this is the tool of *'anā'anā* practices or black magic and was used during fighting between *kahuna* or families much like the famous battles between Kawelo of Lāna'i and Lanikaula of Moloka'i (Beckwith 1970:110-111).

As one of the caretakers of Kaiwaloa Heiau, Mr. Kapu noted that they had started efforts to re-vegetate with *tī* plants and gourds; however, the landowners at that time had cut off access to the water system and were no longer able to maintain the plants (see Sections 5.2.3 and 5.2.4). During a field visit to Kaiwaloa Heiau, both Mr. Nahina and Mr. Kapu felt that it was time to bring the *heiau* back and *malama* (take care of) the *heiau*. They indicated that they would like to begin restoration the *heiau*, first and foremost of which would be to expose the *niho* stones (original stone wall) by removing the boulders that had been pushed along the exterior portions of the enclosing walls by plantation field clearing activities. With regard to access, Mr. Kapu noted that he would like to retain a traditional access "along the cliffside rather than through the residential area" and, along these lines, see a formal establishment of a "community right-of-way to conduct yearly ceremonies at the *heiau* and for the families of the *ahupua'a* who wish to go up to the *heiau*." Mr. Nahina and Mr. Kapu shared that the Season of Kū and Season of Kane are the two times in the year in which traditional Hawaiian ceremonial practices and protocols are carried out at the *heiau*. Mr. Kapu noted that the Season of Kū is longer so that would be the time that they would perform the ceremonies at Kaiwaloa.

Ms. Magalianes identified Kaiwaloa Heiau as the *piko* of Olowalu Ahupua'a (Section 5.3.2.2). At the community field trip to the historic properties within the current project area, Mr. Kapu shared the connection between Kaiwaloa Heiau and its *kahuna* (priest) Kaopulupulu who was sent to Oahu to *malama* (take care of) the *ahupua'a* of Kaiwaloa and Kuholowelowelo Heiau. In the larger picture, Mr. Kapu sees Kaiwaloa as a part of the restoration of the temples of Hawai'i in the example of Pu'ukoholā which serves as the central temple of government and the anchor. Mr. Kapu notes that Kaiwaloa is a living place and again stressed the necessity that access between Kaiwaloa Heiau and the ocean be un-impeded as ritual practices required clear pedestrian access (Section 5.2.5)..

Mr. Al Lagunero felt strongly that access to historic properties, particularly Kaiwaloa Heiau, be closed to the public during seasonal changes and potentially beginning with the rising of Makali'i. He goes on to note that with Kaopulupulu, the four walls all come together which can be interpreted as the return of Hawa'i. Mr. Lagunero shared that his mother would take him to the area near Napoepoe to get medicine, his mother would pray but never go to *heiau* (Kaiwaloa) as only some women were allowed near a *luakini heiau* as *kokua*. The place for women was the *Hale Papa* (*kahalepapa*).

Where the *luakini heiau* was restricted to the rituals of men, *kahaleopapa*, or House of Papa, was the temple dedicated to Papa, or Haumea, and the place in which the rituals of women were received and observed (Cook and Tarallo-Jensen 2006). With regard to rank and the *kapu* of this *heiau*, only the highest ranking chiefess, whose *kapu* equaled that of god, was allowed to enter the Hale o Papa (Kamakau 1992:380). To illustrate the connection between *kahaleopapa* and the consecration of the *luakini*, David Malo (Malo 1951:175) relates the following:

> On the morning of the morrow, which was Olepau, all the female chiefs, relations of the king, came to the temple bringing a *malo* of great length as their present to the idol. All the

> people assembled at the house of Papa to receive the women of the court. One end of the *malo* was borne into the *heiau* (being held by the priests), while the women chiefs kept hold of the other end; the priest meantime reciting the service of the *malo*, which termed *kaioloa* [*kapa* that was bleached with sea water].
>
> All the people being seated in rows, the *kahuna* who was to conduct the service (*nana e papa ka pule*) stood forth; and when he uttered the solemn work *elieli* (completed), the people responded with *noa*. The *kahuna* said, "O Ia!" and the people responded with *noa honua* (freedom to the ground). The consecration of the temple was now accomplished, and the tabu was removed from it, it was *noa loa*.

Within the Olowalu Cultural Reserve, Mr. Al Lagunero notes that there is a Hale o Papa within the reserve (see also Section 5.1.2) that was not identified as such within previous documentation:

> Down here ... is a structure that hasn't been identified in papers. It's a *heiau* like. I feel that heiau is the link of a *Hale O Papa*, the ladies *heiau*.
>
> Its location, some of the things that we see in the different way, that's the women's heiau and I think that's a very important part that it's not part of the paperwork that identifies that. Its location right below of this one is farmed. It's almost like Kawaihae with the men and then the women down below.
>
> ...
>
> Yeah, so I think the placement is traditional...
>
> Here, so this ridge, I think there's something up here or another kind of place where the men to gather before they come down to Kaiwaloa and then down here so women down there is really kind of nice.

Therefore, the rituals of the male (masculine) through the *luakini* and the rituals of the female (feminine) within the Hale o Papa are both represented within Olowalu Ahupua'a.

Section 7 Summary and Recommendations

It is undeniable that Olowalu Ahupua'a is indeed a storied place whose tale is revealed through the prominent landmarks of Mauna Kahalawai and Līhau (see Section 3.1.1 He Mo'olelo no Olowalu), the storied fishing grounds of the fringing reefs (see Section 3.1.2.2 Ka 'Oihana Lawai'a no Olowalu – Traditional Hawaiian Fishing and Other Aquatic Cultural Resources of Olowalu), the poetic and living accounts of the natural elements (see also Section 3.1.1 He Mo'olelo no Olowalu and Section 5.1.3 Mr. Stanley Okamoto), and the stories of the *mo'o* at Kapāiki (see interviews and consultation summaries in Sections 5.1.1 Mrs. Adeline Rodrigues and 5.2.1 Mr. Hinano Rodrigues). In addition to the above, the role of this *wahi* in the politics and warfare between the Maui and Hawai'i Island polities, as well as the atrocity that was the Olowalu Massacre (see section 3.1.2.3 Politics and Warfare), is not only valuable to the history and identity of this place, but to the understanding of the spirituality that encompasses this *ahupua'a*. This strong spirituality is reflected in the representation of the both the masculine and feminine aspects of traditional Hawaiian ritual and ceremony (Section 6.6 Traditional Hawaiian Spirituality and Ceremony), the echoes of which are present in the places and along the paths where *'uhane, menehune,* and night marchers or spirits of the warriors are known to walk (see Sections 5.1.1 Mrs. Adeline Rodrigues and 5.2.4 Mr. Ke'eaumoku Kapu and Mr. Daniel Nahina).

Documented as a *pu'uhonua*, or a place of refuge, since ancient times (Ladana 1858), Mr. Al Lagunero, in his work would like to see this legacy of *pu'uhonua* perpetuated into the present era (Section 5.1.2) stating " ... when you move along to where the surfer's, over there (Awalua), it's a really wonderful area in which people are entering into like a gateway. So when you enter into that gateway, your mind set could change when you come into this area. And when the dialogue of the *pu'uhonua* comes more in common, people begin to look at the islands as *pu'uhonua*."

As a part of the sacred and the spiritual, these lands offered abundant ocean resources, productive agricultural lands, and rich forest resources to sustain a thriving Hawaiian community. Traditional Hawaiian agricultural practices are noted by the Land Commission Awards (*kuleana*) of the Māhele and additionally represented by the archaeological record and ethnographic information that also illustrates that wet-land taro or *lo'i* and *kula* crops were cultivated by the *maka'āinana* in the stream valley and flood plain of the current project area. The *konohiki* and other *ali'i* likely controlled the maintenance and surplus of certain crops, as is revealed by references in Native and Foreign Testimonies to adjacent *poalima* and *konohiki* agricultural plots. With the initial interaction between western ships and the people of Hawai'i, the focus on agricultural production would shift to include production for barter, as produce was in great demand by whalers and sea-faring explorers. This active trade between the people and the sailors for western goods that were coveted by the Hawaiian people would, at times, lead to misunderstandings and sometimes tragedy.

Following western contact, the scene at Lāhainā and surrounding environs changed drastically as Euro-Americans plagued the Hawaiian populace with disease and the introduction of a different economic system that would be based in a desire for foreign products through the trade of western goods. Perhaps the largest ideological transformation experienced by the Hawaiian people was the introduction of private of land ownership in the model of the Euro-American system which ultimately culminated in the Māhele of the mid 1800's.

Assisted by the land divisions of the Great Māhele, foreigners were able to obtain land through either lease or fee simple purchase. Consequently, the alluvial plain of Olowalu Ahupua'a, once the property of the Hawaiian Monarch and categorized as Crown Lands, was ultimately appropriated by foreign entities for the sole purpose of large-scale sugarcane agriculture. Sugarcane agriculture continued until 1998 and covered the majority of the lands of Olowalu Ahupua'a that were suited for such a venture, utilizing both the perennial stream waters of Olowalu Stream and developed groundwater resources of the *ahupua'a*. Since 1998, large tracts of land in the uplands from Ukumehame to Lāhainā, including Olowalu Ahupua'a, have either been subdivided or are in the process of being subdivided for the purpose of residential development.

7.1 Project Effect and Proposed Recommendations

Mrs. Roselle Bailey eloquently states that "Hawaiians need open space; they need to be able to see *mauka* to *makai* and smell *mauka* to *makai*." Specific to this statement were concerns from Mr. Charlie Lindsey (see also Section 5.3.1) regarding the building heights of the proposed master plan and the potential impacts on the *mauka* to *makai* view shed. It cannot be argued that the placement of above-ground infrastructure facilities, as well as, residential homes and buildings on lands that are currently in an undeveloped state will adversely impact the existing landscape and view shed. To this end, and in order to ensure that the proposed project minimizes any potentially significant adverse effect on the existing scenic view sheds and vistas, the following measures were included in the Draft Environmental Impact Statement for the Proposed Olowalu Master Plan (hereafter referred to as DEIS) (Munekiyo & Hiraga 2012) and put forward by Olowalu Town, LLC.:

- An architecturally integrated plan will set the standards for building heights (Munekiyo & Hiraga 2012:20-23):
    - Multi-story buildings and structures will only be allowed in a limited area within the neighborhood town centers;
    - Heights, sizing, and massing of the commercial/business buildings and multi-family residential structures within the neighborhood town centers will be restricted to 2-stories;
    - Exceptions to this height limit will be to allow for a few 3-story residential buildings to increase number of affordable housing units which will be situated in areas that minimize any significant adverse impacts upon *mauka* and *makai* views
- Landscaping, parks, open space corridors and street alignments will be oriented *mauka* to *makai* in order to preserve the scenic view from the mountains to the ocean (Munekiyo & Hiraga 2012:99)
- Orientation of the town centers will be maintained to preserve of the view shed from Pu'u Kilea through the Olowalu Cultural Reserve and Kaiwaloa Heiau in order to maintain a visual connection to Lāna'i and Kaho'olawe (Munekiyo & Hiraga 2012:99-100)

- Implementation of a Green Space Plan will relieve the massing and densities of the built environment, as well preserve open space resources such as the OCR, Olowalu Stream, and 150' shoreline setback area (Munekiyo & Hiraga 2012:100)
- Relocation of Honoapi'ilani Highway along an alignment that will be built at an elevation higher than the existing alignment, at approximately 40 feet above mean sea level, which will also avoid impacting existing views in the area.

Research and consultation identified traditional cultural practices that centered on agricultural pursuits within Olowalu Valley and along the original stream course. With regard to the perpetuation of traditional Hawaiian agriculture within the valley and access to the *mauka* resources, it is should be noted that the establishment of the Olowalu Cultural Reserve consists of "74 acres of cultural lands and cultural sites (already documented and surveyed), from *mauka* to *makai* within Olowalu valley, and follows the (current) streambed to the ocean" that was "set aside by Olowalu Elua Associates on a 99-year lease." (Mr. John Duey and Mrs. Rose-Marie Duey, letter dated July 24, 2012; see also Appendix D). It is envisioned that the Olowalu Cultural Reserve (OCR), will ensure that access between the mountains and ocean is maintained and preserved along the current course of Olowalu Stream. Further, it is anticipated that the re-opening of the *lo'i kalo* within Olowalu Valley, restoration of native plants and historic properties, and educational and outreach programs developed by the members of the OCR will safe guard the natural resources in the Olowalu Ahupua'a for future generations. Within the Reserve, efforts at protecting the archaeological sites, repairing and restoring the *lo'i*, and perpetuation of the traditional Hawaiian culture from *mauka* to *makai*, encompassing the heavens and land, is ongoing. With regard to the proposed Olowalu Town Master Plan in relation to the needs of the Olowalu Cultural Reserve and *ahupua'a* lands as a whole, the following recommendations were put forward regarding access to stream water (see also Appendix E):

- There should be an ample supply of fresh water from the stream for growing *kalo* and other sustainable foods.
- There should be an ample supply of water for native plants and reforestation.
- There should be an ample supply of fresh water in the stream from *mauka* to *makai* for sustainability of native flora and fauna within the stream and the ocean.

Although Olowalu Stream is classified as a perennial stream, due to the former sugar plantation intake and irrigation ditches, the stream only flows year-round above the intake with intermittent flow in the lower elevations only following significant rainfall (Munekiyo & Hiraga 2012:65). The link between the necessity of increased natural stream flow to satisfy both the traditional agricultural needs in the valley and the health of the coastal resources in the near shore area were recurrent. It has been stated that this stream flow is necessary for the sustainability of the *limu* resources as well as enhancement of the quality of the reef. Calls for increased stream flow into the near shore waters were voiced Mr. Scott Fisher of Polanui Hiu (section 5.3.1) and Mr. John Duey and Mrs. Rose-Marie Duey above. To this end, the Draft Environmental Impact Statement (DEIS) for the Olowalu Town Master Plan indicates that an increase in the use of non-potable R-1 recycled water for irrigation purposes and the development of new ground water sources developed through the master plan, will help replace some of the water that is currently being diverted for such uses thus releasing additional water for increase in the stream flows from *mauka*

to *makai* (Munekiyo & Hiraga 2012:66-67). Though not to the levels that were likely known prior to Western Contact, this increase in stream flow should be able to enhance the Olowalu Stream system along the stream margins and into the near shore ecosystem.

With regard to the near shore and offshore resources, serious concerns regarding sediment-laden runoff, the development of injection wells to manage sewage and chemically treated water (e.g. swimming pool water), and intensified recreational and subsistence use were common themes voiced by those concerned about the build-out and inherent population increase resulting from the Olowalu Town Master Plan. As an overall statement, Mr. and Mrs. Duey provided the following comment:

- There should be a greater setback from the ocean, beyond the 100 ft that is protected by state law. This setback would ensure protection from activities such as landscaping and associated chemical use and waste; in addition to stonewall and man-made pavements and structures.
- The dumping of swimming pools water, as well as, other treated water of any sort into the ocean should not be allowed as chemicals leaked or released in the ocean destroys sea life.
- Commercialized ocean activities form shore or ocean should be denied for preservation of these corals and reef life.

Failure of best management practices to address or manage dust resulting from construction in light of the strong winds of Olowalu was also a concern expressed by Mr. Hutaff at the December 6, 2012 MCCRC meeting. Mr. Gaylord Kubota wanted to see more detailed plans with regard to best management practices as siltation due to dust transport caused by the strong winds were a very serious concern.

With regard to concerns about the setback distance from shoreline, the DEIS provides for a 150-foot setback from the shoreline (Munekiyo & Hiraga 2012:60), a distance that was established as a condition of approval for the previous Special Management Area (SMA) Use Permit for the Olowalu Mauka and Olowalu Makai Agricultural Subdivisions. This 150-foot setback will extend along the entire length of the *makai* boundary of the proposed Master Plan and form an area within which no development will occur (Munekiyo & Hiraga 2012:Figure 4). According to Olowalu Town, LLC., the project proponents will additionally seek to incorporate restrictions to this effect in future development design guidelines for shoreline properties.

With regard to runoff and increased sedimentation in the offshore environment, such trends have been associated with dying coral colonies as sediment particles reduce the light available for photosynthesis and adversely affect the structure and function of the ecosystem, and as a result the marine resources that depend on the coral colonies, by altering the physical and biological processes (Rogers 1990). In order to address concerns about sedimentation, precautionary measures to limit the amount of silt or dust resulting from construction activities need to be taken to prevent shoreline and off-shore fishing ground degradation and contamination due to increased sediment in the water. To this end, the DEIS for the Olowalu Town Master Plan states that the appropriate best management practices (BMPs) will be implemented during construction activities (Munekiyo & Hiraga 2012:230). In addition to this, Mr. Mark Hecht of Polanui Hiu suggested the formation of an Olowalu Community Marine Management Group as a community group that could

function as a shoreline monitoring check both during construction and periodically following construction, an approach that was further supported by Mr. Leslie Kuloloia at the December 6, 2012 MCCRC meeting.

Injection wells that have been developed as a mechanism to deal with wastewater have been associated with increased anthropogenic nutrient enrichment of coastal waters (Soicher and Peterson 1997) that may in turn have a causal relationship with the development of algal blooms in the marine environment (Dailer et al. 2010). Such alagal blooms have been shown to contribute to the degradation of the marine ecosystem through diminishing water column oxygen levels, smothering coral by cutting of the light needed for photosynthesis, as well as, an introduction or increase in potentially harmful microbial assemblages, all of which adversely affect the *limu* beds and fisheries (Dailer et al. 2010; DeGeorges et al. 2010; Peterson and Oberdorfer 1985). Mr. Gaylord Kubota and Mrs. U'ilani Kapu expressed concerns on whether or not injections wells would be incorporated into the plans for wastewater management. In a related issue, Mrs. Kapu also wanted to understand what entity (i.e. State, County, or Private) will be responsible for wastewater management. According to the DEIS for the Olowalu Town Master Plan, a private wastewater treatment facility will be developed and utilize a process to treat all wastewater to a minimum of R-1 standards which will then be used for irrigation purposes and require no injection wells (Munekiyo & Hiraga 2012:232). Therefore, adverse impacts to cultural resources directly related to the development and use of injection wells are not anticipated. '

With the increase in population within the lower elevations of Olowalu Ahupua'a, a concern about increased activities and recreational use of the coastline by future residents may escalate pressure on the already over-extended resources of the area (see Section 6.2). In order to address this concern, it is necessary to get an understanding of the existing conditions. According to individuals consulted for this study, numerous scientific research projects have been conducted over the years which may serve to compile a baseline study that can then be used to make coastal management decisions in close consultation with those who currently reside in Olowalu and use the area for subsistence purposes. Mr. Michael Lee has also suggested that along with Western scientific assessments, there should also be an assessment of *makai* resources by the Native Hawaiian cultural practitioners. The integration of these two schools of knowledge would provide a holistic view and understanding of the current state of the marine resources from both the Western scientific and traditional perspectives and provide the understanding necessary to move forward with management decisions based in research and generational knowledge. With regard to management, Mr. Ekolu Lindsey and Polanui Hiu encouraged the implementation of shoreline restrictions, similar to traditional *kapu* seasons or periods, as a means to maintain the health of the environment and allow recovery. Additional, Mr. Lindsey suggested that an area be specifically set aside for traditional cultural fishing practices. Mr. Leslie Kulolia advocated for the formation of a protected area that extended from the shoreline to 20 fathoms out.

Residential lighting and noise of the proposed project at Olowalu may further impact the subsistence practices for those who have traditionally fished on certain nights, as well as observations of the night sky for ceremonial and astronomical purposes. In order to minimize light pollution of the night sky, the DEIS for the Olowalu Town Master Plan asserts that "designs for outdoor lighting will consider the need to respect the night sky" and notes that the placement an designs of lighting fixtures in common and public areas will need to minimize light "spillage" across proposed project boundary lines and shoreline (Munekiyo & Hiraga 2012:221). Prior to

implementation, it was also noted that outdoor lighting plans would be submitted for design review and approval to reduce any adverse impacts from artificial lighting (Ms. Colleen Suyama, Munekiyo & Hiraga – personal communication).

With regard to the protection of cultural sites within the Olowalu Cultural Reserve (OCR) in relation to the potential for adverse effects within the reserve from activities or developments occurring on adjacent lands, Mr. and Mrs. John notes that as a non-profit with limited funds, it would be difficult for the Olowalu Cultural Reserve to bring action against landowners who do not comply with the conditions of the project. In order to rectify this, Mr. and Mrs. Duey state that there should be an avenue or process put in place between OCR and the project in perpetuity should mediation of future activities on adjoining lands impact the cultural sites, land, ocean and practices. It was further suggested that the project's owners and developers carry the buren or costs to mediate invasion of any type to Olowalu Cultural Reserve's intent to protect cultural sites, and practices of its *ahupua'a*. Mr. Michael Lee suggested that an agreement between the descendants of Olowalu and the project proponent be drafted and as a means to economically sustain the OCR, suggested that fees be attached to each property sale that would then go to assist with the needs and maintenance of the OCR.

Finally, concerns and recommendations with regard to the access, as well as, preservation and maintenance of Kaiwaloa Heiau (SIHP 50-50-08-0004) were voiced by the *heiau* caretakers Mr. Ke'eaumoku Kapu and Mr. Daniel Nahina (see also Section 6.6), as well as lineal descendants to Olowalu (see Sections 5.2.5 and 5.3.2.2). The long-term preservation requirements for Kaiwaloa Heiau included the following (E. M. Fredericksen and Fredericksen 2001):

Buffer (ft)	100
Buffer Markers	Yes
Signage[18]	Yes
Preservation Type	Interpretive

Other Conditions: Pathway or foot trail, viewing platform overlooking the heiau for the general public, pedestrian access to the heiau interior restricted to Native Hawaiian traditional cultural practices (pp.10-11); Buffer markers to consist of a native hedge and boulders (p.11)

In connection with the cultural protocols of access and ceremony, Mr. Al Lagunero has offered the creation of a *mapele* within the 13 acres of the OCR that had been set aside as conservation lands, between the stream and the pali on the Ukumehame side of the valley (see Section 5.2.5). This area could be a place dedicated for prayer and *na koa* (warrior) practice under Mr. Kapu. Mr. Lagunero noted that the OCR has an alliance with and honors the Kupuna Council requests for *kahu* and *kuleana* for the Kaiwaloa Heiau to be upon Ke'eaumoku Kapu and Daniel Nahina. To increase the understanding of Loina Kane and *na kaa* led by Ke'eaumoku, Mr. Lagunero offered this area for the private use of the *na koa* and the *kahu* with *kuleana* for Kaiwaloa. The OCR would maintain insurance as is. With regard to preservation and access specifi to the Kaiwaloa Heiau, Mr. Kapu and Mr. Nahina have provided the following recommendations to fulfill the long-term preservation measures listed above:

[18] See preservation plans for signage wording and detailed interpretive requirements

- Vehicular pullout below Pu'u Kilea as the focal point for signage and public education with access restricted to pedestrian access for cultural practices only. A recommendation to have a docent present at this location to educate the public was made by Mr. Kahaiali'i during the community field visit.
- In the event that some type of viewing platform is needed nearer to the location of the *heiau*, this platform could also be the foundation for the *lele* (altar) that is positioned at the southwest corner of the *heiau*.
    - This location would be well away from the entrance and discourage public traffic within the *heiau*.
    - Field boulders that were not a part of the original *heiau* construction but rather pushed into the area during former plantation field clearing activities would be appropriate for construction material.
- The location of the interpretive signage could be placed at either the viewing platform or pullout location below Pu'u Kilea and include a panoramic photo of the *makai* view shed from the *heiau* in its present condition. This panoramic shot would highlight prominent landmarks in the distance (e.g. Pu'u Ō La'i to the south, Molokini, Kaho'olawe, and Lāna'i along with an unimpeded view of Alalakeiki Channel and Auau Channel) as such landmarks may have been important aspects of what was happening at the *heiau* prior to western contact.
- *A'ali'i* (*Dodonaea viscosa*) would be an appropriate plant species for the hedge that marks the permanent 100' buffer as this particular plant is drought resistant and does well in leeward environments.
- Access along the cliffside, rather than through the residential area, is preferable. Formal establishment of this access as a "community right-of-way" is further recommended to conduct yearly ceremonies at the *heiau* and for the families of the *ahupua'a* who wish to go up to the *heiau*.
    - Pedestrian access to Kaiwaloa Heiau must extend from the ocean and would like the access route to the *heiau* proper include the current alignment of the maintenance road.
    - The access route should be planted with tall palms along the Ukumehame side of the road to shield the practitioners and maintain the necessary privacy of the procession to the *heiau* from the landownders of the lots that are adjacent to Kaiwaloa Heiau.
- Finally, Mr. Kapu has requested that in addition to the preservation buffer that is currently in place for Kaiwaloa Heiau, an additional 20 ft. outside of the preservation buffer be designated a no-build area, similar to a construction set back so that encroachement into the preservation area is avoided.

To this end, it is currently understood that Olowalu Town, LLC. is committed to working with Mr. Kapu and Mr. Nahina to insure the implementation of the suggested recommendations.

Overall, Olowalu Town, LLC. has committed to continuing consultation with both the families of Olowalu and those who have expressed concern over possible impact to the cultural resources

both offshore and within the current project area as development plans become more refined. To this end, and as a means to manage protection commitments and implement programs that ensure that the cultural resources are not compromised, individuals consulted have recommended that the project proponents enter into a Memorandum of Agreement with the families of Olowalu and interested organizations. Such an agreement would address the concerns brought forward as a part of this study and draft a plan of action to ensure that the integrity of the cultural resources is maintained.

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Appendix A Land Grant 4973 (Waihona 'Aina 2002)

Grant Number(LG)	**4973**	Source Book:	**24**
Grantee:	**Giffard, Walter M.**	Acreage::	**970** Acs
Ahupua`a	**Olowalu, Ukumehame**	Year	**1906**
District:	**Lahaina**	Cancelled	**False**
Island	**Maui**	TMK	
Miscellaneous			

No. 4973, Giffard, Walter M., Olowalu and Ukumehame Ahupuaa, District of Lahaina, Island of Maui, Vol. 24, pps. 309-311 [LG Reel 9, 00039-00041.tif]

Land Patent No. 4973 (Grant)

On Cash Purchase.

By this Patent the Governor of the Territory of Hawaii, in Conformity with the Laws of the United States of America and of the Territory of Hawaii, makes known to all men that he has this day granted and confirmed unto Walter M. Giffard for the consideration of Thirty seven thousand Seven Hundred and Fifty 00/100 Dollars, $37750 00/100, paid into the Treasury.

And in conformity with Part IV Section 17 of the Land Act of 1895

all of the Land, situate at Olowalu and Ukumehame in the District of Lahaina, Island of Maui, bounded and described as follows:

Sold at Public Auction July 9th 1906
Portion of the Ahupuaa of Olowalu:
Commencing at a iron rail driven into the sand at high water mark at the West end of the Awalua beach, from which the true azimuth and distance to a similar iron rail on the beach about 175 feet west of a small wooden bridge is 322° 25' 955 feet, and from this point to the Kilea Triangulation Station 292° 19' 5001 feet, the boundary runs by true azimuths

1. 216° 00' 500 feet
2. 316° 28' 1024 feet to an iron rail on rocky bridge,
3. 285° 5' 1240.5 feet to an iron rail on rocky bridge from which Kilea Triangulation Station bears 303 31' 3613 feet
4. 303° 39' 30" 2201 feet to an iron rail
5. 254° 20' 30" 2676 feet to an iron rail above end of flume, from which Kilea Triangulation Station bears 42° 59' 30" 2046.5 feet
6. 257° 42' 172.5 feet to an iron rail above flume
7. 302° 46' 889 feet across valley to iron rail from which Kilea Triangulation bears 65° 31' 2540 feet
8. 336° 08' 30" 4442.5 feet to end of stone wall
9. 19° 10' 386 feet to iron rail 199° 10' 10 feet from centre of railroad track

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10. 295° 46' 833 feet along a line parallel to ana 10 feet from centre line of plantation railroad, to iron rail
11. 303° 00' 720 feet to corner of stone wall and fence
12. 24° 51' 130 feet to the sea shore at high water mark
13. Northwesterly along the seashore at high water mark to the initial point, the direct azimuth and distance being 123° 20' 25" 12559 feet

Area 684.7 acres, a little more or less, exclusive of included L.C.A., School Lots and land sold by Kamehameha IV to Kahaulelio, amounting in all to 95.4 acres.

Portion of Ahupuaa of Ukumehame
Commencing on upper side of the Government road at the corner of a stone wall along the road and a fence running mauka, the coordinates of this point referred to the Kilea Triangulation Station being South 4129.5 feet and East 5335.5 feet, and running by true azimuths:
1. 204° 51' 144 feet along fence to corner of same
2. 256° 38' 2180 feet to an iron rail driven into the ground, the coordinates referred to Kilea Triangulation Station are South 3495.0 feet and East 7517.0 feet
3. 280° 10' 1640 feet
4. 295° 50' 347 feet
5. 209° 28' 1519.5 feet to iron rail
6. 206° 4' 894 feet to iron rail on West side of stream above head of auwai
7. 349° 45' 1460.5 feet to iron rail on East side of valley, on West side of stone wall
8. 18° 50' 1463 feet to iron rail on East side of stone wall
9. 305° 52' 3819 feet to fence corner
10. 324° 17' 447.5 feet to fence corner
11. 28° 17' 330 feet to fence corner
12. 92° 53' 1490.5 feet to point on fence 42° 5' 17.5 feet from corner of same
13. 42° 5' 1352 feet along fence and across salt marsh to the sea shore at high water mark
14. Northwesterly along sea shore to high water mark to a point 24° 51' 130 feet, from initial point, the direct azimuth and distance being 125° 29' 35" 7241 feet
15. 204° 51' 130 feet to the initial point.

Area 335.3 acres a little more or less, exclusive of included L.C.A. and School Lot, amounting in all to 123.1 acres.

(1) The Government Belt Road, length about 22000 feet by width of 50 feet and all public road and trails.

(2) A Right of way, 50 feet in width (or so much of said 50 feet as may be deemed necessary for public use,) extending from Government Belt Road to Olawalu Landing

(3) All the Public land between the Western boundary of Olawalu as shown on Registered Map No. 2346, and the Eastern boundary of that portion of Ukemahame as shown on Registered Map No. 2347, and between the sea and a line 100 feet distant and parallel to the high water mark

(4) 1 Church Lot (about 2 acres)

Total area of these reserves 50 acres, a little more or less.

[page 311]

[Diagram]

Containing 970 Acres, more or less, To have and to hold the above granted Land, unto the said Walter M. Giffard and his Heirs and Assigns forever,

In Witness whereof, The Governor of the Territory of Hawaii, has hereto set his hand, and caused the Great Seal of the Territory to be hereunto affixed, this 23rd day of July, A.D. 1906.

(Great Seal)

(sign) G. R. Carter
By the Governor
(sign) Jas. W. Pratt, Commissioner of Public Lands

[Land Patent Grant No. 4973, Giffard, Walter M., Olowalu and Ukumehame Ahupuaa, District of Lahaina, Island of Maui, 970 Acres, 1906]

Appendix B Hawai'i Register of Historic Places Forms

SIHP 50-50-08-0004
SIHP 50-50-08-1200
SIHP 50-50-08-1602
SIHP 50-50-08-1603

Appendix C Response Letters

John V. & Rose Marie H. Duey
575A Iao Valley Road
Wailuku, HI 9793

July 24, 2012

Ms. Tanya L. Lee-Greig, Maui Island Director
Cultural Surveys Hawaii
1860 Main Street
Waiuku, Hi 96793

Re: Olowalu Town

Aloha Ms. Lee-Greig,

As per your and my discussion of recent, John and I are forwarding this letter for your preview and information.

We have heard and seen Akaku's video of a past meeting of the Cultural Preservation Committee where several statements made, and including name dropping, or even speaking on behalf of ourselves were done.

I would like to set the record straight....John and I have neither spoken to or given testimony to anyone regarding the development of Olowalu. We are neither for, nor against the Olowalu Town Development.

We are however, the primary driving force along with many community volunteers of the Olowalu Cultural Reserve, who are working very hard to return the ahupuaa of Lihau, Olowalu.

Olowalu Cultural Reserve is 74 acres of cultural lands and cultural sites (already documented and surveyed), from mauka to makai within Olowalu valley, and follows the streambed to the ocean. These areas where generously set aside by Olowalu Elua Associates on a 99-year lease.

Those who are astute of our Hawaiian history know the destruction by the plantations, and now development, of our cultural way of life and

native areas of cultural habitat and cultural practices are great, so the effort to protect, repair and rebuild takes people who care, and are willing to do so with commitment. The developers should also be a part of this commitment, not just for today, but in perpetuity.

In order for us to return what cultural evidence of what once was, we will need the commitment of the developers to assist us in protecting those things that rebuilds an ahupuaa both on the land and in the ocean.

Regarding the development of Olowalu, the following should be addressed for a healthy, sustainable ahupuaa:

There should be an ample supply of fresh water in the stream from mauka to makai for sustainability of native flora and fauna within the stream and the ocean.

There should be an ample supply of fresh water from the stream for growing kalo, and other sustainable foods.

There should be an ample supply of water for native plants and reforestation.

Olowalu's reef is one of few pristine reefs left and has more than 29 species of coral, and therefore.....

There should be a greater setback from the ocean, than the 100 feet protected by state law. The setback ensures protection from other land activities, i.e., landscaping, chemicals used for such, landscaping wastes, as well as stonewalls, and man-made pavements and structures.

Swimming pools as well as dumping of other treated water of any sort into the ocean should not be allowed. Chemicals leaked or released in the ocean destroys sea life.

Commercialized ocean activities from shore or ocean should be denied for preservation of these corals and reef life.

We realize that regulations, laws, and permitting of the activities mentioned above falls within the county and state venue, and are hopeful that your work will be their guiding tool.

And finally, there should be an avenue or process put in place between Olowalu Cultural Reserve, and the project in perpetuity should mediation of future activities on adjoining lands impact the cultural sites, land, ocean and practices.

A non-profit, such as Olowalu Cultural Reserve with limited funds would be hard press to bring action against landowners who do not comply with the conditions placed on this project.

The project's owners, and developers should carry the burden or costs to mediate invasion of any type to Olowalu Cultural Reserve's intent to protect cultural sites, and practices of its ahupuaa.

We appreciate your consideration of our concerns.

Sincerely,

John and Rose Marie Duey

Appendix D Formal Interviews

D.1 Interview with Mrs. Adeline Rodrigues

Recording Date	August 27, 2012 at 1:35pm
Transcription Date	September 5, 2012 to September 11, 2012
Participants	Tanya Lee-Greig (TLG) Adeline Rodrigues (AR)* *At the request of Mrs. Rodrigues, corrections and clarifications for the final transcript were provided by her son Mr. Hinano Rodrigues and are noted in parentheses.

Adeline Rodrigues, Kapaiki, Olowalu Ahupua'a, Mokupuni o Maui. Mrs. Rodrigues was born Adeline Kamaileolihau Ka'ahui on December 21, 1929 in the old teacher's cottage at Olowalu. Her father worked for the Kahului Railroad while she was growing up, and although Mrs. Rodrigues was raised in Kahului and Olowalu, the family would go to Ukumehame every weekend to tend the lo'i kalo *(taro patches) and visit with her grandparents at Ukumehame and Olowalu.*

Adeline Rodrigues (AR): Oh long time ago

Tanya Lee-Greig (TLG): Yeah, yeah so maybe if we can go from before time when you were a small, small kid time, to kind of now, and how it is and how you feel maybe that Olowalu town is either going be an adverse impact or a positive impact because there are all kinds of things that can be impacted. It could be a bad one or a good one or what, so…

(AR): I think it's going be a good one. I think when Olowalu town is built; it's going to be a town that will look like no other town on Maui. I can't speak for other islands you know, because I haven't traveled all over the islands. I only go two different islands, but the whole island, but I think Olowalu town is gonna be, I'm think I'm gonna be real proud of Olowalu town. I am, I am.

(TLG): Yeah, and how do you think it's different or what do you think it could provide that's different then maybe what you already have? Or you have when you were small kid times?

(AR): I don't have anything, (laughing) I mean, you know, for, what do we have here nothing, nothing, just trees, what kinda trees we have here, Kiawe, and what do you call the other tree? I call it Camacellus or Opiuma. I don't know why they call it Opiuma but you know when you eat the fruit. Eat too much of it, your mouth get numb. Like Opium. Have you ever tried it?

(TLG): I never tried the fruit.

(AR): You should, that's what we grew up when we were young, we ate Opiuma all the time, if were hungry we just go the tree and if we see fruit on it, we eat it, but we choose, because they got two different kinds Opiuma, the red one, and the white one.

(TLG): Oh, okay I didn't know that

(AR): Yeah, that was our fruit and mangoes of course.

(TLG): Yeah, yeah

(AR): That's all we had here in Olowalu, just Mango, guava, what do you call that fruit, there's another fruit, we called it (Jakuro). I know it only as (Jakuro), but it is called Pomegranate.

(TLG): Oh, okay, yeah, yeah.

(AR): That's the kind of fruit we had here, we didn't have too much fruit here, but pomegranate grew a lot here. And yet, you know people talk about the Ulu tree. I don't remember seeing an Ulu tree here in Olowalu. This place is really called Kapaiki. It's not called Olowalu. We always referred to this place as Kapaiki. Kapaiki starts from I think from this boundary of the church towards the last home here in Olowalu. In this area, the Rodrigues.

(TLG): Yeah, yeah

(AR): Stanley Rodrigues, and the Japanese…

(TLG): So right before the store?

(AR): Yeah, and from that store, that bridge (the bridge where Stanly Rodrigues house is), there was a bridge there, from there on, it was Olowalu, the people who lived in, who lived in that camp, always referred us, as we come from Kapaiki, we were always referred to coming from Kapaiki. We felt we were different from that Olowalu village, we were really Kapaiki, but then if you look at the map, where's Mopua?

(TLG): Mōpua is, isn't it on the other side of the road?

(AR): Well, that's what they call Mōpua. I don't know, maybe past Kapaiki. That is Mōpua. This is not Mōpua, but they refer to this place as Mōpua also, but this is called, really called Kapaiki. And the pond, there was a pond in front of our, of my home, and that was called the Kapaiki pond. (Mōpua is the place where Olowalu Church is located. It is also called Mo'opua, Mr. Rodrigues noted that in Hawaiian language, sometimes two similar vowels that are separated by an *okina* are combined and pronounced as a long vowel [e.g. Mo'opua = Mōpua])

(TLG): Kapaiki pond.

(AR): It's a fish pond; It is direct into the highway and to the ocean, and that pond, and the fish that was for the Ali'i, cause where my property is, that is where chief, what's her name? Kahekili's sister?

(TLG): Kalola

(AR): Kalola, that's where she lived. They made, Kama'ema'e made a mistake in her book, she referred Kalola's property; the Saffery's, where the Saffery's lived. Where the Saffery's lived, is where the servants lived. So you guys gotta make some kinda correction in her book.

(TLG): Okay, okay, yeah that will definitely go into the cultural impact assessment. It will come up. So your place is where Kalola was?

(AR): Yes, that's where I lived, that's where the pond is there, that fish pond, and there was a, what you call, I'm sorry I'm getting older now, I kinda forget. There was a… what you call, what do you call lizard in Hawaiian?

(TLG): Mo'o

(AR): Mo'o, there was a Mo'o there.

(TLG): Oh really, was it Kihawahine or…

(AR): I don't know what her name was, I kinda forgot. More or less if I remember I will know who she was, because underneath of my property to my brothers there's ah, what you call, that's where the water comes into the ocean.

(TLG): Oh, okay…

(AR): Ahh… what do you call that?

(TLG): Is there a spring?

(AR): Yes, because the spring water was underneath our house, because you know our cesspool, when they built it, it was three feet and water already.

(TLG): Oh my goodness, wow! So that's where the fish pond water came from?

(AR): Yes, it entered from Olowalu valley.

(TLG): Oh wow, do you know if there was a name for that spring or…?

(AR): It's called (Kalokoi'aokapāiki)

(TLG): Ka Loko'okapāiki.

(AR): I heard it as Kapāiki, but I don't know if I can say that cause I've heard it as Kapiki, but when I ask Hinano he said, kapāiki means small enclosure. Pa is enclosure, iki is small, so the small gate, so we're thinking of the small gate to where? (West Maui)? Cause you know if you look at all the main names for each area, there it's somehow connected with each other. Like Pakala - Pakalā. Actually, we call it Pakala, but you know as the years go by Hawaii is kinda, you know Hawaii is kinda, I wouldn't say mispronounced or they just say it the way…

(TLG): It is

(AR): Yeah, but I always felt that it's not Pakala, its Pakalā. What does Pakalā mean? Pa is gate, kalā is the sun. The gate to the sun; to the sun, so Kapaiki is the small gate. I don't know but maybe if you go and find out. You might be able to…

(TLG): To find out.

(AR): Yeah, I mean Pako'a gotta and what you call it, but you know I should, give you the names of each area here.

(TLG): Yes.

(AR): You know they got 10 you know.

(TLG): Really! That would be so good to know their names.

(AR): Yeah, my grandmother told us what the name of each area is, for Olowalu all the way to Ukumehame.

(TLG): Oh really, okay so…

(AR): You know that Ukumehame Park? That's called Pako'a.

(TLG): The surfers, they call it Thousand Peaks or something like that.

(AR): No, I think Thousand Peaks is more further down. More by Papalaua; I think that's a Thousand Peaks. I'm not sure, I don't pay attention. When I hear you say that I, for me, where did that name came from? Anyway, maybe I should start. You have that?

(TLG): Yeah, I have that already.

(AR): My name is Adeline Kamaile o Lihau Ka'ahui Rodrigues. I was born in the old teacher's cottage, December 21st 1929. Our hanai grandfather was a teacher and the principal here at the time when I was born. That's why I was born in the teacher's cottage and my mom and dad were married March, 1929. And he never worked in his life. My hanai grandfather took care of my dad, because his family was poor, you know before they help take care each other. That's how I call him my hanai grandfather, cause my dad was hanai by William Ho'opi'i.

(TLG): Oh really.

(AR): Yeah, William Ho'opi'i. My mom and dad were born in Ukumehame. And they moved here to Olowalu when they got married. They moved here, They met Ho'opi'i cause the home that I am living in now was his home, so when I was born, he told my dad, that the properties that I own were going to belong to the girl. I was always referred to as the girl. (Giggling) Yeah, I was the girl. After I was born, and anyway, my dad went to work for Kahului railroad in Kahului, my mom stayed here, in 1930 my mom and I and my dad got a home in Kahului. And we lived there until I got married. And then I moved back, we built a home here in 1966. But I didn't really come to live here until 1970, because I didn't want to live in the country. This was country to us, who wants to live in the country.

(TLG): Right. (Giggles)

(AR): Nothing in the country, nothing. And anyway,

(TLG): Was the camp here?

(AR): No, there was no camp here. The camp was just past this church, somewhere, somewhere on the boundary line with Ukumehame and Olowalu, there was a camp there, there was no camp here, there could have been at one time, but I'm not sure between this church property, and where our home start. I think there was about two acres in between, and I don't know, but I heard they had some Japanese living there. When I was born, there was no people living here. Was only, how can I, it was the Ka'ahui's, the Ho'olulu's, and the, who else… the Saffery's and I think, I'm not so sure, I think maybe just before I was born that man moved here, ahh… moved away, Robert Nawahine.

(TLG): Ah, okay.

(AR): Ah where the Rodrigues were living, he lived around there. The camp was, the people that lived in Olowalu camp really came from Ukumehame. When they closed the Olowalu Sugar Company in Ukumehame, that's when the people moved to Olowalu. Cause had different Hawaiians living there and they kind of moved into town. Because I guess when the plantation took over the land around here, they didn't have water for their taro. So people just moved away, so did my grandparents on my mother side. They lived in Ukumehame, and then had to leave Ukumehame, because the plantation shut the water on them, and so they couldn't plant taro.

(TLG): Oh my god.

(AR): And my grandparents were the last people to plant taro in Ukumehame. So my grandmother moved to Olowalu, and lived in my grandfather's place. Right next door to my grandfather, like I said I was born in the teacher's cottage. There was a two acre right next to my home; it was the school and then the teacher's cottage, and then the lot between the house and the church.

(TLG): Okay

(AR): That's all I can remember. What else can I say…?

(TLG): What about up in the valleys; were there any families up there?

(AR): In Olowalu Valley? The Naho'oikaikas, the Puha's, who else lived there; I think mostly the Naho'oikaikas and Puha's, I think there were other families related to each other, like the Keau's. Well I don't know if they were called Cassin. They use the name Cassin.

(TLG): Where was that name from?

(AR): I don't know where that name was from? That sounds like one haole name that Cassin. I don't know if they were Cassin's or Keau's, but you know in Hawaii they kind of change their name around. But the Puha's lived in the valley. That's where my maternal grandmother came from. Victoria Puha.

(TLG): That's your grandmother?

(AR): That's my grandmother on my dad's side. And my grandmother on my mom side came from Ukumehame. The Kekahuna's and Fujishiro's. That's our…

(TLG): Ohana.

(AR): Our ohana…

(TLG): That's how you're related to Paul Fujishiro.

(AR): Yes

(TLG): And that is through your mom?

(AR): The dad and my mom were sister and brother.

(TLG): Oh, okay

(AR): Albert Fujishiro was my mom's brother.

(TLG): So were people, having, they were growing taro in both valleys. So, your family is pili to both valleys then.

(AR): Oh, yeah, cause my maternal grandmother came from Olowalu, and maternal grandfather from Ukumehame, and married an Olowalu girl.

(TLG): Oh wow.

(AR): So that's why we kind of, we almost, we live in two Ahupua'a. Uhhh…What else can I say, do you know Adelaide Silva?

(TLG): Yes!

(AR): She was born here in Olowalu Valley. She comes from the, I forgot the name; I gotta look for the name, and give you that name. I forgot their name. I wonder if she was (Kaaumoana). I don't think she was. You folks interviewed her here, did you guys find out what her maiden name was? Because were related to her also, we practically related to everybody in Olowalu and Ukumehame.

(TLG): I think so, that might be on the digital file. But that day, there were so many conversations happening at the same time and I was listening to it and I was like oh my goodness, I don't know whose voice this is.

(AR): So you didn't pick up some from her, maybe you should go ask her.

(TLG): Yeah, I think, well I have to call Frank, her son. And so we are hopefully going to get together and talk and hopefully get auntie Adelaide when she's in the morning.

(AR): Yeah, that's the best time for her, yeah, when she gets up. What else do you want to know? Did you get to find out the people that lived in the Olowalu village and across the store, who use to live there?

(TLG): Umm, we are gonna talk to the Ichikis. Is that the stores…

(AR): Oh yes, Donald and...not Ichiki, Fujii. Two brothers, I forgot the other brothers name, Donald and…

(TLG): Wayne?

(AR): No. Wallace

(TLG): Wallace. I know there was a 'w' in there somewhere. (Laughing) yeah, so them and then on the other side, I haven't been able to find anything.

(AR): I don't know too much about the village, but I know more or less who used to live there before. Even my family, my mom's family lived there, the Fujishiro's in the village.

(TLG): How about, would Cousin Paul know about Olowalu?

(AR): Yes! He lived in Olowalu village for awhile before he moved to Lahaina. I have a sister who lived here with my grandmother, she was hanai by my grandmother, she lived here until she went to high school. Then she moved back to Baldwin High school. But she's not here, she lives on the mainland. She would know more than I would, but as long as I can remember we came to Olowalu every weekend, every holiday, during the summer, my mom sent all the children to live with the tutu in Olowalu.

(TLG): Yeah. (Giggles)

(AR): But my grandmother didn't like us to go down to Olowalu village to play with the children there. We really didn't associate with them as much, but right next door to where I lived, my paternal grandmother lived there with her son, she was Victoria Puha- Ho'olulu. Her last name was not Ka'ahui. Actually, when the westerners moved here and came here to Hawai'i. I think it was 1869. They told the Hawaiians they all had to have two names. Because all the Hawaiians then they never had two names. It was only one, so when this man Ka'ahui married Papahi from the Big Island. Their son became Ho'olulu, and Ho'olulu is my dad's dad, so that's my grandfather. Ho'olulu, and he married Victoria Puha. So his name was Boniface Ho'olulu, and all the children

and my dad was Ho'olulu. But when we, my mom, I was at line Ka'ahui, not at line Ho'olulu, but my dad didn't change his name until the 40's. Because he was when my hanai grandfather took my dad and raised him he wanted my dad to take the name Ka'ahui. My dad didn't want to take that name Ka'ahui. But then all my siblings were all Ka'ahui, so then he changed his name from Ho'olulu to Ka'ahui in the 40's.

(TLG): Wow.

(AR): So he was Ho'olulu, John Ho'olulu, and we were all Ka'ahui's.

(TLG): That's so interesting because it just gets so tangled.

(AR): Yeah, so my auntie, all his sisters and brothers they are all Ho'olulu's, that's why my grandma was Victoria Ho'olulu, and my uncle were Ho'olulu's and they live right next door to us.

(TLG): But they are all descendents from Ka'ahui, the Ho'olulu's dad?

(AR): Well when the westerners said you have to have a surname then the surname would be Ka'ahui, because that's Ho'olulu's father is Ka'ahui, but when the father was born he was called Ho'olulu, and that's it, there was no other name. Then his name became Boniface Ho'olulu, when he was baptized Catholic.

(TLG): Oh, okay

(AR): You know everyone had a first Catholic name and his was Boniface. And my dad's name came John, cause the Catholics. My parents were Catholics. But they became Protestants years later and yet when we were born we were all Protestants. We were baptized. And I was the last one to be baptized in this Olowalu Lanakila Hawaiian Church in 1930 of November, and I think in December, and the Pioneer Mill burned their cane, and they burnt the roof off of the old church in 1930 and at that time Olowalu, not Olowalu, I don't know, I think Pioneer Sugar Company said they would build a church, if the members would supply the lumber. But then years later, change, supervisors, I don't, I think the supervisor, what you call the big shot?

(TLG): The manager?

(AR): The manager

(TLG): The mill manager

(AR): And when we went to see the manager he said, it was only by mouth, not by contract, so we never rebuilt the church.

(TLG): Ahh

(AR): So, I asked Bill Frampton to help us. And I didn't like the way Elle Cochran ask me a question like that was a pay off, but she found out, somehow she found out, that Bill Frampton was going to help us with our church. But that's not true because we going to pay Bill Frampton $20,000 for him to do all the paperwork for us, go to the county, and get everything cause we don't want it for free, no, we can't do that.

(TLG): Yeah, yeah oh my goodness.

(AR): That's why I said it, we going to have something that we never had before, some help, yeah.

(TLG): So then is it a difficult thing sometimes to stay in Olowalu?

(AR): We came to church every Sunday, from Kahului to Olowalu. Ok, the church burnt, the roof burnt in 1930, so they no longer could use the church except I guess they had to be roofless for awhile, then the Olowalu school closed about 1930, so the land, there was a two acre, and before all schools were two acres I think like churches I think it was two acres, I'm not so sure, but anyway they put up for auction the two properties, the school and the teachers cottage, so my grandfather William Ho'opi'i told my dad oh lets go buy the property, the cottage, the school cottage property and we can use that as a church.

(TLG): Yeah, okay.

(AR): So in 1930 around there, my dad, Olowalu church bought that property, that one acre property, and the one that had the school on it my grandfather bought that for my dad. I forgot how much it was $500.00, $300.00, I don't know.

(TLG): Oh back in the day.

(AR): It's somewhere in the deed on how much we bought it, so we use the teacher's cottage as our church. And all the children and people from the Olowalu village came to our church.

(TLG): So you had at that time you had a pretty big congregation then?

(AR): Yeah we did, then when everybody moved to Lahaina, when they moved all those Japanese people living at the camp to Lahaina, and then the Filipinos came in to Olowalu. They didn't really close out the camp. When the Japanese all moved out, the Filipinos came to live here, I think they closed the Olowalu Camp in the 50's-60's, I can't remember, and that's why it came empty right, and then only the store is there.

(TLG): Then it became more country then, yeah.

(AR): That's why I said I didn't even want to move here. I don't want to build a home here, because why, who wants to live in the country, and I lived in Kahului. And I thought Lahaina was country.

(TLG): Really?

(AR): Yeah, to me Lahaina was country.

(TLG): Wow, so what finally brought you back to Olowalu, you decided okay…?

(AR): Well you know I've been coming back to Olowalu all my life from the time I was born till I moved away I still came back to church every Sunday in Olowalu, and of course we used the teacher's cottage as Olowalu Lanakila Church, then later on all the people in Olowalu Village moved away to Lahaina we hardly at members left.

(TLG): Yeah, yeah

(AR): So then my dad sold that property to my uncle, and we had our church services in our home, my family home, my dad's home, right next door to me, that's where we had our church because my parents weren't living in Olowalu, but they built a home here in 1940. So we used our home as a church. My parents still live in Olowalu. So when my dad died in 1959, that's when my mom moved back to Olowalu. And at that time we were using the old church because then before my dad died in 1959, the reverend, what was his name, anyway Reverend Moku from Ka'ahumanu Church and his wife asked my dad if they could somehow they could help build a camp here for, a youth camp and a camp for the kupuna's to come on the weekends to spend the time here and go

to the beach. And then my dad was going to kind of rebuild the church in 1959 or build a chapel. But then he died, a few months later he died. But the Tri-Isle Association, that's our they came and build cottages here, that's why you see some cottages, old now, it was built in the 60's so they use this place for youth camp and for the kupuna's and Waiola Church had a cabin of their own, so did Iao Congregational, Kahului Union Church, and not so sure who, I think it was the Filipino, I think well not the Filipino church in Kahului, but I forgot the name of the church but the minister now is Olo'oloa, they had a cottage here right next door to this building; right next door. Then later on they kind of lost interest, and then Tri-Isle Association, and because we didn't come church every Sunday, and we even had weddings here and baptism and on the church without a roof.

(TLG): Oh I think that would be pretty.

(AR): Then the Tri-Isle Association wanted to take over the camps, and they told us we are no longer a church and they lease this place to Teen Challenge, and at that time when they opened up that place for Teen Challenge, it was for Hawaii children, people who lived here, and Honolulu or wherever, it was for the children who were under drugs, it was a place for rehabilitation. But later on because they needed grants, and then the rich people who had money started sending their kids here and all of sudden are local children didn't have a chance to come to Teen Challenge, it was more mainland children were here, because of the money. It was all by grants. Then in 1994, we rent the property from Waiola church, and Dean Fujii asked me to reopen the church, so I did in 1994, and before Sunday, like Saturday my family had to carry the chairs into the church grounds, into the church, so we could have service and sit down. Because Teen Challenge was still here, they were still coming, we had some friction between us and Teen Challenge, cause they felt they practically owned this place because they were leasing it, but then it's still our church and two years later, they decided to close down because they didn't have enough money to carry on the Teen Challenge, and that's why we are here.

(TLG): So now you have your services here (The church hall).

(AR): Yeah, we have to renovate, cause the ceiling was falling down, it cost us $10,000 for it to look like this.

(TLG): Oh my goodness

(AR): Yeah, 1999 we started to renovate.

(TLG): I came across some pictures and I didn't know what I was thinking but I didn't bring them with me, it looked like around the 1950's, there was a big renovation at the sanctuary do you remember that?

(AR): Yeah, he did the work, Reverend Williams. He was the man who really worked on that church, but they were going to kind of rebuild that church, because they had brought in all their rocks, but I don't know what happen to that, there was friction. I don't know if it was the church, or Tri-Isle, or Teen Challenge, I don't know what happen. I am glad we are going to have it back now.

(TLG): It is nice, so is there going to be a new chapel?

(AR): We going to build a new chapel in front of the old church, I want the chapel there, because when I sit in the new church, if I am still here, I want to look towards Olowalu Valley, I can lift my eyes up to the hills, and I forgot that song, and I think it's on that story that Louise James had

written, did you see that? Its right in the corner, you can go read that. My brother and I did that. When we open this church it was me and my cousin Albert Fujishiro that opened this church, and years later my brother Abe Ka'ahui moved from Waiola Church to Olowalu church. When my cousin Albert Fujishiro died, I can't remember what year, I have it somewhere, and he left us money to build a new church that is why I want to build a new church, because he left that money. I want to finish up what my dad had dreamed about building a new church. And we are the last members of the former Olowalu Church. Actually my dad was the last member, because we didn't have a place for our service, we had it in the Ka'ahui home.

(TLG): That's amazing; all these small Hawaiian churches just one family is kind of responsible for maintaining the life of that church, and that was you, the Ka'ahui Ohana. Very important.

(AR): Yes, and that's why I want this Olowalu Town built. I think you know Olowalu is a spiritual place, because as long as I remember, everyone would ask "where you come from?" and I would say Olowalu, and they would say "Olowalu, That's the most spookiest place." (Laughter) that's what they tell me, but I don't think so, I feel Olowalu that's where the heart and soul of Maui, the heart and soul of Maui is Olowalu. It's a spiritual place. You know when we had that first fire that started on the hill in I think 1990, I'm not sure, I guess the Maui electric line somehow had explosion. We heard the explosion, then we heard it when we were sleeping, but we didn't get up, we just slept because we thought what that, just an explosion, but we never knew where that explosion came from. Then later on, maybe could have been an hour later I heard my neighbor say fire, fire, there's a fire! And I think where is that fire, and I open I window and look up and there is the fire burning, the fire was huge and wind was blowing down. More like 60 or 70 mph and it was so dusty outside. I'm quite sure it started at 1 o'clock am, and by 3:30 the fire came down and it burnt down the people behind, my sister lived next door and there was a house where my brother Eddie use to live, but he sold his home and his home burnt. And the police came and told us we got to leave, and go down to the Olowalu store, I thought for real I'm not going have a home, but you know before I left, and my husband didn't want to go, he said he was going to stay, and I told him no we got to go. He said don't worry, don't worry the fire is not going to come, and we go down to Olowalu store, and I tell tutu take the fire away. You know the wind shifted, and I'm not kidding it only burnt my brothers house, but back behind my home, my sister in law Jackie lived, and Eddie's son and his friend were sitting on the roof and the police and the fire department didn't know these two guys were in the back there and hiding from the police watching the fire. So this boy, my nephew, Chris said look at that fire ball coming down the hill, it was a fire ball, it was something rolling, and it rolled down and hit my brother's house and the house exploded.

(TLG): Oh my goodness!

(AR): It burnt that house, only that house and at the time my brother was married to Marlene, Marlene Cockett. It burnt that house, and I said tutu take the fire away! Go to Ukumehame, and it did! The wind switched, and the wind stopped, it didn't come down the mountain, it turned and the fire burnt two cottages on the church ground and then caught fire all on that side of Ukumehame. I'm not kidding! And I said tutu, tutu take this fire away!

(TLG): That is amazing!

(AR): Then had another fire! Olowalu had two fires, one started behind where Olowalu tomato farm was, the fire started I don't know what the people were doing… So the fire burned behind

Olowalu tomato farm, and the wind blew the fire and it burned the Naho'oikaikas property. And I was in Ukumehame, I was working with my daughter and husband working in the taro patch, and I saw smoke and I said oh we better go home, I think the fire is in Olowalu. I said oh come on, and you know what they tell me, oh no the fire is not there, it's in Launiupoko. And I said oh no that fire is in Olowalu and it's going to burn, so I tell Starla don't worry, the fire going Launiupoko; the fire going the other way now. The first fire went that way and the other one went this way. And it burnt a home in Launiupoko, one burned I think. I said don't worry the fire is not going down to our house. Not going to burn, because my husband refused to bring us home, and the fire started in the morning, we didn't come home till 5'o clock! We didn't come home, and when we came home, there was nobody there, no one in the community, because they told everybody to leave and it burnt and went towards Cut Mountain. So I said don't worry *tutu* going take care of us. That's why they quoted me two times for the two fires!

(TLG): Oh yeah, that's amazing!

(AR): Yeah, cause that man came from Maui News and ask me "hey, how come your guy's for the second time your house never burnt? And I said "because this is one spiritual place! It's not going to burn! People that live here are not going to have their homes burnt!" So when I hear about people talking about fires in Olowalu, I'm not afraid, because our fires are not going to burn. Not here! Not in Kapaiki! Even back when that tsunami we had, I didn't evacuate! (Laughter) what I did was, Hinano lived in Kihei; I called him and told him "Hinano, come to Olowalu, there's going to be a tsunami, hurry up!" because he wants to see action right! (Laughter) so he said mom, "you not going to evacuate?" I said no why should I, I going hide, and when the police going come by and knock on the door, and I'm not going to answer the door. But I said no Hinano you come and I'm going take my car up in Olowalu uka, the homes above the store, they call it Olowalu Mauka, but it's actually you should never say Olowalu Mauka, it should be Olowalu Uka.

(TLG): Okay, why is that?

(AR): Because it's supposed to be like that, not mauka! uka!

(TLG): Uka-up.

(AR): Yes! Its suppose to be Uka, but I don't want to tell them to change their name, let it be like that, but the right name is suppose to be Uka. (Laughter) its uka!

(TLG): Yeah, because you say I'm going Ma Uka. So towards…

(AR): We say mauka. But when you name something the name changes, its Olowalu Uka, but if they want to call it that, let them. It sounds better though yeah?

(TLG): Yeah, it does

(AR): Like Mililani. It's Mililani Uka, Not Mililani Mauka. So I'm telling Hinano you make sure when Frampton them start naming places, watch how you name your places. Make sure, you know don't have the haolefied names around here; don't do that, make your Kupuna's happy, when they look down. They look down and they say oh that's what we want, keep it like that.

(TLG): So you were going to share with me the place names?

(AR): Yeah, I have it at home; I have to go get it! I can write it for you, do you have some kind of map of… map usually Frampton has those huge maps.

(TLG): Those big maps, yeah would that help, I can bring you one…

(AR): Yeah, you drop it off, and I can write it for you and I can

(TLG): So the older maps?

(AR): Doesn't matter, but maybe the older maps would be better for me because I know the older maps more then I know the newer maps.

(TLG): Yeah, I can bring it by.

(AR): Because I drew my maps. Just the names, yeah so, I don't think everybody knows that you know, the names, and Hinano told me, "don't go and tell everybody those names!"

(TLG): But how they going know?

(AR): I know, what you say that name of that surfing place?

(TLG): Thousand Peaks, and then the one when you just are coming off the Pali, they call that Grandmas.

(AR): Oh, so maybe Thousand Peaks is where? Ukumehame?

(TLG): I think Thousand Peaks is Ukumehame Beach Park.

(AR): Ohhh.

(TLG): I think the surfers call it that, I think so because when you're in the lineup you look back at the mountains and all they see is the mountains.

(AR): Okay so actually because of the peaks over there, they call it. I don't like to hear that. (Also a name that is more likely associated with the *'ale* or windblown waves of the waters fronting Ukumehame that looks like a "thousand peaks".)

(TLG): The real name for that is over at the beach park.

(AR): Hinano said let them keep that, and we just won't say nothing. But you know sometimes we should, especially in Olowalu. You know where those people are camping, where they charge them $10?

(TLG): Yeah, across the street. It use to be…

(AR): You know it's a beautiful beach, such a beautiful beach, I'm glad that outside people, even our locals don't know about that beach, because that's state land, anybody can go on that beach. But I don't say anything to anybody that you can go there if you want to, cause that's where we use to camp before. We always camp there, and that's where the mother shark comes in to lay her babies. That's why you see a lot of baby sharks.

(TLG): Yeah, the black tips.

(AR): Yeah, that's where they come into lay their babies. Right over there, that's why the black sand, there's a name to that place, but I don't know what the name is. I wonder if Hinano knows. But I know there is a name.

(TLG): I can call Hinano too and tell him come on we got to have the place names, got to be right before they give some funny kind names.

(AR): Better not, because I heard Wilmont Kahaiali'i on Akaku with listen, DeNaie just recently, they were talking you know about the reefs, and she doesn't want Olowalu Town. Now, he was talking with her, and they said like this, you know where mile fourteen is, it is where everybody is camping, and right passed the church grounds. He said to DeNaie that there were Lipoa limu growing there before, he remembers this, and every time he passed by he could smell it. I met him recently at one of the OHA's meetings as MCC.

(TLG): The Kuleana one, the one they had for the Kuleana tax breaks?

(AR): Yeah, yeah, and anyway, he was there and I slapped him, I said "hey how come you say that they have the Lipoa Limu at mile 14? There's no limu there, why you say that, there's no limu there, and he said no, no, no, and I said no, you lying. He said no, I said Wilmont look at me, and how old do you think I am? I am 82 years old, and I was born in Olowalu, and you get the nerve to say they had Lipoa limu at mile 14. You're lying! And I walked off. I was so angry. Lipoa Limu is at Papalaua Park, that's where the Lipoa limu stay. I know what limu grew here all the way to Ukumehame... (Questions Kahaiali'i's knowledge of this area). When we listen, don't believe what people say because it's not true, we use to have limu in the front here too.

(TLG): Yeah, what kind of limu did we have here?

(AR): Wawae'iole. The green one,

(TLG): The green one

(AR): The one that the Filipinos like to cook up and put tomato and onion inside, and you cannot refrigerate it, when you pick it off the beach, you bring it home and you clean it and leave it in a colander on the sink because you cannot put it in the refrigerator or it will melt.

(TLG): Oh really

(AR): Yes!

(TLG): I didn't know that.

(AR): That's the kind we use to have in front of here, but no longer limu.

(TLG): So what happen do you think to make the limu just go?

(AR): You know, I don't know really know what's happening to our limu. I don't know, I sometimes I feel it's what we are putting in the water. The thing they are putting on their body, I don't really know what's happening to our water, because we know longer have limu here in Olowalu; we used to have Lipoa at Papalaua. But I don't know because I have not smelled it yet. I think the limu is all gone, because down there, there's an area at the wharf. At Olowalu wharf, there's an area there where my mom and I use to go pick limu; lipe, but there's no lipe'epe'e there anymore, I don't know, maybe Hinano knows why we no longer have limu. But we use to have lipe'epe'e, Lipe'epe'e is the one that they mix with raw squid. Cause each, like Opihi limu; each seafood had its own limu. And that would be the one that was for squid and raw ake. I don't eat that.

(TLG): I'm sorry, I'm making a face.

(AR): That's all right, that's all right, I tried it one time, but it couldn't go down, but Hinano loves it! I think we had...

(TLG): Yeah, I think, wow! And then...

(AR): and what else they had... sea cucumber.

(TLG): Loli

(AR) That's what we use to use.

(TLG): They had loli out there too?

(AR): Oh yeah, had lots. That's what we spent our weekends on the beach, then we couldn't go to the beach, we had to get a key, somehow Horcajo was the project manager over here, and he gave us one key to open, so we could park our cars, around there by the wharf. They closed it off. But right around there, they get one piece of state land. Yeah...

(TLG): So that's where you go...

(AR): That's the only place we could go, if we wanted to stay overnight, we would pitch our tent there, but we didn't listen to what the plantation told us. You know we just went and camp overnight, we just pitch our tent. Don't get sassy, to me eh, I don't get sassy, I say what I was here before you, what you talking about, but that's their job to tell us we can't camp over night, but I tell them who said we can't camp over night?

(TLG): Native gathering rights...

(AR): I don't use that, I just was here long, here forever. Even now we can't even go down to where those people are camping, there, I don't want to go there, I don't know if it's clean or what. But I'm glad that Peter Martin is doing that for people who have a place to stay, pitch your tent, and pay $10. (Laughter)

(TLG): that's better than the hotel room.

(AR): I think about two or three years before I went down to the place where the fence is, and my daughter and I just walk around the beach, and I didn't like how one of them act like they own the beach, I don't like that, oh where you guys came from? Don't even, I say look at me I am a Hawaiian, don't come out and tell a Hawaiian what you guys here for. So when the guy told me that, I say what you guys here for? So when the guy told me that, I said "What's all this Bamboo?" They had bamboo stick in the sand, and I don't know what they were catching, but I said "what about you guys, who gave you guys all the permission to do all this?" And I said "and let me tell you, you want to act sassy, you know that, that don't belong there, move it back, that's state land. Move it back on the plantation land." But of course that was Peter Martin them all ready. I said "move it back, don't go pitch your tent over there, that's not owned by Olowalu, that's not owned by West Maui land." I said like that.

(TLG): Yeah, that's good

(AR): Yeah, don't go act sassy to me.

(TLG): Oh my goodness

(AR): So, and then next time I went down there, I left, they kind of moved, but I'm glad nobody knows about it, and it stays like that, and cause I like Frampton, I'm not telling people oh you folks can go down there and never mind those tents over there, you folks still have a right to go there,

but I don't want people to go over there, because I see what's happening over there I don't need it over there.

(TLG): oh, just right over here, with the kayakers…

(AR): Every weekend that place is choke with people, choke with people, so what they talking about all that reef, what you think they doing over there, they coming across the highway and messing up. There's that dirt road, you should just see what's on that dirt road, just past the church and people just sit overnight, two, three days; where's the toilet?…

(TLG): Oh my goodness…

(AR): You know sometimes because these people come in and complain about the reef, I want to go call the board of health and tell them come down to Olowalu, mile 14 and go across the street and go see what's on the side of the road way, go look! but I don't want to call and say that because West Maui Land owns that, and If I call the board of health, they going to see that that's West Maui Land, and now Ms. Rodrigues was the one that made all the trouble. But they talk about the reef, come on, what about the people doing at that beach? Where you think all those people are going and messing up West Maui Land with their toilet papers.

(TLG): And their eco-tourism.

(AR): Well I don't worry about that. Yeah, I tell myself I feel like calling the board of health, but then all camping stops and you cannot camp overnight. Those people are all camping over night there, I feel sorry for them, where else are they going? There is no other place to go, Kihei is closed already, only hotels there, I'm being nice, I'm being nice, I can make stink for everybody, but I'm not gonna do that, because Frampton is nice and I want to help him.

(TLG): So do you notice there is a difference in the reef now?

(AR): No, no now what I know is we hardly have fish here, we use to have menpachi, moonlight Annie, use to have once in awhile we catch papio.

(TLG): Out here?

(AR): Yes, all the way to the Pali, but I don't tell nobody cause, I keep it to myself, to me yeah why should I go tell everybody what kind fish they have out there, cause then when I go there is no fish for me. Cause the people greedy, instead just taking enough, they want to clean up the ocean, and no more nothing left. So I don't say anything, but I haven't been bambooing lately but my husband and I use to go all the time. You know they the moonlight Annie. The small fish, it doesn't get bigger than this, it's always like this, but you catch it and clean it and you deep fry it, and you eat bone and all.

(TLG): Bone and all?

(AR): Yeah bone and all because it's deep fried its good. And I know where the menpachi and the reef where the menpachi is on the reef cause me and my husband we try to beat each other, so If I catch one, I go some place and take off and go the other place, and I go and get the menpachi and when he see me catch one menpachi, he's not going go till he catch one. But I don't know if they still have, and what else they have out there, that pokey sea urchin. There's a lot.

(TLG): Yeah, there's not, I haven't been out there in a long time, but I don't recall seeing it. It's been years.

(AR): Sea urchin, sea urchin is at Ukumehame Park, and at the wharf, the Olowalu wharf on the left hand side. My husband use to catch and get it at the other end, but once that lady got killed and eaten; we no longer go on the other end. Kind of scared yeah.

(TLG): But she was way out there though no?

(AR): No, no, she was in cause it had some kind of reef there before, we use to walk on that reef, my husband use to go Kukui hele po. I don't know what you call it, I use the Hawaiian words, you call it…

(TLG): With the lamp.

(AR): Yeah, with the lamp, there's an English word for it, but I don't know, my husband use to go on that reef, but now over there, there's no reef over there. It was a beautiful place. There was a reef on the right hand side. Where the weddings are held. Low tide, you could walk on the reef, but now no reef, I don't know what happen. It was a beautiful place.

(TLG): So when you go out at night time, what you looking for at night time?

(AR): My husband, we use to put the light on him, because he was going spearing. They use to have a lot of fish there, but, now, you know when you go to the beach and catch something, people see you, they watching right?

(TLG): Yeah

(AR): Then when you go home, they going over there, and they clean sweep the beach, no more nothing. So, now we don't say nothing, if we know where the limu is we go get that limu. And if somebody bring limu to me, and I say hey, where you get that limu? But, I'm not going to ask you. Thank you for giving me that limu. If you catch, bring, I don't want to know where you get it. Because that's for you.

(TLG): That's amazing, I know sometimes, we work on these projects and construction workers from Honolulu come and they are like oh my god Opihi, because no more opihi on Oahu.

(AR): Like over here, yeah, you can only take what, one, one package, yeah. Even the limu yet, even the rocks for Kalua pig, you can only take one bucket like that now.

(TLG): I didn't know that; really?

(AR): Yeah, (inaudible) my brother Eddie, he took two, and you know my brother Eddie yeah, confrontation. (Laughter) yeah my daughter too, she got caught, she went to get, we call the Ili'Ili rock, to put in your garden or something, they caught her; they said she can only take one bucket. But that guy, that DLNR guy, told my brother Eddie, you can only take one bucket, it's not what he told the guy.

(TLG): How do you expect me to make one imu out of one bucket?

(AR): Got to be smart and go to the river, go to the river. We do it, only by our self but then other people going to stop them. Is this your ahupua'a, go in your own ahupua and get your own stuff, that's a Hawaiian concept. We do not, my grandma told us do not go fishing in another person's

Ahupua'a. You do not go there, only by invitation. You stay in your own ahupua'a, we are told that, and we know that. We don't go anyplace, go fishing. We stay in our own place, that's the Hawaiian concept. Stay out of our ahupua'a. You know Keeauomoku yeah, I say you know Auntie Addie, don't you go testify against Olowalu town, don't you do that. Because you don't see me go Lahaina and go testify against you guys. I have said it to a lot of people… (Talking about other people testifying in Olowalu).

(TLG): What do you think about their concerns, what their saying is bad about Olowalu town?

(AR): I think they don't want development here, I know that for sure, that's why they are using the reef as an excuse. Don't you think so? They don't want development. They call this place pristine, the ocean is so beautiful. People can go to the beach. We have one of the most beautiful beaches here, right in front Ukumehame. But not in front of my place, it use to be like mile 14.

(TLG): Really.

(AR): But when they built that culvert, it changed the way the current went, so it no longer was sand. They built that culvert, because my husband and I went to court and sued the State of Hawaii.

(TLG): How come for?

(AR): It flooded our home; the water came from the plantation. And it could not go back in the ocean because all the culverts were filled with sand.

(TLG): Oh my goodness

(AR): Yeah, so it flooded our home, and we didn't even move into that home when it was flooded. So we had to sue, we had to re-carpet; we had to put new drapes because the drapes go to the floor yeah. We sued the State of Hawaii that's why we are in their law books.

(TLG): For like a case study?

(AR): Yeah.

(TLG): So all the culverts had sand in them, and the State wasn't cleaning out the culverts.

(AR): They wasn't because they planted coconut trees right next to the covert, so somehow the roots got there and they kind of blocked. so yeah, So we won the case against the State of Hawaii, so they built that culvert.

(TLG): Oh my gosh, but that's the covert that changed everything.

(AR): Yeah, it changed the way of the current, so there's no beach, that's where my children learn to swim. On the weekend we come to church and my children had to come, and I'm going to tell you something even Hinano will tell you, I send my children across the road, you could count how many cars had passed the road, but there was no one to take care of them at the beach, to watch over them. And they were young, like 5, 6, 7, 8. Not much older, I had five children in five years. Yeah, five children in five years, so when they went to the beach to swim, 5, 6, 7, 8, 9 and no adult, just them going across the beach, and well they didn't drown.

(TLG): Yeah, that's nice.

(AR): It's a beautiful beach like mile 14, and my children always pick on me about that. (Inaudible)(Laughter)

(TLG): How's my mom?

(AR): You want go swimming, go swimming. Go, go, go. I would be across the highway to watch them.

(TLG): It must be the generation, because my grandmother was the same with us in Makena. We would be like we want to go swimming, and she would be in the house, and we would be out in the bay, swimming. She had confidence in our swimming abilities. I guess because these days I would never, you're not going swimming till I am on the beach, but, maybe, I should have that confidence in them. That's amazing.

(AR): Yeah, and my husband saw Menehunes right across our place. He was, he use to work for the tire company. Turn that up, that was years ago, maybe forty years ago I think, and he use to work for the tire company and he had to go to Lahaina to deliver tires and everything, so one day he passed right in front our place, and he was looking at the beach before it had sand, and he saw two people running to the edge of the water and the water came up, and these two children, he thought they were children, and he thought those two children looked odd, because they were chunky and their hair was stuck to their head or something different about them, so then he passed looking at the two children, he thought oh, I wonder who my mother in law have at her house, because they get two children there, and his mother in law, that's my mom, had a guest, so he looked across to see who it was, niele yeah, and like I said didn't look like children, they looked odd. So he stopped to reverse, and we he reversed he looked across, and they disappeared. He said that was menehune.

(TLG): Just playing.

(AR): Can you imagine that, 50 years ago, there was menehunes playing over here. That's why I say, not only that, when he told me that, I said ah you lying, you kidding. And he said no it was a menehune, because they look to mature to be children, and why they don't have parents with them. So that's why he looks across the street to see who my mom had her house, and you know he told my brother Eddie, and my brother Eddie, make fun yeah, so one day my brother Eddie was driving on the dirt road and his truck got stuck further down from this dirt road, so he had to walk home, that was night time because he was going to drive to Ukumehame, and so when he was walking home, there had a Menehune run across the street, right on the dirt road, right in front of him. So that's why he believed what my husband saw, can you imagine had that kind people before?

(TLG): I can't imagine.

(AR): What, you folks never had that in Makena?

(TLG): In Makena, no, it was more things from…

(AR): Ghost? (Laughter)

(TLG): Ghosts and sounds. Interesting sounds, like musical instruments, or drums or something like that.

(AR): Yeah, yeah, we had that too. The Kaiwaloa Heiau and they go right across to the Heki'i Heiau in Ukumehame. Yeah, had that.

(TLG): It had the drumming

(AR): Oh yeah, we use to hear music,

(TLG): What kind music?

(AR): Funny kind music, it had no tune music, like monotone, there was music but no tune to it, so you know, that's not real, it's not real. We use to hear that, and My husband and I would get up and go to the window and go listen and see what is that sound coming from, but we knew that it was po kane, when they walk in with the drum, and even the drum there was no rhythm, you know but the warriors are walking at night.

(TLG): Does that still happen; on the nights of Kane?

(AR): not anymore, I think the last time my husband and I heard that back here, was 1970's and get what you call that fire ball, akua lele, didn't have here too.

(TLG): I've never seen one of those fire balls.

(AR): I know I saw it, and when I looked at it and saw it the fire going across, I was going to go like this, and go oh, then it burst. Because when I told my dad, because my dad was still living at the time, and I told him hey I saw one akua lele. What was that? Is that for real? He said no, no, because people were talking about that, then he had one word for it, but I forgot it, but he said there was one grave and some kind of...

(TLG): A gas

(AR): Gas come from the ground, sure I believe that, I understand the gas, but why it coming this way, but he would laugh. But my dad didn't like talking about those kind things, my dad was different from my grandparents, he scolded my grandparents when they talked about that, he didn't like my grandparents talking to us about that kind, he was saying that it was gone already, that's gone.

(TLG): But the stories are kind of neat yeah?

(AR): Yeah we had a lot of stories, my grandmother, my mom's mom was born blind in Ukumehame, she was born blind, so Hawaiians before they going to be born blind, they going to find a way a Kahuna, and they did find a Kahuna, and it was that man, that lived, that owns property up in Olowalu valley, but he lives in where they get that Lahaina Shores, his name was Ernest Napaepae. Well, Ernest's dad was a Kahuna, well my great grandmother and my great grandfather went to talk to him because Napaepae had some family living Ukumehame at the same time, they were Ho'opi'i, at the same time, anyway they went to see him to see if he could make my grandmother see again, so he came and told her what to do, to at night or early morning go in Ukumehame Valley and go and pick herbs, and I will tell you which ones to pick up, and you have to go and come back down before the sun rises. Because I got to do it before the sun rises. He came down, and he forgot one thing, and he told his father, do not forget anything because if you do your daughter will only see with one eye, and he brought those things down and he forgot that one thing. And it was the spring water, so she could see only with one eye. That old man Napaepae.

(TLG): Wow, that kind of knowledge is just amazing.

(AR): Yeah, we had a lot of stories.

(TLG): That kind of knowledge is amazing. So did anyone in your family practice la'au lapa'au?

(AR): Oh, my grandmother, my mom's grand aunt took my mom, she was sisters, so when my mom was born, my grand aunt took my mom. They were sisters, Lily and Anna. Anna couldn't have children, so when Lily was pregnant, that sister went and to ask Lily if she could have the child, but the child must be a girl, so when my mom was born, she walked in with the baby blanket and took the baby, and raised my mom, that's why I call her my grandma, because she's not really my grandma, she's my grand aunt. But she knows, she took care of my mom, so she's my real grandma. Even if she didn't have my mom, she's my real grandma and she is the herbal healer in Ukumehame, she could heal a lot of people, but not her family, just outsiders.

(TLG): Oh really

(AR): Yeah, so when she got older, because we never went to the doctor, we were all taken care of by my grandmother. So my mom asked my grandma why don't you teach one of my children, there was nine of us, but she said no, I'm going to die with all of that I have, because you know what's going to happen if I give them all what I know they are going to make money of it, and that's so true today, so true, never seen anybody today, that's not making money with all that knowledge that they have, it's true, so I'm glad my grandmother never told us, because maybe if she did have me, I am the oldest, but I was more on my dad's side, my grandfather said this is my granddaughter. The next one, the other side of the family can have, but I belong to him.

(TLG): You were the girl.

(AR): Yup, he didn't want a boy, he wanted a girl. (Laughter) Yes. So my grandma had to take a boy, but then, that's my brother Eddie, but he didn't want to stay with my grandma, so she had to take the third girl, the third person, my sister (Louise). All grandmas, all families had somebody, and it's always the oldest, but then that's how, because my grandmother, I know a lot of stories, I do, she tells me everything, and she tells me what to do, what not to do. I learned a lot from her, that's why I'm a little more rigid then the rest of my siblings. Because I was raised like that, you're the oldest you got to do this, you got to do that. Even today, when people come to my home to eat, everybody got to eat first, and I am the last to eat. She said you will always be the last one to eat because if there is not enough food, whose going be the one not going to eat, It has to be who, it has to be the hostess, and even today I do that, I never, any place I go with my family, I make sure they take something, before I help myself to something. It's that way, I mean, that's being Hawaiian already. And my grandmother was an ace at catching squid; she could catch fifty squid in one day if she had to. If she had to, but she's not going to do that as she would be taking everything out of the ocean. But sometimes we come to Olowalu and we see all the squid all hanging on the line, waiting to eat, and we just pull the leg, the dry spot.

(TLG): Really, the snack?

(AR): And my grandmother, that's her area, yeah, from Ukumehame to Cut Mountain. She use to go early in the morning, before the sun came out, she would go get squid, and she would end up at that S turn where Awalua is, you know they had families come from that side, and she would stop at every house and she give them something. I would go with her, and in my mind, I was like if she going to stop at every house and give everybody something I hope when we reach home we going get something. Even if only one left, that's what we going have, she would give everybody something. Don't have to be family; as long as she would just walk from the next house, to the next house. Oh wow.

(TLG): Oh wow, that is a Hawaiian thing to do.

(AR): Well she was the only one I ever see doing that, I don't see other Hawaiians doing that, she was the only one at that time I remember, maybe I wasn't paying attention. Maybe I was just watching her; not other people. I was watching what she does, and that's how we were brought up, I mean we got to share everything. That's why even till today, when we go church, I serve lunch every Sunday to my children who come to church. It's a way of saying thank you for coming to church, till today I do that.

(TLG): That so nice, and so how many, is it just you and your children today?

(AR): We have 27 members, but every Sunday at least 12 come. At least 12! Every Hawaiian church is like that. I think they all like that, except the protestant churches here on Maui they have more than 15 would be Ka'ahumanu, Paia Congregational and Waiola. Some churches have less than us like Waihe'e church; they only have 9, or maybe 5. That's all.

(TLG): Keawala'i is…

(AR): Oh Keawala'i got nothing, but…

(TLG): Yeah. (Laughter) I wish…Nothing but you know.

(AR): Nothing but, but that's your church you know, that's your church no matter what, I'm sure later on years from now, when that town is built they will be a lot of people coming to this church. To that chapel we are going to build. I don't want a too big of church. I'm going to hope my children will still come to church; I know they come church because their mother went to church. Still honoring and show respect. When I got married and was raising my children, I never had time to go to church on Sunday; I wanted to go church, but I would stay home, because I was not going to take my children to church. They noisy and not going to listen. So, I never took my children to church. I went by myself, and my husband is a Catholic so he never went to church with me, then my children went to school, to Kamehameha School, then college, so they never come church until they are old now, in their 50's. In their 50's they finally came to church, so it's something that is new to them. But I'm glad I sent them to college because they know how to go on the internet and they can look for information to come to church on Sunday and talk about the scripture reading like bible studies I call it. So it's my children and my sister, my two son in laws they do the sermon on Sundays. We can't afford a minister. But I had Reverend Earl Kukahiko come once a month to do our Holy Communion, but now that he's retired we don't have ministers to come and do Holy Communion. But I've asked the United Church of Christ they got to do something about it; they better go out and find somebody, so I serve Holy Communion, because I'm a deacon. So I serve holy communion, and I don't think the United Church of Christ like that, they never heard about it yet, but I'm sure that one of the churches will say something to the United Church of Christ, and say that Adeline Rodrigues is serving Holy Communion, so let them come and tell me, and then I'm going to say if you don't want me to serve Holy Communion then you catch a plane you come to Olowalu church and you serve us Holy Communion. Don't say we can't do that, and then don't do something about it. There's a difference yeah, so I'm challenging them. And see if they going to say anything.

(TLG): What about Anela?

(AR): They cannot go out of their church; cannot. There are rules you know. So fine, Anela will gladly come or Grale. Grale is sick yeah, Anela would gladly come, but she cannot, that's the rule, only her church, and Grale is that's why Kukahiko retired, and when you retire, you lose all, what do you call that word, not authority, what is that you apply for, permit? Not a permit; something other than a permit.

(TLG): A certificate?

(AR): Not permit, there's another word when it comes to church, when you retire as a kahu, you no longer have authority to preach, to serve Holy Communion, to marry, but for marriage you can go to the State and get a permit to marry people, anybody can marry people, you don't have to be a minister to marry people. But holy communion,

(TLG): Like a decree?

(AR): I don't know, but that's why Kukahiko cannot do anything for us. But I've told him like this, I've been a maverick and I've told him like this, Kukahiko once they make you a Kahu, regardless if you retire, you still a Kahu forever. Forever! God or Jesus didn't tell you, that you have to have a certificate to go and preach the gospel, what's wrong with you guys? But I don't want to say that. That's not being nice. So I cannot have him come here, then I got to write a letter to the ministry to ask if I can have Kukahiko come and only do Holy Communion for Olowalu church and that's it, for no other church. But one time I asked Higa from Ka'ahumanu Church, and then I found out somebody told me you cannot do that, he going lose his license if he come out of his church and go to another church to do Holy Communion.

(TLG): How come? That's…

(AR): Rule!

(TLG): Oh my goodness, so you can't even get another Kahu to come?

(AR): Unless that Kahu has a… I forgot that word I used now.

(TLG): A license?

(AR): No, the other word. Oh shucks. License, I guess a license. To go out of your church and preach at other churches and that must come from the church ministry of the United Church of Christ.

(TLG): And what about Reverend Alika from Keawala'i?

(AR): Reverend Alika is not, he's Tri-Isle Association. We do not use Tri-Isle Association reverends because we are like the Tri-Isle Association, but we have another entity for only Hawaiian churches called the Association for the Hawaiian Evangelical churches. Yes, you got to join that, what you call that, there's a word, so Olowalu Church belong to the AHEC; Association of Hawaiian Evangelical Churches. So we have a hard time the only other minister I can ask to come here is Kamaiki Anakalea from Waihe'e church (talking about reasons why maybe Anakalea has not come to their church) I have a son in law and grandson whose interested and wants to get a license to preach, where you don't have to go to college on the mainland.

(TLG): Like Anela.

(AR): Right, like Anela and Grale; go classes, but they don't have anybody now, they had, but he died. So I don't know what they going to do, but I'm quite sure they going to have to go find people to teach, yeah. Because my grandson wants to do that; He teaches at Baldwin High School; Kawika (Keator), yeah.

(TLG): So that would be nice, a lay minister.

(AR): Yes, yes, so you go to Keawala'i church ever so often? When you feel like…

(TLG): Yeah

(AR): Like anybody else, I was like that too, but my problem was my dad was so strict when I was single, you can't go out Saturday night, if you don't go church Sunday, you better go church Sunday, if you want to out Saturday night or any other night you got to go church. Yeah.

(TLG): Yeah, when my grandma when we were small…

(AR): Who's your grandma?

(TLG): Caroline Delima.

(AR): Oh, I knew her, in my later years you know, when I started to go back to church, she was such a nice lady, nice lady. I remember the Delimas, they made good Luaus. Abner, your grandfather right? Yes, they made the best luau for Keawala'i. I don't know their children, but I remember those two.

(TLG): They were really…

(AR): Yeah church…

(TLG): They were centered around church for grandma.

(AR): Yes, they were famous, that name, Abner and Caroline.

(TLG): So we would go, my mom would ship us to Maui every summer

(AR): Just like my mom, send them to Olowalu. (Laughter)

(TLG): Yeah, we were on Oahu my mom had moved to Honolulu but she would ship us to Maui every summer and we had to go to church and then Keawala'i church had only 10 people in the sanctuary on Sunday.

(AR): Because it's only Hawaiian yeah.

(TLG): Yeah, only Hawaiian.

(AR): That was okay for us even if like 10 people.

(TLG): Yeah, it was nice actually.

(AR): And it was church like all day yeah.

(TLG): All day; all day long.

(AR): Then there was lunch, usually stew.

(TLG): And then we had to clean everything. All of that, and we would go early in the morning because my grandmother would open the church, she would be the one to open the church,

(AR): Yes, yes I remember that.

(TLG): So we all had our chores, we would put books in the pews, and hand out lauhala fans because it was hot.

(AR): I thought only us did that, I never heard anybody say that except you.

(TLG): Yeah every Sunday, and we don't want grandma to get mad at us, so we would sit in the pew, and then we start getting fussy, we would lie down in the pew.

(AR): Yeah, I never took my children to church until they were old, but my mom would take them, and she would take gum to keep them quiet. I wouldn't take them, no you guys not going with me. I don't want to be embarrassed. You folks like me spank you when you guys get home or what? But, you know one thing; I would never spank my children, never, not even once…

(TLG): Really

(AR): Yeah, if they come home late from playing, they get the spatula. Just like that, one whack, but then I do that, and they kind of put it away. Yeah, I never spanked my children I got to admit yeah, my children are good, nice children, Because how can you raise five children, one after another, so I got to do things fast, cook fast, because I got five, but every time they always had to eat before the mom and dad ate, and no matter how old they were, I would always put it in their ears, you guys listen to mom, I don't want no sass back. No, when I open my mouth and say something, don't you even think of telling me something, you going to listen till I finish talking. Even till today, they are older now, so they can say what they want to say, its okay, but if they say something that I don't like, they are going to say something, and they shut up, even now they shut up. Even Hinano shuts up. (Laughter)

(TLG): You got to respect your mom.

(AR): Yes, but they do, they really respect me, they do, and I'm glad, I'm so happy and I love them, I would do anything for them.

(TLG): That's just wonderful

(AR): I always tell people that they are my life, without my children I am nothing. I always say that, without my children I am nothing. Yeah, that's how I feel, I am nothing. That's true you know, if you don't have children, what then? yeah, but you know I have a daughter and she don't have children, and she said mom, I don't like when you say that, and I said I'm not saying anything to you, if you didn't like children, that's you. You know you decide what you going to have out of life. But with me sure when I had five children I had a nuts ticket, how am I going to raise all those children, and everybody tells me how did you do that, and I say I don't know. I just do it, I go to work every day, I had a sister that helped me. I had to work. Five years, five kids, five kids all going college at one time, that's why I had to work two jobs, I sent him to go work; my husband was not like me, I want my children to be educated, not, my husband believed that high school is good enough, for me high school was not good enough because we were all poor, so why not give your children a chance and educate them. So when they grow up in this world they know what to do. The day they graduate, get a party and then I tell them, okay, from tomorrow you go out and find a job then you work until you retire.

(TLG): Now it's your time.

(AR): Yeah

(TLG): That's great, oh my gosh, you should teach classes to all these parents whose children.

(AR): I always wanted to be one teacher.

(TLG): Some of them just run wild; you got to teach these parents to give the looks then their child. Teach parenting classes.

(AR): Yeah, but I stress that, even my grandchildren they all got to go to college, they got to go, I am sorry, and you make sure your children graduate. And you see all these people suffering its cause they never sent their children to school. High school is not enough today. Look what you call it, janitor, there is no such thing as a janitor today.

(TLG): It's a fancy word.

(AR): Yes, yes. And what engineers they don't even have to go to college, and they get that - something- engineer.

(TLG) Sanitation engineer, that's it

(AR): Yes, yes. sanitation engineer all they got to do is clean up the cannery, that's all they do, the sanitation engineer. What is that?

(TLG): So where did you work? In a cannery?

(AR): I started work at 14. My mom sent me to work, because before there was no such thing as two jobs before. There was no such thing, you work till 4 o'clock, and where else can you work? There was no night work at that time, and anyway, I sure had hoped I could have gone to college, but we were too poor, 9 of us, I'm the oldest, the only one who could go to college was my brother Abe. He was the only one that could go to college, and that was alright. What else you said?

(TLG): You were working at the cannery…

(AR): Oh yeah, I started work at Puunene Dairy, I started off cleaning the boss's office and the rest of the other offices, and I use to do that job, and I use to go help the women who would wash and iron the, Puunene meat market, you know they use to wear those white aprons and we use to take it to Puunene Dairy and I use to help those girls. And my mom said I was 14 years old.

(TLG): 14 years old and you were doing that!

(AR): Yeah, summer time only and then they had a war, and then what they call that, victory gardens. And then we had to work in the plantation, and I never like that with the hoe yeah, and then when I reached 16 years I started working for Maui Pineapple Company and I started off as a trimmer, then a packer, then the glove room, where they give out gloves, did you ever work in the cannery? No, you too young for that. When you were old enough; no more cannery. Then when I got older, I got promoted and I worked personnel, I worked myself up.

(TLG): Yeah, that's great.

(AR): So, when I was 30 years old, I worked in personnel as a personnel clerk, clerk sten until I retired. I retired from there at the Maui pineapple company in Kahului.

(TLG): Okay, so where the mall is, is that the cannery that you worked at?

(AR): No the cannery still right next door to Foodland.

(TLG): Yeah

(AR): Yeah 20 years now, and I have a pension, but then I heard a couple weeks back, but I heard they don't want Lipoa point to be developed, but I want Lipoa point to be developed because that's where my pension is supposedly coming from there. That's what I heard. His name, Churchill said something, that, but I kind of heard it but I wasn't so sure yeah, but when I asked my brother, he was like yeah, that's the one for the pension.

(TLG): Oh my gosh!

(AR): That's why they okayed it, I think it was Mike White, Victorino and Elle Cochran still wants to, I don't know if they are going to have a first or second hearing about it, I don't know too much about that, but then they passed it to develop.

(TLG): And it was because people's pensions were depending on that?

(AR): Yes, yes.

(TLG): Wow!

(AR): I didn't know that. I told Hinano, Hinano is that right, you mean to say if Maui Pine don't make money, and then I don't get my pension. He said yes, that's what happen everybody today, a lot of people losing their pension, so you not going to be one of those losing their pension. I said Hinano, if I don't get our pension money, mom and dad cannot go Vegas! (Laughter)

(TLG): Then were not happy.

(AR): (Talking about going to Vegas) thirty years for me and you know what they tell me it's payback time, and Hinano helps, all my children.

(TLG): That's nice, because it's your turn,

(AR): I don't consider it such word as payback time. When you bring children into this world, you are responsible for them. They say only to a certain age, but for me I will be responsible for them for the rest of my life, I believe in that.

(TLG): That's wonderful

(AR): And I wonder why the lord has let me live to this age, I thought I would die, my mom lived to 86. But my dad died at 65. I'm surprised I live this long, even my husband.

(TLG): What you look great!

(AR): My sisters in law, they are older than me, and one is going to be 90 next year! My husband's family is living long. And I think us too! And I'm happy; I thank the lord everyday for that, for that one more year!

(TLG): Because you're so active and you have a town see built.

(AR): I don't know, I'm quite sure the town won't be built for another 5 years. If it's before that, that's lucky! Because I think these people going to make Bill Frampton and Dave jump through hoops! But I think as long as I'm here I'm going to help them. I even went to Victorino's bash just to say thank you! And I said thank you, thank you, and I go and see all of those guys who voted

for Olowalu town and say thank you, I wanted to write a letter, but Hinano said better if I say it to them. Thank you, thank you; so I have a couple more to go.

(TLG): Do you have any concerns about that for Olowalu? And the impact for the reef or the water or anything like that, do you have any concerns about that?

(AR): No, no, I'm leaving it up to Frampton, I believe in them, I have no concerns, nothing, but I'm watching and seeing, and if I don't like anything that is happening I would say it, I would tell him. But I don't think, the reef, oh come on! Hinano said the reefs that are inside don't worry about it; it's the reefs on the outside. So I tell myself well worry about it then. I tell him were not the ones destroying the reefs is the ones snorkeling. It's the boats taking people to Molokini! And then they come in and they all park in front of Olowalu. What are they doing, I would like to know what they are doing! Are they letting their mess out of their boat, we don't know! Oh I would love to be one of those to watch them. If someone told me hey Adie, can you carry binoculars and watch them, I would love to do that. And if anybody told me to go to the beach and see how things, what's happening and see if they are doing what they are suppose to do, I would love to go do that, but the only thing that I don't want here in Olowalu would be riding that boat ski.

(TLG): Jet skis?

(AR): Yeah, I don't want it here, because I think it kills people if you're not careful, and no matter how careful you are it will happen and that's the only thing I don't like here in Olowalu is jet skis. That's the only concern I have, but I'm not going to see that, it's not going to come up for another 10 years, but I'm not going to tell my children, that you know whatever Bill them are going to do here, I don't like jet skiing, not in Olowalu, come on, not in Olowalu, and if they are talking about the reef. Well, you think jet skiing going to be good for the reef? That's the only thing I'm worried about is the jet skiing. Canoe, I don't know about the canoes, if they know what they are doing then okay, but because what that's what people are complaining about the reef, yeah, canoe…reef, that's up to them I'm not going to talk about that, it's just that the jet skiing, I don't want it in Olowalu. Let's keep it more family oriented.

(TLG): And is that what you think Olowalu town is going to bring in, just family oriented kinds of things?

(AR): I hope they do, I hope, that's what I figured they are going to do right, family oriented, so I'm going to believe whatever they said that's what they going to do, so I hope they going do. Like I said, I'm going to have my children keep an eye on them, but I do want Olowalu town. I told everybody I want Olowalu town!

(TLG): Why is that?

(AR): Because people who live here they don't have to travel to go shopping, it's right here, near you, you don't have to get on the highway, you know how bad the highway is, so we need something here, if you're going to build homes you need a town. Why build homes and no town. Why? What for? You going to climb up the highway again to go shopping! If you going to build homes; then get a small town. And I'm happy, I'm really happy there's going to be a town here, I wish it was sooner, that's all I'm going to say. Because if it was sooner, then I don't have to go shopping in Kahului or in Wailuku, I could just shop here. Because you only need things for you and your husband, I would love to have a town here while I'm still living, but I am glad that we

are going to have somebody that is going to build this town. And I've told every Hawaiian that I know, and a lot of Hawaiians they don't want Olowalu town. Oh, but it's such a nice place, but I tell them you folks is being mean. You folks live in the city, you can go shopping, what about me, I live here, I'm old already, so I need a town, but I know the town is not going to be here in 2 years, not going be here, but I'm thinking of my family. And I've heard them say that oh maybe we should all move home, and I said I wish you would move out of Wailuku heights, I have two girls live Wailuku heights, and I told them go sell your home and go buy a home in Olowalu. Because my youngest boy Clyde is going to inherit our home and I've said it, Clyde, this property stays here, goes to nobody else but you, the only person who's going to take this property is going to be that ocean. Only that ocean can take this property, it stays here, no one else is going to own it but you, he knows that, only him, if you don't want it, leave it there, let the ocean take the property, not sell it, what for? Make what, one million dollars. In no time no more million dollars, and no more land. Think of the land, it's so important!

(TLG): That's so true!

(AR): And I know my brother says I get Hawaiian homes, what! Hawaiian homes! Sure, you only own the house on it, but that land underneath you is not yours. You don't own it. It's still Hawaiian homes.

(TLG): 99 years

(AR): Yup, still Hawaiian Homes. Mine is forever, and my daughter said if she could get a good price, she will move home, and I think the one in Honolulu who just retired from HPD, I think he wants to come home but I don't know.

(TLG): Yeah, but slowly maybe the Maui people can come home if there is a good home to come home to.

(AR): I will, I will tell my family, you folks come home and move to Olowalu and come back to the land, and if you smart enough you take the first time, don't wait till second, third, fourth time, because the price go up; the ground work, the first people, get our land here.

(TLG): Yeah that would be good.

(AR): And one more thing, behind of me and my sister lives, there get family homes in the back, when they built their homes in the back, they found bones in the back. What they did they buried the bones on the border of their home property, because where else could they take it, they believe that they found it there, they leave it there. I have a feeling that all those bones they found there, I believe they came from behind the church.

(TLG): I saw that in one of the archaeology reports; one of Frederickson's reports.

(AR): So you got this? Oh good! I was going to ask you if you got this.

(TLG): Yeah, I have that and I saw that Erik Fredrickson dug behind the church yeah.

(AR): Yeah, he asked permission if he could go dig. And I said hey, because he didn't believe me, when I told him, but I said I'm going to tell you folks this, and I said I already testified at the burial and I told them from behind the church or not, there were graves before, but I cannot prove where they are, but whose going tell me, but I know, you tell me, you asking me where are the graves, I

don't know but I can tell you if we had people coming to this church in 1836-1837 and they die where are they buried? You tell me! Where are they buried? Where? Got to be right here!

(TLG): Yeah, on the church grounds, yeah, absolutely.

(AR): Yeah, because this church ground there are burials on the side, but these people are only buried there from maybe 1910, anything else is all in the back, but what they planted sugar cane on that land before, and Hawaiians didn't say anything, why, because they are afraid of the Big Five. So they just take over that land, plant cane, and everything, cause the people who use to plow, they would see bones.

(TLG): Really, behind there?

(AR): Yeah. I would tell you something now; I'm wondering how are they going to clear that acre and a half behind the church, without digging up bones?

(TLG): Oh my goodness.

(AR): Have you ever thought about that? Look at those trees.

(TLG): Those trees are huge!

(AR): I'm feeling sorry for them… they only can use saw, they can't use tractor… I know more or less where my own tutus were buried in later years. But for the one in the back of the church and up I wouldn't know, so I'm wondering how the heck is Olowalu Elua going to get rid of those trees… because no sense, they planted sugar cane on that land for years; they plowed and everything for years, so what's the difference already? What you going to do?

(TLG): Yeah, those roots are probably deep.

(AR): Yeah, and when the rain comes down, heavy rain, they move the bones behind where my sister in law lives, that's where the bones came from, the bones came from the church ground. Because there were no burials in the back of those homes, no more burials, that I can say no more, I can prove it; those bones came from the church ground.

(TLG): The church grounds

(AR): So when Fredrickson came and asked me if he can go dig, I said yeah, go dig, get behind there, and he did, and he found, I said I remember that, that's either my tutu Ka'ahui or my tutu Papahi, that's one of them because they were buried behind there. But I wasn't so sure because what happen was they had a ditch behind the church for the water, for the plantation, for the sugarcane and then they made a road, for the turn hauler to ride out and pick up the cane. So all over there get bones, but at that time we didn't have anything to say, for what, so those people with money, those people can out talk us, they can do whatever they want with us, so no make wave, and the word was no make wave! Until they start this burial commissions. Then we can make waves now. I feel sorry for Olowalu Elua… but I want Olowalu Elua to clean up that place, they wanted to turn it over to us at that time but I refuse, I can't even take care of this place, what I'm going do with one more acre, I'm not ready for that, but they will give it to us in the near future, but I don't want them to give it to us with it looking like that.

(TLG): Yeah, that is just too much to maintain.

(AR): But now they got to go with the saw.

(TLG): Yeah, they do.

(AR): I know that… terrible yeah.

(TLG): Oh my goodness. You got to do what you got to do. I don't know.

(AR): And Bill had asked me if we want to reopen the pond.

(TLG): Yeah, and what you think?

(AR): And I said I don't know. I don't know, but I wouldn't want a park there; you think I want people making noise in front of my house?

(TLG): Yeah, it would be right in front of your house.

(AR): If I had to choose between a park and a pond, a pond going to cost big bucks, but if I had to choose between a park and a pond, I would choose a pond because I don't want people in front of my place. Plantation had offered to sell that property in front of us to my dad.

(TLG): Really

(AR): Yeah, and my dad said they got to be crazy if they think I'm going to buy that property with all that rocks there, you think what was underneath there. Who's going to do that, nobody going dare to build a home on one pond.

(TLG): No

(AR): You going to have people walking through your house all night? You cannot do that, because it's going to happen. You know the house right next door to me, my family house, and my sister got the property. It was for my brother, but he didn't have a family so it went to her, but the house is haunted, so a certain time of the month, it's haunted! It's haunted! Because my dad had built that house on a walk way. My grandfather who lived next door, his mother and his auntie use to walk that path to go across to the school cottage to get fresh water to drink. So they are the ones walking through, it's part of the wall.

(TLG): Oh my goodness.

(AR): Part of the wall, it's true and I know because my sister and I use to sleep in that room, but funny, we never had problems, they never bother us, but my grandparents slept in the same room as us, and they would sleep on the floor, and they couldn't sleep on the bed. They slept on the floor, so sometimes I'm sleeping and all of a sudden, I hear my grandma speaking in Hawaiian and I hear her telling her husband, get up, get up, I see fire on the wall, and then I open my eye, I don't see no fire! What you talking about? I'm thinking to myself oh she got to be nuts! There's no fire, but you don't open your mouth, right, you don't talk to your grandparents about that kind stuff, not going make fun. So I just close my eyes, and I hear them getting up, I hear them reading the bible and I hear them pray and then go sleep again, that's how I know it's haunted. Then one time my mom went to Honolulu and my sisters were home and they had a party there and they slept there, and they went to work and these girls slept in that bedroom, and low and behold, that girl said she heard a lady saying what you doing in my bed? Get out of here! She did, she got up and cried and all the way to the beach and stayed at the beach until my sisters came home from work.

(TLG): Oh my gosh!

(AR): (LL), and no matter how many Kahu's we ask to come and bless that area, Reverend Earl Kukahiko's father, John Kukahiko, told my mom and dad there is nothing he can do about it except move the house. Why you going to do that, what for its old already, but next time don't build a house on that walk way, that path, it goes right across the property, to the next property where they got the drinking water. They got all that kind stuff, but I think because that's my grandfather, that was with my auntie, when I feel there is a day, when I feel that maybe I can go and tell my tutu Willy, please go. Maybe I can go talk them, I can tell them that, but maybe if you talk to them, then maybe you no longer can tell them that, because it's their path, maybe you can tell them, go already! This is my house. You know if you going to come in my house don't make people scared. You can talk to them. You can do that.

(TLG): Yeah.

(AR): Yeah, you can talk to them, but the house is old already, but I don't know.

(TLG): But that just goes back to Olowalu being spiritual, it retains everybody. It keeps everybody.

(AR): Yes, yes, and it is spiritual, and I know this place is going to be a beautiful place when it is built and developed, I think it's going to be one of the…Olowalu Town is going to be the envy of all developers. You tell that to Bill, it's going to be the envy of all developers, I think so.

(TLG): Yeah I could see that.

(AR): Yeah, I think so. I tell you I'm going to be watching from that valley up there. My name is Kamaileolihau. That's the name of that mountain. On the left hand side is Lihau and on the right is the small Lihau, I'm not sure, but I was named after that…

(TLG): After that peak.

(AR): Yeah, because there were Maile's growing up on Mount Lihau. And my daughter's name is Kapualehuaolihauulakalaeohekili, that means the Lehua blossoms that blooms on the Lihau, it's reflected in the water at Hekili point. It was before, when had all those Lehua blossoms blooming on Lihau, It had white, pink and red.

(TLG): Oh my goodness…

(AR): White, pink and red and my mom was the one that named her.

(TLG): Named her that, that's a beautiful name.

(AR): Beautiful yeah, Kamaile, no, Kapualehuaolihauulakalaeohekili

(TLG): That's a beautiful name, but heavy kind mana that name. That's a beautiful name, do you recall seeing lehua up there?

(AR): No, because I never paid attention, I mean you know growing up, you don't know how old you are, nothing, but as you get older and then you finally realize about what's happening, then you really look, I never paid attention to Olowalu until I moved here then I really paid attention, and I love it! I would never move away from here! Can you imagine when I built my home, I said oh I hate living in Olowalu, but I had property here and I needed a home, my husband and I needed a home, we were living with my in-laws, I lived with my in-laws 17 years. My father-in-law didn't want my husband to leave. He wanted the son to live with him, but finally we moved, we built this house in 1967 and moved here in 1970. So we used our home more for weekends until we moved

back to Olowalu. And I love it here, I will never move, I will never sell. Actually the property behind my sister and behind me, belong to me. That property was exchanged for the taro land, my grandfather's taro land in Ukumehame for Olowalu. Because my dad, not my dad; my grandparents could no longer work in the taro patches in Ukumehame so my dad exchanged it I think in 1952, I'm not sure. Exchanged the property, I think it's sad, all together 20,000 square foot for the taro land in Ukumehame, for that 20,000 there.

(TLG): So it was even-even and same square footage?

(AR): Yeah, but one thing my dad didn't think about, is he should of asked for more for the water.

(TLG): Yeah, that was my next question was did he sell the water rights?

(AR): Yeah, my dad don't know that kind, the Hawaiians at that time didn't know too much about rights. What rights?

(TLG): So the plantation guys make out then.

(AR): Yeah, they make out, but when Jim Judge them bought Ukumehame, and they were trying to get where we are now, in the valley, all the way up. He told us why don't we exchange, we leave that place where we are now, and go back down to where my grandfather was because there was no evidence of the exchange, like my grandfather still owned that place.

(TLG): So there is no deed or nothing?

(AR): Yeah, yeah, yeah.

(TLG): Really? wow!

(AR): They wanted us to move, he would get us down there, instead of up there. And up there, I only went to claim adverse possession. That's it! We didn't own it, my grandparents didn't own it. But, Nobody knew the history, but me, nobody knew the history, and you know and of course when we shake hands, and there is something there that Hinano knows, because my brother and my cousin Paul were the ones who wanted to go reopen, not reopen the taro patches in there, but he wanted to take the water from the river out all the way down to where he is. So my brother and him was working and digging the ditch and my brother didn't know what Paul had in mind, and I said what you guys digging this ditch for, oh, cause Paul like the water go down there. And I said what! You know how long this ditch! You guys got to be crazy!

(TLG): Oh my gosh!

(AR): And, then because they were up there, and we went up there, we looked and we loved it, that's me, my brother was already up there, cleaning and digging the ditch, so I told my husband oh we go, up there, we go weekends up there with them, And so we started to go up, and then my brother them they drink, my brothers and sisters they like a good time, so instead they go dig the ditch, they just leave it alone and when they ready they go do that, and so my husband is a worker, so when everybody having a good time, my husband go dig with a shovel.

(TLG): Oh my goodness

(AR): 10 feet every day, until he when reach down where the first taro patch is. We didn't, that's not the reason why we dug the ditch. But we was helping Paul and Eddie about that ditch. Then one day when I called Hinano, he was living on the mainland at that time, and I told him remember

when granny use to live in Ukumehame we up there and he said yeah, what you guys doing up there? and I said oh! We digging the ditch (Laughter). We camping here, we go every weekend and go camp! He tells me, what ditch you guys digging? And I said well, you know we digging from the river. But, then when you go to the end, you park, the field boss used to come and he would see us up there, and he would tell me, because I was always around, and he said oh what you guys doing up here, you guys get one Hui? And when I heard him say that word Hui, I tell myself, wow! He don't know that he owned this property, I'm kind of thinking, oh what this guy don't know that he owns this property, we know that Pioneer Mill owned that property, but when this man asked me that question, like what its ours? You know, is it ours? And we get one Hui because there are a lot of people working up there and having a good time up there! I told myself, Hey this guy don't know, there is something about this that kind of now I'm thinking. Well I know there is a taro patch up there, because tutu and I use to go and plant taro. And he said mom, open up one taro patch, and if the DLNR or anybody come up there, you tell them you digging the ditch, for put water in the taro patch. He was on the mainland, so we were going to do what we like! So, we dig the ditch all the way down to the first taro patch, so I told my brother, eh, clean up that first taro patch, because you can already see the taro patch up there, clean up the taro patch! Paul you go clean up the second taro patch, and I'll take the third one, I was already acting boss up there, because now I know a little bit more right, I'm kind of thinking, yeah, cause Hinano going tell me something, so then we stop that, and then I think that haole guy kind of suspected something, and he said who gave you guys permission to come all the way up here? I said well Paul open the gate and we come in, if you folks no own land up here, you folks not suppose to come up here, we came up with Paul. But then where Paul is; he does not; he's squatting. And our Tutus land is further down so because my mom already gave her rights, and my two uncles when gave their rights to the 12 shares. My sister get three shares, and Paul Fujishiro get three shares, but he's not on the property only he's squatting somewhere else, so I tell my sister, hey (Connie), I want part of your property, so that I can have rights to go inside there. So she when sign off her right of shares that's why we could go further up, because they had a gate up there, the plantation owned the gate. Then the owners came up there where we were, and put a sign about quiet title, and then read about quiet title.

(TLG): Ornellas?

(AR): No, the other one?

(TLG): Probably.

(AR): The Hawaiian guy…

(TLG): Yeah, wow!

(AR): Yeah, they came and they use a word that I was trespassing and I needed a permit and that I had no right to dig the ditch and I said no I'm not! I'm just reopening it, there was a ditch there before, and I'm just reopening it for the lo'i.

(TLG): So you made sure you got everything; the land and the water; your allocation?

(AR): Yeah

(TLG): Wow! That's huge!

(AR): Yeah, we couldn't believe it, we signed with the attorney general, and we got it.

(TLG): That's huge for…

(AR): And I thought that my brother going to be part of that.

(TLG): That's amazing, thank you so much for sharing all of that with me, you know there is stories about, well isn't there a hot spring up there too?

(AR): The spring water, you talking about the spring water? The spring water is in Ukumehame, not Olowalu, the spring water is right across here, it's down here, that's the spring water is, it isn't anywhere up there, it's just pass mile 14 or 15 maybe.

(TLG): Okay, coming out in the ocean?

(AR): Yeah, and yeah that's right. It's underneath there.

(TLG): I wanted to ask you about the night marchers and the nights of Kane, do you know where their trail is, or where their path is or how it goes?

(AR): All I know is that it's connected to that Heiau out there, Heki'i, it's on the other side of the stream, Ukumehame stream. It's right over there.

(TLG): So between the two, so they weren't marching mauka to makai, they were marching Heiau to Heiau. Wow!

(AR): Yeah, Heiau to Heiau, and there is another Heiau on the West end of Heki'i. That's the one they call, well they say Ukumehame Heiau, but I've heard it as Aweoweo, tutu said Aweoweo. She said Aweoweo, she said that, I didn't read it anywhere, but I know they called it Ukumehame Heiau. I knew it as Aweoweo only through my grandmother. Other than that; I don't know.

(TLG): Oh, so do the developers know that this is a night marchers trail?

(AR): Right, yeah they are going to that Heiau there.

(TLG): Wow, and Bill knows, Bill Frampton he knows where?

(AR): I never did, they don't know about that. I never talked to anybody about these night marchers, because nobody asks me, and I'm not going to say it, but because you, I'm going tell you that there was night marchers.

(TLG): Well that is amazing.

(AR): I know it for a fact, even my husband heard it. So it's true. At first I thought maybe my sister came home at 3 o'clock in the morning and put her phonograph or whatever on, but when you listen to the music, it's not that kind of music, its monotone. So you know its po'okane, that's a fact, and last time I heard that was in the 1970's, after that I no longer heard that. Cannot.

(TLG): I wonder why is that?

(AR): The traffic is too noisy, cannot hear, and got to be quiet yeah. But we know! We know!

(TLG): Wow, what about the people who are living up side, do they hear anything?

(AR): Our neighbors, the ones in the valley?

(TLG): No, the new ones, the luxury people that live up around that Heiau.

(AR): I don't know, I never heard anything, but it must be going through their house.

(TLG): Yeah.

(AR): Because the Heiau is all the way, and they got homes all around there, I don't know, but I don't know if they believe that kind, but maybe a car pass by with music on, they don't know, but if they think like us. But maybe they going to realize they will think oh wow! And I hope they didn't build their home on that path. You know if Peter Martin had come and talked to us about this area, and had all that kind stuff maybe we would have told him, but it's not him who's going to ask us, it would be Bob Horcajo. That's why I don't like him; because he went and ask all different kind of people except us. So fine you do what you like. That's when I found out he had ask certain people to serve on that Cultural Reserve and did not pick up any of us family that really lived here, and picked up outsiders, and I told him, Bob how come you didn't ask my brother Abe? He's an educator, he's smart. And he said we are picking up people who can write grants, and I said let me tell you Abe Ka'ahui writes grants for people, why didn't you pick him up, and he didn't say a word. I said okay, you guys do what you guys like, but don't you dare come ask me any kind questions about Olowalu. When Horcajo was around they had been phone calls come around with people from Peter Martins office asks if they can talk to me about Olowalu and I refused. I refuse to talk to any of those people. The only people I came nice to is Bill Frampton, it's the way he came across to me, it's the way he came, if he came like those other guys, I would tell him get out of here! And I know I didn't have a nice, good reputation at that time, but you know I'm Hawaiian yeah. People have taken advantage of Hawaiians, so eh, don't go ask other people, and then when you get stuck and you think you going ask me, what am I? I'm not second best. And I've said it! I mean, I don't like people do that, because I'm nice to people, I help them with whatever they want, but don't think you can go ask those other people who lie to you, they've lied and lied. I know their lying. But I'm not going to tell those people, oh those people are lying why you going ask them. But when they go ask those people for information, and then get stuck and then come ask me, they not going to get nothing from me, nothing and I never said this to anyone but you, because I like Frampton. and you working for Frampton is good enough, you Hawaiian, you not Haole … and Rory was the very one that told me and he said Mrs. Rodrigues, you smart yeah, I said why? You never tell all. And I said why should I tell you guys all, you guys not nice to us, you folks going to ask people from outside, and then what leave us on the side, what you think us? Second best! Yeah, I mean yeah! I've said it to Jim Judge straight in his face, and I don't know if Bill Frampton remembered because Bill Frampton was working for Pacific Rim before I think and then I went to this burial commission meeting, and they didn't tell all about Ukumehame, and I told Maxwell and Dana Hall, eh did these people tell you folks that they had one Catholic church in Ukumehame? What? Yeah! And Jim Judge didn't say a word. And they tell me you know where it is? And I said of course I know where it is! And they say how you know? I said because I use to go with my grandma, from six years old I would walk with my grandma up Ukumehame to work in the taro patch, and she would sit us down and tell us stories about Ukumehame, and she did tell me about one Catholic Church that was there and the name was Saint Philomena. So we had a meeting, everybody had to go up to Ukumehame, even Ed Lindsey went, and Jim Judge, me and the commissioners, the burial commissioners, and who was it Ed Lindsey told Jim judge how can there be one church here when its hilly? How can the church be here? Why, when you start planting sugar cane what, you not going make it flat, it has to be on one hill, so the water can go down, so what they did, fill them up! I was right there, when he said

that to Jim judge how could there be a Catholic Church here, and Jim Judge said there was a Catholic Church here, Mrs. Rodrigues is right … no lie!

(TLG): Yeah, yeah

(AR): Yup, and then we went back and I testify and the Lindseys claim that the (Ukumehame) cemetery was a Lindsey cemetery, I said since when there had a Lindsey in Ukumehame? There was no Lindsey. That Lindsey that you were claiming was a sheriff of Lahaina. Lindsey; that's the grandfather of Ed Lindsey. Grandfather, great grandfather; I don't know but he was the sheriff, my great grandfather Ioane was police; mounted police, he worked under Charles Lindsey that's why Charles Lindsey use to be good friend with that old man that's why he went to Ukumehame, so these people were claiming that that's their tutu that was buried there, and I said, I went to claim that's not the Keola that they claim buried in that cemetery, and so I went to check on that Keola and I found out that the Keola that they claim was a male, is a female, and that male Keola they claim buried there is a Ka'oni. Mrs. Keola married Ka'oni when she and her husband divorced, that man buried there is Ka'oni, that cemetery there is a Ka'oni, not a Keola.

(TLG): Oh my gosh.

(AR): I know all that kind stuff. You tell me one Hawaiian name, I know because my tutu was the one that told me almost every name, more in Ukumehame than Olowalu, because we came from Ukumehame, Olowalu I don't know too much because I am from Ukumehame, but I moved here because my grandma comes from here, my great grandma. Victoria Puha, my dad's mom, her parents lived in that valley; Mose and Kaiulani Kekona Puha.

(TLG): Okay, I think I remember seeing those names.

(AR): Yeah and Mose Puha, their family come from New Zealand, they're Maoris.

(TLG): Oh they're Maoris.

(AR): Yeah, they're Maoris, and we Maoris too because we Puhas. Yeah, they live up there and they lost their land, when Mose Puha died, Ka'iu, she had so many children, so the plantation somehow, I don't know I'm not even going there, but I know that she had to live there with her children, this is only what I hear, and she charged food from Lahaina, had one store in Lahaina, and she couldn't pay, so when she died, they took the land away, and took the land and the children had to disperse right, and had to leave and a lot of them went to Honolulu to Kaka'ako. Where that Hawaiian homes is in Honolulu.

(TLG): Waimanalo

(AR): No in town up that hill, I forget, Papakōlea.

(TLG): Oh, yeah that's right, Papakōlea.

(AR): That's where all the Puhas went, they all went there. Yeah, so I know that property there is a cloudy issue, its right next door to the Napaepae. Now we are related to the Napaepaes but that's for the Napaepaes, but we are all Napaepaes too, but I know about that place over there, because somebody told me, hey you come from that line yeah, cause that line of that property there they related to Kaua'ula. (Laughter) Patty said oh Addie I didn't know what to say, when you yeah, cause you sound mad. Hey, I fight for my rights. I told him I didn't do anything to you, what are

you doing? leave us alone! I could not see another Hawaiian do that to another Hawaiian, because I don't do that to any Hawaiian. I love my Hawaiian people know matter who they are; they are still part of me; Hawaiian yeah. I love my people. I love my people no matter what they are. I love my people.

(TLG): Yeah, I mean because if your own people don't have your back right.

(AR): But then they are saying what are they doing, they should get more education you know; well they are not as lucky as you folks. It starts at home; you guys know that, it starts at home. Everything starts at home; don't go blame the teachers for not teaching the kids, it starts at home!

(TLG): Yeah, that's true, that's so true. Yeah, we are the lucky ones, we got to go away and go to school.

(AR): Sometimes, you know I wish OHA would go find more Hawaiians like you and send them to school with the kind job like you or similar to the job you have, so that they can go and work here in Hawaii. We don't need all these white people come over here and telling us this and telling us that...They should get our Hawaiian people, children who know where their parents talk to them about Hawaii, like I talk to you. That's the kind of education they should go out and look for, something that pertains to Hawaii. I know you can be a doctor; a medical doctor. I know that, but sometimes we need more Hawaiians learning about the ocean, instead of people... coming to say this and say that. What, they only looking for grants, that's how they going to get paid, all by grants. Get a job! (Laughter) I wanted to tell them that go get a regular job instead of writing grants, and they come over here and fight us.

(TLG): Did they even come and talk to you?

(AR): Never once! No, only you folks, that's why I'm saying it, I'm not second best. So when Jim Judge told me "Oh Addie, I should send a project director to come talk to you more about Ukumehame," I looked at him and said you will never get anything out of me, because I'm not second best and I walked off. And Bill Frampton was there with him, so that's why Bill Frampton first came to talk to me he said I learned when you want to talk about Olowalu, you better go see the right people, I said yes, Bill cause I'm going tell you I'm not second best, and I like him, but you know, you don't know see, I mean you tell yourself, you hope that they going to do what they told you they going to do, they might go off track, which happens, I know that, it happens. Just make sure you watch and see that okay well that's alright, it be okay, but don't go way off track because then I'm going to say well I'm sorry Bill you said you were going to do this, you didn't say you were going to do that, but that's their job, we are not suppose to be telling them to do, that's their job, but when they tell you what they going do, and not do it, is what I don't like! Don't do that to me, don't lie, because I'm going to catch you at your lie, I'm going catch you at your lie, watch out. (Laughter)

(TLG): Well, he's on notice then.

(AR): I want him to do what he wants to do. Really do what you want to do, because it's you, it's how you going to make out, and I want him to be successful. That's why I put him, I put Olowalu town on our pray list, we pray for Olowalu Town, I want Olowalu Town and I'm going to pray until we get it. Just can't have Olowalu Town if we don't pray and ask god to help you, Olowalu

Town, because this place is also what? Spiritual, so keep it spiritual not like one carnival. (Laughter)

(TLG): No, the vision, the vision is, it seems to be.

(AR): I know, and Hinano is glad about it.

(TLG): Good.

(AR): Anything else you want to ask me?

(TLG): No, I think we talked about a bunch of things and it's very helpful.

(AR): I know we kind of went off track,

(TLG): That's okay, we went off track and then we come back, that's how right.

(AR): And it's good to know a little bit about Ukumehame, you know because Ukumehame has something to do with Olowalu, because Olowalu people actually came from Ukumehame. But the people in that valley actually, like the Naho'oikaikas are not from Olowalu, the Naho'oikaikas married into whomever, they come from Honua'ula.

(TLG): Yes they do, that's right because my mother talks about Naho'oikaikas.

(AR): Yes, a lot of people think they really come from Olowalu, I said, no, no, they are married into Olowalu people. I don't know who they are because I didn't pay attention. You know, you only know the Naho'oikaikas, I always goes back to Ikaika, it's suppose to be Ikeikas. But now that I'm talking about them I want to go back to that family there, that is staying behind of the store, I don't know if you have anything to do about it, but I want you to hear because you can tell Bill Frampton whatever I said, the Naho'oikaikas got only 4,000 square foot, is that true?

(TLG): I'm not sure. I don't know

(AR): I do tell a lot of Hawaiians already if you don't want Olowalu Town, don't talk! We have a new owner in the back behind my sister, he himself when we had to go testify in Lahaina, he came to me and called me auntie. He had just bought the place in the back and build one house, He said auntie I don't want Olowalu Town, I don't want this place to be developed. I said wait a minute, you looking at somebody who wants Olowalu Town, and he kind of looked at me, and I said you know what, your new here; you just came and bought a property in here, in this ahupua'a. Now you better believe we've been here forever and if you're going to fight us you not going to last long because why? You not going to be happy here... But I know you love that small little place you living, I know you do, because I can see how much you folks love this place, but do not go to any meetings if you are not going to talk nice about Olowalu Town. And that's why I never see that guy at any meetings. Because I've said it if you don't want Olowalu Town, don't show up to any of those meetings...I go tell everybody, I told the Rodrigues too. The son don't want Olowalu Town.

(AR): He's always in the newspaper.

(TLG): Maui News.

(AR): I don't know what, but one morning he came one Sunday, he knocked on my door, and he said oh hello Mrs. Rodrigues and I said hello. Oh I just came over to tell you that Gordon Cockett

said no vote for Olowalu Town. I look at him and I said what? I'm for Olowalu Town, I told him you tell Gordon Cockett if he wants to tell me no Olowalu Town, then come tell me myself, don't go send you guys over here for come tell me not to vote for Olowalu Town but he never did come. When he sees me and I'm at places to testify, Gordon Cockett knows he better not talk too much, I already told him, Gordon when you talking about Olowalu Town, you can talk about the reef, but don't you say that you don't want Olowalu Town. You can talk about the reef, but no talk about Olowalu Town. I've told a lot of people don't you talk about Olowalu Town, because that's my town, I live here! If I didn't want Olowalu Town; no more Olowalu Town. I know, I can say what I like, But I do want Olowalu Town, so, I want Olowalu Town, I do really, and my family too. They said its okay because maybe they want to move back home. I'm quite sure they do, because they have lived their life, here, they spent their early life here, coming home to grandmas. I sent my children home here too to grandmas.

(TLG): Yeah, because I remember going to Makena in the stick's man and holy moly.

(AR): You don't like what you see today yeah.

(TLG): No, it's so.

(AR): But what can you do? The word is you can't fight progress, but you can help too, you can help…

(TLG): You can help make it into a proper vision.

(AR): Yes, if they are going to do it in the right way. But before they didn't, people weren't talking, they just let it go, but not doing it before, But I always tell my husband this, I don't know why they developed Kihei, but I know don't go blame nobody but the Japanese. I said it. And he tell me why? I said because I remember I had to go pay our property tax in the tax office, I was young. Not really young but maybe 12,13, 14,16 years old, and I use to wonder why I see all these Japanese men with these huge books, going through these books and looking, and I seen that, I'm not kidding!

(TLG): Oh my goodness.

(AR): I'm looking at them and I'm telling myself what they looking through? But you know it took me years later to realize they were buying out all of those properties that weren't being paid.

(TLG): Oh my gosh.

…

(TLG): That's amazing.

(AR): Who would think that I would look at that and wonder what it was and think another 60 years or whatever to realize what it was, and I didn't think about it until recently when I told my husband, I read all these things and I use to wonder how did we develop, how did we ever get Kihei to look like that? How? What happen? Did all these people sell all of their properties, and I was picking on the Hawaiians' who owned the land before…

(TLG): Maybe they didn't have the money to pay taxes or didn't even think they absolutely had to.

(AR): Yeah, they needed the money and they sold it for so cheap, and now what you got to go buy that land for one million dollars and maybe they sold it for only four or five hundred or five thousand dollars, and look how much they made, so every time you look at Kihei you think of all those people who got rich.

(TLG): I know, it's something, well thank you so much for sitting down with me and talking story, and I will bring the map, but I will call you before I come and bring you that map with the place names.

(AR): And if you do come, and if nobody answer, and you just happen to come by, just leave it on the counter by the kitchen door, because everybody who comes, I'm not home, I see all the stuff up there, yeah I see vegetables and fruit, and I think wow these people brought all these kind stuff. They do you know! (Laughter)

(TLG): So nice to come home to that.

(AR): Yeah, they do; bringing something.

(TLG): Yeah, well speaking of Ke'eaumoku they are still caretakers for Ka'iwaloa yeah?

(AR): Yeah, okay he talked to me about it, yeah about it just recently and he told me auntie, and I think some, who live next store is encroaching on the property. I said no he's not. That's what I said, I said no he's not that's, he is kind of far away. That's what I said. I said no he's not. I said Keeaumoku, Katie Nahina, Nahina and I had an agreement that anything past Kapaiki its okay what she wants to do, because she's from there, I don't live there, I live on this end, so I told Katie at that time, because she wanted to claim Ka'iwaloa, because she claim that her family was buried on top there, but she said she was going to take care of that, but she died, but she told me she had a son who was suppose to be taking care of that place together with Keeaumoku, because I think one time, they build on top of that stuff. What you call that stuff, the big table, I forgot the word.

(TLG): Oh me too, it's like an altar

(AR): Well if there is anything else you want to ask me, you can call and ask me.

— End Recording —

D.2 Interview with Mr. Al Lagunero

Recording Date	January 19, 2012
Transcription Date	June 16, 2012
Participants	Mr. Al Lagunero (AL), Ms. Katherine Smith (KS), Mr. Bill Frampton (BF), Ms. Tanya L. Lee-Greig (TLG)

Mr. Al Lagunero is an artist and native Hawaiian cultural practitioner with family connections to Olowalu through the Kaumuali'i (Kekaulike) and Hale O Kease lines. He is currently the President for the Olowalu Cultural Reserve, a 501c3 organization with an educational mission focused on learning opportunities where students can integrate and develop skills for either career or cultural re-growth with "the land as the teacher ... the ocean as the mother teacher".

Al Lagunero (AL): I am wondering if the assessment covers, goes into the reserve itself?

Tanya L. Lee-Grieg (TLG): The assessment looks at the *ahupua'a*, from the *ahupua'a* stand point.

(AL): Okay.

(TLG): So the *ahupua'a* from *mauka* to *makai*, including the valley because that's really the only true way to start understanding

(AL): Does it start at Ukumehame and ends at Cut Mountain?

(TLG): It starts at, yes, at the boundary Ukumehame. I know the project area comes a little bit over into Ukumehame Ahupua'a and then it extends to the Launiupoko boundary and then all the way mauka to the West Maui Forest Reserve as we currently know as the mauka project.

(AL): In the *moku* statements, how is, *hiki no*, in the old history of this, in the *moku* statement, these straight lines are today lines. Can we have any idea what those old inclusiveness looks like?

(TLG): It is the landmarks. So what we are currently understanding traditional landmarks for the *ahupua'a* boundary to the, I'm sorry I don't have this on the top of my head which I should. (*Papers rustling/flipping*) They connect the *pu'u* that we understand. Our current understanding is that it is a connection to the *pu'u* up the ridge line on the Ukumehame side. The place name for that is

Bill Frampton (BF): We got these boundaries from the map of Maui that takes every single *ahupua'a* so it starts with this, this is the *moku*, right?

(TLG): Yes, the *moku* here, Lāhaina.

(BF): We're almost towards Ma'alae'a and then we got this put on by using like the USGS maps and the planning department maps and some air photos we were able to trace this exhibit was simply to show the reader's our project is within Olowalu.

(AL): What I'm interested in is that as people come into the area while you have your signage and stuff, "Welcome to this place." The idea of a *pu'uhonua* is a very strong one. And it could be something that moves into people's being quite differently than other places that seem to be

more museum type situations. But we are coming into a living *pu'uhonua* again. And that possibility for that living *pu'uhonua* may not be necessarily this line.

(TLG) and (BF): Okay.

(AL): So when you move along to where the surfer's, over there, it's a really wonderful area in which people are entering into like a gateway. So when you enter into that gateway, your mind set could change when you come into this area. And when the dialogue of the *pu'uhonua* comes more in common, people begin to look at the islands as *pu'uhonua*. A different kind of way of looking at it. I think my *mana'o* goes in and out of care and PR.

(TLG): Right.

Laughter

(AL): Make sense right?

(TLG): I have the *ahupua'a* bounding place areas as Mōpua on the Ukumehame side and then it touches the land forms of Helu and Līhau on the Launiupoko side. Ending in Awalua on the Launuipoko side follows the ridge line up toward the head wall of 'Īao Valley.

(AL): Great, perfect.

(TLG): So that's what I listed at.

(AL): I like that it goes even deeper.

(BF): Way past our boundary there.

(AL): Yeah. So does Manini come up in that, the hill. Does Manini in there, some place? I wondered why they would call it Manini.

Katherine Kama'ema'e Smith (KS): Oh, Mānienie.

(AL): Mānienie?

(KS): Yeah, it's the "flat grass." It's a flat area where the grass grew and it was a resting place.

(BF): Inside?

(KS): Inside 'Īao. In the back of 'Īao. Mānienie, that's where the *ali'i* watched the battle where the Maui Ali'i, where Kalola, observed Kepaniwai and the place of which they escaped.

(AL): Thank you.

(TLG): I think we can start with the formality part if could share your full name and birthday and connection to Olowalu.

(AL): Donald Trump.

Laughter

(TLG): That's going in the transcript.

(AL): Just put Al Lagunero, enough.

(TLG): Okay.

(AL): Thank you. 10/19/1945 and 8/08/1988. I get two birthdays.

Laughter

(TLG): Oh, okay.

(AL): Nah, October 19th and then what else?

(TLG): And then maybe a little about your connection to Olowalu Ahupua'a.

(AL): Presently I'm the President for the Olowalu Cultural Reserve. I have different families that lived in Olowalu. And I think historically, family roots also to cover different areas in the islands, inclusive. As I understand it, there's the Kaumuali'i (Kekaulike) line and to some degree I think that it is Hale O Keawe as well.

(TLG): And currently you are with the Olowalu Cultural Reserve?

(AL): Yeah.

(TLG): When did that begin, the Cultural Reserve?

(AL): 1997 is when talks began and about 2000 is when we got our papers.

(TLG): How did you become a part of the Cultural Reserve? Can you share that with us?

(AL): Bob Horcajo called and he asked if people could come together so *maika'i* that.

(TLG): Can you talk a little about the mission or what the purpose of the Olowalu Cultural Reserve is and what you kind of, how you kind of see the Reserve now and in the future and potentially when the master plan gets realized? If it ever gets realized.

(AL): The mission is educational. It is a 501c 3 educational designation. Entwined with that is an opportunity to move back onto the land with the land as the teacher, the ocean as the mother teacher. So what we are looking at is the possibility of working the lands to have a place where learners can come integrate and then develop different kinds of such with regards to either career opportunity or cultural re-growth and all that's involved in re-growing and adding to culture. For example, contemporary works, contemporary writings, contemporary different kinds of things that have been left maybe not been taken in by Bishop Museum. The idea for the school, I feel should be, could be some kind of ambassadorship, training, where people not necessarily only elementary school children or young people to come to school but also for the *kupuna* and the parents (intergenerational). I think, if we could look towards re-integrating our family systems by allowing education to come into play for that. So a child doesn't go home with just the homework, everyone shares in the homework. Everyone shares in the care. So a lot of that *mana'o* although we just slightly talked about it here and there, I think comes together with some kind of consortium as to how that comes about. It is something that I've taken from conversations throughout my years with Maui and with other cultural areas. One of the big things I remember with Keali'i Reichel was that we have no place to present or to study without having to instruct others by that kind of thing that public organizations must do as non-profit organization. So he was looking for a place where they could just be *hālau* and not worry about all those other things to have interface with nature as it was and to *kōkua* that whole area. Those kinds of conversations that come up over the years and I think I echo a lot of those. I collect in my thought, in my heart, my *na'au* the kinds of discussions that we have. I feel that many of

the people who share that seem to have a certain kind of movement in themselves to keep that tie alive and interfacing cooperatively. If that is a start of an ambassadorship, I think that is wonderful. The other part of that is that we can have classrooms without walls which is a big part of the whole kind of exchange that we miss when we go into public forums. Exactly that word rather than a place where, you know, we could lay down, talk story and let it go without having all of that kind of confined space. We look forward to this *mauka* to *makai*. We have hope that the canoe that's being built for the Reserve will find a parking place down by the sea. Hopefully that can become very active in terms of returning the waters to proper use and access. Planting, you see people planting *limu*, little bays along tbe shore. Families come in, you park your car, you go over there, get on the canoe, take the *limu* and plant and go here and there and plant. I think much has been taken away from the waters and so it causes the water to do something else. I don't know what that ship can be like tide wise when it goes to other areas, if it becomes much more than just planting *limu*. For example, at Kāne'ohe Bay with the Hawaiian Institute of Marine Biology out at Coconut Island and partnerships that bring in that kind of activities. What I think is that we can allow the Cultural Reserve to walk in the footsteps of the ancestors. To allow that voice to be enjoyed, shared with people so that we can, from there become an ambassador just in place. That's some of the *mana'o* I think that has gone through our board and some of the people throughout maybe my 30 years.

Laughter

(AL): On Maui.

Laughter

(AL): Like that.

(TLG): Can you share with us if there are any unique resources to Olowalu that helps in this?

(AL): Yes.

(TLG): And what they might be?

(AL): Yes. The star that brings the canoes to Hawai'i, the star that is the tutelary star of West Maui is Rigel, Puanakau, is the constellation and in that comes the guide to Makali'i. In terms of the historic factor of that and having people look at *ahupua'a* different than just land marked by straight boundaries. We have at least that kind of thing, talking about walking in the steps of the ancestors. So when we come to realize the connections that way, *iluna* , *ilalo*, you can have a little bit. It continues to help to grow a community awareness. The idea of experience is something that really is so important and I think the access to the land and ocean at Olowalu allows us an opportunity to bring that experience to both, you know, those kinds of areas. As an artist, I paint and I become very much aware of the subject matter and what people put into their work when they talk about *maoli* art. Some of it is very, very intriguing; I find that it misses the experience level. I think it's a very opportune situation when we can take any of the schools like Kamehameha and whoever goes out that they can touch and smell. When we talk about the *limu* and stuff, all the links that we have in Hawai'i our computer is so beautiful. Just in the art of *lei* making, if you making for Pele dances or if you making for ocean dances those kinds of links for the child who is taking *hula* could be a little bit more pronounced, you know, why do you wear those *leis*? Who made that *lei*, you or your grandparents? So what is the link,

those kinds of things goes on and on. At the same time, we have new materials and things. So things like feather capes, Joanne Kahanamoku are very respected for their feather capes but their capes are a matter of contemporary material. Its contemporary feathers, dyed feathers and those kinds of things but the idea behind them, process of which it involves, really helps to instigate and maintain a sense of what that beauty is all about. This is why the Reserve, I feel is very important that we can

(TLG): Come outside.

(AL): Go back, go inside but I think that it's very exciting too is that we can deal with the new, old way now. And the new, old way has such to use what wisdoms we might experience from our *kupuna* and how we might adjust some of that for today. When we look at, aunty on Kaua'i was sitting down on her porch and somebody came and said, "Oh, we want to talk to you about some sustainability projects."

Laughter

(AL): And aunty says, "What sustainability? We been hea all our whole life."

Laughter

(AL): *Hiki no* so it's all that kind of thing. I think it's ingrained in terms of *kupuna* ideas, sustainability, sustainable culture. I think, presently, some of us for whatever reasons are is that a word "cultural centric?" You know, when we are involved in that way. Sometimes it feels like a division but I think we need to fill our cups in a way to allow sharing of a full cup. So that's going to be big work on both sides because I think when we looking at new, old way what brings in to that conversation is how we become who we are today? I get a little flack if I'm going to go and say, "This is open to everybody." But to some way we need to kind of balance Maoli to other ways. I think that is really wonderful because we were nomads. We travelled, we zigzagged the Pacific.

(TLG): Yeah, I think people forget that part.

Laughter

(AL): Yeah.

(BF): You mention once before, about this, exactly that and could have kept on going. Europe, wherever. This is the only place.

(KS): It's not the only place.

(AL): I think if you look at Fornander, it says we are already there.

Laughter

(BF): I love that point that it's just not only here.

(AL): 'Cause there's some basis, I think, in the Fornander accounts that when we come out of Africa, in the Berber areas, you look at the colors and then the weavings of Berber is very much those old primal colors but then we are strong in that. And so you look at us in the Mediterranean areas before we take to the self growing and we go back and forth according to Fornander to

place like China or India. So in the remnant times of religious, spiritual practices, there are, you can find hints of where we've been. The account in Fornander for the Kūali'i chant that he accounts for their travels into some of these areas. I think in terms of having some *palapala* for our people, they can look at the Kūali'i chants and then we can look at those other kinds of things of our blood line and I think what we'll come to discover is that things that are kept by peoples records other than us, were geographic changes. At least four major geographic changes for the surface of the earth has now brought us in to this point and they are expecting the new one. I'm talking about the Hopi prophecy storms on which the *pōhakuki'i* was already there, right. So there is some kind of connection. I think for Olowalu it comes as a matter of, you know, introducing questions very slowly into this because sometimes we get all upset all over the world. People going, "Who said?" *Hiki no*, right. I don't know where I'm going with that.

(KS): I remember you telling me about the *waolani* of Peru, the ancient people of Peru, *waolani*.

(AL): Oh, yeah, yeah.

(KS): And we have the *wao* here.

(AL): Yeah, it's a group actually it's the Amazons and National Geographic has it. They went into one of the villages that they call "Waolani." Their oli is just like the 'o on the records. You hear the elders singing to the children when they go to sleep or after the day's *pau*. (*Al demonstrates this oli – this is the* i'i *style, major verbrato on "O" sound*) That kind of thing you kind of feel the old uncles are doing that kind of thing and the feathers.

(BF): In the Amazon?

(AL): Yeah. I think, you know, with Rapa Nui and Rapa Nui's exchange in those areas, along coastlines. In Chile, for example, you have *mākaha* and *lima*.

Laughter

(AL): Yeah, like that. You go across the waters to many of these places and can see it. So, I think Olowalu has that thing about ambassadorship as a really wonderful opportunity for education and allowing people, I think, to use old ways that are connected maybe from shorelines, other shores to us. One of the interesting things that happened maybe about 12 years ago, that there was an effort by marine biologists to bring people into some agreement, countries, into an agreement about caring for the waters of the Pacific. It started with, I think, Taiwan, China, Japan. Hawai'i had an invitation. University of Hawai'i declined the invitation. I don't know why but they continued by diverse studies out of the waters that were coming in out of China, especially around some of the delta areas. I felt that that kind of thing is exactly what we should have been involved with because it brings us that wisdom that is shared. When you hear Rubellite's *mana'o* on that whole aspect of where we have come from especially on her dialogue for Taiwan as a grounding area. I feel that she's addressing quite a bit. She's always been ahead, right, doing that kind of work and it's just us, maybe, just trying to catch up. Questions? I have a question or maybe a request. (referring to a map of the project area)

(KS): Pu'u Kīlea is there.

(BF): This is the big lots are up top here.

(AL): Down here is a structure that hasn't been identified in papers. It's a *heiau* like.

(TLG): Okay.

(AL): I feel that heiau is the link of a *Hale O Papa*, the ladies *heiau*.

(TLG): Okay.

(AL): Its location, some of the things that we see in the different way, that's the women's heiau and I think that's a very important part that it's not part of the paperwork that identifies that. Its location right below of this one is farmed. It's almost like Kawaihae with the men and then the women down below. At Kawaihae, I think it's like this, yeah, from the *heiau*, next to the ocean.

(KS): But this is next to the stream.

(AL): Yeah, so I think the placement is traditional. And then the ridge, where's the ridge?

Here, so this ridge, I think there's something up here or another kind of place where the men to gather before they come down to Ka'iwaloa and then down here so women down there is really kind of nice. The men are up on the ridge and they're coming down. There's a flat land on the top of that ridge and I don't know if that was a lighthouse. Kind of a guide place for movement to Kaho'olawe and back. Signals.

(TLG): Oh, okay.

(AL): So if we look at Makahiki signals like Waimea to Kaua'i, fire branding they called it. Those kinds of things are not there. If we take the alignment outside of here and see how it connects, you know, like from Kaho'olawe to Lāna'i, what's occurring in there and how can, let that become part of the school from Kaho'olawe.

(TLG): Okay, so up, further up there's a flat land

(BF): Up on the ridge kine? Oh, yeah, yeah.

(AL): It's about here, yeah? In the recognition of this place as a *pu'uhonua*, in the constellation Puanakau is a star, at the lower bottom called Pu'u Honua. Then there's these other stars around it, the Cat's Cradle, Kahiehie

(KS): Ka Heihei O Na Keiki

(AL): I think the stars have much information. Kaho'olawe with recognizing that maybe it is a training ground for the movements to the south and returning. I think we are looking at this star and this location as a part of the whole conversation. We began to look outside of the current realty of; you know, line like this and allow that conversation to maybe come in into this. The fact that the *pu'uhonua* goes back into this area is really very promising kind of thing to have the connection down here to Waihe'e with Kalola's Heiau to, at Pu'u, at Paukūkalo. What is that?

(KS): I'm sorry I'm not following.

(AL): The heiau at Paukūkalo

(BF): By the sand hill

(KS): Oh, Hale Ki'i

(AL): Hale Ki'i Pihana. Pihanakalani and then she moves from Pihanakalani down into here quite with her presence then the land really becomes *kapu*, yeah. There's a *kapu* on it. I'm just kind of thinking those kinds of things are really important to know. How we relate to Haumea. How do the children show themselves when the sunlight comes up in the valley? What's there? When you look at the ridge of the mountain, not ridge but here's the mountain and then this layer like this sometimes especially in 'Īao when the light comes like this, then the shadows are cast this way and you begin to see them coming out like this. *Hiki no*, the formations of the stone people that kind of thing. The whole, that dialogue that informs us that informed our ancestors are all very important in the naming of the place. So that how we *pili* to one place, they always *pili*. They're always there. I think that kind of value is very strong and saying why the land is so important. The idea with Haumea and all of her children is that we are included. If we begin to understand that then the whole notion that we have is much more *pono*.

(BF): What do you do with something like that? Where do you even begin?

(AL): With what, the structure?

(KS): Get rid of the tank.

(BF): Yeah, the tank is no longer of any use, of any value of the water system of today. I don't believe it has any value. I believe it was a part of the old hydro power facility or something like that because if it was used, they would have cleared everything away or whatever. I don't know even where you'd begin to, how you would take something like that out or bring it back to

(AL): They gave it to Olowalu Cultural Reserve and it's our duty.

Laughter

(BF): Yes, it's in the Reserve.

(KS): It's in the Reserve?

(BF): Yeah, it's clearly in the Reserve.

(TLG): And it's on the downside of the ridge.

(BF): Yeah, you walk by it, you see all this work that's been happening and all of sudden it's there and it's just…anyways, it would be neat

(AL): There's a highway going through at least the lower portion of that area. I think the Reserve brings us close to host culture possibilities or presentation or use. It can soften the highway, if the highway needs to go there. How that's done, I think is quite exciting in that it could be a really different entryway into Lāhaina and kind of take away the idea of whaling, only whaling. Increase, increase the noise there. *Hiki no*, beautification projects, help people see that … I don't know it's such a and they just have to come back.

Laughter

(BF): Let me know how.

(AL): I need to see more where that's (the highway) is going to cross.

(BF): Yeah, yeah, in fact the architect so we have the original architect team was Andres Duany, this world renowned guy, he brought in 11 architects. I think it's like 11 or 10 architects that

were from Chile, Venezuela, Philippines, China, Japan, Germany. They came and assembled all the different versions and once we had this version (referring to the map of the master plan). So, this is the version that happened at the end of the workshop. This was the plan. That was back in 2005 so since 2005, we've gone around and met with like 113 or 114 different presentations that Dave and I have done to all these different kinds of groups. And every one of those meetings whether it was one comment or five comments, there were a lot of neat comments that were given from the non-professional engineers or architects or whatever. These neat comments that we've taken all of them and sat down with George Ricksey, who is our local architect. George is, I sort of say, is the one who's calibrating the plan. He's taking that and making it a little bit more Maui and he has some really neat, his thoughts of the crossing, he spent a lot of time going out there and just walking with us, without us 'cause it was very important. He has some, I don't have them here, but they're really, I was just sitting here awhile ago thinking, "Man, I wish he could have been here a little longer. He could of met you." But it would be really cool if you had a chance to meet him. He's a fantastic guy. One quick, funny story about him. When we brought over Andres, everyone was, "Oh, what's Andres doing?" So we sat down and had dinner and he said, "Whose your local architect. You need to have someone local that would understand the codes and help us." We said, "Oh, we got this guy, George Ricksey." And he stopped and looked up and went, "Who?" "George Ricksey." "THE George Ricksey." *Laughter*. I went, "Ah, maybe?" I just seen him the day before with his surf shorts, tank top, cruzing to go surf and I'm going, "I think so." He's like, "The one with the award winning design of the community in Maryland." I said, "I had no idea that was George but I know the project." He said, "That was George Ricksey, he was the architect and the developer of this incredibly, brilliantly planned community in Maryland." He moved here years and years ago. You would have never known, you'd have to struggle to pull that out of him. He's a very neat, we feel lucky to have him. I think he would love to hear more discussions like this; it would be very neat for him, really inspiring. That crossing is, in different forms and when you look at the topography of this area, he talks about preserving an ability for people and vehicles to be able to come underneath it. I think it would be really, really important to look at. I like that 'cause at that point, you see, you have an opportunity to see a lot of things at that point, *mauka, makai*.

(AL): Staying on the idea of pass ways and access. The upper trails, do you want to speak on the upper trail?

(KS): The Olowalu trail?

(AL): Yeah.

(BF): Oh, yeah, sorry that, these are some of the things, if I'm wrong, but some of the things we'd be looking for to understand the access, is something that I've; the first time I ever heard someone mention it was Nāhina. Daniel or David Nāhina? Told me about, the only comment he had for our plan, we sat with him in 2005 was, "You better correct what's going on now 'cause the highway has completely blocked the free flow of *mauka* to *makai*. People can't walk that." And he said, "That is why you have the worst accidents on the island are there because you've shut down that ability for the spirits to go back and forth." And he said, "In your plan, you better address that." Anyways, access has always been and we tried to in the plan. We have

the ability to go from the Cultural Reserve all the way up to the top without ever crossing a road.

(AL): One of the early parts, just talking story with Peter, is an invitation to *mālama* some of those areas as a Reserve even if the Reserve was to stretch outside of the Reserve. Go to Kapalua and maintain some of those trails that go to Kapalua and then the other direction. I can dream, this is just a wish list is that those trails become places where people, along the trail, once you start moving in the trail and people have movement along the trail is to have places where we can bring plants and then people who love walking the trail, can plant something to remember them and do that. Sandlewood, put it but they're not *kupuna* but maybe yeah. Put some of those plants back.

(TLG): So can we talk a little bit about those *mauka* trails. Where at Olowalu do they start? I know that there's the connection between Olowalu and 'Īao that it is not there anymore, landslide or whatever that cover the pass.

(KS): Just the top of the Olowalu trail.

(TLG): So, I know about that. Are there's that go laterally?

(KS): I don't know if I've seen the lateral trail, parallel to the Ala Loa in Olowalu. I've gone up to the diversion plate up there in the stream but I expect it would have been somewhere near there which is usually a mile or two in.

(AL): The waterways that were used may have been a part of that kind of movement in that area 'cause we just see layer on top of layer when it becomes modern and keep out residential areas, they always stay residential areas and that kind of thing. I think my *na'au* when I was up there with Peter was to look at the water and how the water was brought from Ukumehame and then Olowalu and how they shared some of that with the plantations. You think then who's working the fields? Is it local people over there and they not going put the trail, the trail maybe have been already established areas where they can access easily. So they're going to follow

(TLG): What they know.

(AL): Yeah, what they know. So I'm wondering if some of that could look at some of that water. Hello, water.

Laughter

(TLG): When you were up there spending more time up *mauka* beyond maybe the real estate boundaries, can we talk a little bit about the plants that are up there? Are there any native plants yet, still up there?

(AL): I talked with a guy, what was his name? At Kahikinui.

(BF): Renee Silva?

(AL): Not Renee, the new one.

(BF): He has the beard?

(AL): Yeah, planting all up in that area.

(BF): The restoration up by

(AL): Rodriguez?

(BF): Pu'u Mākua they're doing that restoration.

(AL): Those people, might be good to have. I haven't been up there.

(KS): Up as far as the diversion, I don't know if there are any plants up there, that I saw, maybe a couple of *wiliwili* trees.

(BF): Bob Hobdy, in his report the flora and fauna report but he only sticks with boundaries of Olowalu. He has a pretty good assessment just for that area. What was the plant that Frank

(TLG): The tea, kokolā.What plant is that?

(AL): What?

(KS): Tea, *kokolā*?

(AL): *Kōko 'olau*

(TLG): *Kōko 'olau*, he called it kokolā, they make a drink out of it. *Kōko 'olau*.

(AL): What is your question with that plant?

(TLG): That's the name of the plant?

(BF): In our interview with Ms. Silva,

(TLG): Yeah, Frank Silva was saying that because they were Mormon in this area that they couldn't drink certain things but that was the one thing that they could drink when they would go *mauka*. So I was wondering about that?

(AL): I wouldn't be surprised if quite a few of that *ti* plants are still there especially along the stream.

(TLG): Yeah.

(AL): Where the water collects there, could be the *māmaki* and the *kōko 'olau* could be on ledges here and there.

(TLG): Oh, okay.

(AL): But I think when you come to that, then you can begin to think about habitat.

(TLG): How do you prepare that drink? Is it just

(AL): The flowers after awhile give off kind of like a thistle and then you collect that. That's a rubbish plant you can make, you know the one that sticks to you?

(TLG): Oh, yeah.

(AL): You take all of that black stuff, put it in a jar and you ready to make tea if you put that.

(TLG): Really?!

(AL): Yeah, I was so surprised my mother, "Here, make tea." And I thought, "What?!" I looked just like Lipton. I says, "Wow mom, let's go get some more."

Laughter

(BF): Is that the tea *Kōko 'olau*?

(AL): No, that's not the tea *kōko 'olau*. That's the Spanish

(BF): Oh, the Spanish needles?

(AL): Needle.

(BF): Really?!

(AL): Yeah.

(BF): I was usually covered in those things, would drive my mom crazy.

(AL): Sometimes even the smaller plants like ferns over here and like that. Thing's we don't look at as very important in the list. Thing's like the other one, the velvety

(TLG): *'Uhaloa*?

(AL): *'Uhaloa*, plentiful, yeah, over there. It's an important tea. It's an important part of that but you think, "Weed." So, we don't identify with it and we'd rather look at the big ones.

Laughter

(AL): *Hiki no*, I had certain experience with just plants. I mean they're so as our *kupuna* notes, very alive, they have, share different kinds of stuff. Sometimes in the garden when I go pick one small little flower, I thought, "Okay, I going take you inside." And the other plants say, "What about us?!"

Laughter

(AL): "You know we're all beautiful." So the idea is no smaller or greater, they're <u>all</u> important.

(TLG): My kids, they don't like *'uhaloa* tea at all. Every time they got a sore throat, they're like, "Don't make us drink that. Please!"

Laughter

(KS): Do you use the leaves?

(TLG): No, I use the root and they're like, "It tastes like dirt." So I try and put honey in it.

(KS): Rose Marie said that somebody tried to make the tea but with the leaves

(AL): I just got some interesting reading on the areas where the *kukui* nuts flow out and then they create a sediment in an area and the sediment helps create different habitats for fish. I think one of the board members mentioned that if we plant too much kukui, it's *'a 'ole maika 'i* for the whole. I was thinking, "Oh, it's not only up there but down there by the ocean." You know when we go certain places and all those things are coming down from the mountain and creating that sediment.

(BF): Canoe Beach has a lot.

(AL): Yeah, so it's an important factor for those kinds of plants and we have plenty *kukui* trees or want to plant more kukui trees, keep the water cool in our area.

(TLG): That's kind of that *mauka, makai* connection too that contribution of that plant to the ocean.

(AL): Right.

(KS): And that plant in the valley, in Handy and Handy, they mention the planting of the *kukui* tree on the slope above the valley floor so that the nuts run down hill and then underneath the nuts and the leaves become the compost for the *'uala*.

(AL): Wow, that's major.

(KS): You don't have to rake them down if you plant them on the hill. They run down anyway.

(AL): I think that's major because Kona you have to pile the stones, right, and put inside. Over here you just wait for it to pile up

Laughter

(BF): You know the *limu* you were talking about growing, that would be just along the shoreline. That's something

(AL): Depends, I think it's rather shallow area that moves out, yeah. It's not too deep.

(KS): South of the point.

(BF): This whole area, it's all shallow and then it gets deep out here.

(AL): Then *(inaudible)* will come back.

(TLG): In the Reserve, are you seeing some of the freshwater resources in the Reserve, in the upper reaches of the Reserve? Like the *hīhīwai* or is that not

(AL): Oh you thinking about, the waters not, the water I experience only goes up to the area where we cleaned and then there's that concrete area where the water flow changes. So what we have is not fast moving water. Above maybe there's that kind of water in that area for the *hīhīwai* and other fish.

(BF): You know what's happened, couple times, in the last two months I've been out there and the water has gone all the way down. You go to the wood bridge and it's moving. There's been a lot of rain but there's been water flowing all the way down and our hydrologist, Tom Nance, his assessment is fascinating conclusion 'cause the State Water Resource Commission guy's have said, "Olowalu's aquifer has 2 million gallons a day, sustainable yield." You can pull out 2 million gallons a day and supposedly that's safe. He did a more comprehensive study and he went out with the marine biologist and studied where all the ground water seepage is and flow rates and his conclusions is that we have 7 million gallons a day sustainable yield because of this cap rock that exists underneath. But he said the stream is heavily influenced by the dike water.

(KS): Perk water.

(BF): Yeah, perk water and dike infusion so when you go up to the diversion, on the mauka side of the diversion there's a lot of water. You merely past it, there's not much. You come a little further down and there's a lot of water again and you go, come down by the Reserve, there's not much. Go little further and he found more and a little further, there's not much again. Its different points where the water comes in. He tested the water, it's the exact same quality as the ground water way down below. It was a really cool report.

(KS): So can you recharge the stream?

(BF): So this is what's been going on is the diversion right now, they're diverting almost anywhere from 1 million to 1.5 million gallons a day is being diverted from the stream. That's the source for the non-potable water. That's a system the Peter folks collect all that water and can go to all the mauka residents, the village and all down here has one of the taps that their sources of water is non-potable. That's a purple pipe and they can use it for all outside irrigation. Their other source is from the well. That brings up the freshwater, that's the potable or the inside water usually used for drinking. Very clean, good, good water. But the potable water system, they're diverting about a million five usually average.

(KS): The non-potable.

(BF): The non-potable. They use from the measurement from their meters they can calculate how much they use, is about 60,000.

(TLG): Wow.

(BF): Yeah, so there's a handful of things going on. One is, I heard that, at first where the H is all the water going? Well it's the transmission itself is putting horrible conditions while it diverts that much water at the diversion, you go from there up to the top reservoir, a ton of it is already lost. Doesn't even get to the reservoir. Once it gets to the reservoir and starts being used, there's more loss there and by the time you get to the houses, they're very efficient, they're new pipes. So the idea that we've always said in our approach was from a cultural side and we may be mistaken or not saying it correctly but I've told Dave, we have a tremendous amount of water in the ground. At complete build out, we only need about 900,000 gallons a day. That would take care of <u>all</u> of our needs. We're going to have a wastewater treatment plant that's going to produce 500, 600,000 gallons a day of non-potable water to make everything green. The non-potable water, is going to be as clean if not cleaner than the ground water which is amazing technology. That means the water that's being diverted now, we don't really need. But the idea is maybe we should keep that and take just a fraction and have it for storage or backup, fire protection, whatever. The rest of the water from the beginning, I always thought that we could bust up that diversion put it all in the stream and see if that would make a difference. That's been the idea in the cultural perspective is can we help enhance OCR (Olowalu Cultural Reserve) by providing much more water and not only to use but to have what you're talking about, the flow. If you could have a continual, perennial type flow, you then

(KS): There's possibility that some of the fauna can come back.

(BF): Yeah, yeah that's the idea.

(TLG): Everything will come back.

(BF): In terms of if you want to do an assessment, this is very, very tiny of the big picture but one positive component I saw on the project is usually the exact opposite. Usually you come to a place, you have a certain amount of existing water, you're going to take all of that and it's yours and the environment pays the price. In this case because of the integrated resource planning approach that we're doing like re-using our own water, only taking what you need ground water, you can put back water into a stream. Instead of saying, "I need more of that water." We're saying, "We <u>don't</u> need that water and if we need anything, it's just a fraction." It makes sense,

originally I said completely get rid of it and that threw off a few people. But we don't need it. 'Cause the way we've designed it, we don't need it but I think it makes sense to keep some, a fraction of that maybe. They're taking a million and maybe keep 100,000 or something.

(TLG): Even putting a little bit back in the stream for recharge I mean than in and of itself is

(BF): For multiple perspectives is that is a positive impact, I think.

(AL): The one that goes through the mountain and then down, right?

(BF): The intent is to provide much more water to the Reserve is what I was looking at. Rather than struggling to get some, if we can very easily as part of our project, design it so that flowing water will be much more easier to get to and there would be so much more. It would be really, then if you have the little school site or where ever, if kids do walk outside, there is water. I had that experience with the Cub Scouts was hysterical. I took them Camp Olowalu and we were playing and I said, "We're going *mauka* and we're going to take you to the petroglyphs, heiau, bring your suits 'cause it'll be super hot and we'll let you jump in the stream, cool off." Got all the way up there and they're complaining the whole way and I'm just like "Hang in there." I get to the diversion and it's dry. *Laughter.* My son does not let that go. That was like four years ago and I still hear it from him. But the idea is you could get there and ideally if it's done right, there would be water.

(TLG): Bringing back the stream would also help your coastline and your idea of bringing back the *limu* because it brings the nutrients down from *mauka*.

(BF): Exactly. So that's something that

(AL): *Limu* brings the fish.

(TLG): Limu brings the fish and that's why everything would be

(BF): Where that *limu* is there's freshwater and they can find the source. That was one of the things I was talking about awhile ago with you, Tanya, that when we are able to explain the whole story again, I think our project we could not sit here and say, "We could not have a negative impact." Clearly, if you put a community out there, there's gotta be negative components compared to today. But, there is also neat opportunity like you said, "There's opportunity for education."

(AL): I think one of the come backs opportunity you are trying to address it in the book for down Makena way (Honua'ula). How the chiefs make decisions and the conversation we also had. That comes to mind as I look at some of the names and the history names that come to this area of decision making within the community and a picture of what you are trying to do with the book is to show that kind of care that's been there for generations.

(KS): Headman families making decisions and shared authority.

(AL): Yeah so historically that kind of, it's reaching forth but the idea that when we are talking about Hawaiian cooperatives, society, what are we looking at? What are we saying about it? It's just not people coming together for that but it's inherited. There's a sense of that inherited responsibility to make these decisions and to influence that. So I think here we haven't really, I mean in terms of refreshing some of our opportunities for cultural renewal and organizational structures. The non-profit no longer becomes the place where we have to make all of those

decisions and conform to something that's not a part of that maoli effort. To some degree, I think, that could become part of our discussion. I think one of the original plans or *mana'o* that we had for that area was that Hawai'i doesn't have a welcoming place, traditional welcoming place for all of those coming up from the south especially to retain connections to the South Pacific cousins. So, if we had a place down at the point to receive the canoes that would come in, our canoe would be there to greet and then could walk up and then develop an arena in the mauka area to host the protocols that are necessary between us and have a place for these people to stay when they come. Otherwise, we're behaving like non-profits, non-profits.

Laughter

(AL): During our birthdays, I had a moment to reflect. I always go have this personal evaluation and I found that each four I've been involved in non-profit things. Mom took us to Hawaiian Civic Club meeting at Waialua at Hale'iwa. Always there's something and then you go Kawaiaha'o and then do all of this kind of stuff. It just goes on and on and I got sick thinking about all of that. For how long I've been doing it, all my life. So the Hale Hālāwai, that whole aspect that is taking into another kind of arena and dictated by another hand. So now I'm on another move and it's like, okay, let's not have to depend on money. Let's try to get it different. If we use what we have, then maybe we can deal with some of that. Put in a little bit, *hiki no*, if was in shave ice or in soda.

Laughter

(AL): So anyway, I think with your office there's probably a lot of different kinds of potential to unearth or bring forward some of that kinds of conversations. I look forward is that kind of relationship with your office and you to kind of help us develop those kinds of, 'cause can, yeah, pro bono.

Laughter

(BF): Have you shared a little bit with Al some of the work we're doing, what you've done so far to date with the research with the newspaper, the testimony.

(KS): The Māhele.

(BF): The Māhele testimony.

(KS): I haven't have a chance to talk to him about it but the markers that you see on this map here are the names of the people who received the Māhele awards for those properties. I thought it was very important that we would locate not only the family names so that we could do the genealogies and perhaps find more descendants of these original Olowalu people. But the other thing was to locate in the Māhele records the names of the *'ili* and the *mo'o* within this valley. Because the little markers on this map just have Olowalu but when you go to the testimony, the people will talk about the real place names. So now I have a list of 17 different *'ili* or *mo'o* names. I'm writing down all the testimonies from the native register's and the number of *lo'i* in the valley is going to be considerable and Olowalu also had lots of dry *kalo* land. They were growing dry *kalo*, they were growing 'uala and lots of it. It was major agriculture. They had *lauhala* places where they cleaned and made the *lauhala* for the *moena*. I also found another *loko i'a* besides the one that's down by Aunty Addie's house.

(BF): So the other one's down here, right? That's the one

(KS): The one by Aunty Addie's house down there and the other one is up near the *pali* up near, I think, Alapa'i.

(BF): Okay so the red meant is names of family people, blue is for a place and one of the things that

(KS): But I only knew a couple of them when I did this before. Now, there's many, many more.

(BF): So this is just the first draft?

(AL): Is this the photo you sent me?

(KS): The *kamani*?

(AL): Of the heiau of this area.

(KS): Yes, that's the picture that Tanya took.

(BF): Exactly looking mauka.

(AL): Okay.

(BF): Yeah, that's incredible. One thing is now that it's on a scaled map like this, I can also take out sight plan, put it on top.

(AL): Oh, okay.

(BF): And start to possibly identify one way to retain the names, streets or parks or community centers or whatever just to hold on, not to lose.

(AL): Did this *heiau* come much later anytime around Lili'u's time or with her mother, Keohokālole?

(TLG): We don't know much about that heiau. It wasn't mentioned when Emory came through. When Emory came through, he identified Ka'iwaloa Heiau and talked to the folks about Ka'iwaloa but when Walker came through 15 years later he found what Emory found and this other one which he called an unnamed *heiau*.

(AL): The photographs I saw that you sent for that area, the stones didn't convince me.

(TLG): Yeah, it looks more like a house site or something like that.

(AL): Yeah, wasn't river stone. *Mauka* they use the river stone up by Ka'iwaloa. So, down here, when I looked at it, it wasn't that kind of river stone. It was more crusty. I don't know what kind stone that. *Hiki no*, just in that area. Maybe people just piled on top on the earth. My question about its timeline is its relationship to Keohokālole.

(TLG): Okay.

(AL): Lili'u 'cause this *kamani* is her, *hiki no*, when she wears that lei, very identified with Lili'u. In this area where Keohokālole comes, you know maybe it goes, I wonder what is that tradition and if that is why that *heiau* is there and was it for something other than the navigational kinds of things or with the things of Hale O Papa, with the ladies, with Makahiki and with whatever else Ka'iwaloa is doing. If this is coming in here, does this mean that this is now becomes some of the break way for Christianity 'cause the church is located in there, right, in these areas. Couple of churches one at Ukumehame down here and then up there.

(BF): Yeah, there's the one church and then there's the Catholic Church

(KS): And the church up.

(BF): And up above here is the Mormon one here, yeah.

(AL): Yeah so, you know, three in a time, you know, the changeover. "You folks all over here, I going put ours." You know, just like Ruth when they built, Princess Ruth and they built 'Iolani and then she says, "I gotta keep up." So she go build her house, right, that big one in Honolulu. So, I wouldn't put it past those people. 'Cause I don't know that it has any view point, the Hale Kamani, Heiau Kamani. What ritual purpose does it serve?

(TLG): The only thing that is striking about the position of that particular structure is its location in relation to the other house lots and the older diversion. The older

(KS): Stream bed.

(TLG): The older stream bed.

(BF): The original stream alignment.

(TLG): Yeah.

(BF): The original stream alignment came down right through here and right now it's hard 'cause the big rock pile.

(KS): You can't tell if it had a view 'cause of the rock pile is in front of them, between that and the sea.

(BF): You definitely understand the mauka one which she took the photo. If you stand there and turn around, the big rock pile is there. You do, you can get a sense of what it might be like looking this way.

(AL): So this is the land awards, the commission

(BF): Yes, these are the ones scattered through here.

(KS): Kamani is just an *'ili* name for that area and the heiau is just placed there beside it.

(TLG): It's small though. It's not substantial like Ka'iwaloa at all.

(KS): The other thing that we wanted you to see was a house site that had a *ko'a* next to it or some kind of maybe it was an *ahu* next to it. And that's out by the, where would it be on the map?

(BF): Right over here. You can see it on this topo. There's the *pali* area and it's right over here.

(KS): And that's a pretty well preserved *kahua* for the house. It has another *pā* area and then the *ahu* or *ko'a* and we would really need you to interpret that.

(AL): Where is it?

(BF): I've never been up there until we walked it. It's right up over here.

(AL): This area?

(BF): Yeah, right around the corner, that general area. Overlooking down below is the surf site.

Paper rustling

(AL): The *ko 'a*'s are all fishing related, yeah.

(KS): I think we need to feel it out because there's a presence there.

(BF): It was really cool. Yeah, here and if you walked from here we just sort of followed it and here's the surf site, the driveway for the old landfill station is right there.

(TLG): The little drainage right here. The *ko 'a* is actually in here, the paved area.

(BF): There's the big rock pile.

(AL): That's at Kamani?

(BF): Yeah, so there's a big rock pile in the reservoir right below.

(AL): Adeline might have more history around this area if she can, get her talk about more of this area. They remember going up this area when they were children. She might have that because of that relationship to that family. The only thing I can think of a *ko 'a* in that area is that it has the view for fishing and maybe protected from north winds, if at all, anything in there. But *ma 'a 'a* is all over the place, the wind.

(BF): That one area

(KS): Is this where the water came down and they had a stone shelf in here?

(TLG) and (BF): Yeah.

(KS): Or is it here?

(BF): Right through here.

(KS): Oh that was wonderful, it was all bare rock. There was all puddles, puddles 'cause the water was just collects all in there.

(BF): was falling, it had been really heavy rain.

(KS): There's a gulch but it's lovely formation.

(AL): Any finds for habitat at that type of place?

(TLG): Over here.

(BF): Yeah, remember walking from over here over?

(TLG): Oh, yeah

(BF): I started seeing all those little corals

(TLG): In here, branch coral.

(AL): Branch.

(TLG): Branch coral, the kind you see on *ko 'a*'s, all up in here.

(BF): There started being scattered stuff right in that area. It's a neat area.

(KS): These aerial view, when you see stuff like this and you wonder, "Oh my gosh is it a trail?" You cannot see it from the ground. You don't know where to go. What's that square?

—End Recording—

D.3 Interview with Mr. Stanley Okamoto

Recording Date	January 13, 2012
Transcription Date	February 6-7, 2012
Participants	Stanley Okamoto (SO), Bill Frampton (BF); Tanya Lee Greig (TLG)

Mr. Stanley Okamoto was born on December 12, 1926 in Wailuku, Maui. While Mr. Okamoto was not born in Olowalu, he noted that his father was born and lived in Olowalu until 1925. As a child, Mr. Okamoto would visit his grandmother who remained at Olowalu Camp working for Olowalu Sugar Mill until she relocated to Wailuku in 1930.

Tanya Lee Greig (TLG): ...This is Tanya Lee Greig, Cultural Surveys Hawai'i, at the offices of Frampton and Ward in Wailuku, and we're sitting here with Stanley Okamoto and Bill Frampton to talk about Olowalu Town, and the plantation time period during—for Olowalu. Umm, this is the part that's a little bit niele, and, I have to ask, if you could share your full name, and when you were born, and where, and how long—and how you came to be at Olowalu.

Stanley Okamoto (SO): Okay, my name is Stanley Okamoto, it's Stanley Okamoto. And I was born on December 12, 1926. Andn , my dad lived—was born in Olowalu, and lived in Olowalu, until 1925. So, in 1926 I was not born in Olowalu but I was born in Wailuku.

Bill Frampton (BF): Oh, wow.

(SO): But I have a older sister—I had a older sister, who was born in Olowalu in 1924.

(BF): Oh, I see.

(TLG): Okay.

(SO): So, my connection to Olowalu is that, ah, because Grandma lived in Olowalu, and—so, from Wailuku we used to go to Olowalu to visit Grandma, until Grandma relocated to Wailuku, you see.

(TLG): Okay, and she relocated to Wailuku in what year?

(SO): The year was 1930, that she relocated to Wailuku. Because my dad was one of seven siblings and he was the only son. And, he had six sisters you see. And so, when my grandfather died at the age of 49, so Grandma didn't have—wasn't—well she worked in Olowalu for the sugar mill, and, then, when my dad went to Olowalu to work and then, came back and lived in Wailuku, then Grandma came to live—

(TLG): Oh, Okay.

(SO): —with us in Wailuku.

(TLG): And, may I ask what your grandmother's name was?

(SO): Grandma's name was Chise, C-H-I-S-E Okamoto.

(TLG): Okay. And your grandfather?

(SO): Uh, was Tsunetaro (SP?) Okamoto.

(BF): Is that...?

(SO): Yes, oh you got it! Tsunetaro Okamoto.

(BF): I didn't know if that was the one!

(SO): Yes.

(BF): And what was...I was telling Tanya, over in Olowalu, had the burial—you know the cemetery?

(SO): Yes, yes, yes.

(BF): Yeah, the cemetery. And I found these in the records. And it shows your family—I saw the family name, after I talked to your brother.

(SO): Yes, yes, yes.

(BF): And—that it was buried somewhere in here...was, ah...that was your grandfather?

(SO): Yes.

(BF): Okay.

(SO): That was my grandfather.

(BF): Oh, wow. Oh wow.

(SO): But, you see, he, ah...died at the age of 49 at Kula San.

(BF): Kula San?

(SO): He contracted—he was ill. And so, he...was at Kula Sanatorium.

(SO): I don't know what he was.

(BF): I wonder. Kula San. My dad was there. For a couple—for quite a while after his accident.

(SO): Uh-huh.

(BF): Yeah. 1926, after that.

(TLG): So is your grandfather still at the cemetery here? In Olowalu?

(SO): Ah, no...in 19—no, 2000, about 2000, I...you see, removed all of the remains of the Okamoto family, from the Olowalu cemetery. And then we put 'em in the columbarium in Wailuku, you see.

(TLG): Oh, okay.

(BF): Oh, wow.

(SO): But ah, it was a twice a year trek to Olowalu.

(TLG): Yeah?

(SO): Yeah.

(TLG): How was that trek to Olowalu from Wailuku?

(SO): Well, it was, ah...in the old Model-T that my dad had.

(TLG): Uh-huh.

(SO): And every time we came to Ukumehame, he says "Okay, all of you hang on to the roof!"

[Laughter.]

(SO): So the wind don't blow it away!

(TLG): Oh, really!

(SO): Yeah.

(BF): 'Cause the wind!

(TLG): The wind.

(SO): The wind at Ukumehame.

(BF): Oh, yeah!

(SO): The wind will come down, you know.

(BF): Strong!

(TLG): Oh my gosh.

(BF): [Laughter.]

(TLG): That's great. And how—how was the road back then? Going over the pali*?*

(SO): Well it was…a one lane road, you know. So you pull on the side when the traffic from the other side was coming. It was windy.

(TLG): Yeah.

(SO): And, I always marveled at the way the stone walls were made, along the *pali* highway.

(TLG): Yeah. So you...so you traveled that road when the road was, was the road where the retain—where the stone walls are?

(SO): Yeah!

(TLG): Is that—that's that. Before the puka *in the* pali*?*

(SO): Yeah.

(BF): Oh, wow. And that's where the rock wall…

(SO): Yeah, the cut—cut rock walls were built along the way and…just narrow enough for where two cars can go by.

(BF): [Laughter.]

(TLG): Yeah.

(BF): Must have been scary on some of the areas! [Laughter.]

(TLG): I know! [Laughter.]

(SO): Yeah, that's the way it was. So it was an all day thing, yeah?

(TLG): Uh-huh.

(SO): When we went to Lahaina, to visit friends, because my dad used to work for one of the stores before he moved to Honolulu.

(TLG): Uh-huh.

(SO): So, he would visit the Masuda Store, and visit with friends at Makawao, and they had a store there too. And we would stop there for shave ice, at Nakagawa Store

[Laughter.]

(SO): It was sherbet, it was sherbet I think it was! And then we would come home.

(TLG): Oh...And so, at Olowalu, the name of the store was...? Who had that store at Olowalu? When you were a boy?

(SO): Gee, I don't remember.

(TLG): Oh...

(BF): Was it—

(BF and *TLG*): Ichiki?

(SO): Yeah, Ichiki Store.

(BF): Is that right?

(SO): Ichiki Store. Mr. Ichiki, who was originally from Lahaina, and he…had daughters and sisters and all of that. So he had a store in Lahaina, based. And that's the main store. Then they had one in Honokowai, where he had his brother-in-law run, then he had his daughter—ah, sister, who got married to the Kagihara, in Makawao, so there was an Ichiki Store in Makawao.

(BF): Oh, really?

(TLG): Oh wow! It was a chain store!

[Laughter.]

(SO): Yeah, yeah, and he had a sister, who married Mr. Hasegawa, and—

(TLG): Oh, really?

(SO): Not—

(TLG): Not that one?

(SO): Not that (inaudible) Hasegawa, but—

(BF): Oh.

(SO): Herbert Hasegawa. And he opened a store in Wailuku. So, he had Ichiki Stores in Lahaina, Honolua—I mean, Honokowai, and Makawao.

(TLG): Wow.

(SO): And all the family related, you see, because—

(BF): And then—then they got on here too, then? Olowalu?

(SO): Olowalu—

[End of file 001, begin file 002]

(SO): Well yes, ah, all the Ichiki Stores were turned over to the relatives that were running them, when Mr. Ichiki moved to Honolulu. And the Hoolau Market that ah—in the Aala area, in Honolulu, he opened the Hoolau Market there.

(BF): Oh, wow.

(SO): And then, he moved everything to Honolulu, and left the stores here in charge of his sister-in-law, and so forth. And they ran the store.

(BF): Wow. I didn't realize there were that many.

(SO): Yeah, so Donald Fuji can tell you, or Wally Fuji, is, his mother, was related to Mr. Ichiki.

(BF): Oh, okay.

(SO): I don't know if she was an Ichiki girl—

(BF): Okay.

(SO): But, they ran the Olowalu store.

(BF): Wow.

(TLG): Amazing. And do you remember where in Olowalu your grandma lived? From the Ichiki Store...?

(SO): So from the Ichiki Store, ah...in the road, going into the camp...

(BF): Yeah.

(TLG): Okay.

(SO): Ah, she was about the fourth house, in.

(BF): Wow! So probably right around here.

(TLG): So right...right in here, maybe?

(BF): 'Cause here's the store...

(SO): Yeah, yeah...

(TLG): This is the store...

(SO): Yeah, and then, this is the—

(BF): House, house, house...

(SO): Yeah. Somewhere around here.

(TLG): Okay.

(SO): Because the Yonamine house was...

(BF): Oh, yeah! Oh, okay. I found a map of the Yonamine house—

(SO): Yeah.

(BF): This historical book. What—

(SO): Yeah.

(BF): Does it say right here, Tanya? There was a club—

(TLG): This was a club house, a store, the Japanese school over here...

(SO): Uh-huh.

(BF): Do you remember any of that? Any of that, Stanley? But I found Yonamine's house.

(SO): Yeah.

(BF): I found them on this book, ah...There was a baseball team last year that came to Maui. The all-star team? To play the all-star team on Maui. And they called me up and asked me if we'd buy bento lunches for them. So I said, "Sure, sure", and got them from Takamiya. And, I thought about it, I said, "You know, I don't know"—and I told...ah, Mikio, it's ah, Shishido, Tahai Shishido?

(SO): Shishido.

(BF): Yeah. I told him, I said, "I don't know if you're interested, but we have...I have records of where Wally Yonamine came from." And he said "Ah, I'll tell the team." He told the team, I guess they got all excited. So I made copies of the maps, and of his house—

(SO): Uh-huh.

(BF): And they drove out here.

(SO): Yeah.

(BF): And I just said—pointed—said, um...

(SO): That camp—

(BF): It's not here, but that's where the camp was. The kids loved it. Just got 'em cookies and POG. But they got to know where it was and I made a bunch of copies they could take home. But ah...Yonamine...do you remember the—Wally?

(SO): Oh yeah, Wally was younger than, ah—well, he and Bill McWayne were at Lahainluna at that same time. Then he moved to Farrington, you see.

(BF): Okay.

(SO): So, but ah, Bill McWayne and I were classmates at Wailuku Elementary School. So, we about the same age.

(BF): Oh wow, oh wow. Do you remember Wally, doing athletic stuff?

(SO): Yeah, at Lahainaluna, because he was younger than us.

(BF): Okay.

(TLG): And so, did you—you attended Lahainaluna then?

(SO): No, no, no.

(TLG): No? Oh.

(SO): No, I was in Wailuku, I was born in Wailuku. But because I went to Lahaina, and Olowalu frequently, 'cause Grandma was there, and so forth.

(TLG): Okay. So she was about the fourth house up from—

(SO): Yes.

(TLG): —The store.

(SO): Uh-huh.

(TLG): One, two, three, four. Can you tell me about the—just the community, in Olowalu. Were there a lot of people living in Olowalu at that time, when you used to visit?

(SO): Yes, there were!

(TLG): Yeah? And what kinds of things would you do when you'd visit Grandma?

(SO): What—what did I do?

(TLG): Yeah, yeah.

(SO): I just went to visit Grandma.

(TLG): You'd just visit.

(BF): You guys play, play around, mess around?

(SO): No, because, what the—mainly, it was to go to the beach.

(TLG): Oh, okay!

(SO): Yeah, you know from—because, I mean, Wailuku—

(BF and *TLG*): Yeah!

(SO): We go to visit Grandma's house and, we go down to the old mill site, where the track went into the ocean, because the swimming was good and so forth.

(BF): Was it like this? The old mill, this is the picture…

(SO): No, when I went, the mill wasn't there.

(BF): It was shutting down already.

(SO): Yeah.

(BF): Oh and they moved it, to Lahaina town.

(SO): Yeah.

(BF): Okay, okay.

(SO): Okay, so the old mill site, where they had—there were railroad tracks, going into the ocean.

(BF): Right, right, right.

(TLG): Yeah

(BF): These ones.

(SO): Yeah.

(BF): These ones came all the way out.

(SO): Yeah, all the way to the ocean. That's where we used to go and swim. Because they had clear, white sand and clear beach.

(BF): Was nice!

(TLG): White sand out there? At Maalaea—I mean, Olowalu?

(SO): Yeah.

(TLG): Nice…

(BF): This is a better, I think, photo, when the mill was gone.

(SO): Yeah, and we used to come in here.

(BF): Yeah, really nice.

(TLG): Uh-huh.

(BF): Oh wow. Yeah, 'cause about this time, they had a smoke stack, the mill it's gone, and just stacks and stuff left over. Was it—was it, ah…other kids playing in the area.

(SO): No, because the Olowalu kids were not playing in the area. We were visitors so that's where we went.

(BF): Okay, okay.

(TLG): And do you know where the kids from—where the Olowalu kids would go? Do you know where they went swimming?

(SO): No, I don't know where they went swimming. I loved to swim.

(TLG): You loved to swim! So when you would go down there you would—would you go swimming, fishing…?

(SO): For swimming only!

(TLG): Oh, swimming only.

(SO): I'm not a fisherman.

[Laughter.]

(BF): Do you remember any—if the church—any of the churches that were in the area?

(SO): No, I don't.

(BF): Okay.

(SO): Because, when I began to remember, as an older child, it was the twice-a-year pilgrimage to the cemetery. So I knew about the cemetery…where the cemetery was, and so forth.

(TLG): Right. And then, when you would go—do you remember how you would get to the cemetery from—

(SO): Yeah.

(TLG): —From the—

(SO): Now there's a gate, but ah…

(TLG): Yeah.

(BF): You would, maybe just—I think it's right here…

(SO): Somewhere around here…

(BF): It's that triangle.

(SO): Don't know where the river is…

(BF): Here's the river.

(SO): Yeah, so…

(BF): Think it's that triangle space, right here.

(SO): Uh-huh.

(BF): 'Cause when you look at the…the…yeah, it shows, that's *makai*—

(SO): Yeah.

(BF): And this is the edge of the road I think that comes up, or maybe it's there 'cause it's the end of a rock pile…Maybe—maybe that's the rock pile. Oh no, no, 'cause that's where the road comes close to the water. It's back here.

(SO): Back here.

(BF): Yeah, I think it's right up there.

(SO): Right past the river I think.

(BF): Yeah. Because this—I know this parcel of land, and it's right about the middle of it when you come up.

(SO): Uh-huh.

(BF): Yeah. Were there—was the condition of the burials—was it in pretty good shape? 'Cause nowadays it's all busted up.

(SO): Yeah, I busted it up.

[Laughter.]

(SO): Because my grandpa's grave was ah…my dad did a good job. And, it was the most prominent cement block, and then the polished tombstone and so forth…was there. So all those—my dad did a good job for his father.

(BF): Yeah I wonder—I always wonder if '24—

(SO): Tsunetaro, yeah?

(BF): Yeah.

(TLG): Uh-huh.

(BF): Right there.

(SO): Uh-huh.

(BF): Yeah, it looks like the bigger…but yeah…

(TLG): There used to be a theater, I understand, at Olowalu, as well. Would you ever—was that there, when you were visiting?

(SO): Yes, right at the entrance of Olowalu town, next to the store. That's what I remember.

(TLG): Next to the store?

(BF): On this side.

(SO): Yeah, right around there.

(BF): And when you drove out to Chez Paul, nowadays…It was just next to Chez Paul?

(TLG): So would that—

(SO): Yes, yes, yes, yes.

(TLG): —Be building number seven, right here?

(BF): Yeah.

(TLG): Okay.

(BF): I think so, because…

(SO): So what is this one here.

(BF): Warehouse.

(TLG): It says it's a warehouse.

(BF): Fertilizer…

(SO): Oh, that must have been the theater before.

(BF and *TLG*): *Oh...*

(TLG): Okay.

(BF): That might have been, yeah, yeah.

(SO): Yeah.

(BF): Yeah. I don't remember his name, but, one of my neighbors…the father still lives with the daughter. And he's a Japanese man that lived in, um…the camp out in Lahaina, not Puukolii, what's the one, towards, um….

(SO): Keawe Camp.

(BF): Not Keawe, you go towards—

(SO): Right past the —past the mill.

(BF): Just past Kaanapali.

(SO): Oh, past the…

(TLG): Past Kaanapali?

(BF): Up *mauka.*

(SO): Yeah, that's Puukolii.

(TLG): Puukolii?

(BF): Yeah, that one. And he said, he used to walk over to Olowalu to play with Wally Yonamine's brother. I think a younger brother?

(SO): Akira. No, older brother.

(BF): Older brother. He used to go play with him. And he was the one that told me he used to go see the movies. And he always joked, he said, that's where everybody clapped in the theater. And I said, "Really?" He said "Yeah, 'cause it didn't have a roof and there were always mosquitoes. So he said… [Laughter.] So he said everybody was always clapping. [Laughter.] But he remembers, he went to a couple of movies, he said. Ah…I can't remember his last name. Very nice man. He was a fun guy. He said he would go there, and there were some girls that lived up towards—further up by the pig farm.

(SO): Uh-huh.

(BF): That—they would go up there and the dad would chase them away. [Laughter.] Yeah.

(SO): Uh-huh.

(TLG): Yeah so—so you think that the warehouse—was shown as the warehouse, was probably the theater.

(SO): Yeah, yeah, the theater, that used to be the theater there.

(TLG): Uh-huh. Did you go to the theater at all?

(SO): No I didn't, because the movies were at night, and we would drive home before that.

(BF): Oh, yeah, you'd have to go home.

(TLG): Okay, so it was just a day trip, a full day trip, not an overnight trip.

(SO): No.

(BF): There was one…there was a…DeMello…Catherine King's father. He was one of the Luna, and his name was—last name was DeMello. He drew a map of the area…oh there! This one. He helped sketch out a map once, and it showed…

(SO): Names of residents.

(BF): Yeah…Yonamine…And, he lived down here. And he talked about there was a park across from the store, and then he had some of the other deals. Store, office—there was a clinic, like a health clinic.

(SO): Yeah.

(BF): Bathhouse, Japanese school another store, clubhouse…Do you remember any other little store that was up there, or just Ichiki?

(SO): No, I don't. I don't. Because I was in—born in Wailuku, so I was a visitor, that's why.

(BF): That's right, that's right, yeah.

(SO): I remember the bathhouse.

(BF): Oh yeah?

(TLG): The bathhouse? Where was that?

(BF): Yeah? Was that close to your grandma's?

(SO): Yeah, because we lived…

(TLG): That was here.

(BF): So almost across the little road.

(SO): Yeah.

(BF): Oh wow.

(TLG): Okay.

(BF): How about the petroglyphs? Did you ever go up and see them?

(SO): No, no, no.

(BF): No?

(SO): I, you know…As an adult, because they talk about the petroglyph, and I went to the cemetery all the time, twice a year, so, I said, well maybe I should go see the petroglyph, but I never—

(BF): Never—never did. Do you remember, were there still folks living up in the valley, like Hawaiians?

(SO): No, I don't remember.

(BF): You don't remember? Yeah.

(TLG): So during your time on the Planning Commission, when you were spending all that time on the Planning Commission, do you recall how—kind of—can we talk about how this place kind of changed from your perspective, or…?

(SO): No, not…as change came about, and so forth, because I was already an adult, and so, as I passed through Olowalu. So, what I remember most is the homes that were there, the Yonamine home, and so forth. And, the…Nishimura home, and so, that's what I remember. But other than that, you know, the bathhouse across from the residences and so forth.

(TLG): Yeah, yeah.

(BF): And the funny thing is that it's—that it was a community.

(SO): It was, it was.

(BF): Telling these planners, it drives me crazy, 'cause they're the only ones who fight the project. And they, ah…they don't get this part. I think it's important. Did any project—did Kaanapali, or Pioneer Mill folks, ever come to the commission with any plans for the area?

(SO): No, not that I recall.

(BF): Okay. I saw some sketches before, of the area. 'Cause they had hotel zoning. There was hotel zoning, multi-family apartment zoning, at this area. And when Peter Martin folks bought Olowalu, they got records from Pioneer Mill. And I saw some sketches, and it was big. They had a lot of—they had the hotels going—

(SO): Yeah, on this side, yeah.

(BF): Yeah, yeah, yeah. That side, yeah. And um…

(TLG): Do you remember any discussions about that—those plans?

(SO): No, as an adult—

(TLG): As an adult, yeah.

(SO): When I was on the planning commission, and I heard that people were trying to develop this side.

(BF): Yeah, yeah. While, did the community plan…when they did the first community plans, from the west side, all over, did that—were you on the commission that approved…

(SO): No, I was not.

(BF): Yeah. 'Cause I remember I was working for Mike, when Mike was the consultant, and that was an amazing job, out of college, to…go to every meeting, and hear, what was these long-term plans for the island. And I remember them talking about Olowalu. But, I don't remember a lot other than, when you would drive through, all the sugar cane.

[Laughter.]

(BF): There was a lot of it.

(TLG): Can you…do you recall when folks started to migrate away from Olowalu town?

(SO): No, I don't.

(TLG): Yeah?

(SO): 'Cause I was still a child then, so.

(TLG): Oh, okay, so you were still a child when they started to migrate. So as an adult, do you remember when this whole area kinda transformed back into cane?

(SO): No, I don't.

(BF): Your grandfather…he died in 1946—no, '26. Is that right?

(SO): 1926, yeah.

(BF): And then your Grandma lived in Olowalu until—

(SO): Ah, 1930.

(BF): 1930, and then moved over to this side.

(SO): Yes.

(BF): Okay, okay.

(TLG): So when your grandmother moved, there was still a substantial community—

(SO): Oh yes.

(TLG): —In Olowalu?

(SO): Yes, it was.

(BF): Okay. Did she like Olowalu?

(SO): Well, she had many fond memories. As I told you, she even came with the needle that they used to sew the sugar bags.

(BF): Oh really!

(TLG): Oh!

(SO): Yeah. And—

(BF): Oh, that's right. You—I remember you said that. Yeah, yeah.

(SO): Yeah, about this long, they was.

(BF): That's right!

(SO): And, when they sacked the sugar, and then they had to hand-sew the bags.

(BF): The burlap?

(SO): Burlap bags, you know. Roll it over and then sew. And she came to Wailuku with the needle.

(BF): [Laughter.]

(SO): And..what we used it—the needle for, was when we grew eggplant, and then we would sell the eggplant we would sew the eggplant together and say, "Okay, four for a dollar."

[Laughter.]

(SO): You know.

(BF): The eggplant?

(SO): Yeah, to…to bind it together.

(TLG): Uh-huh.

(SO): You know how odd-shaped the eggplant is.

(BF): Yeah, yeah.

(SO): So, right at where it grows you sew it.

(BF): Goes through that.

(SO): Yeah, and that's what we'd use the needle for.

(BF): The eggplant lei. [Laughter.]

(TLG): And this would come from you garden here in Wailuku?

(SO): Yeah.

(TLG): You would—your family would garden and sell at market?

(SO): Yeah.

(BF): Did your grandma have a little garden, or did the neighbors have little gardens?

(SO): You know—

(BF): In Olowalu?

(SO): No, I don't remember.

(BF): Yeah.

(SO): I think it was a community thing that they had.

(BF): Community garden more.

(SO): Yeah, yeah.

(BF): Yeah, okay.

(TLG): Do you remember where this community garden might be?

(SO): I don't.

(TLG): Oh, okay. So what are some of the other jobs that your grandmother had, at Olowalu, do you recall? Besides that laborious sewing of the sugar bags.

(BF): So she sewed the bag.

(SO): Yeah, she sewed the bag shut. That's what her work was at…

(BF): And then they would load them up, and take them to the wharf?

(SO): Yeah.

(BF): Wow, wow. That's neat that your—she actually was work—what did your grandpa do?

(SO): Grandpa was with the mill itself. I don't know whether it was boiler or what ever it was.

(BF): Okay so down—down in the mill, not out in the fields.

(SO): No.

(BF): That was hard labor, up in the fields, huh.

(SO): Uh-huh.

(TLG): Yeah.

(BF): One of the things that's—I find very fascinating was the old waterways. The infrastructure that was in place. And there's one…one shack that's ah—it's an incline shack, with 250 stairs or something, that you walk down up here, into the mountain, and you get down into a big room—

(SO): Cavern, yeah.

(BF): —Twice the size of this area. And huge pumps. And...almost like a cut square little reservoir goes straight back, about the size of this room, and it taps into the water. It just fills up. It must be near groundwater level. And they had a pipe in it. And it sucked the water up.

(SO): Up.

(BF): Yeah. And that was just one source. They had other wells, they had diversion. But Olowalu had a lot of water. A lot more than other areas, because there was it's own valley. And so they didn't have to bring water in from—

(SO): Right.

(BF): Honokowai, Napili—

(SO): Right, right.

(BF): Was all right there.

(SO): For the irrigation, yeah.

(BF): Yeah, yeah. So they had good water. And it's still there, a lot of the system. It's amazing that they built all that.

(SO): Yeah, it's in—your description is almost the same with this Iao—

(BF): Iao one.

(SO): —The water shaft that they have there. The tunnel goes in.

(BF): Goes down in. I had…about a year and a half ago was the first time I went in it. And I took my son, he was ten. And it was amazing. You walk down. And the stairs, are all cement, but the cinder had come down from on top, so every once in a while the cinder was already filled up. You had to like find the stair, take one step at a time, slowly going down. But it was really neat to get down in there.

(SO): It is.

(BF): But the engineering work, to do that.

(SO): Oh, yeah, and to excavate it, you know, is…

(BF): I just—it's…yeah, amazing. Do you remember on this side, when they were constructing Iao stuff?

(SO): No, I don't but I've been down there.

(BF): Oh, okay, okay. Yeah.

(TLG): I wanna talk a little bit about your grandparents. Where—so, your grandparents were first generation, here on Maui?

(SO): Yes.

(TLG): Yeah. And they came from…?

(SO): Hiroshima.

(TLG): Hiroshima.

(SO): And, my dad, at the age of two, was…you know, only son, they took him back to Japan to stay with the grandparents. And they came back, my grandma and grandpa came back. And—and then they were working at Pioneer Mill. And my dad, at the age of 15, came back to Hawai'i. And he always told me, can you imagine a 15-year old, going to the first grade, to learn English at Olowalu school?

(TLG): Really?

(BF): Oh! So this—

(TLG): This school over here?

(BF): This school?

(SO): Yeah!

(BF): I wonder if he's in there! [Laughter.]

(SO): Well, I don't know, he was—

(TLG): Well, he would be 15!

(BF): Yeah! Is there one big kid? [Laughter.]

(SO): Yeah, I don't know, 15-year old…

(BF): Yeah, the one tall boy. [Laughter.]

(TLG): Wow.

(SO): And that's where he started to learn his English.

(TLG): Uh-huh.

(BF): 'Cause he had gone back—

(SO): Yeah.

(BF): And so was…wow.

(SO): You know the old custom, they took the number one child back to Japan, to be educated, before he came back at 15.

(BF): Wow.

(TLG): Oh, okay.

(BF): Even just coming back, he had to do it by boat.

(SO): Yeah, it took ten days, yeah?

(TLG): Yeah, so did he say where he came in at? On Maui? Did he say where he—

(SO): No Honolulu.

(TLG): Oh, Honolulu. So then from he came to Maui through…Lahaina?

(SO): Yeah, Mala.

(TLG): Mala, he landed at Mala.

(BF): Wow…

(TLG): Oh, neat. And then, went to school here when he was 15.

(SO): Fifteen. He says, imagine being in the first grade being 15, he said.

(BF): [Laughter.]

(TLG): Oh no!

(BF): That must have been in—wow, wow.

(TLG): That must have been a little intense.

(BF): Manny DeMello, who helped put together this map, he came to,l ah…his father—no, he came when he was ten years old, form Portugal. And sailed all the way across the Atlantic, down around the Cape at South America, and across—at ten years old. I cannot…

(SO): Imagine that, yeah.

(BF): No! A ten year old! I mean, my boy has trouble driving from Kula to Wailuku.

[Laughter.]

(BF): He thinks that's a long ride. [Laughter.] But, that's wild. So then, your father came back, lived here, and then went…

(SO): No, he lived in Olowalu.

(BF): Okay.

(SO): And he worked at the Masuda Store in Lahaina. You know, for a while.

(TLG): Was the Matsuda Store near 505? Near Front Street? Or—

(SO): No, where the old Lahaina store is. Where Takeuchi is right now, or thereabouts, right on Front Street.

(TLG): Oh, okay.

(SO): And then, it wasn't the Matsuda Store then.

(TLG): And so he would drive back and forth between Olowalu and…

(SO): No, he used to live in Lahaina. They used to board, you know they…had boarding facilities for people to work.

(TLG): Oh, I didn't know that.

(BF): Oh wow, so that's like the live-work idea. We want to do that kind of stuff over here. But, that's more for Maui Land and Pine, had dormitories for workers. So that was pretty common.

(SO): You know, in recent time Maui Pine was a recent era. Prior to that all of the plantations had homes.

(TLG): Uh-huh.

(SO): You know Pioneer Mill had homes, and HC&S, Wailuku Sugar had homes.

(BF): Wow.

(SO): You know, and ah…in Happy Valley where I was born, well they had homes for plantation employees. Because as they brought the laborers from the foreign countries, from Philippines, and Puerto Rico, and there about, they had homes. So, you had Puerto Rican camp, you had

(BF): Right, right.

(TLG): Yeah.

(SO): By ethnic groups.

(BF): And to bring those employees in, to have the houses ready, its a different era. That's interesting.

(SO): Yeah. It was all under the Hawaiian Sugar Planter's, HSPA, I think. You know, the standard as to the plantation homes.

(BF): The unions.

(TLG): No. Not at that time.

(BF): No?

(SO): No, it wasn't union then, it was the companies, and they provided the homes.

(BF): Oh wow.

(SO): For these people. In order to bring the workers in.

(BF): Okay, okay.

(SO): It was way before the union days.

(BF): Okay.

(TLG): [Laughter.]

(BF): Before the union. I remember reading about…I think it was on Kaua'i. Is that where the… first…?

(SO): Sugar, yeah.

(BF): First sugar started. And then they needed housing for the employees. Yeah, wow.

(SO): Of course, on Maui it's, you know, HC&S has all these camps, McGarrow Camp, Hawthorne Camp, and all of that so. Those were as the immigrants were brought in, that's how these names came out.

(TLG): Oh...

(BF): Okay, okay.

(TLG): Did the camp that your grandma was in at Olowalu—did that have a name?

(SO): No.

(TLG): No.

(SO): Olowalu was just the plantation camp.

(TLG): Oh, okay.

(BF): Someone told me that Olowalu Camp was very diverse. Had a lot of ethnicity—

(SO): Yes.

(BF): —At Olowalu. A wide range—more so than some of the other camps.

(SO): And then, of course, below the highway, there were the supervisors, you know. The *haole* camp.

(BF): The big time guys.

[Laughter.]

(BF): And they let you go swim there?

(SO): Yeah, because, it was way after the era.

(BF): Someone told me that was off-limits except for the Christmas party.

(SO): That's right.

(BF): Once a year, they would let people come and play over there.

(SO): That's right.

(BF): Yeah, yeah. And they would get a orange, orange…

(SO): Orange and a package of candy.

(BF): Yeah, yeah, that was the big deal. [Laughter.]

(SO): Well, you know, when I think about this thing, it's company sponsored and they went to the trouble of giving you a package of candy.

(BF): Yeah, yeah!

(SO): And they didn't have to. [Laughter.]

(BF): And that's what the guy was saying, he said it was a big deal!

(SO): Big Deal, that!

(BF): That was a really—the kids couldn't wait, and they…yeah. Huh. Did the Ichiki Store, did—do you remember, did you go inside, the store?

(SO): I've been there, yes.

(BF): Did you go in, when you visited?

(SO): No, no, no. Not that—not as a child.

(BF): Okay. Okay.

(TLG): Okay.

(SO): But ah, all of the stores back then was a general merchandise, had everything from kerosene lamps to candies and all of that.

(BF): A wide range.

(SO): Right.

(BF): Like how Hasegawa General Store was always like that, yeah.

(SO): [Laughter.] Yeah.

(BF): Yeah, yeah. Yeah, that's how the store up at Morihara, where I lived in Kula—

(SO): Morihara.

(BF): We used to go down there, and we had a charge account—

(SO): Everything that you needed.

(BF): Yeah.

(SO): Morihara Store.

(BF): And my parents had the charge account. And you could go there after school, call your parents, and if they told you it's okay you'd hand the phone to Mr. Morihara and say, "Okay," and he'd let you get a candy and a soda or something.

(SO): Yeah.

(BF): They still had charge account up until…it was in the 90s, they still had the accounts going. I remember my mom still charging there, before the credit cards.

(SO): That's right.

(BF): Yeah.

(SO): Before the advent of credit cards. They were charging.

(BF): Yeah.

(SO): All the time. And, you know, like Ichiki Store, and Onishi Store, they had salespeople around, who would go out in the camp, because…ground transportation was hard. Not everybody owned an automobile. So the stores used to go out, and they used to have salespeople go out.

(BF): Oh wow!

(SO): And…you know, and they'd come to your house, they'd talk story, and they says, "Oh, how about rice today, and…we have this, and we have that, and we have this dry goods and so forth." And they would make a list of charge accounts, okay. And you would go. Then—maybe this is Monday they come out, and Tuesday, they go out and deliver all of that.

(BF): Oh wow! So they take the order—

(SO): Yeah.

(BF): That's pretty—that was the first—

(TLG): You guys should do that!

(BF): Yeah!

[Laughter.]

(BF): That's our new—[inaudible] in the project, I'm gonna do that! [Laughter.]

(SO): Yeah, order takers. They hired these order takers.

(BF): Wow.

(SO): And then they would go. And then, the following day, there was the delivery. Or maybe two days later, or one day [inaudible]. And they would have it all in a sack, and say, "Okay, this is yours." And so forth.

(BF): Wow.

(TLG): Oh, neat.

(BF): Wow.

(SO): And at the end of the month, you got the bill.

(BF): You got the bill, then you gotta go pay.

(SO): Yeah.

(BF): So after your grandfather passed away, did your grandma live there just by herself?

(BF): Ah, no, there were…let's see, siblings—

(BF): The siblings, were there?

(SO): Yeah, my...aunt…and, my two youngest aunts were living with grandma there. And then…with grandma, yes.

(BF): Wow.

(TLG): Did they stay on when—when Grandma moved to Wailuku?

(SO): Yes, because my dad built the home, and so the two youngest aunts moved in with Grandma into my dad's home.

(BF): Okay.

(TLG): Oh, okay.

(BF): That must have been hard, though, before that…Before they moved, just your grandma and your two younger aunts.

(SO): Well, know, you see…

(BF): Did everybody help each other out?

(SO): Yeah, and then, ah…since my grandfather died…I still remember my grandmother getting a pension check from Pioneer Mill.

(BF): Really?

(SO): Yeah, you know. And, even when she moved to Wailuku, it was a big deal to her, ten dollars or twenty dollars a month.

(BF): It was still sent?

(SO): Yeah. And so, I remember, when she expired, there was one check that she didn't cash. So I took it over to Pioneer Mill and I said, "You know, my grandma died, and so forth, and this is the pension check, you know, that we still have." "Oh," they says, "Oh, you keep it!"

[Laughter.]

(BF): Wow!

(SO): Yeah. But ah, Pioneer Mill took over Olowalu Plantation, and they paid all the pensions and things like that.

(TLG): Right, right.

(BF): Did your grandma…you know, when I was growing up, by the time I got back from college, Pioneer Mill had the name in the community where people weren't—didn't look at them highly, and they didn't trust them, and all that. But, um…back before that, when your grandma was there, did people look like...that sounds pretty good, if they gave pension.

(SO): Oh yeah!

(BF): So they were looked—

(SO): Yeah! They—

(BF): Happy to have work, and favorably? That's great.

(TLG): Was—did she mention that there might have been a difference, between the way Olowalu was before, like when your grandpa was the engineer at the mill, and then after...Amfac came in? Is there—was there a difference?

(SO): I wouldn't know what the transition was like.

(BF and *TLG*): Yeah.

(BF): That's interesting, 'cause Olowalu Sugar Company—

(SO): Right.

(BF): Was—that was it's own company, that's right. And then…Amfac took over I think in 1937 or '38, I think, is when they closed down the camp, about that time. And everyone…or a lot of people, must have gone to Lahaina?

(SO): Yes.

(BF): Yeah.

(TLG): So, can we talk a little bit about Olowalu during the war?

(SO): During the war, Olowalu had military personnel there, on the beach side. But, ah, it wasn't…affected…affected very much. There were some camps…I mean military establishments along the way there.

(TLG): Along the way. Can you tell me where?

(BF): I didn't know that Olowalu…Wow! Had any! That's good!

(TLG): Can—do you recall about whereabouts the military personnel would stay?

(SO): I was…I would have a tendency to say at the entrance here. And then along this side, here, where now they plan to develop over there.

(TLG): Oh...

(SO): That's about it.

(TLG): Okay.

(SO): That's about it. Very short…small.

(BF): Short-lived.

(TLG): What kind of—did they have—did they build barracks, or...?

(SO): No.

(TLG): No, oh, okay.

(SO): It was temporary…shelters.

(TLG): Okay, yeah.

(BF): And maybe station few guys…

(SO): Yeah.

(BF): By the wharf…thinking people could—yeah. Okay.

(SO): Yeah.

(TLG): Was—

(SO): The landing could come.

(BF): That that could be a strategic—

(SO): Yeah.

(BF): —Site.

(TLG): Do you remember if the military did anything to the outer reefs over here?

(SO): No.

(TLG): 'Cause I heard stories about U—Ukumuhame, they had to blow out some of the reef, to make their—

(SO): Their landing.

(TLG): Yeah, yeah, yeah. Do you recall—

(SO): No, not in Olowalu, that I recall.

(TLG): Okay.

(BF): Oh wow, huh. Hey, can I get you any water?

(SO): No, no, no.

(BF): You're good.

(SO): I'm fine.

(BF): [inaudible].

(SO): You're okay.

(TLG): And then, um, what about road closures, would they...would they close the road? Because, by the time of the war your grandma had already gone to Wailuku?

(SO): Oh, yes, yes, she was in Wailuku.

(TLG): Oh, okay. Do you remember any difficulties coming through Olowalu at all, during the war, going like towards Lahaina?

(SO): No, ah...our twice-a-year trek to visit the cemetery, and so forth, we did not have any problems, that I can recall. We were able to go and visit the cemetery. I know now they have a fence!

(TLG): [Laughter.]

(SO): I mean a gate.

(TLG): Yeah, yeah.

(SO): That they had put a gate out there.

(TLG): Oh. Okay. And then, by the time the war...they had the military here during that time. Was there still a pretty good community at Olowalu, or...?

(SO): Yes.

(TLG): Yeah?

(SO): There was.

(TLG): Even by that time?

(SO): Yeah. And then, the military did have personnel along the shoreline.

(TLG): Yeah, yeah. Okay.

(SO): Because, you know, the shelter between Lanai, Molokai, Kahoolawe and Molokai, for enemy landing, is so easy, you know, coming in, and deep waters in Lahaina...when I grew up, you know, the entire Pacific fleet used to be anchored in Lahaina.

(TLG): Really?

(SO): Every summer. It was my annual trip to go to Lahaina.

(BF): Oh wow.

(SO): You know, because, you know from Olowalu 'til Lahaina, Kaanapali, the entire pacific fleet used to come in. And then, when these people had liberty—shore leave, they would land right past Olowalu, because that area—where the rubbish dump is—

(TLG): Oh, okay!

(BF): Oh, yeah, by Cut Rock, they call that.

(SO): Yeah.

(BF): It gets deep right there. You can come in close.

(SO): You come in close, and then, they would have shore leave, and they would come in by boat, and then go—right there by Cut Rock, and then get off the boat. And so, we would see all nothing but whites, you know.

[Laughter.]

(SO): They all came back and forth over there.

(BF): A big stream.

(SO): Yeah.

(BF): And then the railroad track, must—yeah, interesting...

(SO): It was there, because they had to take the sugar cane to Lahaina.

(BF): Yeah! Back to Lahaina. You could jump on it for a ride.

(TLG): And there were passenger cars as well? For this?

(SO): I don't recall passenger cars. But, it was a sight to behold here, the Lahaina Road, what they—was referred to the Lahaina Road, when the entire pacific fleet would be anchored there. And we would drive out at night to see, because, the entire ocean is lit with boats over there.

(TLG): That must have been neat!

(BF): Wow, that must have been crazy, yeah, wow.

(SO): And then—

(BF): And there's not a lot of light on shore—

(SO): No, no.

(BF): So, very easy to see.

(SO): And then you on the back side of Lanai, and Kahoolawe, so you can see all of this light. And then, ah...because very few taxis at the fort so you can see all of the white sailors walking back and forth.

[Laughter.]

(BF): All wanting to go to town.

(TLG): So they would all walk into Lahaina town?

(SO): Yeah.

(BF): So from there it's just...probably two, three miles.

(SO): Yeah, about three miles.

(BF): Probably about three miles, yeah, yeah. And at that point, three miles, that's...easy!

(SO): Easy.

(BF): To get off the boat, you probably walk ten miles and be happy! [Laughter.] Just to be on land.

(SO): Yeah.

(BF): And walk on land.

(SO): So, I remember the entire pacific fleet being—they congregated right there, you know.

(TLG): Right in front of Cut Rock.

(SO): Right in front of Cut Rock.

(BF): Out—'cause it's a sheltered area.

(SO): Yeah!

(BF): Right, Kahoolawe, Lanai…

(SO): Kahoolawe, Lanai, and Molokai, so you can see how sheltered it was.

(TLG): Yeah, yeah, that's very neat.

(SO): Well, it's not good naval strategy today, to congregate all you ships [laughter].

(BF): To put all your ships at once!

(TLG): To put all your boats in one spot!

(BF): Yeah.

(TLG): You would have think they'd have learned, about that.

(SO): Yeah, but, you see, that's the…that's all the maneuver for all the midshipmen and all of that…people, the navy personnel, so they would have maneuvers out in the Pacific ocean and then come back to Hawai'i, you see.

(BF): And that was before Pearl Harbor?

(SO): Before Pearl Harbor.

(BF): Yeah. So they just came there and never thought about having all your ships together at one time.

(SO): That was before Pearl Harbor.

(BF): Yeah, yeah, before. 'Cause, they wouldn't do it afterwards. Yeah.

(SO): Yeah!

(TLG): Oh...that's very neat.

(SO): Yeah, and so Olowalu was big time, back then. Sugar mill…I wish my dad could be here to tell you about it, but ah...

(BF): Oh, yeah!

(SO): And he…he was one that left early, and...as a young fella, he tried to see what Honolulu had to offer, too, so he was—

(BF): Oh, yeah!

(SO): And then he finally came back. And just about then I think the '30s it was, that California Packing Corporation—CPC—started the cannery. Pineapple industry.

(TLG): Okay.

(BF): Oh, wow.

(SO): And so my dad came back from Honolulu and worked for CPC, at the Kahului cannery.

(BF): Huh. I didn't know that, wow.

(SO): Yeah, and the Kahului cannery, which is now Maui Pine, was originally built by CPC. California Packing Corporation. They started to pack pineapple in Kahului. So my dad came back. Came in the '30s…ah, '26, about '30, to work at Maui Land and Pineapple.

(BF): CPC. Huh. That was staring to become—

(SO): Pineapple, yeah.

(BF): Yeah. I met with, um, do you know Bob Kimura?

(SO): Uh-huh.

(BF): Robert Kimura? I met with him a couple times.

(SO): Uh-huh.

(BF): And he took me to lunch. Really nice guy. And he told me about his father, on the Big Island, was in—

(SO): Kohala.

(BF): Yeah, Kohala. And he…the father had invent—helped invent... it was either a cutting—I think pine—the pineapple cutting, and canning, some equipment—

(SO): Ginaca machine.

(BF): Yeah! Okay, yeah! [Laughter.]

(S)O): His grandfather—his father's…no, his mother's father—

(BF): Okay.

(SO): His grandfather, anyway, Otani, you know. And, he came from Kohala. And he—

(BF): Yeah.

(SO): And he worked at the…in developing the machine for processing of pineapple.

(BF): Yeah, he told me that. And it was a neat…neat story. Yeah…yeah.

(SO): Mrs…Esther Otani got married to Mr. Toyoki Kimura, and he—Mr. Kimura, Bob's father, opened up a store at the corner of Mokuhau and Market Street, there.

(BF): Yeah!

(SO): [Inaudible.]

(BF): Yeah! That's what he told me. That's what he said. Yeah, yeah…yeah. I haven't seen him in a while, I think 'cause his health—

(SO): I haven't seen him too.

(BF): Yeah, his health…isn't doing well.

(SO): I see.

(BF): That's what I heard. But he had…he had heard about my project, and came into my office, and said "You'd better do that! You'd better get that project going!" He knew that project, and he liked—he liked the idea.

(SO): Yeah, so his father…and Bob I think had a lot to do with the apartment houses that they built, see.

(BF): Yeah.

(SO): Bungalows, yeah.

(BF): Yeah.

(SO): And now it's Jeanette Weinberg…units, yeah.

(BF): He told me that he rented a house to—or an apartment to Mike Victorino and his wife. [Laughter.] Yeah. Yeah, I remember that. So he did have apartments.

(SO): Yes, and know he's—it's Jeanette Weinberg apartments over there.

(BF): Okay.

(SO): So, Mr. Kimura built a lot of homes, where their property is, and he sold a lot of them, too.

(BF): Hmm. Yeah.

(SO): You see, it's only about four houses away is where I was born, you know. I think it's 2031 Mokohau Road, you know.

(BF): Huh.

(SO): But, in Happy Valley, I was born there. And then, my dad bought a half a acre property at the end of Mokohau Road, and built a home there, you see.

(BF): Oh, wow, okay, okay. Half acre, that's a good size piece of land.

(SO): Well yeah—

(BF): A lot of work, to take care of it.

(SO): Yeah, so, I grew up as a farmer.

(BF): Yeah. That's a lot of work!

(SO): Well, the thing is, we had water rights. You know…irrigation water rights, from Wailuku Sugar, so we could plant things.

(BF): Yeah?

(SO): Yeah.

(BF): Oh wow!

(SO): That's a big thing, you know!

(BF): Yeah!

(TLG): [Laughter.]

(BF): I was gonna say, wow!

(TLG): I'd like to talk about that a little bit more!

(BF): Yeah! That's amazing, to get water from them.

(SO): Yeah.

(TLG): Did that come with the land that your…that your dad purchased?

(SO): Yeah, because…it was the Mohikea family had the whole property, and then they subdivided you see, and the water rights came from Wailuku Sugar, from Waihee Ditch, from Waihee Valley that came all the way down, to Wailuku. And that's the one we tapped into.

(TLG): Oh…okay.

(BF): Wow. Did they ever try to take that water back, or…?

(SO): No.

(BF): No. They weren't that crazy. [Laughter.]

(TLG): So, do you still have that property?

(SO): No.

(TLG): Okay.

(SO): We sold that.

(TLG): Okay. Did the water rights go with the property as well, or did the—

(SO): By the time the water…the water was diverted and what not so there wasn't that much water.

(BF): Wasn't much left.

(TLG): Really…

(BF): Huh. Interesting.

(SO): Was interesting as I grew up and watched how the water came from Waihee Ditch, all the way from Waihee Valley, came all the way, and then, you know, it goes under the Iao Stream and up on the other side where that reservoir you saw—

(BF): Yeah!

(SO): The water goes up there.

(BF): Wow.

(SO): Because the Waihee side if higher, so the water would come down under the—

(BF): Under the stream?

(SO): Yeah, under the stream. And then—

(BF): Hoo! The engineering!

(SO): It's fantastic!

(BF): Yeah. It's…I took my boys out to Twin Falls on New Year Day. We got up to one of the ditches. And they were looking at it and looking at me, and I explained to them, said that's, a very interesting piece—

(SO): Yeah, my, the irrigation.

(BF): It was an amazing piece of history, what that…what that represents, and engineering. Phenomenal engineering.

(SO): Oh, yeah.

(BF): How they calculated that.

(SO): I don't remember who the guy is, but he lost his arm.

(BF): Yeah! The one arm!

(SO): One arm.

(BF): Was it VonTempski, or…?

(SO): No, was it—my mom remembers the name, 'cause she used to talk about it class when she was the teacher. She'd tell the kids that one of the guys was afraid to repel down—

(SO): Yeah, get one arm, he did.

(BF): And he showed up and he was like, "What!" And he went up there with his one arm and went all the way down this big cliff. [Laughter.]

(SO): Maliko Gulch.

(BF): Yeah!

(TLG): Oh my goodness.

(SO): Yeah.

(BF): And he just went…and then, after that, all the guys went. They said they couldn't…yeah.

(SO): There's a railroad trestle, where that…built over there, in Maliko Gulch.

(BF): Incredible. That's big.

(TLG): That's huge!

(BF and *TLG*): I saw photos!

(TLG): [Laughter.]

(BF): Yeah, and that thing is so big! I just…amazing, how they did this. And the work ethic, and the dedication…it's…different now.

(SO): Irrigation, or water. The central plains of Maui—

(TLG): That's amazing.

(SO): Because the water—

(TLG): HC&S.

(SO): EMI and Wailuku Sugar.

(BF): Yeah, it's remarkable. I mean, even the west side, they bring water pretty far.

(SO): Oh yeah, from Honolua, they bring the water in.

(BF): Yeah, but Olowalu always had—

(SO): Had their—

(BF): Always had their on, so they were separate, and um…separate and distinct, they had their own. And that's what we wanna keep, is that separate identity, that sense of plane. We wanna keep that. Yeah.

(SO): Last year sometime I went up to the wind farm, eh? And then I walked—I drove up through the top, and looked down Ukumehame.

(BF): Oh, wow.

(SO): You know, it's quite a view into Ukumehame.

(BF): Yeah.

(SO): And ah, I thought about it, that Ukumehame has a… valley, and then the wind farm is up there, but yet, you look, it's separated, yeah? You know.

(BF): Yeah. Yeah, it's big ridges.

(SO): Yeah.

(BF): Big mountain ridges.

(SO): I…you know, I had my sandwich. I had the cliff, and looking down Ukumehame, I…it's, ah…

(BF): Remarkable.

(SO): Remarkable. And then, I could see the plane, flying, way below me!

(BF): Below, right! [Laughter.]

(SO): Into the valley, it was coming out, that's the one that comes out to Iao Valley and likewise, you see.

(BF): That—when you get up there, it's a different perspective.

(SO): Oh, yeah.

(BF): 'Cause you drive up country, up where I live in Kula, it takes a while, when you get up there it's beautiful—

(SO): Beautiful.

(BF): Beautiful view. But to look back at Haleakala, I love doing that. I took, um…that's a hard hike. I did the *pali* hike. And I joked with my wife, when we first started dating, I said, "Let's go on a hike!" She said, "Okay." I said, "Let's go do that one!" She said "Okay." And she—we got there all the way to the top, and I joke that she still stayed with me, so she's in it for life!

[Laughter.]

(SO): Alright, alright.

(BF): But it was—you get up there, I was just saying that, to look back at the central plain and Haleakala from that side is rare.

(SO): Different.

(BF): It's a unique view.

(SO): Very different.

(BF): Yeah, very different. A lot of wonderful ways to see it. Yeah.

(SO): So, as far as Olowalu is concerned, I'm amazed at what you people have over here. I remember the bathhouse and all of that over here.

(BF): The, ah…the project that we're gonna do—

(SO): Uh-huh.

(BF): I was gonna give you one of these. This is the newspaper…It explains what my partner Dave and I wanna do. You can take it.

(SO): Wow.

(BF): It talks about Olowalu—

[End of file 002, begin file 003.]

(SO): [Inaudible.]

(BF): Yeah, two little town centers. Stores, churches, the school, police and fire, medical, we—a real, real community, is what we need to do.

(SO): The only thing that I remember, adverse, would be the wind coming down the valley.

(TLG): Oh, yeah.

(BF): Yeah, yeah!

(SO): It gets—it gets windy. It's not a sustained wind, you know, it comes and goes, you know.

(BF): Right.

(TLG): Yeah.

(BF): I've heard—

(TLG): Can you talk a little bit about what that wind would—was it a destructive wind? Just would it [whooshing sound] like that, or…would it, do anything—

(SO): No, because, I was driving through, you know what I mean, as a child. And I hang onto the Model-T roof—

(TLG): So did you feel it?

(SO): And I, you see…but, that's about it.

(BF): You know, there's a—I found a clipping…I don't know where it is, I'll get—I'll try to find it for you. But it talks about in 1920, the smokestack blew down. It was so strong. And it tipped—it tipped it over, and it was in the Maui News, a little clipping that said, "1920, wind with—a strong gust, pushed it over." I've heard about that here, and the other one I've heard is Launiupoko.

(SO): Launiupoko is also windy.

(BF): It's not always sustained, but when it comes, it's very strong. Yeah.

(TLG): Is this a wind that you could hear coming? Like, you can—it's not there yet, but you can kinda hear it on it's way, like—

(SO): No, no, no…

(TLG): It would just show up.

(SO): it just—just shows up, that's all.

(BF): Yeah, I've been there a couple times when it's…strong. And what's interesting is it won't be too windy on either side.

(SO): Yeah, it just—

(BF): It takes a special direction of a wind to just funnel through, just right.

(SO): Yeah, and so, it's…you know, I was…from my layperson standpoint, it's just this wind off of the mountain, it comes over the valley down in, that's all, see. So it's…around here, see, so, you know—

(BF): Right down through there.

(SO): Depends on how your trade winds are.

(TLG): Right.

(SO): And then it'll come down in—

(BF): It's a—it takes a certain angle. 'Cause it—you're right, it's not always there. It's pretty rare. But when it does come, it's strong!

(SO): Yeah.

(BF): So our design…

(SO and *TLG*): [Laughter.]

(BF): That was one of the things we've gotta make sure of. We gotta be sure on that. And um…our architect is…he's really good. He's talked about that wind and how the streets—how we line the streets up, and making sure that we're aware of that.

(TLG): Do you recall any big storms in the area? Big...?

(SO): Not that I can recall. You know where—

(TLG): Yeah.

(SO): It's not where they've had to shut down, and all of that.

(TLG): Uh-huh. Yeah. 'Cause like in—I know, like Kihei side they always talked about the stuff that would come down the mountain during a storm and I was wondering if there was a similar thing at Olowalu.

(BF): You can find cabbage that's through the store (?)

(TLG): They said that pigs would come down Waiakoa Stream!

[Laughter.]

(BF): It shows up down here. Yeah. We ah...I really appreciate you coming in and sharing.

(SO): No problem. No problem, because...

(BF): I love hearing the old stuff. And then, form you, it's special, because you know a lot.

(SO): Well, I wish I could share more!

(BF): Oh, you share plenty! [Laughter.]

(SO): Yeah. But ah, a lot stuff is heresay, but what I lived I can share with you.

(BF): Yeah, yeah, yeah. I met—so Mrs. Wakamatsu...I—do you know any other...can you think of other families...that...I know the Saffrey, Eugene Saffrey, he was related to Hanneman, Hanneman—

(SO): Hanneman.

(BF): Who was one of the head guys, in charge out there. He was the son, that was his father, Eugene Saffrey. I was just trying to think of any other families we might want to talk to. That might have similar stories to what you experienced.

(SO): Because the guys that I know now, who live in Olowalu, are not very familiar with the old days.

(BF): Oh, yeah, right, right. That's why I was really happy when your borther told me to call you up! [Laughter.] How's your brother doing?

(SO): Oh, he's alright!

(BF): Yeah? Good. He—I went and presented our project to Kiwanis. He was good—he asked good questions. And then finally I could tell that he knew more than the other guys. [Laughter.] That's why he—that's when he said, "My family was there."

(SO): Yeah, because...he is...what, ah, about fifteen years my junior, you see, so...He was born in Wailuku I think, so like that.

(BF): And so, by the time he was born, your grandma was already over this side, and you didn't go through there, yeah.

(TLG): I think that's what he said.

(BF): That's what he said, was talk to you. Yeah.

(TLG): Great. Just real quickly, I want to return to the cemetery site. Do you know of any other families that might have left—might still have folks in the cemetery? Or did...?

(SO): No, because I...my family, relatives were all exhumed and then we sent them back to Japan and so forth.

(TLG): Oh, oh, oh.

(BF): Kawashima...

(SO): Yeah, Kawashima—

(BF): Kawasaki...Yeah, there's names.

(SO): Yeah.

(BF): I know Kawashima from my librarian, from Kula School.

(SO): Uh, Mel Kawashima and Sanajiro Kawashima.

(BF): Yeah. Is that—

(TLG): Are they still—

(BF): —The husband who was in DOE?

(SO): No.

(BF): No. Different.

(SO): No, that's a different one.

(BF): Okay. Sinota, Nakakawa, there's Yonamine.

(SO): Uh-huh.

(BF): 1927. Takahashi...

(TLG): Are any of these...their descendants might be still on Maui, you think?

(SO): Ah...

(TLG): Or, a...?

(BF): Hayashi. Huh. That was my old neighbor. Nakamura. Kobayashi. Matsumoto.

(SO): Kawasaki...No, I don't think he would know. But ah, Tise's...Tise Market.

(BF): Is that Kimura? Right, no?

(SO): No, that's TK.

(BF): Oh, that's TK.

[Laughter.]

(BF): Yeah, yeah.

(SO): Tise is Kawasaki. Ah...I forgot his name anyway.

(BF): Okada? Shikeo Okada…it says parents in Wailuku.

(SO): Okada?

(BF): It says, Yamaguchi, or Kawashima…

(TLG): Ms. Okada was in, ah, '35.

(BF): Does it 5-15, no?

(TLG): No, I think this must be—

(BF): Oh, it different one.

(TLG): —A sibling or something.

(BF): Okay.

(SO): Yeah, Masai Ichi Okada, I don't think he…Masai Ichi Okada lives in Hale Koa. Ah…He may know something. Kawasaki, is that, ah, paper products.

(TLG): Maui Can?

(SO): Maui Paper.

(BF): Oh, down on lower Main?

(SO): Yes, Tise's Market.

(BF): Yeah. I had to go there for Mike, Onekeo, couple times. Printed up reports for us.

(SO): Uh-huh.

(BF): Yeah, I remember going there. By the, um…pass by Honda, down that way. Lower Main. If it's the one I'm thinking of.

(TLG): So he's...so this person, who's—he's over there, working over there?

(BF): Um, well I remember meeting the older gentleman, the older man, and he had…yeah, and he printed up the reports for us, I remember, um—

(SO): Over Maui Paper, right?

(BF): Yeah.

(SO): Maui Paper.

(BF): Yeah, yeah.

(SO): Yeah, he's…a Olowalu—

(BF): Really?

(SO): —Resident, yeah.

(BF): I didn't know that.

(SO): Yeah. Well, see I don't know where [inaudible] is now, maybe—but his son runs that.

(BF): Okay. That might be someone we maybe we go try talk to.

(SO): Uh-huh.

(BF): Okay. [Chuckle.] Wow.

(TLG): Wonderful, wonderful.

(BF): That's great, though! We really—

(TLG): Thank you so much.

(BF): —Really appreciate you sharing.

(SO): Well, I would like to share with you more, but, I don't have—

(BF and *TLG*): [Laughter.]

(BF): You shared plenty.

(SO): Okay.

(TLG): Thank you so much.

—End Recording—

APPENDIX HI.

Air Quality Study

AIR QUALITY STUDY

FOR THE PROPOSED

OLOWALU TOWN PROJECT

OLOWALU, MAUI

Prepared for:

Frampton & Ward, LLC

October 2011

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1.0 SUMMARY

Olowalu Town, LLC is proposing a master plan development at Olowalu on the island of Maui. The proposed development includes approximately 1,500 dwelling units, commercial office and retail space, public facilities, the realignment and widening of Honoapiilani Highway and other associated improvements. Full build out of the project is expected by 2020. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities. Mitigative measures are suggested where possible and appropriate to lessen any impacts from the project.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are generally comparable to the national standards although the state standards for carbon monoxide are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the project area is very much affected by its elevation near sea level and by nearby mountains. The West Maui Mountains shelter the project area from the northeast trade winds, and local winds (such as land/sea breezes and upslope/downslope winds) affect the wind flow in the area much of the time. Temperatures in the project area are generally very consistent and warm with average daily temperatures ranging from about 65°F to 84°F. Rainfall in the project area is minimal with an average of only about 11 inches per year.

Except for periodic impacts from volcanic emissions (vog) and possibly occasional localized impacts from traffic congestion, the present air quality of the project area is believed to be relatively good. There is very little air quality monitoring data from the Department of Health for the project area, but the limited data that are available suggest that concentrations are generally well within state and national air quality standards.

If the proposed project is given the necessary approvals to proceed, it is inevitable that some short- and long-term impacts on air quality will unavoidably occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment and from the disruption of traffic may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the project boundary. Hence, an effective dust control plan should be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Excess exhaust emissions from traffic disruption can be mitigated by moving construction equipment and workers to and from the project area during off-peak traffic hours and by minimizing road closures during peak traffic periods.

After project construction is completed, motor vehicles coming to and from the proposed development will result in a long-term increase in air pollution emissions in the project area. To assess the potential long-term impact of these emissions, a mesoscale (medium scale) analysis was performed. The mesoscale analysis was designed to provide estimates of air pollution emissions from project-related traffic using Honoapiilani Highway in the Olowalu area. The analysis considered an existing (2011) case and two future scenarios. The future scenarios included 2020 without the project and 2020 with the project.

The mesoscale analysis indicated that in 2011 the totals of emissions from traffic using Honoapiilani Highway within the study area were 1,297 lbs per day of carbon monoxide, 103 lbs per day of volatile organic compounds and 130 lbs per day of nitrogen oxides. These emission amounts are relatively small in comparison to island-wide emissions, amounting to about 1 percent or less. Without the project in the year 2020, it was estimated that carbon monoxide emissions would decrease by 20 percent, volatile organic compounds emissions would decrease by 37 percent and nitrogen oxides emissions would decrease by 54 percent. Although increased traffic volumes are expected, these would be more than offset by the retirement of older, higher-emission vehicles over time. With the project in the year 2020 compared to without it, carbon monoxide emissions and nitrogen oxides emissions would each increase by 20 percent, while volatile organic compounds emissions would increase by about 8 percent. Although emissions in 2020 with the project would be somewhat higher compared to without it, emissions would be lower than the existing emissions.

Although more detailed analyses could be performed using computerized emission and atmospheric dispersion models to estimate worst-case ambient concentrations of carbon monoxide near roadway intersections in the project area, such analyses were not

prepared for this project. However, based on the larger-scale analysis that was performed, it appears likely that emissions from project traffic would not have a significant adverse impact on air quality in the project area. Project development will include the realignment and improvement of Honoapiilani Highway in the Olowalu area. Project plans call for the development of "O-turn" intersections. O-turn intersections keep traffic flowing continuously without stoplights or over/underpasses. The O-turn design features long merge lanes which allow for easy turns. Maximum carbon monoxide concentrations typically occur near congested intersections where traffic queuing occurs. The O-turn intersections will serve to eliminate traffic queuing, which will reduce the possibility of carbon monoxide "hot spots".

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were not made, but any significant air quality impacts are unlikely.

Based on the results of the analyses of the potential long-term effects of the project, it may be concluded that the proposed project would likely not have a significant impact on the air quality of the area. Although options are available to mitigate long-term traffic-related air quality impacts, requiring these to be implemented is probably unnecessary and unwarranted in this case. Incorporating energy conservation design features and promoting conservation and recycling programs within the proposed development could serve to further reduce any indirect impacts due to electric power usage and to solid waste disposal and would help to conserve the island's resources.

2.0 INTRODUCTION

Olowalu Town, LLC is proposing to develop the Olowalu Town Project on the island of Maui at the village of Olowalu (see Figure 1 for general project location). The proposed project would involve the development of a master-planned community at Olowalu that would include approximately 1,500 residential dwelling units, neighborhood town centers for commercial retail and office space, areas for public facilities, parks, open spaces, and other associated facilities and infrastructure improvements. A major portion of the project would also involve the realignment of Honoapiilani Highway to a more mauka location. The highway would also be widened and intersection improvements would be constructed. The proposed development would be constructed in phases over a 10-year period.

The purpose of this study was to evaluate the potential air quality impacts of the proposed project and recommend mitigative measures, if possible and appropriate, to reduce or eliminate any project-related degradation of air quality in the area. Before examining the potential impacts of the project, a discussion of ambient air quality standards is presented and background information concerning the regional and local climatology and the present air quality of the project area is provided.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national

and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit. On the other hand, the current

Hawaii AAQS for sulfur dioxide are probably less stringent than the national standards. During the early part of 2010, the national primary annual and 24-hour standards for sulfur dioxide were revoked in favor of a new national 1-hour standard which is considered to be more stringent than the Hawaii short-term standards. The Hawaii AAQS for sulfur dioxide have not yet been updated to bring them in line with the national standards.

In 1993, the state revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and as a result, the new standards for particulate were finally implemented during 2005. To date, the Hawaii Department of Health has not updated the state particulate standards.

In September 2001, the state vacated the state 1-hour standard for ozone and an 8-hour standard was adopted that was the same as the national standard. During 2008, the national standard for ozone was again revised and made more stringent. The Hawaii standard for ozone has not yet been amended to follow the national standard.

During the latter part of 2008, EPA revised the standard for lead making the standard more stringent. So far, the Hawaii Department of Health has not revised the corresponding state standard for lead.

During early 2010, a national 1-hour primary standard for nitrogen dioxide was implemented. To date, Hawaii has not promulgated a 1-hour standard for nitrogen dioxide, but the

Hawaii annual standard for this pollutant is more stringent than the national annual standard.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affect the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

The topography of Maui is dominated by the great volcanic masses of Haleakala (10,023 feet) and the West Maui Mountains (5,788 feet). The island consists entirely of the slopes of these mountains and of a connecting isthmus. Haleakala is still considered to be an active volcano and last erupted about 1790. The project site is located along the lower southwestern slope of the West Maui Mountains at an elevation of about 300 feet or less.

Maui lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. Because the project area is located on the lower southwestern slope of the West Maui Mountains, it is sheltered much of the time from the northeast trade winds. Local winds such as land/sea breezes and/or upslope/downslope winds also influence the wind pattern for the area. During the daytime, winds can typically be expected to move onshore because of seabreeze and/or upslope effects or because of the aerodynamic cavity caused by the trade winds flowing around the mountains. At night, winds are often drainage winds that move downslope and out to sea. During

winter, occasional strong winds from the south or southwest occur in association with the passage of winter storm systems.

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depends to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project site's lower elevation and leeward location results in warmer temperatures compared with many other parts of the island. At Lahaina, which is about 5 miles to the north of the project area and at an elevation of about 50 feet, average daily minimum and maximum temperatures are 65°F and 84°F, respectively [1]. Temperatures at the project site can be expected to be very similar to this.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is often measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 is the least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the Olowalu area, stability classes 5 or 6 typically occur during the nighttime or early morning hours when temperature inversions form due to radiational cooling or to drainage flow from the nearby

mountains. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the onset and extent of the sea breeze.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3,000 feet (1,000 meters).

Rainfall can have a beneficial affect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The climate of the project area is very dry due to the leeward location. Historical records Olowalu show that this area of Maui averages about only 11 inches of precipitation per year with the summer months being the driest [1].

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from vehicular, industrial, natural and/or agricultural sources. Table 2 presents an air pollutant emission summary for the island of Maui for calendar year 1993. This is the most recent year for which an island-wide emission inventory is available. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, most of the manmade particulate and sulfur oxides emissions on Maui originate from point sources, such as power plants and other fuel-burning industries. Nitrogen oxides emissions are roughly equally divided between point sources and area sources (mostly motor vehicle traffic). The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic and sugar cane burning), while hydrocarbons are emitted mainly from point sources. Emissions today are probably higher than those shown in the table, but the proportional relationships are likely about the same.

The largest sources of air pollution in the immediate project area are most likely agricultural operations, automobile traffic using local roadways and the power plant at Maalaea. Emissions from the agricultural and motor vehicle sources consist primarily of particulate, carbon monoxide and nitrogen oxides. The power plant at Maalaea mostly emits sulfur dioxide, nitrogen oxides and particulate. Emissions from this facility will be carried offshore most of the time by the prevailing winds. Volcanic emissions from distant natural sources on the Big Island also affect the air quality at times during kona wind conditions. By the time the volcanic emissions reach the project area, they consist mostly of fine particulate sulfate.

The State Department of Health operates a network of air quality monitoring stations at various locations around the state, but only very limited data are available for Maui Island. The only air quality data for the project area consists of particulate measurements collected at Kihei (about 10 miles to the east). Although it is doubtful if this data is representative of the Olowalu area, it is the only air quality data available for all of Maui.

Table 3 summarizes the data from the Kihei monitoring station. Annual second-highest 24-hour PM-10 particulate concentrations (which are most relevant to the air quality standards) ranged from 60 to 119 $\mu g/m^3$ between 2005 and 2008. Average annual concentrations ranged from 20 to 26 $\mu g/m^3$. One exceedance of the state standard was recorded during 2005. This was reported to be due to agricultural tilling operations in the area. Another exceedance of the standard was reported during 2007. This was considered an exceptional event due to a brush fire nearby. Monitoring of PM-10 at the Kihei monitoring station was discontinued in 2009.

As indicated in Table 3, PM-2.5 particulate is also monitored at the Kihei monitoring station. Annual 24-hour 98th percentile PM-2.5 particulate concentrations (which are most relevant to the air quality standards) ranged from 8 to 16 $\mu g/m^3$ between 2005 and 2009. Average annual concentrations ranged from 4 to 6 $\mu g/m^3$. One relatively high value was flagged during 2006 due to fireworks. No exceedances of the state standard were recorded during this period.

Given the limited air pollution sources in the area, it is likely that air pollution concentrations are near natural background

levels most of the time, except possibly for locations adjacent to agricultural operations or near traffic-congested intersections.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur during project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site and from the disruption of traffic due to road construction.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with land clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled fugitive dust emissions in the project area would likely be somewhere near this level or possibly lower due to the rocky nature of the soil in the area. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction

activities at the project boundary, and thus an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is oftentimes a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Indirectly, slow-moving construction vehicles on roadways leading to and from the project area could obstruct the normal flow of

traffic to such an extent that overall vehicular emissions are increased, but this impact can be mitigated by moving heavy construction equipment during periods of low traffic volume. Likewise, road closures during peak traffic periods should be avoided to the extent possible to minimize air pollution impacts from traffic disruption. Thus, with careful planning and attention to dust control, most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation required further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, and these began to take effect during the past decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles are retired and leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 20 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential air quality impact of the proposed project, a mesoscale analysis was performed. A mesoscale analysis is a larger scale evaluation of daily and annual emissions from the roadway network in the project area. For this project, the mesoscale analysis was designed to quantify project-related emissions of carbon monoxide, nitrogen oxides and hydrocarbons occurring from motor vehicle traffic using Honoapiilani Highway in the Olowalu area. Emission estimates were prepared for the existing case and for the future (year 2020) with and without project scenarios.

The mesoscale emission estimates for each scenario were made by first obtaining the estimated average daily traffic (ADT) volumes and average travel speeds (ATS) for the section of highway under study from the project traffic impact analysis report [4]. The length of the section of highway included in the project is approximately 2.3 miles. Total vehicle-miles per day were then calculated, and emission estimates were prepared for each scenario based on the estimated vehicle-miles of travel, average travel speeds, and U.S. EPA emission factors obtained using the computer model MOBILE6.2 [5]. MOBILE6.2 is the most recently released version of the EPA mobile emission model. Aside from vehicle speed, several other key inputs are required by the model. One of these is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 34.2% light-duty gasoline-powered automobiles, 52.8% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.6% heavy-duty diesel-powered trucks and buses, and 0.6% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change somewhat with fewer light-duty

gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Another key input to MOBILE6.2 is ambient temperature. An average ambient temperature 77 degrees F was used for all of the mesoscale emission computations.

The resulting emission factors generated by MOBILE6.2 are given in terms of grams of volatile organic compounds (VOC), carbon monoxide (CO) and nitrogen oxides (NOx) emitted per vehicle mile. Within the speed range of interest, emission factors for carbon monoxide and nitrogen oxides are generally proportional to vehicle speed, while emission factors for VOC are inversely proportional to vehicle speed. It should also be noted that at a given vehicle speed emission factors are generally lower for future years due to the effects of older, more-polluting vehicles being retired.

Table 4 provides the details of the mesoscale analysis. A summary of the results is presented below:

Scenario	Emissions (tons/year)		
	CO	NOx	VOC
2011 Existing	237	24	19
2020 Without Project	189	11	12
2020 With Project	226	13	13

In comparison to the island-wide emissions given in Table 2, emissions in the year 2011 from traffic using Honoapiilani Highway within the project area were relatively small, amounting to about 1 percent or less.

Without the project in the year 2020, carbon monoxide emissions within the project area were estimated to decrease by about 20 percent compared to existing emissions, nitrogen oxides emissions were estimated to decrease by about 54 percent and VOC emissions were estimated to decrease by about 37 percent.

With the project in the year 2020, emissions of carbon monoxide and nitrogen oxides would increase by about 20 percent each while VOC emissions would increase by about 8 percent compared to the without-project case. Although emissions would increase by relatively small amounts with the project compared to without it in the year 2020, emissions would be lower than the existing emission levels. Compared to island-wide emissions, traffic-related emissions in the project area would be relatively small.

7.2 Electrical Demand

The proposed project also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. Electrical power for the project will most probably be provided mainly by oil-fired generating facilities, but some of the project power may also be derived from photovoltaic systems, wind power or other alternative energy sources. In order to meet the electrical power needs of the proposed project, power generating facilities will likely be required to burn more fuel and hence more air pollution will be emitted at these facilities. Estimates of project electrical demand are not available, but it is probable that any associated indirect air pollution emissions will be small in terms of the island-wide emission estimates given in Table 2.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development may result in indirect offsite emissions of air pollution. Currently, all solid waste on the island of Maui is buried at solid waste landfills. Thus, assuming this continues to be the method for solid waste disposal, the only associated air pollution emissions that will occur will be from trucking the waste to the landfill and burying it. Estimates of the amount of solid waste generated by the proposed project are not yet available, but any associated air pollution emissions should be relatively minor.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Existing Conditions

Although very little ambient air quality data are available to characterize existing conditions, it is likely that state and federal ambient air quality standards are currently being met in the project area, except perhaps for occasional exceedances of the stringent state carbon monoxide standards within small areas near traffic-congested locations.

Short-Term Impacts and Mitigation

The major potential short-term impact of the project on air quality will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall and other factors. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall.

Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive areas of the project that have been disturbed could be controlled by mulching or chemical stabilization. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Establishment of landscaping early in the construction schedule will also help to control dust.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from the disruption of normal traffic flow. Increased vehicular emissions due to the disruption of traffic can be alleviated by minimizing road closures during peak traffic hours.

Long-Term Impacts

Traffic-related emissions from the project are relatively small compared to island-wide emissions. Without the project by the year 2020, mesoscale analysis indicates that emissions of carbon monoxide, nitrogen oxides and VOC from motor vehicles operating within the project study area would decrease substantially despite the higher traffic volumes from general growth over the next several years. This is because the higher traffic volumes would be more than offset by the retirement and replacement of older vehicles that have less efficient emission control systems.

With the proposed project in the year 2020, emissions of carbon monoxide and nitrogen oxides would increase by about 20 percent each compared to the without-project case and VOC emissions would

increase by about 8 percent. Even with these relatively small increases, emissions in the year 2020 would be lower than the existing emissions. Although a more detailed microscale analysis of carbon monoxide concentrations near specific intersections could be performed, it is unlikely that the relatively small increase in carbon monoxide emissions from project-related traffic will result in any significant impacts on air quality in the project area, especially if sufficient roadway capacity is provided. Project plans call for the development of "O-turn" intersections. O-turn intersections keep traffic flowing continuously without stoplights or over/underpasses. The O-turn design features long merge lanes which allow for easy turns. Maximum carbon monoxide concentrations typically occur near congested intersections where traffic queuing occurs. The O-turn intersections will serve to reduce the possibility of carbon monoxide "hot spots".

Any long-term impacts on air quality due to indirect emissions from supplying the project with electricity and from the disposal of solid waste materials generated by the project will likely be small.

Long-Term Mitigation

Options available to mitigate long-term, traffic-related air pollution are generally to further improve roadways, to reduce traffic and/or to reduce individual vehicular emissions. Aside from providing added roadway improvements, air pollution impacts from vehicular emissions could conceivably be additionally mitigated by reducing traffic volumes through the promotion of bus service and car pooling in the project area and/or by adjusting local school and business hours to begin and end during off-peak times. This mitigation measure is generally considered only partially successful. Reduction of emissions from individual

vehicles would have to be achieved through the promulgation of local, state or federal air pollution control regulations. For example, Hawaii currently does not require annual inspections of motor vehicle air pollution control equipment. However, at the present time there is no indication that the state is contemplating adopting such rules.

Indirect emissions from project electrical demand could likely be reduced somewhat by incorporating energy-saving features into project design requirements. This might include the use of solar water heaters; designing building space so that window positions maximize indoor light without unduly increasing indoor heat; using landscaping where feasible to provide afternoon shade to cut down on the use of air conditioning; installation of insulation and double-glazed doors to reduce the effects of the sun and heat; providing movable, controlled openings for ventilation at opportune times; and possibly installing automated room occupancy sensors. Promoting conservation and recycling programs within the proposed development could serve to further reduce any indirect impacts due to solid waste disposal and would help to conserve the island's resources.

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Figure 1 - Project Location

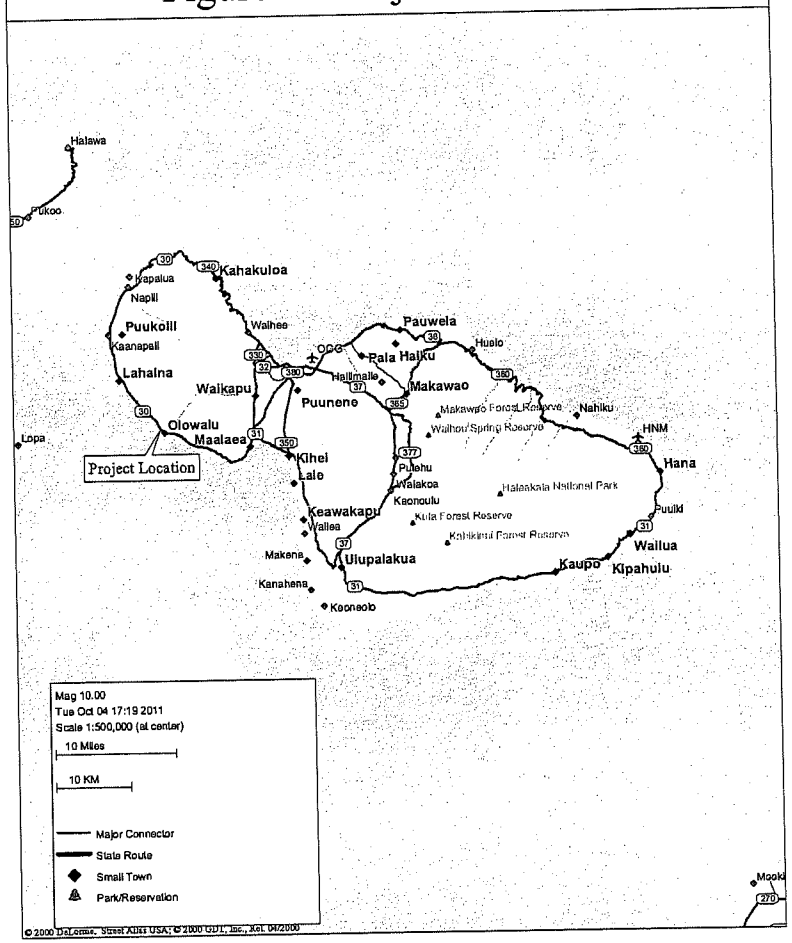

Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	$\mu g/m^3$	Annual	-	-	50
		24 Hours	150[a]	150[a]	150[b]
Particulate Matter (<2.5 microns)	$\mu g/m^3$	Annual	15[c]	15[c]	-
		24 Hours	35[d]	35[d]	-
Sulfur Dioxide	ppm	Annual	-	-	0.03
		24 Hours	-	-	0.14[b]
		3 Hours	-	0.5[b]	0.5[b]
		1 Hour	0.075[e]	-	-
Nitrogen Dioxide	ppm	Annual	0.053	0.053	0.04
		1 Hour	0.100[f]	-	-
Carbon Monoxide	ppm	8 Hours	9[b]	-	4.4[b]
		1 Hour	35[b]	-	9[b]
Ozone	ppm	8 Hours	0.075[g]	0.075[g]	0.08[g]
Lead	$\mu g/m^3$	3 Months	0.15[h]	0.15[h]	-
		Quarter	1.5[i]	1.5[i]	1.5[i]
Hydrogen Sulfide	ppm	1 Hour	-	-	35[b]

[a] Not to be exceeded more than once per year on average over three years.
[b] Not to be exceeded more than once per year.
[c] Three-year average of the weighted annual arithmetic mean.
[d] 98th percentile value of the 24-hour concentrations averaged over three years.
[e] Three-year average of annual fourth-highest daily 1-hour maximum.
[f] 98th percentile value of the daily 1-hour maximum averaged over three years.
[g] Three-year average of annual fourth-highest daily 8-hour maximum.
[h] Rolling 3-month average.
[i] Quarterly average.

Table 2

AIR POLLUTION EMISSIONS INVENTORY FOR ISLAND OF MAUI, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	63,275	7,030	70,305
Sulfur Oxides	6,419	nil	6,419
Nitrogen Oxides	7,312	8,618	15,930
Carbon Monoxide	4,612	20,050	24,662
Hydrocarbons	1,991	234	2,225

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 3

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR MONITORING STATIONS NEAREST OLOWALU TOWN PROJECT

Parameter / Location	2005	2006	2007	2008	2009
Particulate (PM-10) / Kihei					
24-Hour Averaging Period:					
No. of Samples	337	337	326	331	-
Highest Concentration ($\mu g/m^3$)	155	72	281[a]	78	-
2nd Highest Concentration ($\mu g/m^3$)	119	66	93	60	-
No. of State AAQS Exceedances	1	0	1[a]	0	-
Annual Average Concentration ($\mu g/m^3$)	25	22	26	20	-
Particulate (PM-2.5) / Kihei					
24-Hour Averaging Period:					
No. of Samples	108	109	78	58	358
Highest Concentration ($\mu g/m^3$)	10	30[b]	11	16	26
98th Percentile Concentration ($\mu g/m^3$)	8	10	10	15	16
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	5	5	5	6	4

[a]Exceptional event (brush fire)

[b]Data flagged due to fireworks

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2005 - 2009"

Table 4

ESTIMATED EMISSIONS FOR HONOAPIILANI HIGHWAY AT OLOWALU

Scenario	Segment Length (miles)	Average Daily Traffic Volume	Vehicle Miles Per Day	Average Travel Speed (mph)	Emission Factors (grams/veh-mile)			Emissions (lb/day)			Emissions (tons/yr)		
					CO	NOx	VOC	CO	NOx	VOC	CO	NOx	VOC
Existing	2.3	22,840	52,532	43.1	11.2	1.12	0.891	1,297	130	103	237	24	19
2020 Without Project	2.3	24,470	56,281	42.0	8.34	0.478	0.520	1,035	59	64	189	11	12
2020 With Project	2.1	29,850	62,685	50.0	8.95	0.505	0.496	1,237	70	69	226	13	13

APPENDIX I-1.

April 19, 2015 Letter from B.D. Neal & Associates

B.D. NEAL & ASSOCIATES

Applied Meteorology • Air Quality • Computer Science

P.O. BOX 1808 • KAILUA-KONA, HAWAII 96745 • TELPHONE (808) 329-1627 • FAX (808) 325-6739
EMAIL: bdneal@bdneal.com

April 19, 2015

Mr. Bill Frampton
Frampton & Ward, LLC
2035 Main Street
Wailuku, Hawaii 96793

Subject: Olowalu Town Project
Air Quality Study Update

Dear Mr. Frampton:

In accordance with your request, we have reviewed the revised Traffic Impact Analysis Report (TIAR) dated April 14, 2015 for the subject project as it relates to the air quality study we prepared in October 2011. In comparing the revised TIAR to that used for the air quality study prepared in 2011, the revised estimated traffic volumes are approximately 10 to 15% higher. Thus, the traffic-related air pollution emissions can also be expected to be about 10 to 15% higher.

In the October 2011 air quality study for this project, it was concluded that emissions from project traffic would likely not have a significant adverse impact on air quality in the project area. This conclusion will not change with the slightly higher traffic volumes forecast in the revised TIAR.

Please call me if you have any questions about this.

Very truly yours,

Barry D. Neal

Barry D. Neal
Certified Consulting
Meteorologist

APPENDIX I-2.

June 4, 2015 Letter from B.D. Neal & Associates

B.D. NEAL & ASSOCIATES

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June 4, 2015

Mr. Bill Frampton
Frampton & Ward, LLC
2035 Main Street
Wailuku, Hawaii 96793

Subject: Olowalu Town Project
Air Quality Study Update

Dear Mr. Frampton:

In accordance with your request, we have reviewed Alternatives 1 and 2 for the subject project as they relate to the air quality study we prepared in October 2011. Both project alternatives will include 1,500 residential units and 300,000 to 375,000 square feet of commercial space, except Alternative 2 reduces the land area by eliminating the lands Makai of Honoapiilani Highway. Because it is anticipated that either alternative would generate about the same volume of motor vehicle traffic, the air quality study prepared in 2011 is applicable to either alternative.

Please call me if you have any questions about this.

Very truly yours,

Barry D. Neal

Barry D. Neal
Certified Consulting
Meteorologist

APPENDIX ~~I~~J.

Preliminary Acoustic Study

PRELIMINARY ACOUSTIC STUDY FOR THE HONOAPIILANI HIGHWAY REALIGNMENT AT OLOWALU TOWN LAHAINA, MAUI

Prepared for:

FRAMPTON & WARD, LLC

Prepared by:

Y. EBISU & ASSOCIATES
1126 12th Avenue, Room 305
Honolulu, Hawaii 96816

OCTOBER 2011

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CHAPTER I. SUMMARY

The existing and future traffic noise levels in the environs of the proposed Honoapiilani Highway realignment mauka of Olowalu Town on the island of Maui were studied to evaluate potential noise impacts associated with the Build Alternative. Noise measurements were obtained, traffic noise predictions developed, and noise abatement alternatives evaluated.

Existing traffic noise levels in the project area probably exceed the U.S. Federal Highway Administration (FHWA) and Hawaii State Department of Transportation, Highways Division (HDOT) noise abatement criteria at two existing residences. Future (CY 2020) traffic noise levels are expected to continue to exceed the "66 Leq" HDOT noise abatement criteria at one of the two existing residences under the No-Build Alternative. The noise abatement criteria will not be exceeded at existing noise sensitive dwelling units under the Build Alternative. Traffic noise mitigation measures in the form of noise barrier construction, increased setback distances, or closure and air conditioning may be applied at future residences of the Olowalu Town development. Because of the potential visual impacts of the noise barriers and the potential for graffiti, landscaping should be used on the roadway side of the barriers.

The following general conclusions can be made in respect to the number of impacted structures and lands which can be expected by CY 2020 under the Build Alternative. These conclusions are valid as long as the future vehicle mixes and average speeds do not differ from the assumed values.

- The HDOT's ">15 dB increase" criteria for substantial change in traffic noise levels will not be exceeded at any existing noise sensitive structure. Maximum increases in traffic noise levels in the project area should not exceed 7.3 dB as a result of growth in traffic volumes and the construction of the new highway.

- Under the No Build Alternative, future traffic noise levels at 1 existing residence which is located within the limits of project construction are expected to exceed the HDOT "66 Leq" criteria.

- Under the Build Alternative, future traffic noise levels at existing residences which are located within the limits of project construction are not expected to exceed the HDOT "66 Leq" criteria.

- Future traffic noise levels at the commercial structure (Olowalu Grocery Store) on Honoapiilani Highway should not exceed current HDOT and FHWA noise abatement criteria under the Build or No Build Alternatives.

- The construction of sound attenuation barriers along the new highway Rights-of-Way and Top of Fill is a possible noise mitigation measure which could be applied to meet FHWA and HDOT policy criteria at future residences or other noise sensitive uses. For ground level receptors, sound attenuating walls which

are required to meet the minimum HDOT's 7 dBA attenuation criteria at the affected residences may be constructed. Other noise mitigation measures (increased buffer distances and closure and air conditioning) may also be applied at the developer's option to meet HDOT and well as FHA/HUD sound attenuation criteria.

Potential short term construction noise impacts are possible during the project construction period along the entire project corridor. However, minimizing these types of noise impacts is possible using standard curfew periods, properly muffled equipment, administrative controls, and construction barriers as required. The possible use of blasting or chemicals to break or dislodge rock will be considered to reduce the total construction period, and to reduce the amount of time required to remove the rock if only mechanical (such as hoe ram) equipment were used. Controlled blasting operations using relatively small charges may be feasible without causing adverse noise and vibration impacts at nearby residences. In addition, the use of chemical expansion to break or dislodge rock during construction will also be considered where blasting or mechanical means are less desirable.

CHAPTER II. GENERAL STUDY METHODOLOGY

Noise Measurements. Existing traffic and background ambient noise levels at six locations in the project area were measured in July 2011. The traffic noise measurements were used to calibrate the traffic noise model which was used to calculate the Base Year (CY 2011) and future (CY 2020) traffic noise levels under the No Build and Build Alternatives. The background ambient noise measurements were used to define existing noise levels at noise sensitive receptors which may be affected by the project. Also, the measurements were used in conjunction with forecast traffic noise levels to determine if future traffic noise levels are predicted to "substantially exceed" existing background ambient noise levels at these noise sensitive receptors, and therefore exceed FHWA and HDOT noise standards and noise abatement criteria.

The noise measurement locations ("A," "B," "C," "D," "E," and "F") are shown in Figure 1. The results of the traffic and background noise measurements are summarized in Table 1. In the table, Leq represents the average (or equivalent), A-Weighted, Sound Level. A list and description of the acoustical terminology used are contained in Appendix B.

Traffic Noise Predictions. The Federal Highway Administration (FHWA) Traffic Noise Model, Version 2.5 (or TNM, see Reference 1) was used as the primary method of calculating Base Year and future traffic noise levels, with model parameters adjusted to reflect terrain, ground cover, and local shielding conditions. At all traffic noise measurement locations, the measured noise levels were compared with TNM model predictions to insure that measured and calculated noise levels for the existing conditions were consistent and in general agreement. As indicated in Table 1, spot counts of traffic volumes were also obtained during the measurement periods and were used to generate the Equivalent Sound Level (Leq) predictions shown in the table. The average vehicle speeds entered into the TNM were typically higher than posted speeds during the am and off-peak periods so as to achieve better agreement between measured noise levels and those calculated by the TNM. During the pm peak period, when traffic congestion was greater, the average vehicle speeds were closer to the posted speed limits. With these input speed adjustments, the agreement between measured and predicted traffic noise levels was considered to be good and sufficiently accurate to formulate the Base Year and future year traffic noise levels.

Base Year traffic noise levels were then calculated at receptor locations shown in Figure 2 along the existing and proposed highway corridors using Base Year (2011) traffic volume and average vehicle speed data for the PM peak hour from Reference 2. The traffic volumes are summarized in Appendix C. Traffic mix by vehicle types for the various sections of the existing and future roadway were derived from observations during the noise monitoring periods. Determinations of the periods of highest hourly traffic volumes along the project corridor were made after reviewing the AM and PM peak hour traffic volumes from Reference 2, the noise measurement results, and Reference 3. Total two-way traffic volumes were generally highest during the PM peak

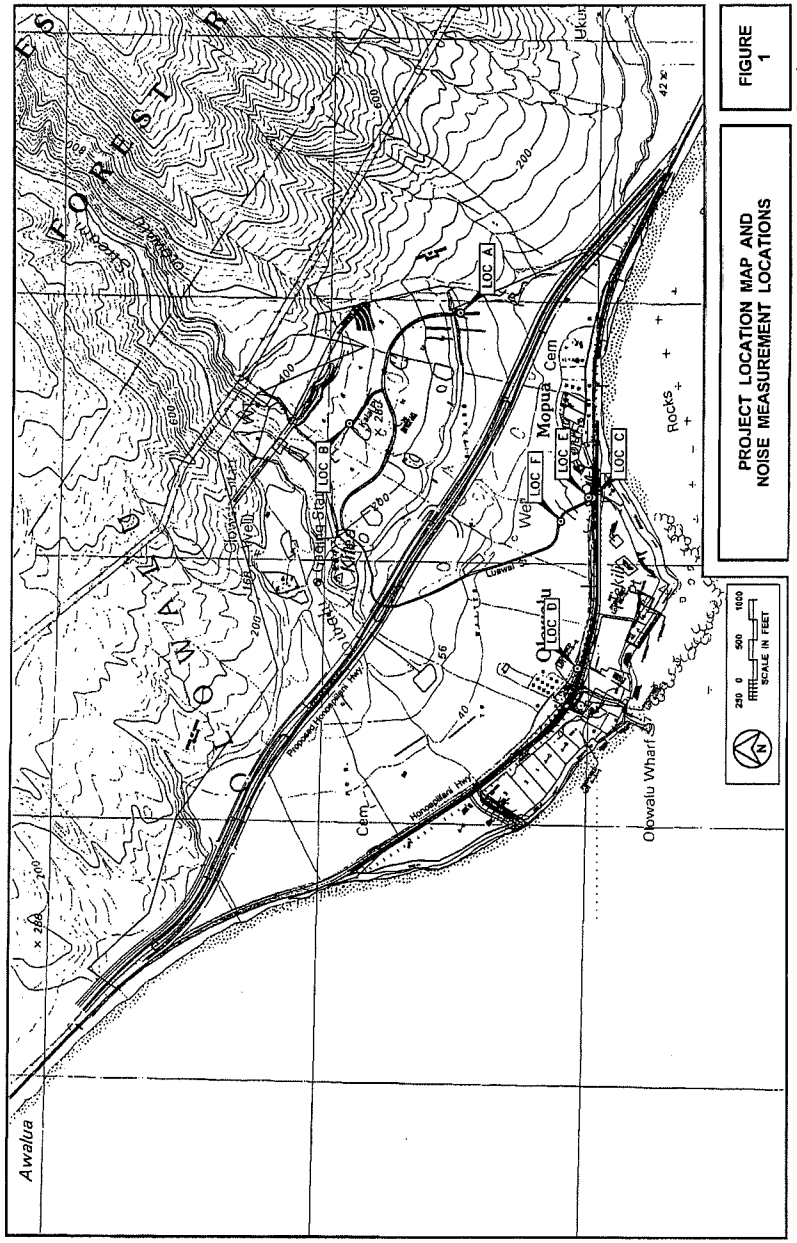


FIGURE 1

PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS

TABLE 1
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

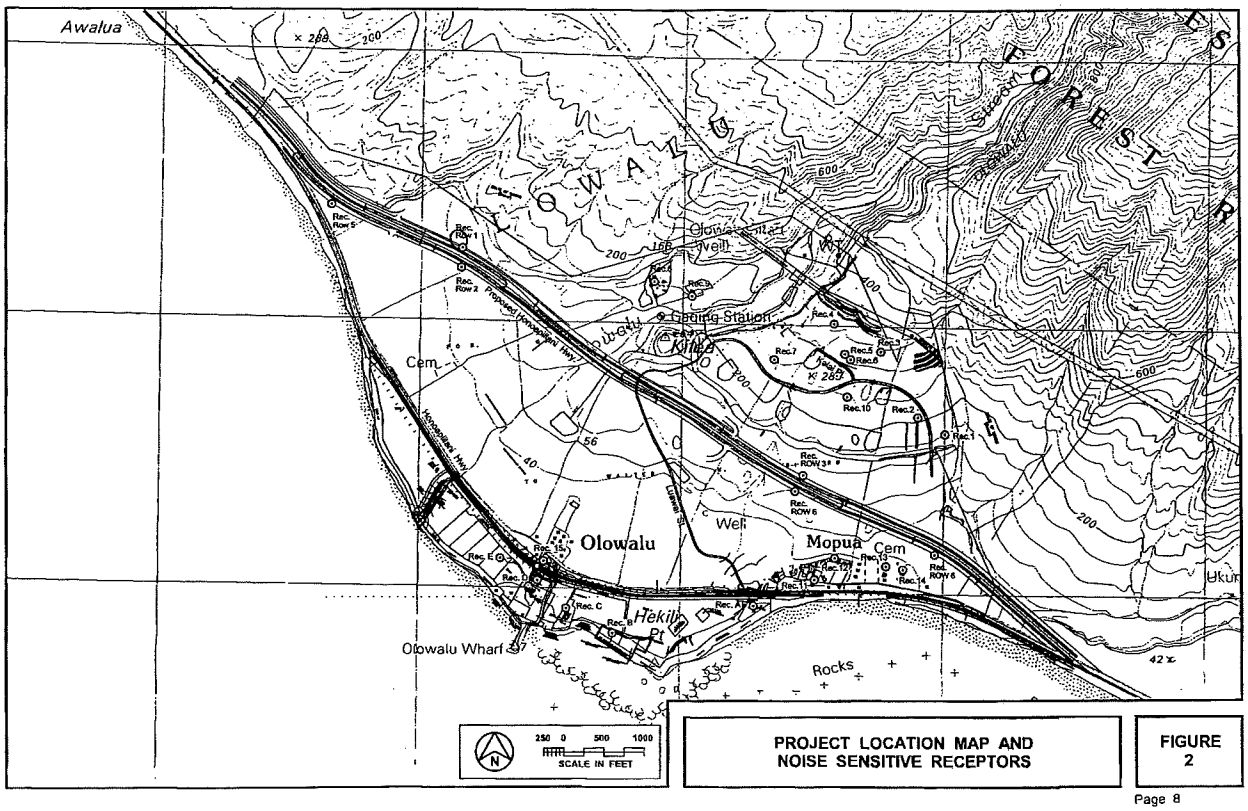
	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A	At east end of Luawai Street (7/10/11)	0944 TO 1014	N/A	N/A	N/A	N/A	42.2	N/A
B	At west end of Kalai Place (7/10/11)	1032 TO 1102	N/A	N/A	N/A	N/A	38.0	N/A
C	60 FT from the center-line of Honoapiilani Highway (7/11/11)	0645 TO 0745	55	1,330	40	19	71.7	70.2
D	50 FT from the center-line of Honoapiilani Highway (7/11/11)	0755 TO 0855	47	1,261	34	38	70.4	70.4
C	60 FT from the center-line of Honoapiilani Highway (7/11/11)	1132 TO 1232	55	1,472	45	20	70.8	70.7
E	110 FT from the center-line of Honoapiilani Highway (7/11/11)	1132 TO 1232	55	1,472	45	20	60.0	60.4

TABLE 1 (CONTINUED)
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
F	400 FT from the center-line of Honoapiilani Highway (7/11/11)	1241 TO 1311	N/A	N/A	N/A	N/A	49.1	N/A
E	110 FT from the center-line of Honoapiilani Highway (7/11/11)	1241 TO 1311	N/A	N/A	N/A	N/A	60.7	N/A
A	At east end of Luawai Street (7/11/11)	1321 TO 1351	N/A	N/A	N/A	N/A	44.6	N/A
E	110 FT from the center-line of Honoapiilani Highway (7/11/11)	1321 TO 1351	N/A	N/A	N/A	N/A	60.7	N/A
B	At west end of Kalai Place (7/11/11)	1355 TO 1425	N/A	N/A	N/A	N/A	38.4	N/A
E	110 FT from the center-line of Honoapiilani Highway (7/11/11)	1355 TO 1425	N/A	N/A	N/A	N/A	60.1	N/A

TABLE 1 (CONTINUED)
TRAFFIC NOISE MEASUREMENT RESULTS

	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
D	50 FT from the center-line of Honoapiilani Highway (7/11/11)	1435 TO 1535	42	1,463	25	22	69.0	69.0
C	60 FT from the center-line of Honoapiilani Highway (7/11/11)	1616 TO 1716	47	1,900	28	8	69.1	69.1
E	110 FT from the center-line of Honoapiilani Highway (7/11/11)	1616 TO 1716	47	1,900	28	8	58.6	58.9



PROJECT LOCATION MAP AND NOISE SENSITIVE RECEPTORS

FIGURE 2

hour. However, measured traffic noise levels were actually higher by 1 to 3 dBA during the AM and midday peak hours than during the PM peak hour. This was due to the lower average vehicle speeds observed during the PM peak hour when traffic congestion was greatest. For the purposes of this study, the PM peak hour was used to model the period with the highest traffic noise levels using the average vehicle speeds provided in Reference 2. But in all evaluations of the existing and future traffic noise levels in respect to FHWA or HDOT noise mitigation thresholds, a 3 dBA margin of safety was applied to the calculated PM peak hour noise levels which were calculated using the traffic volumes and average vehicle speeds of Reference 2.

The Equivalent (or Average) Hourly Sound Level [Leq(h)] noise descriptor was used to calculate the Base Year and CY 2020 traffic noise levels as required by Reference 4. Aerial photo maps, tax maps, and project plans (where available) of the area were used to determine terrain, ground cover, and local shielding effects and distances from building structures, which were entered into the noise prediction model. Topographic maps of the areas far beyond the highway Rights-of-Way were not available, so receptor elevations were assumed to be equal to the ground elevations shown on the USGS topographic maps at locations closest to the study receptors. Using the measured traffic noise levels shown in Table 1 along Honoapiilani Highway, the average vehicle speeds were adjusted so as to achieve the best agreement between measured and predicted traffic noise levels using the traffic noise model. These derived average speeds shown in Table 1 were compared to those provided in Reference 2 for the Base Year, and the differences were noted.

For noise modeling of the existing and the future traffic noise levels, the average vehicle speeds contained in Reference 2 were used in conjunction with the PM peak hour traffic volumes in Reference 2 (and reproduced in Appendix C). Because the highest hourly noise level may occur during free-flow traffic conditions at hours other than during the PM peak hour, it is possible that the predictions of traffic noise levels during the PM peak hour may be underestimating the worst case hourly traffic noise level by at least 3 dBA. For this reason, a 3 dBA margin of safety was applied to the PM peak hour noise levels which were calculated using the average vehicle speeds of Reference 2.

Future year (2020) traffic noise levels were calculated at receptor locations shown in Figure 2 for the No Build and Build (roadway realignment) Alternatives using the future traffic assignments and average vehicle speeds of Reference 2. Forecast mixes of vehicle types were assumed to be identical for both existing and future traffic, with 96.0% automobiles, 2.0% medium trucks, 2.0% heavy trucks and buses. Assumed average vehicle speeds for Year 2020 were assumed to be lower than their Base Year values for the No Build Alternative (from Reference 2), and in accordance with estimates provided in Reference 2 for the Build Alternative along the new highway. Future traffic conditions along the existing highway under the No Build Alternative are expected to worsen, with average vehicle speeds declining as a result of increased congestion.

Impact Assessments and Mitigation. Following the calculation of the future traffic noise levels, evaluations of the future traffic noise levels and impacts at noise sensitive receptor locations along Honoapiilani Highway and in the land areas at higher elevations east of the existing highway within the limits of construction were made. Comparisons of predicted future traffic noise levels with FHWA and HDOT noise abatement criteria (see Table 2) were made to determine specific locations where the noise abatement criteria are expected to be exceeded.

The HDOT 66 Leq(h) noise abatement threshold criteria and the HDOT "greater than 15 dB increase" criteria were applied to all noise sensitive buildings along the project corridor. By Reference 5, the HDOT has replaced the FHWA 67 Leq(h) criteria with their 66 Leq(h) criteria. The HDOT 71 Leq(h) noise abatement threshold criteria and the HDOT "greater than 15 dB increase" criteria were applied to all commercial buildings along the project corridor. Along the project corridor, the locations of the 66 and 71 Leq(h) traffic noise contours, without the benefit of shielding from natural terrain or man-made sound barriers, were also used to identify noise sensitive and commercial receptor locations, respectively, where the HDOT's noise abatement criteria would not be exceeded, and which would not require more detailed evaluations. In addition, the HDOT's criteria of "greater than 15 dB increase above existing background noise levels" was also used as a noise abatement criteria for this project (from Reference 5).

Where noise mitigation measures were indicated for this project, the effectiveness of sound attenuating barriers and other possible noise mitigation measures were evaluated. The ability to meet the HDOT criteria of 7 dBA noise reduction was also examined for various noise barrier heights. Because the new highway plans and profiles obtained from Reference 6 were preliminary and subject to future refinement, the results of the noise mitigation analysis and conclusions were also subject to future modifications. However, the initial results indicated that noise mitigation measures may only be required for future noise sensitive receptors under the Action Alternative.

The noise barriers which would be required to meet the HDOT's 7 dBA noise reduction criteria were then examined in respect to potential cost per benefited residence. By HDOT policy (Reference 5), the sound attenuation walls were considered "reasonable and feasible" if their costs did not exceed $60,000 per benefited residence. For CMU walls, a cost of $39.00 per square foot was used to develop the cost estimates for the sound attenuation walls. For rock walls, a cost of $35.00 per square foot was used to develop the cost estimates for sound attenuating walls which are located on top of existing rock walls. Walls whose estimated cost exceeded $60,000 per benefited residence were identified for possible exclusion from the highway realignment project. This task was not completed because noise barriers should not be required for existing noise sensitive receptors, but may be examined in respect to future noise sensitive receptors.

Because the Olowalu Town Development plan includes proposed development

TABLE 2

FHWA & HDOT NOISE ABATEMENT CRITERIA
[Hourly A–Weighted Sound Level– –Decibels (dBA)]

ACTIVITY CATEGORY	LEQ (h) (Note 2)	DESCRIPTION OF ACTIVITY CATEGORY
A	57 (Exterior)	Lands on which serenity and quiet are of extra–ordinary significance and serve an important public need and where the preservation of those qualities is essential if the areas are to continue to serve their intended purpose.
B (Note 1)	67 (Exterior)	Residential.
C (Note 1)	67 (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or non profit institutional structures, radio studios, recording studios, schools, and television studios.
E (Note 1)	72 (Exterior)	Hotels, motels, offices, restaurants/bars, and other develped lands, properties or activities not included in A–D or F.
F	------	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	------	Undeveloped lands that are not permitted.

Notes:
1. Includes undeveloped lands permitted for this activity category.
2. The Hawaii State Department of Transportation, Highways Division, utilizes Leq criteria levels which are 1 Leq unit less than the FHWA values shown.

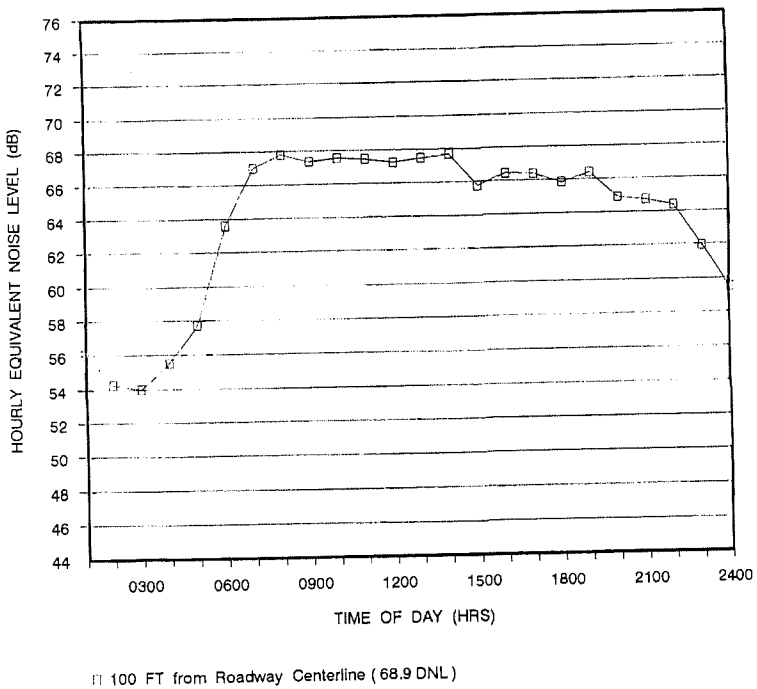
of noise sensitive properties along the new highway alignment, the potential for future traffic noise levels exceeding the Federal Housing Administration, Housing and Urban Development (FHA/HUD) noise standard was also examined. For the purposes of determining noise acceptability for funding assistance from federal agencies, an exterior noise level of 65 DNL (Day-Night Average Sound Level) or lower is considered acceptable. The DNL noise metric incorporates a 24-hour average of instantaneous A-Weighted sound levels as read on a standard Sound Level Meter. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL. In Appendix B, the Ldn symbol is used in place of the DNL descriptor symbol.

The relationship between the peak hour Leq and DNL were derived from the hourly traffic volumes along Honoapiilani Highway of Reference 3. The hourly noise levels and DNL at 100 FT setback distance from the highway were calculated as shown in Figure 3. From Figure 3, it was concluded that the DNL was approximately 3 dB greater than the PM peak hour Leq when traffic congestion is present during the PM peak hour.

Evaluations of potential airborne noise and ground vibrations from blasting operations to break and/or dislodge rock during construction were also performed. Predictions of expected airborne and ground vibration levels were performed at the closest residential areas in the project environs. Comparisons between predicted levels with current blast noise and vibration criteria and standards were also performed. Potential airborne noise and vibration impacts from blasting operations during construction were then evaluated, and mitigation measures recommended as necessary.

FIGURE 3

HOURLY VARIATIONS OF TRAFFIC NOISE AT 100 FT SETBACK DISTANCE FROM THE CENTERLINE OF HONOAPIILANI HIGHWAY NEAR UKUMEHAME BEACH PARK (STA. B74003001089; MAY 20, 2009)



CHAPTER III. EXISTING ACOUSTICAL ENVIRONMENT

For the purposes of this study, 2011 was used as the Base Year for calculating changes in traffic noise levels associated with the future No Build and Build Alternatives. The Base Year noise environment along the project corridor was described by calculating the Hourly Equivalent Sound Level [Leq(h)] along the existing roadway during the PM peak traffic hour for the 2011 time period. The hourly sound level, expressed in decibels, represents the average level of traffic noise along the project roadway during the PM peak hour of the study's Base Year.

Table 3 presents the traffic volume, speed, and mix assumptions used to calculate the Base Year noise levels during the PM peak hour along the existing Honoapiilani Highway. Shown in Table 3 are the calculated peak hour Leq(h)'s at reference distances of 50, 100, and 200 FT from the geometrical center of the inbound and outbound lanes of the highway. The calculated distances to the 66 and 71 Leq noise contour lines under unobstructed, line-of-sight conditions to the roadway are shown in Table 4A for the PM peak hour. The actual distances to the contour lines will generally be less than indicated in Table 4A when intervening structures or terrain obstructions exist between the roadway and a receptor. This reduction (or shrinkage) of the traffic noise contour distances from the roadway's centerline is the result of noise shielding (or attenuation) effects caused by the intervening structures or terrain features (such as highway cuts).

By using the traffic noise data shown in Tables 3, 4A, and 4B and aerial photo maps of the existing improvements on the west (makai) and east (mauka) sides of the project corridor, the relationship of the existing free-field traffic noise contours to existing noise sensitive dwellings and commercial buildings in the project area were obtained. Table 4B was also included to depict the existing setback distances to the 65 DNL and 75 DNL contours.

Table 5 presents the Base Year traffic noise levels at the various noise sensitive structures on both sides of the existing Rights-of-Way. The relationships of these receptor locations to the existing highway are shown in Figure 2. The existing traffic noise levels could possibly exceed the 66 Leq criteria at 2 single family structures (Receivers 15 and A) within the limits of project construction during the off-peak or AM peak hour, when traffic noise levels may be as much as 3 dBA higher than the 64.3 dBA values shown at Receivers 15 and A for the PM peak hour. From Table 4A, existing traffic noise levels could exceed the HDOT 66 Leq criteria at any residence located within 93 feet from the centerline of the highway. During the off-peak or AM peak hour, the HDOT 66 Leq criteria could be exceeded at 131 feet setback distance from the centerline of the existing highway. Existing traffic noise levels do not exceed the 71 Leq criteria for commercial properties at the Olowalu General Store.

Existing residences mauka of the existing highway at the east end of the project presently experience traffic noise levels between 53 and 61 dBA during the PM peak hour, and between 56 and 64 dBA during the off-peak and AM peak hour, and are

TABLE 3

EXISTING (CY 2011) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS SECTIONS OF HONOAPILLANI HIGHWAY (PM PEAK HOUR)

LOCATION	SPEED (MPH)	TOTAL VPH	******** VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
West End of Olowalu Town *	44	1,776	1,704	36	36	69.8	64.3	58.4
At Olowalu Grocery Store **	41	1,785	1,713	36	36	69.0	63.0	58.2
East End of Olowalu Town ***	48	1,787	1,715	36	36	70.9	65.4	59.3

Notes:

1. * 43 mph westbound; 45 mph eastbound
2. ** 45 mph westbound; 37mph eastbound
3. ** 50 mph westbound; 46 mph eastbound
4. All distances shown are from the center of Honoapiilani Highway.
5. Calculated Leq's are for unobstructed line-of-sight conditions.
6. The calculated Leq's for the AM and mid-day peak hours may be as much as 3 dBA higher than the values shown for the PM peak hour.

TABLE 4A

YEAR 2011 AND 2020 DISTANCES TO 66 AND 71 LEQ CONTOURS (NO ACTION, PM PEAK HOUR)

STREET SECTION	66 Leq SETBACK (FT) EXISTING	66 Leq SETBACK (FT) CY 2020	71 Leq SETBACK (FT) EXISTING	71 Leq SETBACK (FT) CY 2020
West End of Olowalu Town	81	79	43	42
At Olowalu Grocery Store	71	71	40	40
East End of Olowalu Town	93	73	49	39

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLES 3 and 6 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.
(4) Loose soil conditions assumed along all roadways.

TABLE 4B

YEAR 2011 AND 2020 DISTANCES TO 65 AND 75 DNL CONTOURS (NO ACTION, DNL)

STREET SECTION	65 DNL SETBACK (FT) EXISTING	65 DNL SETBACK (FT) CY 2020	75 DNL SETBACK (FT) EXISTING	75 DNL SETBACK (FT) CY 2020
West End of Olowalu Town	131	129	38	37
At Olowalu Grocery Store	116	116	35	36
East End of Olowalu Town	147	121	44	34

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLES 3 and 6 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.
(4) Loose soil conditions assumed along all roadways.

TABLE 5

EXISTING AND FUTURE TRAFFIC NOISE LEVELS WITHOUT AND WITH THE PROPOSED PROJECT (4.92 FT RECEPTOR, PM PEAK HOUR)

RECEPTOR LOCATION		EXISTING (CY 2011) Leq	FUTURE (CY 2020) Leq NO BUILD / (CHANGE)	BUILD / (CHANGE)
HONOAPIILANI HIGHWAY (MAUKA):				
TMK 4-8-03:010	(Rec. 1)	39.3	39.0 /-0.3	43.5 /4.2
TMK 4-8-03:096	(Rec. 2)	39.0	38.7 /-0.3	43.4 /4.4
TMK 4-8-03:087	(Rec. 3)	37.3	37.2 /-0.1	41.1 /3.8
TMK 4-8-03:089	(Rec. 4)	37.0	36.9 /-0.1	41.1 /4.1
TMK 4-8-03:088a	(Rec. 5)	37.6	37.5 /-0.1	42.1 /4.5
TMK 4-8-03:088b	(Rec. 6)	37.7	37.6 /-0.1	42.3 /4.6
TMK 4-8-03:091	(Rec. 7)	38.2	38.1 /-0.1	45.1 /6.9
TMK 4-8-03:011	(Rec. 8)	37.7	37.7 /0.0	44.9 /7.2
TMK 4-8-03:012	(Rec. 9)	37.5	37.6 /0.1	44.0 /6.5
TMK 4-8-03:094	(Rec. 10)	38.8	38.6 /-0.2	44.7 /5.9
TMK 4-8-04:004	(Rec. 11)	60.7	59.2 /-1.5	44.6 /-16.1
TMK 4-8-04:003	(Rec. 12)	52.5	51.5 /-1.0	46.8 /-5.7
TMK 4-8-03:018a	(Rec. 13)	54.4	53.2 /-1.2	49.9 /-4.5
TMK 4-8-03:018b	(Rec. 14)	54.9	53.7 /-1.2	51.0 /-3.9
TMK 4-8-03:031	(Rec. 15)	64.3 *	64.4 /0.1 *	38.5 /-25.8
HONOAPIILANI HIGHWAY (MAKAI):				
TMK 4-8-03:002	(Rec. A)	64.3 *	62.6 /-1.7	41.1 /-23.2
TMK 4-8-03:045	(Rec. B)	50.7	50.6 /-0.1	37.5 /-13.2
TMK 4-8-03:044	(Rec. C)	54.1	54.2 /0.1	37.6 /-16.5
TMK 4-8-03:084	(Rec. D)	60.1	60.2 /0.1	37.9 /-22.2
TMK 4-8-03:122	(Rec. E)	58.0	58.1 /0.1	37.9 /-20.1
NEW HONOAPIILANI HIGHWAY:				
ROW 1	(Rec. ROW 1)	41.7	41.9 0.2	65.9 24.2
ROW 2	(Rec. ROW 2)	42.4	42.5 0.1	64.6 22.2
ROW 3	(Rec. ROW 3)	42.5	42.1 -0.4	65.6 23.1
ROW 4	(Rec. ROW 4)	43.6	43.2 -0.4	51.8 8.2
ROW 5	(Rec. ROW 5)	57.9	57.8 -0.1	65.2 7.3
ROW 6	(Rec. ROW 6)	49.9	49.0 -0.9	62.5 12.6

Note:

* Traffic noise levels shown may exceed 66 Leq noise abatement criteria for Activity Category B during off-peak or AM peak hours when traffic noise levels may be 3 dBA higher than the PM peak hour values shown in the table.

within the HDOT 66 Leq noise abatement criteria. The existing residence west of the Olowalu General Store building (Receiver 15) currently experiences traffic noise levels of 64 dBA during the PM peak hour, and as high as 67 dBA during the off-peak or AM peak hour. These levels could exceed the HDOT 66 Leq noise abatement criteria for residences during the off-peak or AM peak hour.

The existing residence on the makai side of the highway at the Luawai Street intersection (Receiver A) currently experiences traffic noise levels of 64 dBA during the PM peak hour, and as high as 67 dBA during the off-peak or AM peak hour. These levels could exceed the HDOT 66 Leq noise abatement criteria for residences during the off-peak or AM peak hour.

At areas removed from Honoapiilani Highway (such as the residences mauka of the highway and near Luawai Street), existing traffic and background noise levels are typically greater than 35 dBA and less than 45 dBA. At these locations which are removed from the existing highway, other non-traffic noise sources (birds, local traffic, distant construction or yard maintenance equipment, and foliage moving with the wind) also were contributors to the total background noise levels.

CHAPTER IV. DESCRIPTION OF FUTURE TRAFFIC NOISE LEVELS

Under the Build Alternative, realignment of Honoapiilani Highway is proposed as shown in Figure 1. Figure 2 presents the noise sensitive receptor (or receiver) locations where future traffic noise levels were calculated for the No Build and Build Alternatives using the FHWA Traffic Noise Model.

The future traffic noise levels in the project area during CY 2020 were evaluated for the No Build and Build Alternatives. The same methodology that was used to calculate the Base Year noise levels was also used to calculate the Year 2020 noise levels. Under the No Build Alternative, it was assumed that the existing Honoapiilani Highway would remain, and carry higher traffic volumes at reduced average speeds. Under the Build Alternative, the existing highway would be replaced by a new mauka alignment which would carry even higher traffic volumes at reduced average speeds. Under both the No Build and Build Alternatives, vehicle mixes were assumed to be identical to the Base Year values.

Tables 5, 6, and 7A summarize the traffic conditions, noise levels, and setback distances for the Build Alternative during the PM peak hour in CY 2020. The predicted CY 2020 traffic noise levels during the PM peak hour at the various receptor locations are shown in Table 5 for the No Build and Build Alternatives. Table 5 also indicates the increases in future traffic noise levels expected under the No Build and Build Alternatives prior to the inclusion of sound attenuation walls. Under the No Build Alternative, relatively small increases and decreases in traffic noise levels are expected to occur throughout the project area. As indicated in Table 5, the increases and decreases in future traffic noise levels under the Build Alternative vary in relationship to the receptors' proximity to the existing and proposed highway alignment. Future traffic noise levels at receptors in the immediate vicinity of the existing highway are predicted to decrease by approximately 4 to 26 dBA between CY 2011 and CY 2020 as a result of new highway alignment under the Build Alternative. Future traffic noise levels at existing receptors closer to the proposed highway realignment are predicted to increase by approximately 4 to 7 dBA between CY 2011 and CY 2020 as a result of new highway alignment under the Build Alternative. Under both the No Build or Build Alternatives, no existing residence is predicted to experience traffic noise levels above the HDOT 66 Leq noise abatement criteria by CY 2020.

Tables 4A and 4B depict the changes in setback distances from the existing highway centerline to the critical 66 Leq, 71 Leq, 65 DNL, and 75 DNL contours under the No Build Alternative. Tables 7A and 7B depict the predicted setback distances to the critical 66 Leq, 71 Leq, 65 DNL, and 75 DNL contours from the future highway centerline under the Build Alternative.

Table 6 contains the results of calculations of future traffic noise levels at 50, 100, and 200 feet from centerline of the proposed new highway alignment. It should be noted that the traffic noise levels shown in Table 6 may be as much as 3 dBA higher

TABLE 6

FUTURE (CY 2020) TRAFFIC VOLUMES AND NOISE LEVELS ALONG VARIOUS SECTIONS OF NEW HONOAPIILANI HIGHWAY (PM PEAK HOUR; UNDER BUILD ALTERNATIVE)

LOCATION	SPEED (MPH)	TOTAL VPH	******** VOLUMES (VPH) ********** AUTOS	M TRUCKS	H TRUCKS	50' Leq	100' Leq	200' Leq
West End of Olowalu Town *	40	2,381	2,285	48	48	73.4	65.8	59.0
At O-Turn Project Access 1 **	36	2,383	2,287	48	48	72.2	64.6	58.1
At O-Turn Project Access 2 ***	33	2,331	2,237	47	47	71.2	63.7	57.2
East End of Olowalu Town ****	37	2,282	2,190	46	46	72.4	64.8	58.1

Notes:

1. * 38 mph westbound; 41 mph eastbound
2. ** 37 mph westbound; 35 mph eastbound
3. *** 38 mph westbound; 28 mph eastbound
4. **** 38 mph westbound; 35 mph eastbound
5. All distances shown are from the center of Honoapiilani Highway.
6. Calculated Leq's are for unobstructed line-of-sight conditions.
7. The calculated Leq's for the AM and mid-day peak hours may be as much as 3 dBA higher than the values shown for the PM peak hour.

TABLE 7A
YEAR 2011 AND 2020 DISTANCES TO 66 AND 71 LEQ CONTOURS (ACTION, PM PEAK HOUR)

STREET SECTION	66 Leq SETBACK (FT) EXISTING	66 Leq SETBACK (FT) CY 2020	71 Leq SETBACK (FT) EXISTING	71 Leq SETBACK (FT) CY 2020
West End of Olowalu Town *	N/A	98	N/A	62
At O-Turn Project Access 1 **	N/A	88	N/A	56
At O-Turn Project Access 2 ***	N/A	81	N/A	51
East End of Olowalu Town ****	N/A	90	N/A	57

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 6 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.
(4) Loose soil conditions assumed along all roadways.

TABLE 7B

YEAR 2011 AND 2020 DISTANCES TO 65 AND 75 DNL CONTOURS (ACTION, DNL)

STREET SECTION	65 DNL SETBACK (FT) EXISTING	65 DNL SETBACK (FT) CY 2020	75 DNL SETBACK (FT) EXISTING	75 DNL SETBACK (FT) CY 2020
West End of Olowalu Town *	N/A	147	N/A	57
At O-Turn Project Access 1 **	N/A	132	N/A	51
At O-Turn Project Access 2 ***	N/A	120	N/A	46
East End of Olowalu Town ****	N/A	134	N/A	52

Notes:

(1) All setback distances are from the roadways' centerlines.
(2) See TABLE 6 for traffic volume, speed, and mix assumptions.
(3) Setback distances are for unobstructed line-of-sight conditions.
(4) Loose soil conditions assumed along all roadways.

during the off peak or AM peak hours, when average traffic speeds may be higher than those shown in the table for the PM peak hour. Based on the results contained in Table 6, it was concluded that the HDOT 66 Leq noise abatement criteria would not be exceeded during the PM peak hour in CY 2020 beyond the 200 foot wide Right-of-Way, but that the HDOT 66 Leq noise abatement criteria could be exceeded beyond the 200 foot wide Right-of-Way during the off-peak or AM peak hour (after adding 3 dBA to the results in Table 6).

Table 7A contains the setback distances of the 66 and 71 Leq traffic noise contours from the centerline of the proposed new highway during the PM peak hour. Both the 66 and 71 Leq contours are not predicted to be outside the new highway's Rights-of-Way during the PM peak hour, but may be located outside the Rights-of-Way during the off-peak or AM peak hours. The locations of the 66 Leq contour under these worst case conditions range from 108 feet to 133 feet from the new highway's centerline. So noise buffer distances of 108 to 133 feet from the new highway's centerline will be required for any noise sensitive land use or park land if other noise mitigation measures are not included in the project. The 71 Leq traffic noise contour should not extend beyond the new highway's Rights-of-Way during the PM, off-peak, or AM peak hours, so other less sensitive land uses (such as commercial) located near the new highway alignment should not require traffic noise mitigation measures.

The existing residence west of the Olowalu General Store building is predicted to experience future traffic noise levels of 64 dBA during the PM peak hour, and as high as 67 dBA during the off-peak or AM peak hour under the No Build Alternative. These levels exceed the HDOT 66 Leq noise abatement criteria for residences during the off-peak or AM peak hour. This is the only existing residence where future traffic noise levels are predicted to exceed 66 Leq under the No Build Alternative. Under the Build Alternative, no existing residence is predicted to experience traffic noise levels which exceed 66 Leq during the PM, off-peak, or AM peak hours.

The 71 Leq criteria for commercial properties will not be exceeded at existing or future commercial properties under the No Build or Build Alternatives by CY 2020.

The following general conclusions can be made in respect to the impacted structures and lands which can be expected by CY 2020 under the Build Alternative. These conclusions are valid as long as the future vehicle mixes and average speeds do not differ from the assumed values.

- The HDOT's ">15 dB increase" criteria for substantial change in traffic noise levels will not be exceeded at any existing noise sensitive structure. Maximum increases in traffic noise levels in the project area should not exceed 7.0 dB as a result of growth in traffic volumes and realignment of the highway.

- Under the No Build Alternative, future traffic noise levels during the PM peak hour are expected to decrease or increase slightly at existing single family dwellings on both sides of the highway. Traffic noise levels at the existing

dwelling next to Olowalu General Store may continue to exceed the 66 Leq criteria under the No Build Alternative.

- Future traffic noise levels should not exceed the 71 Leq criteria for commercial structures under the No Build or Build Alternatives along the existing or new highway.

- Under the Build Alternative, the 66 Leq noise mitigation criteria may be exceeded along the new highway if adequate setback distances are not provided for future residences, public use structures, or park lands. These setback distances may range from 108 to 147 feet from the new highway centerline, and may be reduced if sound attenuating walls are constructed along the future highway Rights-of-Way.

CHAPTER V. POSSIBLE NOISE MITIGATION MEASURES

Possible noise mitigation measures considered included the following:

A. Restricting the Growth In the Number of Noisy Buses, Heavy Trucks, Motorcycles, and Automobiles with Defective Mufflers. The percentage contribution to the total traffic noise by heavy trucks, buses, and noisy vehicles is currently less than 30 percent, and elimination of these noise sources would reduce total traffic noise levels by less than 2.0 Leq(h) units. Restricting the growth rate of these vehicles (to growth rates below passenger automobile growth rates) could produce noise reductions in the order of 0.1 to 1.0 dB, which are not considered significant for the level of regulatory efforts required.

B. Alteration of the Horizontal Or Vertical Alignment of the Roadway. This project involves the realignment of the eastbound and westbound lanes of the highway and involves major alterations to the vertical and horizontal alignments of Honoapiilani Highway at Olowalu. Existing noise sensitive receptors which are located along the existing highway alignment will benefit from reductions in traffic noise levels of 4 to 26 dBA due to increased distances between their locations and the highway. Existing noise sensitive receptors located north of the existing highway will experience increased traffic noise levels ranging from 4 to 7 dBA due to the shortened distances between their locations and the highway. Increases in future traffic noise levels should not exceed the HDOT's ">15 dB increase" criteria for substantial change in traffic noise levels.

C. Acquisition of Property Rights for Construction of Noise Barriers, and/or Construction of Noise Barriers Along the Right-of-Way. For single story, noise sensitive buildings, construction of a sound attenuating wall is normally the preferred noise mitigation measure. The 5 to 7 dB of noise attenuation achievable with a 6 FT high wall is normally sufficient for single story structures. Because of the higher sloping terrain on the north side of the proposed highway, wall heights may need to be higher due to the elevated structures. In addition, the upper floors of those structures will not benefit from sound attenuation walls which are 6 to 8 feet high. Wall heights in excess of 8 feet above ground level along the Rights-of-Way will be required to attenuate traffic noise at the upper floor spaces. It should also be noted that the sound barrier will block the views to the roadway which some of the residents may enjoy. For this reason, concurrence from the affected homeowners should be obtained prior to construction of a sound barrier as a noise mitigation measure.

D. Acquisition of Real Property Interests To Serve As A Noise Buffer Zone. Because the highway realignment is part of a Master Plan for Olowalu Town, the allocation of lands for noise buffer zones along the new highway will be considered in the planning for the entire project. For this reason, acquisition of developed lands along the existing highway for noise buffers is not required.

E. Noise Insulation of Public Use or Nonprofit Institutional Structures. It is anticipated that no public use structures should require noise insulation as a result of the proposed highway realignment.

CHAPTER VI. FUTURE TRAFFIC NOISE IMPACTS AND POSSIBLE NOISE MITIGATION MEASURES

Future traffic noise levels are not expected to exceed the HDOT 66 Leq(h) noise abatement criteria by CY 2020 under the Build Alternative at existing noise sensitive structures on both sides of the new highway. Adequate margins of 3 dBA or more exist between the HDOT 66 Leq noise abatement criteria and the predicted future noise levels at these existing noise sensitive structures. Therefore, additional sound attenuation measures should not be required to mitigate future traffic noise impacts at existing noise sensitive receptors.

At planned residences, parks, and other noise sensitive land uses along the proposed highway alignment, future traffic noise levels may exceed the HDOT 66 Leq criteria. Possible noise mitigation measures include: increasing the Rights-of-Way widths along the new highway from 200 feet to as much as 294 feet at noise sensitive receptor locations; including additional buffer distances of 20 to 47 feet between the Rights-of-Way and the noise sensitive structure or exterior area of frequent human use; or adding sound attenuating walls along the makai and mauka Rights-of-Way or Tops of Fill or tops of retaining walls fronting noise sensitive lots. Because the project's grading plans and detailed highway sections were not available, it was not possible to determine the top wall elevations which are required to comply with the minimum 7 dB attenuation criteria of HDOT for ground level receptors. So, if adequate setback distances (see following paragraph) of the noise sensitive structures are not possible, the project plans should include sound attenuating walls along the mauka (north) Right-of-Way, and along the top of fill along the makai (south Right-of-Way.

The adequate setback distances from future highway centerline to meet the HDOT 66 Leq criteria are as follows: a. 133 feet west of Project Access 1; b. 119 feet between Access 1 and Access 2; c. 108 feet between Access 2 and Access 3; and d. 120 feet east of Project Access 3. These setback distances should be adequate to allow for a 3 dBA increase in the peak hour noise levels.

The adequate setback distances from the future highway centerline to meet the FHA/HUD 65 DNL standard are as follows: a. 147 feet west of Project Access 1; b. 132 feet between Access 1 and Access 2; c. 120 feet between Access 2 and Access 3; and d. 134 feet east of Project Access 3.

Where required sound attenuating wall heights exceed 6 feet, a variance from local building codes may be required to construct the taller walls which may be required to achieve at least 7 dBA of noise reduction. By the existing HDOT policy (see Reference 5), an acceptable noise mitigation measure is one which provides at least 7 dBA of sound attenuation. In order to achieve this performance, the wall height must meet the minimum height requirement, the sound attenuating walls must be continuous without see-through openings, and must be constructed from solid materials which have a minimum surface weight of 5 pounds per square foot. Use of landscaping on the

a minimum surface weight of 5 pounds per square foot. Use of landscaping on the roadway side of the wall is also recommended to soften the visual impacts of the walls and to minimize the potential for graffiti.

By the existing HDOT policy (see Reference 5), if the cost of the sound attenuating wall does not exceed $60,000 per benefited residence, construction of walls can be considered to be reasonable and feasible.

It is anticipated that potential noise impacts at any new noise sensitive or commercial establishments located in the project area may be mitigated through the inclusion of sound walls or other noise mitigation measures (such as closure and air conditioning) within the individual lot development plans. In addition, any new commercial establishments, public use facilities, or housing units which may be planned alongside the roadway represent areas of potential adverse noise impacts if adequate noise mitigation measures are not incorporated into the planning of these future projects. It is anticipated that the project's roadway improvements will be completed prior to any redevelopment of the presently open areas adjacent to the roadway, and that noise abatement measures such as adequate setbacks, sound attenuating walls or berms, or closure and air conditioning will be incorporated into these new developments along the roadway as required. In any event, new structures whose building permits were obtained after the date of this noise study will not qualify for noise abatement measures under existing HDOT procedures.

CHAPTER VII. CONSTRUCTION NOISE IMPACTS

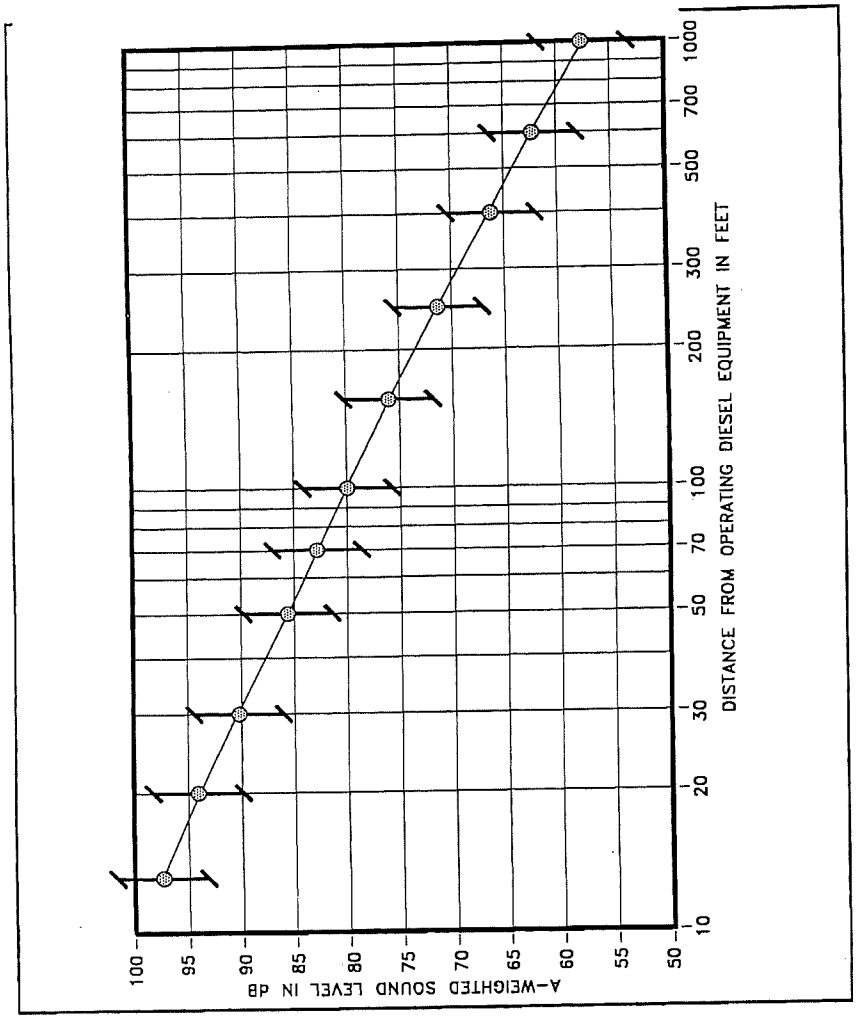
General Construction. Short-term noise impacts associated with construction activities along the existing highway may occur. These impacts can occur as a result of the relatively low background noise levels at existing dwelling units closest to the anticipated construction corridor. The total duration of the construction period for the proposed project is not known, but noise exposure from construction activities at any one receptor location is not expected to be continuous during the total construction period.

Noise levels of diesel powered construction equipment typically range from 80 to 90 dBA at 50 FT distance. Typical levels of noise from construction activity (excluding pile driving activity) are shown in Figure 4. The maximum impulsive noise levels of rock breaking equipment (such as hoe rams) can be 5 to 8 dBA greater than those shown in Figure 4. Adverse impacts from construction noise are not expected to be in the "public health and welfare" category due to the temporary nature of the work and due to the administrative controls available for its regulation. Instead, these impacts will probably be limited to the temporary degradation of the quality of the acoustic environment in the immediate vicinity of the project site.

Construction noise levels at existing structures can intermittently exceed 75 dBA when work is being performed within 300 feet of these structures. Along the new highway Rights-of-Way, distances between the construction sites and receptors are expected to be between 300 and 2000 FT, and construction noise levels may intermittently exceed 75 dBA. The State Department of Health currently regulates noise from construction activities under a permit system (Reference 7). Under current permit procedures (see Figure 5), noisy construction activities are restricted to hours between 7:00 AM and 6:00 PM, from Monday through Friday, and exclude certain holidays. Noisy construction activities are normally restricted to the hours of 9:00 AM to 6:00 PM on Saturdays, with construction not permitted on Sundays. These restrictions minimize construction noise impacts on noise sensitive receptors along the roadway project corridor, and have generally been successfully applied. In this way, construction noise impacts on noise sensitive receptors can be minimized.

In addition, the use of quieted portable engine generators and diesel equipment should be specified for use within 500 FT of noise sensitive properties. Heavy truck and equipment staging areas should also be located at areas which are at least 500 FT from noise sensitive properties whenever possible. Truck routes which avoid residential communities should be identified wherever possible. The use of 8 to 12 FT high construction noise barriers may also be used where close-in construction work to noise sensitive structures is unavoidable.

Blasting. Blasting may be used to fragment and/or dislodge rock during the construction operations to reduce the time required to cut into the faces of the existing highway cuts. Nighttime or early morning blasting operations should not be required.



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 4

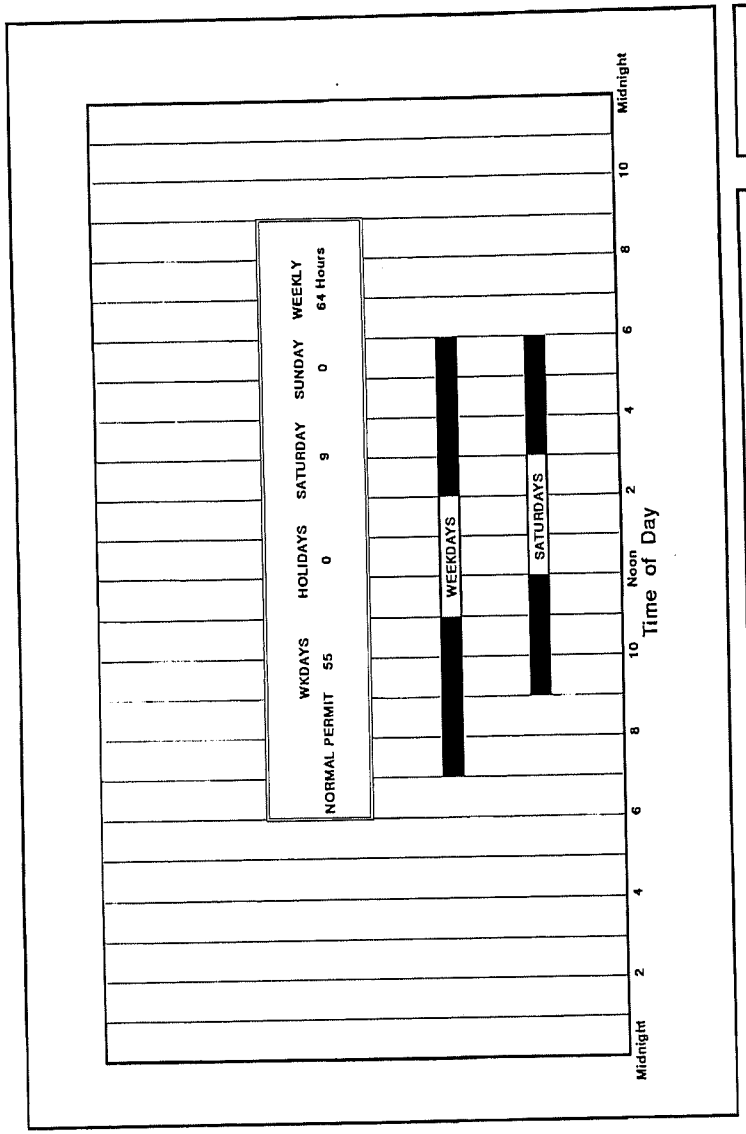


FIGURE 5

AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

Blast induced ground and air vibrations have the potential to startle or annoy surrounding residents, and to also cause damage to structures. However, when properly controlled, blasting operations at the proposed construction site need not pose significant risks of damage or annoyance to neighboring buildings or residents.

Airborne Noise from Blasting. The air blasts associated with blasting are concussion type, low frequency vibrations, which are of relatively short duration (or impulsive) and generally described in terms of peak over pressure in psi, or in dBL. The dominant sources of the air blast are the Air Pressure Pulse, which is caused by the large displacement of the ground surface near the charge, and the Stemming Release Pulse, which is caused by gas pressure ejecting the stemming (fill) material from the hole bored for the explosive charge. The low frequency characteristic (usually referred to as bass sounds) of air blast noise tends to induce vibrations in structures (and subsequent complaint reactions) due to the low resonant frequency (10 to 25 Hz) of buildings. High frequency sounds of amplitudes equal to blast noise generally do not induce vibrations and cause physical damage to structures. Although the human ear has an opposite characteristic (i.e., the ear is less sensitive to low frequency sounds), structures which vibrate can produce secondary audible effects such as rattling sounds (of fixtures, doors, etc.), and effects which are sensitive to touch (or feelable). Sound levels at which these secondary effects occur vary with the weight (and probably stiffness) of the structure. In general, the inception point of sound induced vibration is difficult to establish, but may occur at levels as low as 80 dBL. These levels are significantly below the peak levels of 120 to 136 dBL which have been associated with low risk of damage to structures.

If blasting is used to break or dislodge rock, the charge weights per delay will be adjusted so as to eliminate any risk of damage to nearby structures. The levels of air blast are anticipated to be well below the structural damage criteria for buildings, so risks of window glass breakage from the blasting at the proposed project are considered to be very low. Since complaints resulting from air blast noise levels may occur at levels considerably below those necessary to cause damage to structures (120 to 136 dBL), additional analyses were conducted to estimate the percent of the neighboring population which may be highly annoyed by blasting operations. At air blast noise levels of 120 dBL, and with no more than five blasts per week, the average noise exposure levels from blasting operations are predicted to be 41 Lcdn, which is analogous to 41 Ldn except for the use of C-Weighting rather than A-Weighting filters. An exposure level of 41 Lcdn (or 41 Ldn) is very low, and less than 1.0 percent of the population exposed to this level are expected to be highly annoyed (see Reference 8). For these reasons, risks of adverse noise impacts from blasting operations of up to five blasts per week which are also controlled to avoid risks of damage to structures are considered to be very low.

Ground Vibration from Blasting. Ground vibrations, or seismic waves, are also generated during blasting operations, and are generally described in terms of peak particle velocity in inches/ second. Most of the seismic energy remains trapped in the ground, but some energy is released as an over pressure pulse into the air (or Rock

Pressure Pulse). In general, the ground vibrations as well as the airborne Rock Pressure Pulse are expected to be less intrusive than the Air Pressure and Stemming Release Pulses. As an example, tunneling work under Dole Street on Oahu for a sewer project generated some initial air blast complaints from nearby residents during blasting of the surface entrance to the tunnel. However, once the entrance to the tunnel was formed and blasting was confined to tunneling underground, complaints stopped.

Predictions of peak over pressure or ground vibration levels vs. scaled distance from the blast are not precise, with initial uncertainties for a given location in the order of 20 to 30 dBL. For this reason, it is standard practice to employ seismograph monitoring of air and ground vibrations during blasting operations with a 3-axis geophone (for ground vibrations) and a microphone (for air vibrations).

The separation distances between the potential blasting areas and surrounding noise sensitive neighbors range are relatively large and range from approximately 300 feet to 2,000 feet. At the shorter separation distances between the blast areas and surrounding noise sensitive neighbors, charge weights will probably be limited to less than three pounds of explosives per delay. At 2.75 pounds of explosives per delay, the predicted vibration levels at 300 feet separation distance are in the order of 0.04 to 0.20 inches per second. These predicted levels of ground vibration are encroaching into the thresholds for structural or architectural damage to buildings, and may be feelable (see TABLE 8). In addition, these levels are also encroaching into the 0.35 inches per second threshold recommended to minimize adverse human responses to vibrations resulting from sporadic impulsive shock excitations (see Reference 9). Based on these predictions of vibration levels from blasting operations, it was concluded that risks of adverse impacts from ground vibrations can be very low, but the sizes of the charge weights per delay will need to be controlled in order to minimize risks of damage to nearby structures.

Mitigation of Noise and Vibration Impacts from Blasting. Because blasts may be both feelable and audible at the surrounding residences, mitigation measures will probably be required to minimize risks of antagonizing nearby residents. These recommended mitigation measures are described as follows:

- Regularly monitor air blast and ground vibration levels simultaneously at the closest noise sensitive residence(s) or structure(s) during the blasting operations to develop the data base for the surrounding area.

- For initial blasts, prior to establishment of a data base of ground vibration and air blast levels vs. scaled distance, use the minimum practical charge weight (in equivalent pounds of TNT) per delay as well as the minimum practical number of delays (or bore holes).

- If practical, reduce maximum air blast levels to less than 110 dBL at the nearest noise sensitive residences in response to air blast complaints. Possible methods

TABLE 8

SUMMARY OF BUILDING DAMAGE CRITERIA

PEAK GROUND VELOCITY (mm/sec)	PEAK GROUND VELOCITY (in/sec)	COMMENT
193.04	7.6	Major damage to buildings (mean of data).
137.72	5.4	Minor damage to buildings (mean of data).
101.16	4.0	'Engineer structures' safe from damage.
50.8	2.0	Safe from damage limit (probability of damage <5%).
		No structural damage.
33.02	1.3	Threshold of risk of 'architectural' damage for houses.
25.4	1.0	No data showing damage to structures for vibration <1 in./sec.
15.24	0.6	No risk of 'architectural' damage to normal buildings.
10.16	0.4	Threshold of damage in older homes.
5.08	0.2	Statistically significant percentage of structures may experience minor damage (including earthquake, nuclear event, and blast data for old and new structures).
		No 'architectural' damage.
3.81	0.5 to 0.15	Upper limits for ruins and ancient monuments.
1.0	0.04	Vertical vibration clearly perceptible to humans.
0.32	0.01	Vertical vibration just perceptible to humans.

Source: 'State-of-the-Art Review: Prediction and Control of Groundborne Noise and Vibration from Rail Transit Trains'; U.S. Department of Transportation; December 1983.

of accomplishing this are: reducing charge sizes; increasing delay intervals; increasing hole depth; orienting bore holes to direct the Stemming Release Pulse away from noise sensitive properties; trucking in high quality stemming material to minimize stemming blowouts; and filling (sandbagging) over the area to be blasted and the detonating chord.

- Schedule actual blasting during the warm periods of the day to minimize the possibility of thermal ducting and focusing of air blast noise at large distances from the blast. If possible, also schedule blasting during fixed time periods, so that the members of the community can also schedule their activities accordingly.

- The most conservative vibration criteria for damage to "Ruins and Ancient Monuments" (see TABLE 8) is 0.15 inches per second. Initial test shots should be structured so as to not exceed this limit at the closest structures, with subsequent shots adjusted to reflect the results of the blast monitoring data.

APPENDIX A. REFERENCES

(1) "FHWA Highway Traffic Noise Model User's Guide;" FHWA-PD-96-009, Federal Highway Administration; Washington, D.C.; January 1998 and Version 2.5 Upgrade (April 14, 2004).

(2) Existing and Future Peak Hour Traffic Volumes along Honoapiilani Highway; July 5, 2011 email from Bill Frampton.

(3) Hourly Traffic Volumes On Honoapiilani Highway At Station B74003001089; Hawaii State Department of Transportation, Highways Division, Planning Branch; May 20, 2009.

(4) Federal Highway Administration; "Procedures for Abatement of Highway Traffic Noise and Construction Noise;" 23 CFR Chapter I, Subchapter H, Part 772;" April 1, 1995.

(5) "Highway Noise Policy and Abatement Guidelines;" Hawaii State Department of Transportation, Highways Division, and U.S. Department of Transportation, Federal Highway Administration; April 25, 2011.

(6) Preliminary Plans and Sections of Proposed Realignment of Honoapiilani Highway; May 11, 2011 email from Mark M. Matsuda, Otomo Engineering, Inc.

(7) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.

(8) "Method for Assessment of High-Energy Impulsive Sounds with Respect to Residential Communities;" American National Standard, ANSI S12.4; Acoustical Society of America.

(9) "Guide to the Evaluation of Human Exposure to Vibration in Buildings;" American National Standard, ANSI S2.71; Acoustical Society of America.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I

A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

TERM	SYMBOL
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) (1)	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

APPENDIX B (CONTINUED)

TABLE II

RECOMMENDED DESCRIPTOR LIST

TERM	A-WEIGHTING	ALTERNATIVE(1) A-WEIGHTING	OTHER(2) WEIGHTING	UNWEIGHTED
1. Sound (Pressure)(3) Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level (4) Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is Leq(1). Time may be specified in non-quantitative terms (e.g., could be specified as Leq(WASH) to mean the washing cycle noise for a washing machine.

APPENDIX C

SUMMARY OF BASE YEAR AND FUTURE YEAR TRAFFIC VOLUMES ALONG HONOAPIILANI HIGHWAY

ROADWAY LANES	**** CY 2011 *****		CY 2020 (NO BUILD)		CY 2020 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Along Existing Honoapiilani Highway:						
At Solid Waste Transfer Station (WB)	865	935	995	1,075	N/A	N/A
At Solid Waste Transfer Station (EB)	606	841	697	967	N/A	N/A
Two-Way	1,471	1,776	1,692	2,042	N/A	N/A
At Olowalu General Store (WB)	865	933	995	1,073	N/A	N/A
At Olowalu General Store (EB)	622	852	715	980	N/A	N/A
Two-Way	1,487	1,785	1,710	2,053	N/A	N/A
At Luawai Street (WB)	863	944	991	1,086	N/A	N/A
At Luawai Street (EB)	608	843	698	969	N/A	N/A
Two-Way	1,471	1,787	1,689	2,055	N/A	N/A
Along Proposed Honoapiilani Highway:						
At Solid Waste Transfer Station (WB)	N/A	N/A	N/A	N/A	1,170	1,220
At Solid Waste Transfer Station (EB)	N/A	N/A	N/A	N/A	771	1,161
Two-Way	N/A	N/A	N/A	N/A	1,941	2,381
At Project Access 1 (WB)	N/A	N/A	N/A	N/A	1,108	1,222
At Project Access 1 (EB)	N/A	N/A	N/A	N/A	781	1,161
Two-Way	N/A	N/A	N/A	N/A	1,889	2,383
At Project Access 2 (WB)	N/A	N/A	N/A	N/A	1,059	1,201
At Project Access 2 (EB)	N/A	N/A	N/A	N/A	814	1,130
Two-Way	N/A	N/A	N/A	N/A	1,873	2,331
At Project RIRO Access 3 (WB)	N/A	N/A	N/A	N/A	1,049	1,209
At Project RIRO Access 3 (EB)	N/A	N/A	N/A	N/A	817	1,073
Two-Way	N/A	N/A	N/A	N/A	1,866	2,282

NOTES:

1. "No Build" Represents Conditions without Olowalu Town Master Plan Project and without Honoapiilani Highway Realignment.
2. "Build" Represents Conditions with Olowalu Town Master Plan Project At Build-Out Plus Honoapiilani Highway Realignment.

APPENDIX J-1.

September 16, 2015 Letter from Y. Ebisu & Associates

Y. Ebisu & Associates
Acoustical and Electronic Engineers

1126 12th Ave., Room 305
Honolulu, Hawaii 96816
Ph. (808) 735-1634 – Fax (808) 732-0409
e-mail: ebisuyassoc@aol.com

September 16, 2015

Dave Ward and Bill Frampton
Olowalu Town, LLC
2035 Main Street, Suite No. 1
Wailuku, Hawaii 96793

SUBJECT: Preliminary Acoustic Study of the Proposed Olowalu Town Master Plan Development, dated October, 2011

Dear Mr. Ward and Mr. Frampton:

Our October 2011 Preliminary Acoustic Study for the Olowalu Master Plan Study addressed the noise impacts related to the proposed Honoapiilani Highway Realignment. Our study addressed Alternative 1, the Preferred Alternative. With the adoption of the Maui Island Plan (MIP) in December 2012, Alternative 2 was introduced as a second alternative within the realm of implementation potential. Alternative 2 reflects a master plan concept which follows the MIP's growth boundaries. That is, lands makai of Honoapiilani Highway are not included as part of the Master Plan. Both Alternatives 1 and 2 call for the development of up to 1,500 residential units and between 300,000 to 375,000 square feet of commercial space.

The technical basis for our noise impact analysis relates to future traffic noise levels, together with environmental factors such as terrain, ground cover and local shielding conditions. Future traffic noise levels developed in our Preliminary Acoustic Study dated October 2011 are similar to those based on the traffic study provided by Roger Dyar's Olowalu Town Traffic Impact Analysis Report (TIAR) plus peak hour traffic data received in September 2015.

We have reviewed the updated TIAR (April 14, 2015) and the peak hour traffic data received in September 2015, and have determined that the traffic outputs presented in this updated report do not materially impact the results of our noise model results. Additionally, other factors used in developing our study methodology (terrain, ground

cover and local shielding conditions) have not changed. These modeling factors apply to both Alternative 1 and Alternative 2.

No new circumstances have arisen with respect to the subject project or property that will result in different or likely increased environmental impacts not previously dealt with in our 2011 report. Accordingly, we confirm that the findings, conclusions, and recommendations presented in our October 2011 Preliminary Acoustic Study remain applicable and are valid for both Alternative 1 and Alternative 2.

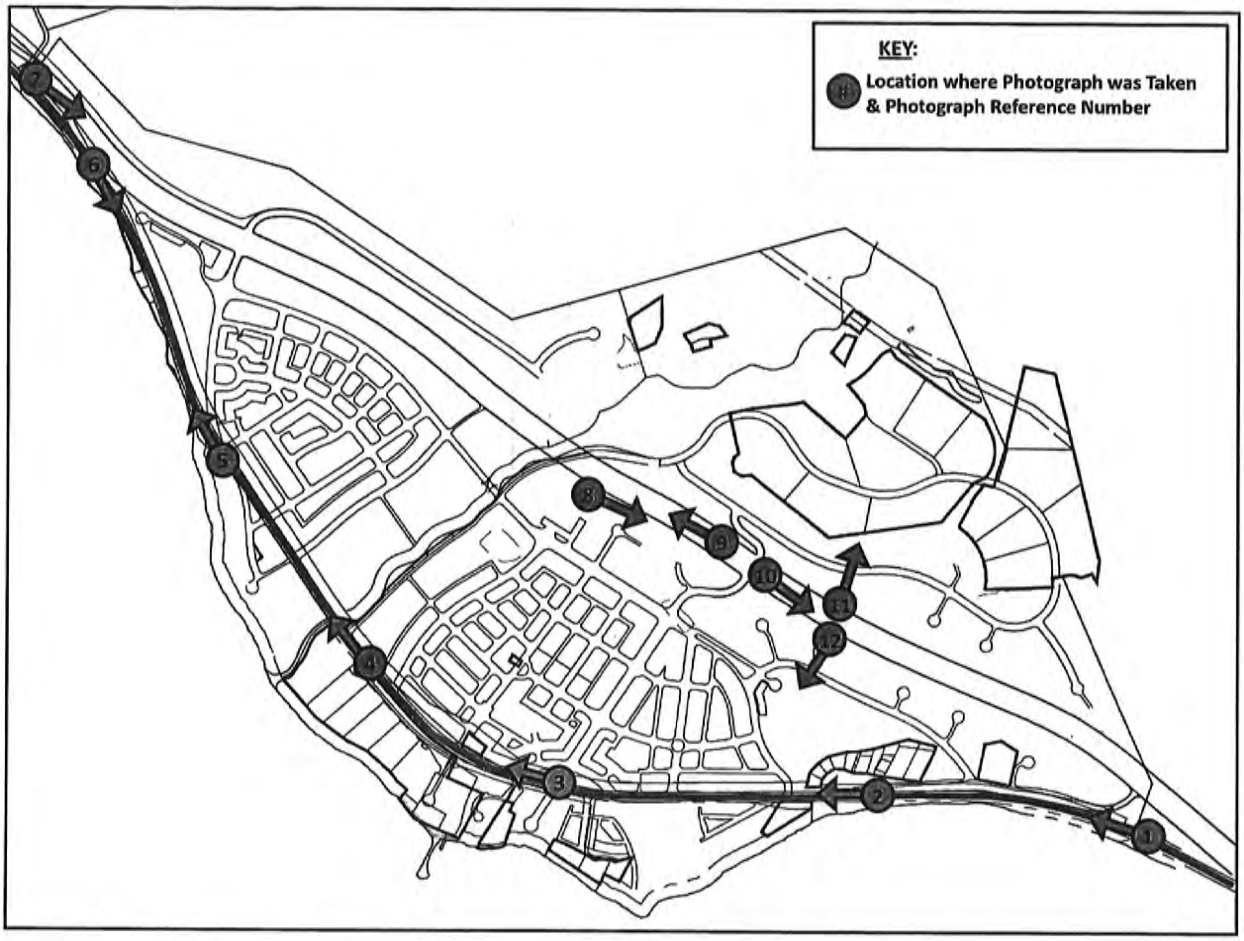
Sincerely,

Yoichi Ebisu, P.E.

YE
cc: Colleen Suyama, Munekiyo Hiraga

APPENDIX ~~J~~K.

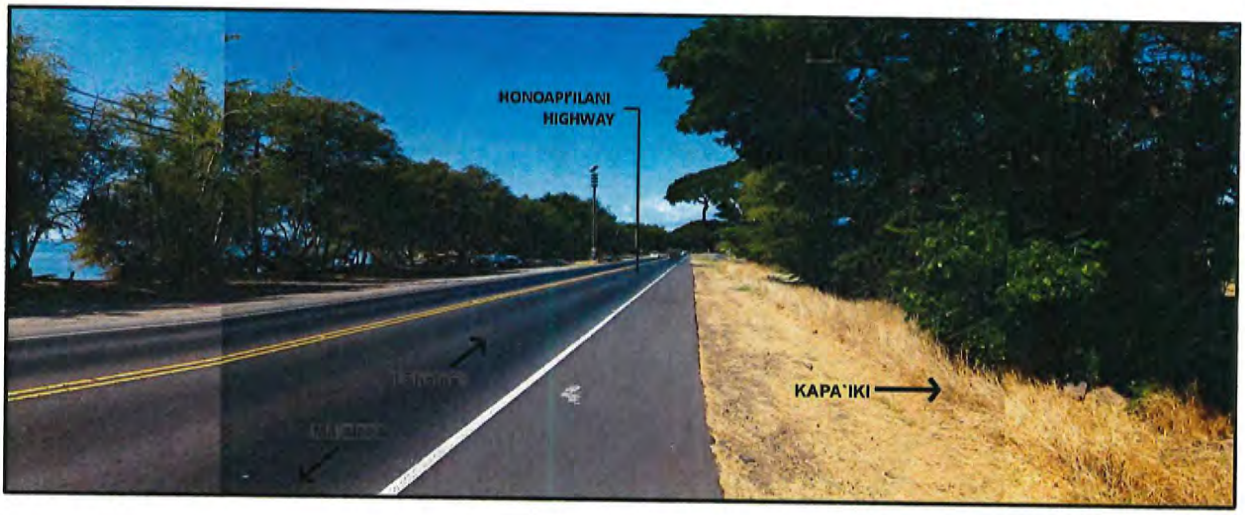
View Analysis

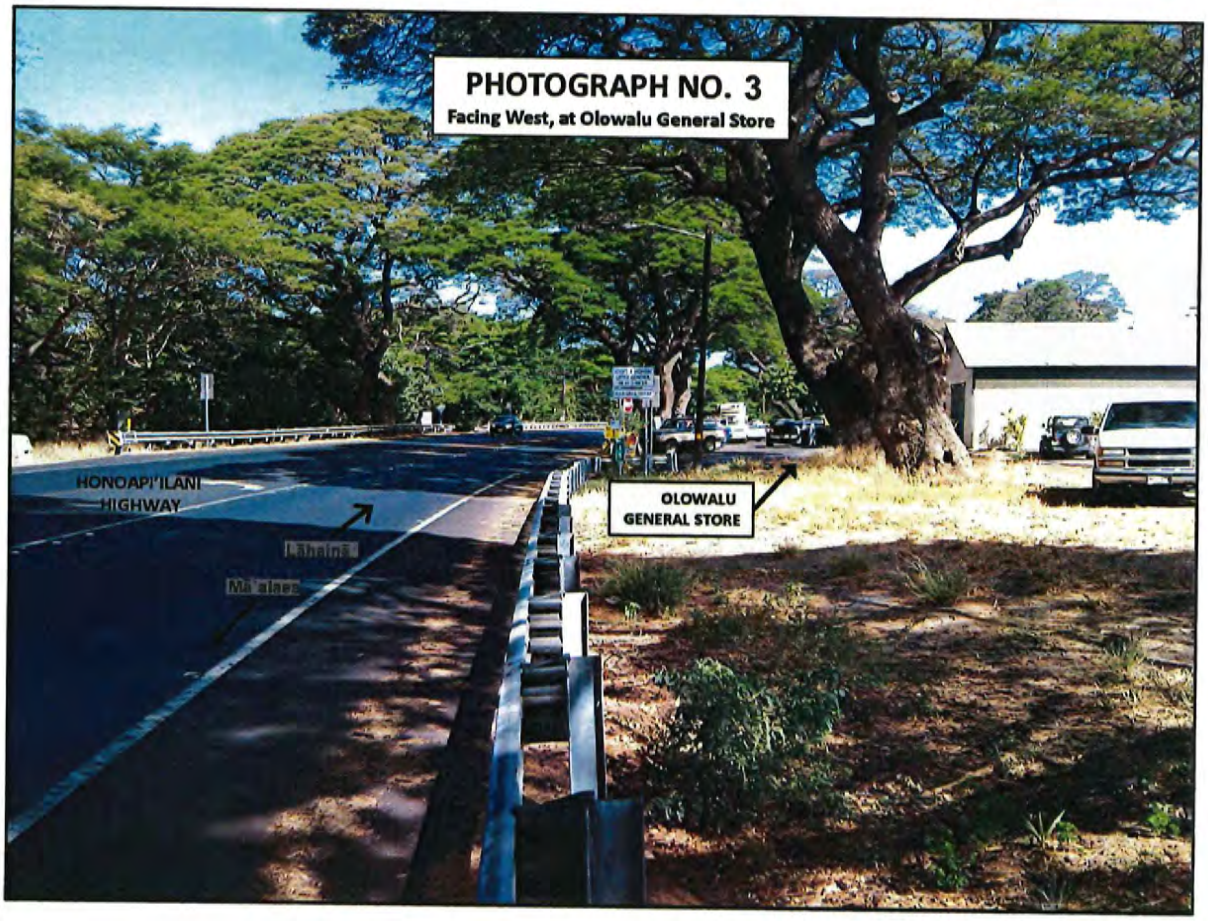


PHOTOGRAPH NO. 1

Facing West, near State Highway Mile Marker No. 14

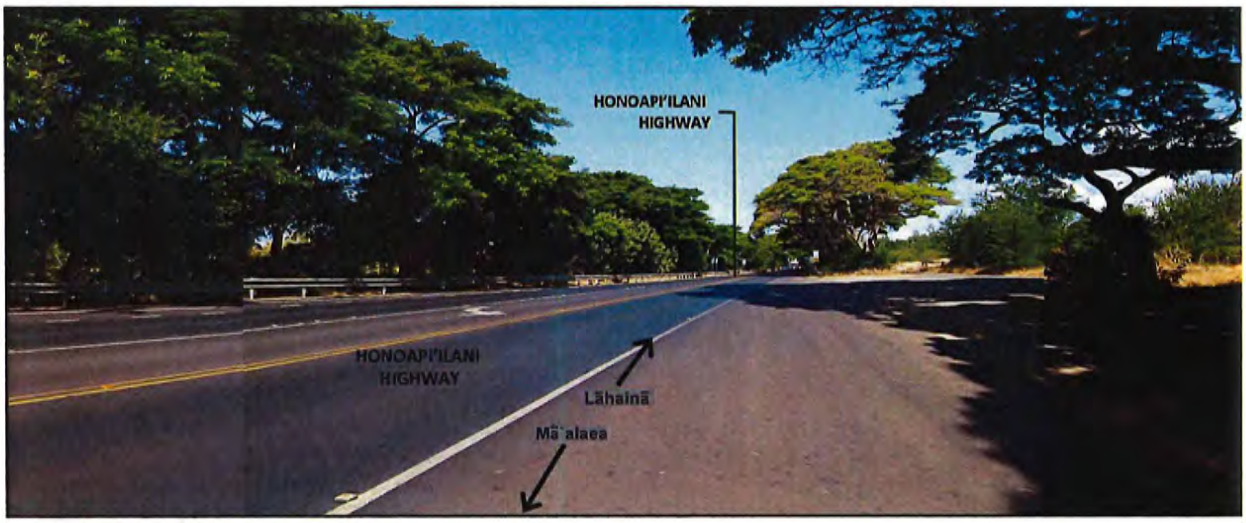
PHOTOGRAPH NO. 2
Facing West, near Kapa`iki





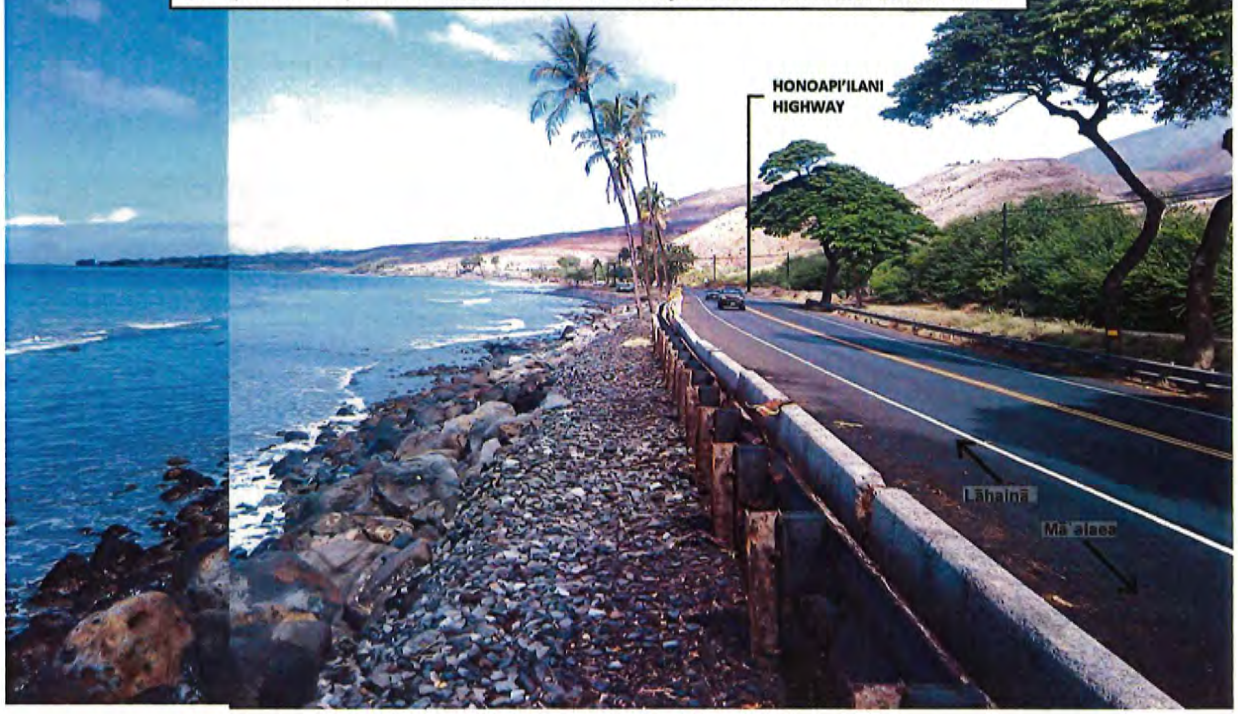
PHOTOGRAPH NO. 4

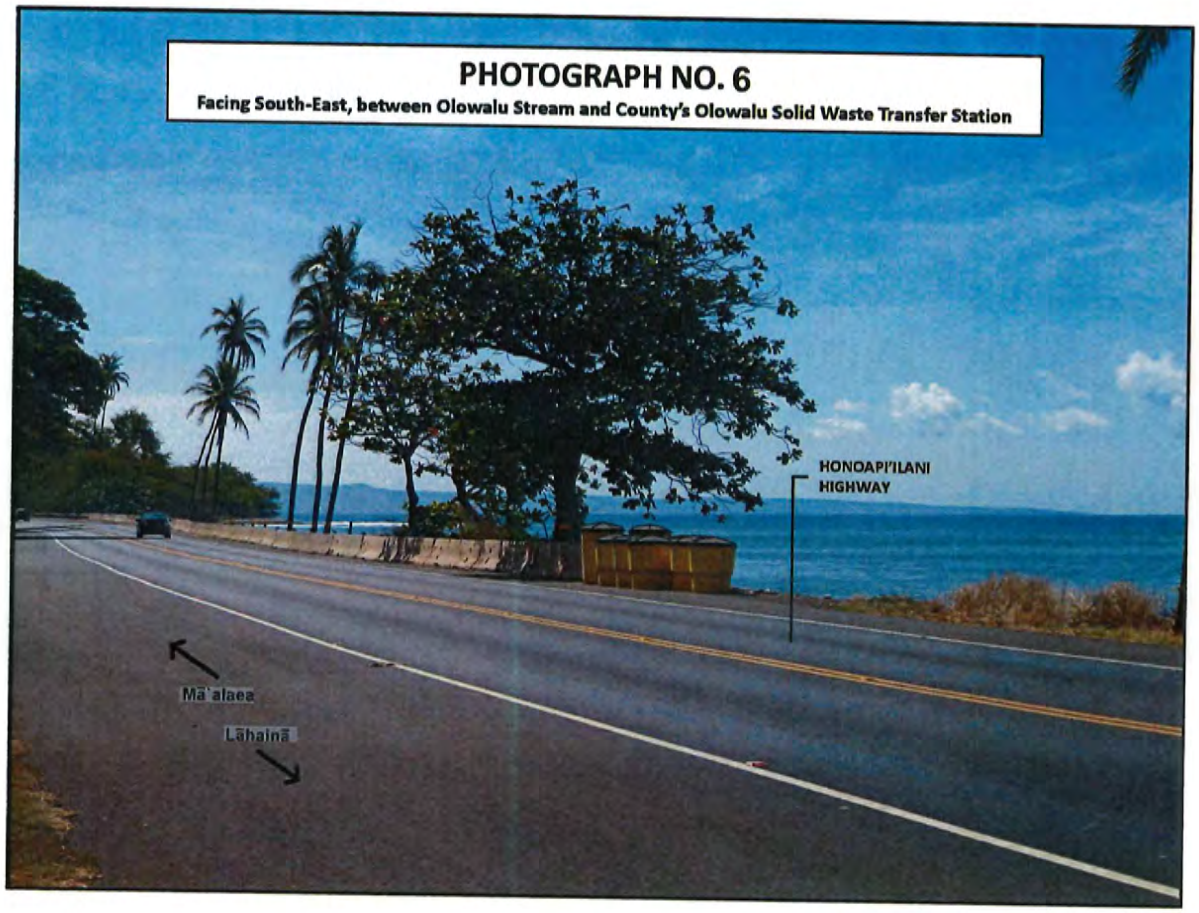
Facing North-West, between Olowalu General Store and Olowalu Stream



PHOTOGRAPH NO. 5

Facing North-West, between Olowalu Stream and County's Olowalu Solid Waste Transfer Station





PHOTOGRAPH NO. 6

Facing South-East, between Olowalu Stream and County's Olowalu Solid Waste Transfer Station

PHOTOGRAPH NO. 7

Facing South-East, near County's Olowalu Solid Waste Transfer Station

PHOTOGRAPH NO. 8

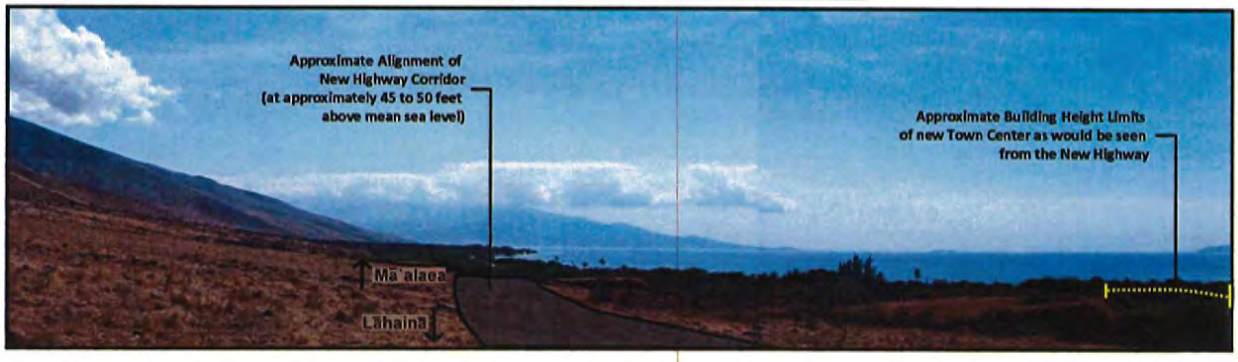
Facing East, in vicinity of new Mauka Highway corridor and Luawai Street

PHOTOGRAPH NO. 9

Facing West, in vicinity of new Mauka Highway corridor

PHOTOGRAPH NO.10

Facing East, in vicinity of new Mauka Highway corridor

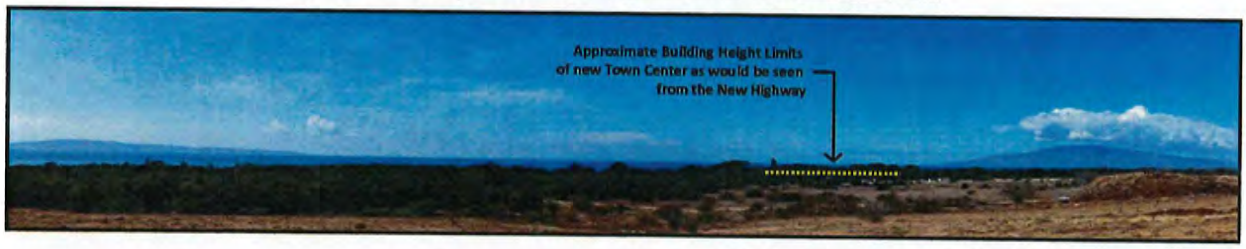


PHOTOGRAPH NO. 11

Facing North (Mauka), in vicinity of new Mauka Highway corridor

PHOTOGRAPH NO. 12

Facing South (Makai), in vicnity of new Mauka Highway corridor



APPENDIX ~~K~~L.

Market Study

PREPARED FOR: **MR. BILL FRAMPTON**
OLOWALU TOWN LLC
2073 Wells Street, Suite 201
Wailuku, Hawaii 96793

EFFECTIVE DATE: **May 1, 2011**

A MARKET STUDY OF THE PROPOSED OLOWALU TOWN MASTER PLAN DEVELOPMENT
OLOWALU, ISLAND OF MAUI, HAWAII

ACM CONSULTANTS, INC.

ACM CONSULTANTS, INC.

A Real Estate Appraisal, Research & Advisory Group

May 20, 2011

10-9106-DS

Mr. Bill Frampton
OLOWALU TOWN LLC
2073 Wells Street, Suite 101
Wailuku, Hawaii 96793

Re: Market Analysis for the proposed Olowalu Town Master Plan in Olowalu, Island and County of Maui

Dear Mr. Frampton:

In accordance with your request, we have inspected the above-referenced property in order to provide a defined scope market study and economic impact study of the proposed Olowlalu Town Master Plan Development in Olowalu, Island and County of Maui. This *counseling report*, and the conclusions herein, are based on the on-site inspection of the property, a study of current political and economic conditions, and a historical review of the real estate market in Central Maui and on Maui overall. The effective date of this report is May 1, 2011.

The subject consists of approximately 636 acres of land and is currently zoned State Agricultural District. The proposed project is identified as Olowalu Town and will be located along Honoapiilani Highway between Maalaea and Lahaina. Olowalu Town will be a community comprised of residential uses, commercial and civic uses, parks and recreation sites, agricultural uses, and a cultural preserve.

At full build-out, Olowalu Town is expected to be comprised of approximately 1,500 living units, including single-family, multi-family and live-work units, together with up to 300,000 square feet of commercial and civic space. Within the 1,500 living units, on-site affordable housing units will also be included in compliance with the County of Maui's Residential Workforce Housing Policy.

The assignment will include the following:

> **Market Analysis -** The Consultant agrees to provide a market analysis for this proposed project by (1) defining and delineating the market area; (2) identifying and analyzing the current supply and demand conditions that comprise the specific real estate market segment; and (3) identifying, measuring and forecasting the effect of anticipated developments or other changes on future supply in each market segment.

The following report presents a narrative review of the market study and our analysis of data along with other pertinent materials on which this report is predicated. It contains data and exhibits

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gathered in our investigations, and will include a description of the analytical process and our conclusions.

Thank you for allowing us the opportunity to work on this interesting assignment.

Respectfully submitted,
ACM Consultants, Inc.

Glenn K. Kunihisa, MAI, CRE
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2011

Dominic J. Suguitan
Certified General Appraiser
State of Hawaii, CGA-576
Expiration: December 31, 2011

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PART I – INTRODUCTION

A. EXECUTIVE SUMMARY

Background

The proposed Olowalu Town Master Plan Development is located on both sides of Honoapiilani Highway in Olowalu, Island and County of Maui. The subject is primarily zoned State Agricultural District and consists of approximately 636 acres of land. The project, which is still in its preliminary planning stage, will consist of approximately 1,500 residential units, including single-family, multi-family and live-work units; passive parks and open space, such as cultural preserves, neighborhood parks, and archaeological sites; active parks/community services, such as coastal parks, community centers, schools and police/fire facilities; up to 300,000 square feet of commercial space (inclusive of live-work and civic uses); and, an on-site wastewater treatment facility. Potable water for the project will be provided by a private water well. According to the Developer, the proposed land use is as follows:

Proposed Land Use	Acreage
Urban Residential/Commercial	290 acres
Rural Residential	170 acres
Agricultural	161 acres
Conservation	15 acres
	Total: ± 636 acres

Preliminary plans call for 400 to 800 single-family units, 600 to 900 multi-family/apartment units, and 150 to 200 live-work units. The Developer has estimated an 8- to 10-year build out for Olowalu Town.

Study Objectives

ACM Consultants, Inc. has been retained by Mr. Bill Frampton of Olowalu Town LLC to analyze each of the specified segments of the real estate market as it relates to this proposed project. In particular, the Consultants studied economic trends and demographics, and supply and demand factors for residential and commercial properties. Residential properties included single-family residences, single-family house lots, and condominium/apartment units. Commercial properties included vacant developable lots as well as improved properties. In the process, they gathered as much information as possible on real estate activity on Maui while focusing on the West Maui, Central Maui, and the South Maui market.

The objectives of the market analysis were as follows: (1) to define and delineate the market area; (2) to identify and analyze the current supply and demand conditions specific to the subject's market; and (3) identify, measure and forecast the effect of anticipated developments or other factors on future supply.

Summary of Conclusions

Residential Component

Maui in general has seen growth in its population, tourism and economy over the past two decades. Similar to many real estate markets on the mainland, Maui's real estate market had seen significant increases from 2000. During that period, median prices attained record highs in 2005. As a result, the county administration placed the affordable housing issue among its top priorities, from as early as 2004.

The real estate climate has since reversed course, due to economic woes and more stringent lending practices. Through 2009, residential sales statistics showed lower median prices, less sales volume and longer marketing times. However, 2010 is showing some evidence of stability, based on year-ta-date sales price medians.

There are numerous ongoing residential projects that should provide the immediate supply throughout Maui for the next few years. The Maui Lani and Kehalani Project Districts continue to build their already entitled units in Central Maui. In addition, there are a few other projects in Central Maui that may add inventory to the market in coming years but are still in the process of gaining governmental approvals. Other on-going projects are located in South Maui and West Maui.

However, after five years, it becomes more difficult to determine which future projects will actually be brought to the market. The recommended Directed Growth Areas, as shown in the Draft Maui Island Plan for Maui, are estimated to provide additional supply of 11,623 housing units by 2030, without the subject included. However, some of these potential projects will likely meet with governmental or community resistance, leading to long delays; meanwhile, others may never be completed for various financial reasons.

The economic downturn being witnessed across the nation has significantly affected Maui, through a drop in visitor counts and the drastic slowdown of construction. These industries are two of the primary employment forces on the island and their decline has had an adverse impact on the local economy. Unemployment rose steadily from 2006 to 2009 to levels not seen since 1992, with many that are still employed indicating concern over job security. Meanwhile, the heavy losses witnessed in the financial sector since the fourth quarter of 2008 have surely diminished the investment capital for other potential buyers. Combined with a more stringent lending environment, it has become increasingly difficult to purchase real estate, regardless of current market conditions.

At the height of the market, the primary obstacle for buyers was the high asking prices for residential products. Many buyers who did not own a home found it difficult to even come up with enough money for a down payment. Meanwhile, homeowners saw their property values increase to a point where they were able to use their equity appreciation to upgrade to larger, more elaborate accommodations. For many, this option is no longer possible, as the retreat of home prices has caused a significant loss of equity. Currently, the ability of qualified buyers to purchase housing may be more difficult than a few years ago; however, it is fairly safe to assume that as economic conditions improve, housing units within the workforce market segment will continue to be the most sought after. Local economists have varied opinions as to the timing of the economic recovery, but many have pointed to late-2011 or 2012 for this turnaround.

If the Olowalu Town Master Plan Development were to come on-line today, it would have likely been facing the same types of sales difficulties that other ongoing projects are witnessing. However, the subject will still need to go through entitlement, design and construction processes before sales can occur. As such, release of the subject's housing units may be timely with the economic recovery. Once market conditions improve, the project can expect to see heightened interest, due to its location between the visitor resort area of Lahaina, Kaanapali and Kapalua and the island's primary shipping and transportation venues, government and judiciary facilities, financial institutions, secondary education campus, and retail centers in Central Maui.

Most importantly, the Olowalu Town Master Plan will be heavily targeted toward the workforce market segment desiring a small-scale community environment. Statistical evidence has clearly shown that regardless of conditions, this market segment has the most demand. Although the pricing of the project units have not been determined, this development is anticipated to give entry level market participants an opportunity for home ownership.

The property owners continue to work diligently with government agencies in an effort to design a master plan community that represents smart-growth for all of Maui. As previously discussed, the proposed project is consistent with many of the goals, objectives, policies and implementing actions set forth in the Countywide Policy Plan, which provides a policy framework for the Maui Island Plan and Community Plans. After consideration of current economic and real estate market conditions; forecasts by Hawaii economists; as well as long-term supply and demand recommendations being deliberated for the 2030 General Plan, it is the Consultant's opinion that Olowalu Town should be well positioned to capitalize on the recovery of the real estate market and help to provide a long-term solution to the

housing needs of Maui's workforce. As such, it is the Consultant's opinion that the subject's **1,500 housing units are expected to be absorbed within an 8- to 10-year period.**

Commercial and Industrial Component

Not surprisingly, demand for supporting commercial and industrial space on Maui has followed the same trend as the residential real estate market. Commercial and industrial land values, sales prices for improved properties, and rental rates all saw considerable appreciation from 2000 to 2006. This was followed by a period of decline that has continued to the present where there now appears to be some stability.

Market conditions have deteriorated within the past few years, evidenced by decreased land values and longer marketing time. Research revealed that there is approximately 40 acres of commercial and industrial land for sale in Central Maui, with most of the available inventory coming from the Maui Lani Village Center. The 36 acres being offered within this recently completed mixed-use business park is priced at the high end of the asking price range, which may not be affordable to many potential buyers, given current economic conditions.

Regardless, the 40 acres of commercial and industrial land available will only provide short-term supply for Central Maui, based on historical absorption in the region. Although Central Maui has the lowest ratio of population-to-acres of commercial/industrial subdivision land, the strong demand for this type of property is evidenced by new project absorption rates that are similar or higher than other regions. This is no doubt due to its location with respect to major transportation facilities in Kahului, as well as having the governmental seat in Wailuku Town. On average, land in commercial and industrial business parks in Central Maui have been absorbed within a range of 5 to 19 acres per year. The wide range of absorption rates was attributed to cyclical market conditions, in addition to the overall lack of land entitled for such use.

Preliminary projections indicate up to 300,000 square feet of commercial uses in support of the community and anticipated visitors through Olowalu Town. In this light, it is the Consultant's opinion that the 300,000 square feet of commercial space will be absorbed within the forecasted 8- to 10-year absorption timeframe for the Olowalu Town Master Plan Development's 1,500 housing units.

B. PURPOSE OF THE REPORT

The purpose of this report, as of May 1, 2011, is to generate a market analysis report with respect to the proposed Olowalu Town Master Plan Development.

C. INTENDED USE OF THE REPORT

The intended use or function of this report is to provide real property information and real estate market date in support of an Environmental Impact Statement, a State Land Use District Boundary Amendment, a Community Plan Amendment, and a Change in Zoning.

D. SCOPE OF THE REPORT

The Consultant has agreed to provide a current market analysis of this project by (1) defining and delineating the market area; (2) identifying and analyzing the current supply and demand conditions that make up the specific real estate market; and (3) identifying, measuring and forecasting the effect of anticipated developments or other changes on future supply. The market analysis will be developed and prepared in conformity with, and subject to, the requirements of the Code of Professional Ethics and the Standards of Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice.

E. STATEMENT OF COMPETENCY

ACM Consultants, Inc. (formerly ACM, Real Estate Appraisers, Inc.) has been actively involved in the real estate appraisal business since 1982. Our business emphasis has focused mainly on the valuation of residential and commercial properties located within the State of Hawaii. The company considers itself competent to conduct a market study for a proposed master plan project in Olowalu, Island and County of Maui.

F. EXTRAORDINARY ASSUMPTIONS AND HYPOTHETICAL CONDITIONS

1. As of May 2011, the subject was still in the preliminary stages of planning. A land use map from the Developer provided a visual indication of the proposed layout of the project district. The Consultant is not liable for any changes in the project plan past this date, nor for information that has not been released or communicated to the Consultant.

2. The Consultant has no control over economic conditions and other international events that could have an affect upon

Hawaii's economy and the Maui real estate market. As a result, this report has not made any assumptions regarding potential conflicts with other nations, or external factors affecting economic conditions here.

3. The counseling report is also subject to standard "Limiting and Contingent Conditions" located in the pages following.

G. CONFIDENTIALITY PROVISION

The contents of this market study are confidential. Release of this counseling report by ACM Consultants, Inc. is limited to you and for your preparation of an Environmental Impact Statement for the proposed Olowalu Town Plan Development. The intended users of this report include Olowalu Town LLC and the appropriate government agencies to which this report will be submitted. Any further release of this report, or portions herein, is strictly prohibited and you shall accept the risk and liability for any such release without the previous written consent of ACM Consultants, Inc. Further, you shall indemnify and defend ACM Consultants, Inc., and its individual consultants/appraisers, from any claims arising out of any such unauthorized disclosure.

H. CERTIFICATION

The undersigned does hereby certify that except as otherwise noted in this appraisal report:

1. The Consultants' compensation is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event.

2. The Consultants' have no present or prospective interest in the property that is the subject of this report, and no personal interest or bias with respect to the parties involved. The "Estimate of Market Value" in the appraisal report is not based in whole or in part upon the race, color, or national origin of the prospective owners or occupants of the properties in the vicinity of the property appraised.

3. The Consultants have personally inspected the property, and are signatories of this Certification.

4. To the best of the Consultants' knowledge and belief, all statements of fact and information in this report are true and correct, and the Consultants' have not knowingly withheld any significant information.

5. No other person provided significant professional assistance to the persons signing this report.

6. The reported analyses, opinions and conclusions are limited only by the reported assumptions and limiting conditions, and are the Consultants' personal unbiased professional analyses, opinions and conclusions.

7. All analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Appraisal Practice.

8. This counseling report is subject to and in conformance with the Code of Professional Ethics and Standards of Professional Conduct of the Appraisal Institute. The analyses, opinions and conclusions of this counseling report have been made in conformity with, and subject to, the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

9. This counseling report is to be used only in its entirety and no part is to be used without the whole report. All conclusions and opinions concerning the real estate are set forth in the counseling report were prepared by the Consultant(s) whose signature(s) appears on the counseling report. No change of any item in the counseling report shall be made by anyone other than the Consultant, and the Consultant shall have no responsibility for any such unauthorized change.

10. The Appraisal Institute, of which this Consultant is a member, has a legal right to review this report.

11. The qualifications of this Consultant, including completed educational requirements of his/her candidacy are located in the Addendum to this report. Any member signing the report has completed the requirements of the Appraisal Institute's continuing education program.

ACM Consultants, Inc.

Glenn K. Kuhihisa, MAI, CRE
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2011

Dominic J. Suguitan
Certified General Appraiser,
State of Hawaii, CGA-576
Expiration: December 31, 2011

I. LIMITING AND CONTINGENT CONDITIONS

1) This is a Counseling Report which is intended to comply with the reporting requirements set forth under Standards Rule 5 of the Uniform Standards of Professional Appraisal Practice for a Counseling Report. The information contained in this report is specific to the needs of the client and for the intended use stated in this report. The Consultant is not responsible for unauthorized use of this report.

This report has not been prepared for federally-related mortgage financing purposes, and has not been prepared in compliance with the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

2) No responsibility is assumed for legal or title considerations. Title to the property is assumed to be good and marketable unless otherwise stated in this report.

3) The property analyzed is free and clear of any or all lines and encumbrances unless otherwise stated in this report.

4) Responsible ownership and competent property management are assumed unless otherwise stated in this report.

5) The information furnished by others is believed to be reliable. However, no warranty is given for its accuracy.

6) All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property.

7) It is assumed that there are no hidden or unapparent conditions of the property, subsoil, or structures that render it more or less valuable. No responsibility is assumed for such conditions or for arranging for engineering studies that may be required to discover them.

8) It is assumed that there is full compliance with all applicable federal, state, and local environmental regulations and laws unless otherwise stated in this report.

9) It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a non-conformity has been stated, defined, and considered in this counseling report.

10) It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization

have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

11) Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

12) It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report.

13) The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence af hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the analysis process.

14) Unless otherwise stated in this report, the subject property is evaluated without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

15) Any proposed improvements are assumed to be completed in a good workmanlike manner in accordance with the submitted plans and specification.

16) The distribution, if any, of the total valuation in this report between land and improvements applies only under the stated program of utilization. The separate allocations for land and buildings must not be used in conjunction with any other appraisal and are invalid if so used.

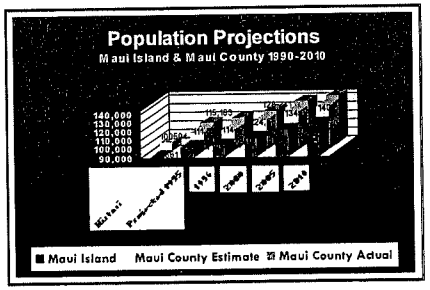
17) Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purpose by any person other than the party to whom it is oddressed without the written consent of the consultant, and in any event, only with property written qualification and only in its entirety.

18) Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

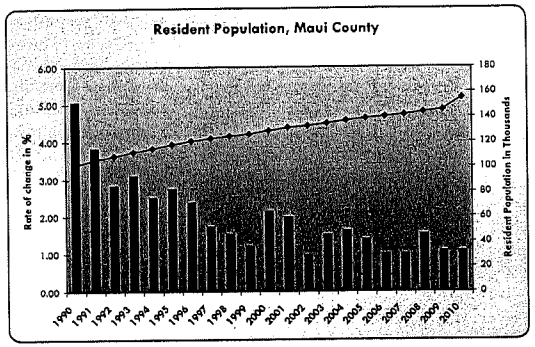
PART II – FACTUAL DATA

A. REGIONAL DATA - MAUI COUNTY

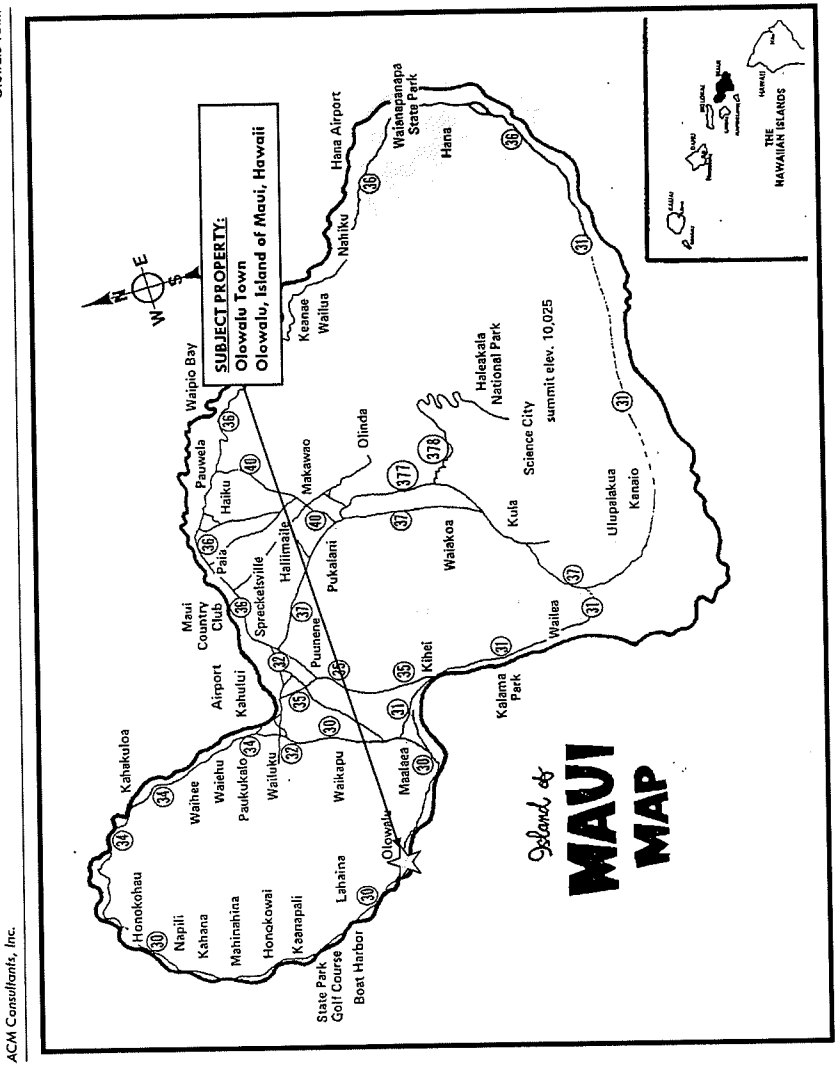
Maui County is the third most populous of the four counties of Hawaii, with a total resident population of 154,834 (2010 Census) and a change of 20.9 percent since 2000. Maui County consists of the islands of Maui, Molokai, Lanai, and Kahoolawe. Ninety percent (90%) of County residents live on Maui; the 2000 U.S. Census of Population reported 7,404 residents on Molokai and 3,193 on Lanai. The Island of Maui consists of a total of 734.5 square miles, or 470,080 acres. Population Projections for Maui County and the Island Maui are illustrated on the table below.



The following graph illustrates the resident population change in Maui County from 1990 through 2010. The graph indicates that Maui's population has been growing at a steady pace.



Source: UHERO Economic Information Service



Like all the Hawaiian Islands, Maui, Molokai and Lanai are blessed by warm air temperatures year-round, and ocean waters that range from 72-77°F in winter to 77-81°F in summer. The islands' distance from other continents, the moderating effects of the surrounding water and the tropical location combine to create this pleasant climate. Hawaii's topography, particularly the mountains and valleys and location of each island, contributes to the great variety of microclimates within very small areas. On Maui, the West Maui Mountains and Haleakala are the primary geological features affecting the weather. Due in part to the above geographical factors, Maui, for fifteen out of the last sixteen years, was selected "Best Island in the World" by readers of Condé Nast Traveler magazine.

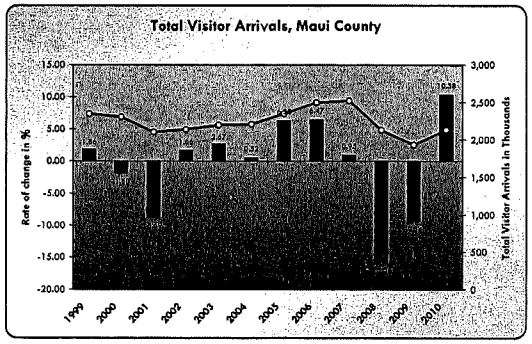
Visitor Industry

Historically, Maui hotel occupancies typically exceeded any area in the state with the exception of Waikiki. Its high rating is due to a number of factors. First, Maui receives the good fortune of location and climate. Second, Maui has the infrastructure in place to move tourists to a diverse variety of activities with a minimum of inconvenience and down time. The accommodations on Maui are another reason. Maui resort hotels have consistently ranked above other Hawaii resort destinations. In the same Conde Nast Traveler magazine, nine of the "Top 20 Hawaii Resorts" for 2009 were Maui County resorts. The Four Seasons Maui at Wailea topped the list, while other Maui County resorts garnering honors included: Four Seasons Lanai, The Lodge at Koele (3rd); Hotel Hana Maui and Honua Spa (4th); Four Seasons Lanai at Manele Bay (5th); Fairmont Kea Lani, Maui (9th); Grand Wailea (12th); Ritz-Carlton Kapalua (14th); Hyatt Regency Maui Resort & Spa (15th); and Westin Maui Resort & Spa (20th).

With the possible exception of Kauai, Maui is more dependent on tourism than any of Hawaii's four counties. That sector is not treating Maui very well today. For years, Maui has worked very hard at cultivating a worldwide image as a premier, upscale tropical island destination. In fact, it is the only county government in Hawaii that spends money to support tourism. In the wake of the current financial crisis, Maui's tourism counts and hotel occupancy have fallen significantly. Even the upscale and affluent markets, it appears, have curtailed their spending on trips to the Valley Isle.

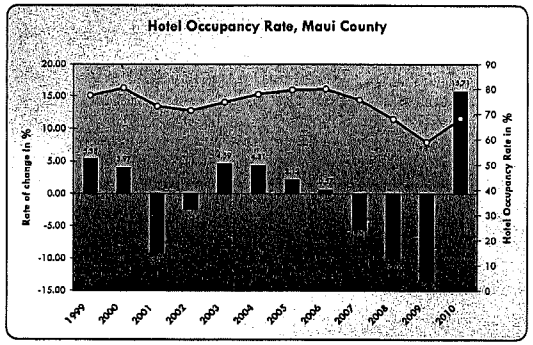
Tracking the tourism counts during this decade begins with the effects of the September 11, 2001 terrorist attacks on this country which had a drastic impact on the tourism industry. The final Maui visitor count for 2001 was 2,104,480. In 2002, the visitor count rebounded slightly to 2,139,427 as the visitors slowly returned during the mid to latter part of the year. Visitor totals for 2003 indicate an increase of 2.7 percent over 2002, 2004 total visitor arrivals increased by 0.52 percent over 2003, while 2005 visitor totals showed an increase of

6.28 percent, to 2,346,480. There was a rebound in 2006, with a 6.5 percent jump to 2,498,200, followed by another 1.0 percent gain in 2007 to 2,522,000. In 2008, visitor arrivals plummeted 16 percent to 2,129,040, and another 9 percent in 2009 to just 1,923,360 visitor arrivals. However, in 2010 the visitor count rebounded with a 10.38 percent jump to 2,132,860, as the economic conditions began to show signs of stability.



Source: UHERO Economic Information Service

In addition, for 2010, Maui County had the second lowest occupancy rate of all the Hawaii counties at just 68.20 percent, ahead of the Kauai at 59.23 percent. Meanwhile, Big Island showed occupancy of 56.37 percent and Oahu occupancy topped the list at 78.25 percent.



Source: UHERO Economic Information Service

Visitor shopping opportunities have increased in recent years with the opening of The Maui Marketplace, a 275,000 square foot shopping complex, modeled after Oahu's successful Waikele Center. The Maui Marketplace is now home to such retail superstores like Lowe's Hardware, Pier One Imports, Sports Authority, Starbucks Coffee, and Office Max, as well as many small local retailers and restaurants. Also opening in the same Kahului area were Home Depot, Wal-Mart, Big K and Costco. In addition, the Shops at Wailea opened in December 2000 and added approximately 150,000 square feet of high-end retail space in the Wailea Resort. At about the same time, the 150,000 square foot Piilani Shopping Center opened in Kihei with Safeway as its anchor tenant. The latest entry into the retail sector is the Lahaina Gateway, which opened in 2007. Dubbed a "lifestyle center", Lahaina Gateway, offers almost 137,000 square feet of gross leasable area.

Maui offers more than any other Neighbor Island in the way of proven vacation experiences. It has a larger tourism activities industry relative to the size of its economy than any other county. Such activities include ocean recreation, helicopter tours, biking down Haleakala, and golfing, among numerous other activities. Maui's well-developed ocean recreation industry ranges from windsurfing to snorkeling, scuba diving and sailing cruises which leave regularly from Lahaina and Ma'alaea Harbors.

Maui also has theme destinations, such as the Maui Tropical Plantation. But the premier theme destination on the island is the Maui Ocean Center. This center, featuring the marine environment of the Hawaiian Islands, is modeled after five other aquarium parks developed elsewhere in the world by Coral World International. This ocean center is located just behind the Maalaea Boat Harbor, and is easily accessible from Kahului/Wailuku, and the resort areas of Lahaina/Kaanapali and Kihei/Wailea. The Maui Ocean Center anchors the 18-acre Maalaea Harbor Village, which also includes a retail strip shopping center, restaurants and other services.

When the United States and the world in general recover from the current economic crisis, it is hoped that Maui will continue to be a strongly favored destination for Mainland tourists. The island has a large share of condominiums available for families and groups on a budget. The California recovery in the early 2000's fueled higher demand for condominium rentals and this may possibly happen again in the next decade.

Hatels have not been adding much in the way of jobs, in fact, many hotel and other tourism-related industries have cut back their work force. Even when tourism numbers were growing steadily, job creation in the visitor industry was not matching that growth. Today, with

tourism waning, the work force is noticeably decreasing. While tourism still dominates the labor force, the profitability problems of the large resorts have led managers to refine their operations.

Real Estate

Residential real estate can be divided into three broad categories (single-family homes, condominiums and residential lots) and four important geographic regions. As a result, there are eight subsections of the market that have proven capable of moving up and down with relatively little correlation with the others. Upcountry has virtually no condominium properties; and two other subsections, South Maui and Central Maui, have few leasehold condominiums. Only West Maui has all three types.

Of all the neighborhoods, several have virtually all luxury housing, such as Kapalua, Kaanapali, and Wailea. Kahului has no luxury housing and Wailuku only a little. All other areas have a mix.

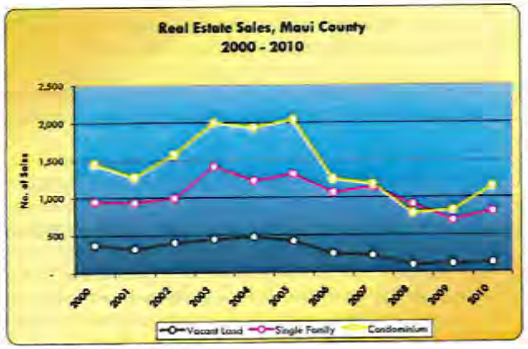
Owner-occupied housing on Maui runs about 56 percent of all occupied housing units. The total housing stock has been growing at a rate of about 1,000 units a year in the 1980's. The total accelerated to 1,500-2,000 new units in the late 1980's, well short of demand. The Maui population has expanded tremendously for the past 10 to 12 years, but housing was not being built at the same pace as the 1980s. As a result, demand for housing during that period outpaced supply and homes prices and rents rose dramatically. The median single-family home price on Maui averaged $460,000 in 2010, which is a drop of 7.7 percent from the 2009's average of $498,708. Median sales price for a single family home was $574,760 in 2008, $627,887 in 2007, $697,450 in 2006, and $678,321 in 2005. Years 2005 through 2007 were considered the height of the real estate market.

Since then, the real estate market has changed direction, with a less stable economy and more stringent lending practices. In 2010, interest rates averaged 4.69percent, down from the previous year's average rate of 5.04 percent. The 2010 average interest rate represented the lowest annual average since 1971. While interest rates remain relatively stable, the current economic recession continues to stifle Maui real estate.

The following summarizes a sales volume history for Maui County from 1990 to 2010, which includes resales and new project sales.

Year	Vacant Land	Single Family	Condominium
1990	298	560	1,459
1991	116	430	593
1992	120	382	496
1993	121	361	461

1994	148	404	592
1995	118	331	495
1996	126	451	577
1997	182	507	812
1998	276	641	999
1999	408	965	1,348
2000	372	951	1,456
2001	318	938	1,274
2002	402	997	1,578
2003	447	1,420	2,001
2004	477	1,228	1,935
2005	421	1,311	2,041
2006	255	1,066	1,247
2007	226	1,138	1,179
2008	97	907	788
2009	110	693	826
2010	127	814	1,147



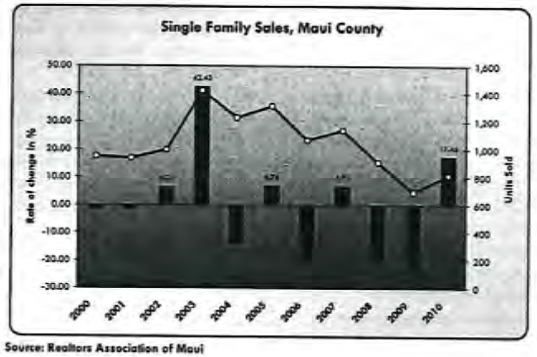
Source: Realtors Association of Maui

The real estate market increased significantly between 2002 and 2006. Single-family sales saw noteworthy increases in 2003, where the number of single-family sales leaped upwards of 42 percent. There was a 13 percent dip in 2004, followed by a rebound of almost 7 percent in 2005. For 2006, there was a decrease of 18 percent, with a subsequent upward bounce of almost 7 percent in 2007. Then, with the eroding economic conditions and financial crisis in 2008, Maui County experienced a 20 percent drop in sales. The continued economic recession in 2009 caused an additional slide of over 23 percent. This was the biggest decline in sales since 1991, when sales of single-family homes dropped by 25 percent. In 2010,

the market made a positive turn with a 17.5 percent increase in single-family sales over 2009. However, median prices continued to decline in 2010 by 7.2 percent from 2009.

The increase in single-family sales volume and simultaneous drop in average median price in 2007 was partially attributed to the closing of numerous units in Waikapu Gardens. This affordable priced subdivision had over 14 percent of the island's single-family home closings in 2007, with 164 units, at an average sales price of $356,876.

The following graph further illustrates the single-family sales volume history for Maui County from 2000 to 2010.

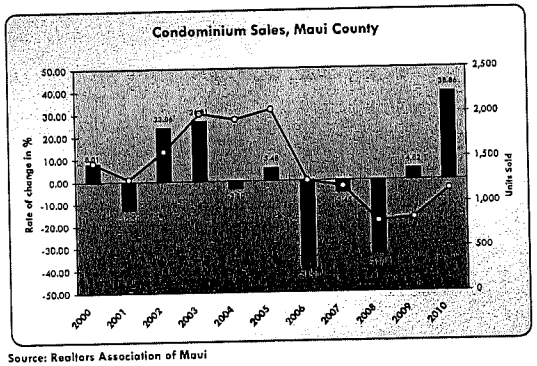


Source: Realtors Association of Maui

Similarly, condominium sales had experienced significant increases since 1999 in terms of units sold, achieving a new high in 2002 and a slight decrease in 2003. In 1999, 1,348 condominium units were sold, registering a 34 percent increase from the prior year. In 2001, the number of sales fell slightly, but rebounded significantly in 2002. In 2003, however, total condominium sales skyrocketed to 2,001, fell slightly to 1,935 units in 2004 and then jumped to 2,041 units in 2005. It appears that 2006 was the turning point for sales volume, as condominium sales plunged over 38 percent, followed by another 5 percent fall in 2007. For 2008, sales volume dived 40 percent; however, a 4 percent increase was seen in 2009 and a 38 percent increase in 2010. Nonetheless, condominium median prices continued to trend downward 15 percent from 2009 levels. It should be noted that since 2005, there has been little new condominium inventory, with the exception of the resort market.

Meanwhile the plummet of condominium sales volume in 2006 was deemed to be market stabilization from the spike in new inventory between 2003 and 2005. During this time period, Villas at Kenolio and Hale Kanani (Kihei), Villas at Kahana Ridge (Kahana), and Kehalani Gardens and Iliahi (Wailuku) closed on their units. Since then, there have been few non-resort condominium projects become available.

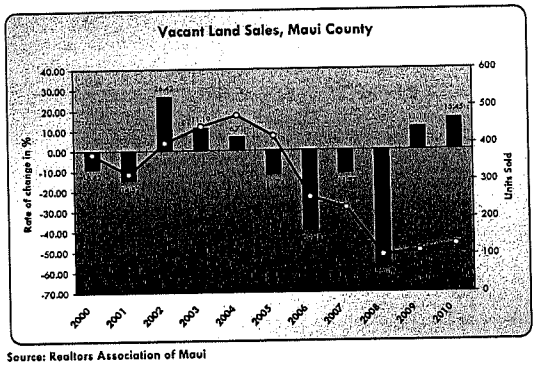
The following graph further illustrates the condominium sales volume history for Maui County from 2000 to 2010.



Source: Realtors Association of Maui

Land sales increased steadily between 2001 and 2004, but dropped 11 percent in 2005 with only 421 sales, then another 39 percent to 255 sales in 2006. This trend continued in 2007, with an 11 percent slide to 226 sales, surpassed by a huge 57 percent plunge in 2008. The first increase in four years was witnessed in 2009, as vacant land sales volume increased by 11 percent. Volume continued to increase in 2010 by 15 percent. Many developers, realtors and lenders consider the passage of the Workforce Housing Ordinance (December 2006) and the Water Availability Ordinance (December 2007) to have had a significant contribution to the severe decline of sales of vacant land.

The following graph further illustrates the vacant land sales volume history for Maui County from 2000 to 2010.



Source: Realtors Association of Maui

Meanwhile, median prices rose continued to rise until 2006 for all categories of real estate. The average monthly median prices in 2006, for land parcels, single-family homes and condominium units, increased 29 percent, 2 percent and 33 percent, respectively. In 2007, average monthly median prices for land and single-family property decreased 19 percent and 10 percent, respectively, while the average median price for a condominium increased 6 percent. For 2008, the average monthly median prices for single-family homes retreated by approximately 8 percent. Vacant land saw a slight gain of about 4 percent over 2007, while condominiums decreased by almost 6 percent. In 2009, vacant land median price increased by 3 percent. For that year, single-family properties decreased by 13 percent and condominiums saw an 11 percent drop.

Construction and Development

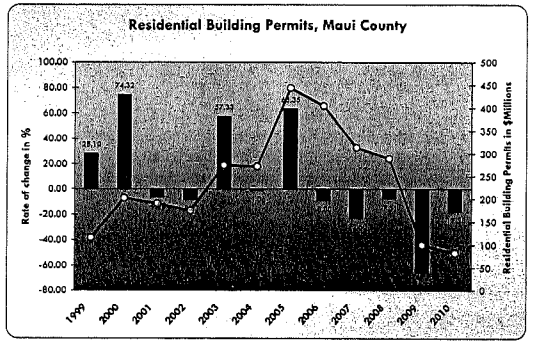
The construction industry, in the mid part of this decade, benefitted from a robust economy and building climate.

Three new commercial centers were built in 2000. The Wailea Shopping Village had been demolished and was replaced with The Shops at Wailea, which includes 150,000 square feet of upscale retail and restaurant space. Also, the 150,000 square foot Piilani Village shopping center was built at the same time and is anchored by a 55,000 square foot Safeway store, one of the largest Safeway in the state. The Ma'alaea Harbor Village shopping complex, where the premier Maui Ocean Center presently stands, was also built during the same period; however, since then, no other project has been attempted and the majority of the lots in this commercial subdivision sit vacant. As previously discussed, the Lahaina Gateway was completed in 2008 and injected an additional 137,000 square feet of retail space.

The effects of the late-2008 financial crisis and subsequent economic recession are still clearly visible across the island, as many new commercial and industrial projects completed during this period remain empty, or are having difficulty selling off/leasing units.

Construction of single-family residential properties has fallen significantly, as developers have curtailed building to meet their anticipated sales levels. As mentioned earlier, the single-family and condominium real estate markets have softened, with sales volume and median prices generally decreasing, while marketing days have increased.

The following graph illustrates the trend of residential building permits (in dollars) in Maui County from 1999 through 2010. As shown in the following graph, residential permits peaked in 2005 at the height of the real estate market. As previously discussed, many feel that the passage of County ordinances relating to development in 2006 and 2007, coupled with the financial crisis, have severely lessened the ability to feasibly create new housing projects.



Source: UHERO Economic Information Service

In Central Maui, the majority of the residential construction is within the Kehalani and Maui Lani project districts, which are being developed with several new subdivisions and condominium projects. Situated in the Kehalani district are Koa, which offers both house lots and single-family homes; Akolea and Cottages, both consisting of house and lot packages; Villas at Kehalani and Milo Court, which are townhouse condominium developments. Presently, there are four ongoing projects at Maui Lani. They include Na Hoku and Traditions (single-

family homes), Sand Hills Estates (house lots), and Parkways (both house lots and single-family homes).

The demand for housing in the Central Maui area had been extremely strong up to mid-2006, with projects usually sold out prior to completion of construction. Due to the more recent downward trend of the economy and residential real estate market, developers are now finding themselves holding inventory and most new construction has ceased.

Meanwhile, Spencer Homes completed construction of a 410-unit affordable project in 2008, called Waikapu Gardens. Approximately half of the houses met County affordable housing pricing requirements. This project was welcomed by the community as "affordable" prices were stated to be below $300,000. This project gained approval by the Maui Nui Affordable Housing Taskforce which was set up in response to the growing need for affordable housing on Maui.

The demand for housing in the Central Maui area had been extremely strong up to mid-2006, with projects usually sold out prior to completion of construction. Due to the more recent downward trend of the economy and residential real estate market, developers are now finding themselves holding inventory and most new construction has ceased.

Up to 2006, Kihei had also seen an upswing in residential development brought upon by ongoing residential projects including Ke Ali'i Ocean Villas (townhouse condominiums) and Moana Estates (single-family homes) by Towne Development, Kamali'i Alayna (single-family homes) by Betsill Brothers, Inc., and Signature Homes' Hokulani Golf Villas (residential condominiums). Other current South Maui projects are Kilohana Waena (house lots) and Kai Ani (townhouse condominiums). Similar to Central Maui, the developers of ongoing projects have slowed construction while continuing to market their units; whereas, previous Kihei developments were often sold out prior to construction completion.

In Wailea, the Shops at Wailea and Wailea Town Center are the only established commercial developments. Both centers target the high-end residents of this resort community and Wailea's upscale visitors. Phase I of Wailea Town Center was completed in 2006 while Phase II was completed in 2007. It contains neighborhood services which include retail and office owner-occupants. The second phase included more commercial condominium units and residential units on the second floor. Current condo owners in this project include Coldwell Banker and First Hawaiian Bank. This development was met with high demand as all of the units have already sold and some have even

resold. Another commercial retail/office project, Wailea Gateway Center, was completed in 2009. Tenants include Coldwell Banker, Destination Resorts, Old Republic Title, Pita Paradise, and Subway, among others.

Retailing

In retail, the most significant addition to Maui is the Lahaina Gateway situated along Honoapiilani Highway across from the Lahaina Cannery Mall. It was dubbed as a "lifestyle center" with specialty retail shops, services and restaurants. Opened in late 2007, this 137,000 square foot center includes anchor tenants such as Office Max, Barnes & Noble, Outback Steakhouse, The Melting Pot, and Lahaina Farms, a supermarket owned by Foodland's Sullivan family. Prior to Lahaina Gateway, Maui Marketplace on Dairy Road was the last large retail development to be built, at 275,000 square feet. This center contains the likes of Lowe's Hardware, Office Max, Sports Authority, Pier One Imports, Burger King and Starbucks Coffee.

Wal-Mart and Home Depot are also located on Dairy Road, immediately west of the Maui Marketplace. These outlets joined earlier arrivals Costco and Kmart, as well as Alexander & Baldwin's neighboring Triangle Square, in carving up the Maui retail pie. However, the local malls are answering the challenge with more food and entertainment, and retailers that can compete in their niche. Maui's largest mall, Queen Kaahumanu Center in Kahului, has been challenged by the presence of these large box retailers and vacancies are very noticeable. The most recent and highly publicized closure was that of JC Penney in January 2003.

In Kaanapali, Whalers Village has taken a turn toward the luxury market popular with the Japanese. After completing a $3 million renovation and a change in its tenant mix, this oceanfront center now aims for both westbound and eastbound visitors. Japanese visitors are targeted with Duty Free Shoppers, Louis Vuitton, Prada, Loewe and other high-end shops.

The 150,000-square foot Shops at Wailea opened in 2000, offering upscale shopping in its high-end retail shops. Tenants include Louis Vuitton, Coach, Bally, Fendi, Tiffany & Co., Banana Republic, and Georgiou. Restaurants in this mall include Ruth Chris Steak House, Tommy Bahama Café and Emporium, and Longhi's. Other retailers include Crazy Shirts, Hot Topix, Gap, Wolf Camera, and Whalers General Store.

Agriculture

Agriculture on Maui is dominated by larger operations like Maui Land and Pine and Alexander & Baldwin's Hawaii Commercial and Sugar (HC&S).

Pineapple now confronts more foreign competition from places like Thailand. In 2007, the company shut down the canning portion of its operation to rely solely on the more profitable fresh fruit segment. Downsizing of the plantation occurred in 2008, which resulted in a reduction of over 200 employees. In December 2009, Maui Land and Pine shut down its agricultural arm, citing continued annual losses. However, a new smaller operation, Haliimaile Pineapple Company, was formed the following week and immediately took over pineapple operations.

HC&S survives as Hawaii's only remaining sugar operation because of its economies of scale, its shape (a compact area in the isthmus of the Valley isle rather than being strung out along some coastline, which facilitates cane hauling), and its decisions over the years to reinvest and upgrade plant and equipment. But the last active sugar plantation in the state is facing other hardships, namely water. There had been drought conditions on Maui between 2007 and 2009, contributing to low yields. According to HC&S, future viability is heavily dependent on continued stream diversion; however, those opposed to this practice have become ever-more vocal. HC&S plans to re-evaluate its operation at the end of 2010.

Another of Maui's sugar operation casualties, Pioneer Mill in West Maui, is missed visibly. For years, proponents of maintaining and sustaining Hawaii's sugar industry argued that growing sugarcane imparted to this economy an important, if underestimated, non-pecuniary benefit; sugar kept the land green and attractive, for tourists and locals alike, even if it lost money. Economists call this situation an "externality," an activity that affects others for better or worse, without those others paying or being compensated for activity.

Anyone who doubts that logic now has only to drive the West Maui coast from Olowalu to Kaanapali and look mauka, at an entire mountain side of dry brush and unused fields. As with many cases where sugar plantations have shut down, most diversified agriculture crops are just not land intensive enough to utilize all the vacant land. Coffee and seed corn operations are possibilities, but they make only a small dent.

In addition to sugar and pineapple cultivation, Maui also offers rich opportunities for agricultural diversification by small farmers and large agribusinesses. Top among new agricultural products are: papaya, cut flowers, coffee, Kula onions and strawberries, and Chinese cabbage from Kula. Molokai offers its sweet potatoes, Molokai lettuce and alfalfa, as well as taro.

High-Tech

Maui's contribution to Hawaii's fledgling high-tech industry remains pre-eminent in the state. It also represents genuine diversification of

the economy. The Maui Research and Technology Park in Kihei has all of it's infrastructure in place, and has completed three major building projects. Most important, it houses one of the country's most powerful supercomputers. The park now hosts over 30 companies and aver 300 employees on 415 acres.

With access to one of the most powerful supercomputers in the world, funded by the U.S. Air Force, the Maui Research and Technology Park is continuing its efforts to diversify the Maui economy into something fundamentally different from what exists in the county or anywhere else in the state.

An office building was developed by the Maui Economic Development Board in 2006, and contains approximately 31,500 square feet of rentable area on a 2.8-acre site. Another completed project is Park Plazo, a 15-unit commercial office condominium building developed by Goodfellow Brothers and Betsill Brothers. Both Goodfellow and Betsill plan to occupy just over half of the entire building. Since its completion in 2008, sales have been very sluggish.

The park is sticking to its long-run strategic plan to capitalize on its location at the center of the Pacific Basin. Its extensive fiber-optic network to the U.S. Mainland makes it one of the most fiber-rich environments in the world, greater than many facilities actually located on the Mainland.

County Government

Maui County is unique in having several inhabited islands in its jurisdiction: Maui, Molokai, as well as Lanai, and the uninhabited island of Kahoolawe.

Maui County has an elected Mayar and County Council, and the Board of Water Supply and Liquor Control Commission are semi-autonomous with appointed directors. Although all courts are conducted by the State, the County is responsible for prosecution and the Mayor appoints the prosecutor. The council has nine members, each residing in one of nine districts; however, voters cast ballots for all nine seats.

Unlike other states, Hawaii has only two layers of government: State and County. The State is responsible for many functions that elsewhere come under the jurisdiction of municipalities, such as schools, hospitals, and airports. Also, unlike other states, Hawaii has statewide zoning carried out by the State Land Use Commission. The County has zoning authority within the boundaries established by the commission.

The County of Moui is encountering a lack of affordable housing. Maui is one of the most expensive counties for single-family home buyers. A record high median price of $780,000 was set in July

2006 for a single-family hame. Since then, the median single-family price has continued to fall, with an average monthly median sales price af $498,708 in 2009, down from $574,760 in 2008 and $627,137 in 2007. According to the latest State of Hawaii Data Book, 8 percent of the houses are overcrawded on Maui and 41.4 percent of the households pay more than the recommended limit of 30 percent of their incame on housing. In fact, 27.1 percent pay more than 40 percent on housing.

This heightened effort by the County resulted in the passage of Ordinance 3418 on December 5, 2006, under which all proposed developments are subject to review if they are to cantain five or more units or lots. Under this ordinance, if the average sales price is projected to be less than $600,000, 40 percent of the total units must be priced to meet the various affordable categories. If the average sales price in the project is $600,000 or more, then 50 percent of the units must be affordably priced. An alternative to providing the affordable units is to pay an in-lieu fee equal to 30 percent of the average projected sales price of the market rate units multiplied by the number of affordable units required in the development. Or, the owner may elect to provide land which is equal in value to the in-lieu fee. This ordinance has had a profound effect on residential development since its passage. The subsequent reduction in proposed projects had many in the building and real estate industries questioning whether the ordinance created too much of an obstacle for developers.

In an effort to stimulate residential construction, the ordinance was revised by the County Council on February 26, 2010, as Ordinance No. 3719, reducing the amount of required affordable housing units built on site to 25 percent, provided the average sales price of the market units is projected to be less than $600,000. If the average sales price in the project is $600,000 or more, then 50 percent of the units must be affordably priced. The new law also clarified the calculation of required affordable units built off site; based on 50 percent of the total number of on-site market units, regardless of their projected average sales price. Time will tell if this latest version of the ordinance will help to achieve its intended goal.

The water availability ordinance is another law that has made an impact on the development cammunity. On December 14, 2007, the County of Maui passed into law Ordinance 3502. As a result, the Department of Water Supply (DWS) is presently restricting the issuance of meters for all uses in the central and south Maui service areas and this bill restricts issuance of any building permits until the DWS can issue a meter consistent with the provisions of the bill. In order to do so, the DWS director needs to provide verifiable, long-term supply of water to the property. Landowners and professionals

in the development community have been openly critical of the ordinance, some calling it a de facto moratorium on housing. Not surprisingly, sales of vacant development lands have been very scarce.

B. NEIGHBORHOOD DESCRIPTION

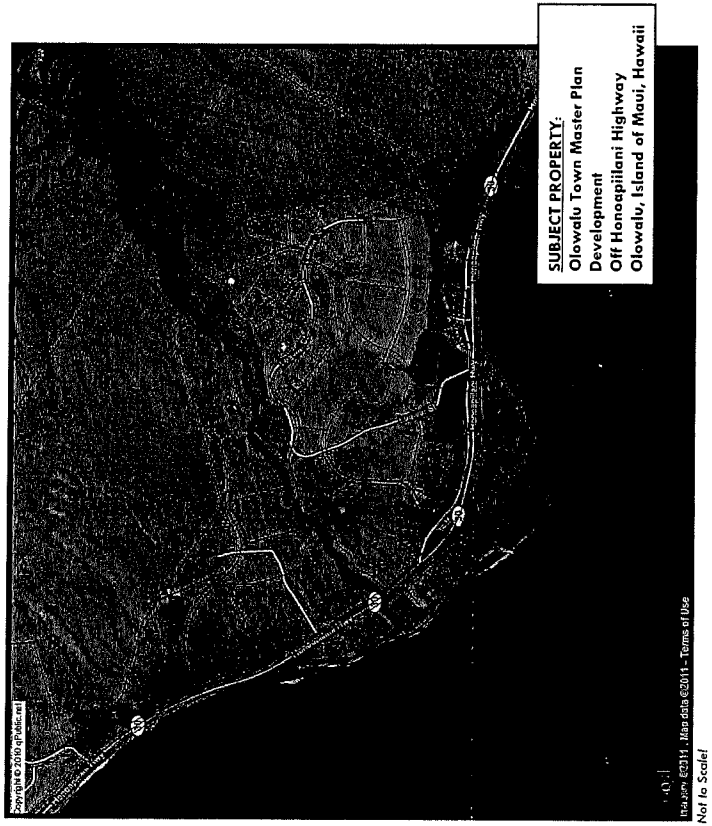
Since real estate is fixed in location, its marketability and rentability are strongly influenced by economic and social trends in its immediate environment. The continuing attractiveness of this neighborhood environment to potential users and tenants, and its competitive relation to those of substitute properties, must therefore be evaluated and forecast by the appraiser. In particular, perceived neighborhood trends affect both the quality and quantity of the revenues the subject property can reasonably be expected to generate.

A neighborhood of income-producing properties is a geographic area characterized by similarity of uses and/or users, within which any change has a direct and immediate effect on the subject property and its value.

The geographic area surrounding the subject property is defined by physical and man-made boundaries, and encompasses an area known as Lahaina, which is located on the western slopes and coastal plain of west Maui. Its common boundary with the Wailuku Judicial District begins at the southern shore of west Maui, about two miles west of Papawai Point. Beginning at this point, the Lahaina region boundary travels mauka along the centerline of the Manawainui Gulch to the ridgeline of the West Maui Mountains. The boundary then continues in a northerly direction to Eke Crater then due North along Poelua Gulch to the northern shoreline of West Maui. West Maui generally includes the greater Puamana, Lahaina Town, Honokowai, Mahinahina, Napili and Kapalua neighborhoods.

Development also reflects the region's visitor and agricultural industries. Visitor accommodations are located at the shoreline along with necessary support facilities and residential communities. Kapalua and Kaanapali have developed into important visitor destination anchors while the old Lahaina Town with its historic character and charm has developed into the regions visitor, service, commercial and residential center. Small plantation camps and agricultural communities are located further inland.

Access to Lahaina from other parts of Maui is via Honoapiilani Highway, a State thoroughfare consisting of two asphalt-paved lanes, which widens to four lanes between Lahaina and Kaanapali. Extending past Launiupoko Park to the south of Honokowai Park is a proposed Lahaina by-pass.



NEIGHBORHOOD MAP

In order to fully understand and appreciate the potential for expansion, as well as factors that could limit the growth of this region, a brief summary of recent or proposed developments in this area, along with a few important issues facing future development are in order.

Residential

Population and urban settlements in the Lahaina region are located at Olowalu and in a narrow band along the shoreline between the southern end of Lahaina and Kapalua. At Lahaina Town, settlement patterns extend mauka at Wahikuli and along Lahainaluna Road. This development pattern is set in the midst of former sugar cane and pineapple fields, at the base of the West Maui Mountains.

Residential neighborhoods directly in Lahaina Town are generally older, and many of the wood-framed dwellings (over 50 years old) are slowly being replaced with new homes. These properties were subdivided prior to the inception of the Maui County Code; consequently, land sizes of residential properties in Lahaina may vary anywhere from 1,600 to 30,000+ square feet instead of the 6,000 square foot minimum requirement set by the Maui County Code.

Only a handful of new residential subdivisions or condominium projects have been developed within the past few years. The most recent projects include the Mahanalua Nui, Makila and Pu'unoa agricultural subdivisions in the Launiupoko neighborhood, Lanikeha and Kaanapali Coffee Estates in Kaanapali; the Kapua Village Subdivision and Villas at Kahana Ridge in Kahana; and Honolua Ridge in Kapalua.

With the continued demand for workforce housing in West Maui, more focus has been made on the development of affordable units. One such contributor was Kapua Village, an employee housing project for Maui Land and Pineapple employees built in 2003. It consists of 46 affordable, single-family residential lots in the Kahana neighborhood of West Maui. The other project to bring affordable housing units to the region was the Villas at Kahana Ridge condominium project which added 117 affordable units to the market in 2005. Both projects were well received and sold out in a short time period.

Recently completed condominium projects on the West Side include Opukea in Lahaina, West Maui Breakers in Honokowai, as well as the Honua Kai development on Kaanapali Beach which is the first new oceanfront condominium development in this area in 20 years.

Commercial

Lahaina Town, the central hub of the Lahaina area, was once the capital of the State of Hawaii. Since the move of the capital to Honolulu, Lahaina Town has transformed into a major visitor oriented area replete with shopping centers, boutiques, and restaurants. It also contains the central business district of this region, with a number of

professional office buildings, financial institutions, post office, medical facilities and service businesses. These types of businesses are situated along the interior roadways of Dickenson Street, Wainee Street, Papalaua Street, and Lahainaluna Road.

The 600 to 800 blocks of Front Street, situated along the ocean, are a shopping mecca frequented by hundreds of tourists each day. This popular commercial corridor commands the highest retail rents on Maui. One of the major developments on the 600 block is the Wharf Cinema Center which contains three levels of retail and restaurant space which is a popular stop for tourists and residents. Built in 1978, it reflects a traditional look of old, wooden oceanfront buildings. Also on the 600 block is the redeveloped Six Fathoms building, a retail building which has generated renewed interest in this southern section of the shopping district. At the northern end of the corridor is Lahaina Center, a 150,000 square foot commercial complex with an 800-stall parking lot. It includes such tenants as the Hard Rock Café, Hilo Hatties, and Ruth Chris Steak House and a multi-screen movie theater.

The other major retail area is situated approximately 5 miles northeast of Lahaina Town in the planned development of Kaanapali. The exclusive Kaanapali Resort is home to a number of hotels including the Hyatt Regency, Marriott, Westin, and Sheraton. Besides the luxurious hotels, Kaanapali includes all of the resort-type amenities including condominium developments, championship golf courses, custom single family homes, restaurants, shopping and other recreational facilities. Whalers Village sits on 8.5 acres of prime Kaanapali oceanfront property with close to 60 shops and restaurants, a food court and whale museum. Developments such as the Hyatt Regency, Maui Marriott Hotel, Kapalua Resort, the Lahaina Cannery Shopping Center, along with numerous new businesses geared primarily to the visitor trade, had strengthened the employment center of West Maui.

Since late-2008, West Maui has seen a drop in tourism numbers, similar to the rest of the State. This was attributed to the global financial crisis, which stalled economic growth nationwide. This has led to the closure of businesses and created a number of retail vacancies. Even Lahaina Town, which rarely has available commercial space, has seen a significant drop in asking rents.

Meanwhile, several ongoing projects were completed, and are expected to have a significant impact in West Maui. The Ritz-Carlton Kapalua completed a 180 million dollar transformation in 2008 and now provides 463 guest rooms, Club level accommodations and the addition of one and two bedroom Residential Suites. The hotel is tiered down a 37-acre hillside and includes a spa, four world-class

restaurants, fitness center, tri-level swimming pool, and over 150,000 square feet of meeting space.

In 2008, West Maui also saw the opening of Lahaina Gateway. This 145,000-square foot center is perched on an 11-acre site directly across Lahaina Cannery Mall. Dubbed a neighborhood "lifestyle" center, this shopping destination features specialty stores and service providers including Barnes & Noble, Outback Steakhouse, Melting Pot, Office Max, and Lahaina Farms, in addition to many other smaller businesses. Directly across Keawe Street, construction also began on a Burger King, Kentucky Fried Chicken, Panda Express and Walgreens.

There are two industrial parks in Lahaina: The Lahaina Business Park and the Wili Ko Industrial Subdivision. The Lahaina Business Park is the newest development with recently completed buildings in both Phases I and II. One of the largest projects within the park is the Emerald Plaza complex which consists of three phases, comprised of Emerald Plaza, Emerald Plaza Center and Emerald Plaza Place. These developments have seen regular sales of their spaces within the past several years. Continued building within both phases of the park is expected to continue through the next few years.

After more than 20 years of discussion, planning and design, the construction of the Lahaina by-pass began in April 2009. Extending past Launiupoko Park to the south of Honokowai Park, the 9-mile corridor should relieve much of Lahaina Town's traffic congestion when completed.

Conclusion

All public utilities including electricity, water, telephone and sewer service are available to the greater Lahaina area. Police and fire protection are provided by stations directly in Lahaina, as well as ambulance service. Shopping, schools, and other commercial, civic, recreational and religious facilities are located within Lahaina Town. Airline service to the Lahaina area is provided by commuter airlines into the Kapalua-West Maui Airport.

In previous years, the primary source of employment was provided by the Pioneer Mill. Since the mill's closure, however, the development of hotel resorts had created new job opportunities and the demand for employees had grown substantially. This demand for employees spurred growth in the area and also growth in commercial and other support activities. Inherent with this growth is the strain on the limited infrastructure in West Maui, as well as a keen shortage of available and affordable housing.

Due to the large land holdings of private companies and the State of Hawaii, available land in Lahaina for private, individual ownership is limited and subsequently, land values have risen steadily. The

availability of affordable residential lots is expected to be in short supply for the foreseeable future.

The continued growth of Lahaina as a large urban area, as well as a major resort destination, is anticipated to be a catalyst for further growth in residential, commercial and various support facilities over the long term.

C. PROJECT DATA

Environs

The subject is located on the southwestern foothills of West Maui Mountains, approximately four (4) miles south of Lahaina Town. Olowalu Town is presently a small residential community with limited services available to residents, including Olowalu General Store. Surrounding the store are plantation-era single-family residences, including a residential cluster located to the south, known as Kapaiki Village, and the former plantation manager's house, associated residences, and Camp Olowalu (formerly Camp Pacusa) located makai of Honoapiilani Highway.

The lands surrounding Olowalu have been utilized for small farming operating or have remained fallow. The lands that comprise Olowalu have been subdivided, with a limited number of lots sold to individual purchasers. The majority of the lands surrounding the existing village are retained under ownership by Olowalu Elua Associates, LLC and Olowalu Ekolu, LLC.

Description of the Proposed Project

The subject currently consists of twenty-two (22) agricultural parcels and five (5) roadway lots encompassing approximately 636 acres. The Olowalu Town Master Plan will combine conservation, agricultural, rural and urban land uses to re-establish a small-scale and mixed-use community as a center of employment, housing and recreation. The Master Plan will also be guided by the values and principles of the "Ahupuaa" which will re-establish agricultural uses along Olowalu Stream.

Olowalu Town Master Plan is designed to be a pedestrian-friendly community which will allow residents to live within walking distance of corner stores, schools, parks, employment centers, gathering areas, beaches/shoreline, and other social and civic resources, ultimately reducing reliance on automobiles. This "mixed-use community" will provide for a wide series of uses, including residential, commercial/business, agricultural, civic, social, parks, and open-space. The land uses will be categorized into a range of zones which will transition from the central neighborhood town centers to rural to agricultural and natural.

The Olowalu community will consist of 1,500 residential dwelling units to be built concurrent with appropriate infrastructure in phases spread out over a period of approximately 8 to 10 years. The majority of the dwelling units will be located within the urban zones where residents will have easy access to daily goods and services. A variety of single-family and multi-family dwellings are included in the Master Plan, comprised of houses, condominiums, apartments, flex house (live-

work), cottages, rural homes and farmsteads offered at a wide-range of income levels for both rental and fee ownership.

Table 1 – LAND USE ALLOCATION SUMMARY

Land Use Category	Approximate Acreage	Approximate Percentage	Typical Uses	Approximate Distribution of Dwelling Units
Urban (Neighborhood Town Centers)	160 to 175	25% to 30%	Higher density mixed-use: single-family homes on small lots, multi-family apartments, town-houses, offce/retail, restaurants, live-work units (flex house), small scale lodging, town greens, pocket parks, playgrounds, plazas/squares, bikeways, greenways	1,200 to 1,350 units (85% to 90%)
Rural	135 to 145	20% to 25%	Medium to low density rural residential: single family homes on 1/2 acre or larger lots, parks, bikeways, greenways	150 to 225 units (10% to 15%)
Agriculture	35 to 45	5% to 10%	Agricultural farmsteads and dwellings, community gardens	15 to 45 units (1% to 5%)
Natural	255 to 270	40% to 45%	Active/passive parks, gathering facilities, greenways, bikeways, trails, ball fields, open-space	N/A
Civic	20 to 30	3% to 5%	Police, fire, medical, educational facilities, library, community and cultural centers, outdoor amphitheater	
TOTAL	**635**			**Approximately 1,500 units**

Table 2 – RESIDENTIAL HOUSING TYPES

District	Dwelling Types
Urban (Neighborhood Town Center)	Higher density single-family dwellings on 5,000 to 10,000 sq. ft. lots, cottages, townhouses, multi-family apartments (low and medium density), and flex house (live/work)
Rural	Medium to low density single-family dwellings on minimum half (0.5) acre lots; accessory dwellings
Agricultural	Farm dwellings on minimum two (2) acre lots

PART III – ANALYSIS AND CONCLUSION

For the purpose of estimating the market response to this planned development, a market study was conducted to determine how supply and demand for residential housing units, as well as commercial and agricultural properties might be affected by the development of the subject's 636 acres.

OVERVIEW

When determining an absorption rate for an individual project, such as a single-family residential subdivision or one multi-family residential development, there are typically two components: First is the design and pricing of the proposed project. Second is the overall market environment at the time of pre-sale and project completion. The latter is obviously more difficult to define because it involves forecasting such variables as interest rates, overall market conditions, and general and specific sector reol estate market conditions.

The added complication with most projects is the time frames and time lags involved. Since most subdivisions or condominium projects take several years between conception and completion, market and interest rate conditions can change significantly. Thus, a project may commence in a favorable environment and be completed in an unfavorable one (or vice versa). Furthermore, real estate is a cyclical industry and sales activity tends to move in spurts. It is not unusual for a new project to sell half its units in the first year of marketing ond require 2 to 3 years (or longer) to sell the remaining half.

However, accurately predicting an absorption rate becomes even more challenging for a large-scale planned development, like the subject, where full build-out may take up to 10 years or longer. Of course, these time periods could expand or contract depending upon market conditions. Thus, the notion of a linear sales rate may be deemed unrealistic for practical purposes, but is a useful and convenient tool for planning.

In light of the significant changes currently underway for numerous County of Maui planning policies, such as the Countywide Policy Plan and Maui Island Plan, the Consultant has primarily focused on long-term supply and demand characteristics to give the reader the best perspective of the overall market.

A. RESIDENTIAL MARKET ANALYSIS

RESIDENTIAL SUPPLY CHARACTERISTICS

Olowalu Town is conveniently located between South Maui ond West Maui, but is categorized as being within the West Maui district. It

follows that the subject's primary market area is the West Maui region, while Central Maui, South Maui and Upcountry Maui are expected to be secandary markets. West Maui is a major tourist destination and is home to the famous Front Street retail corridor which allows for pedestrian access to numerous retail establishments within Old Lahaina Town. Further north of Lahaina are the Kaanopali and Kapalua master planned resorts. Central Maui is home to the County and State government offices and is the industrial center of the island with convenient access to the major transportation facilities. South Maui has become a tourist destination with its expansive beaches and retail establishments targeted towards the visitor industry. The resort neighborhoods of Wailea and Makena are also located in South Maui. Upcountry Maui consists primarily of rural residential subdivisions and agricultural farmland.

A survey of the market revealed that there are over 2,300 housing units currently far sale within recent, on-going projects and those developments which are planned for construction within the next one to two years. Based solely on historical annual absorption rates of other new projects (590 units per year from 2001 thraugh 2010), the short-term market supply would be expected to last approximately 4 years. Of course, a multitude af other factors can influence the capture rate. For instance, the larger percentage of affordable units in the future supply points to a faster-than-normal absorption. Also, the number of buyers from the U.S. mainland and from foreign countries can fluctuate from year to year, and their presence in the market is not as predictable as the demand from local residents.

Olowalu Town is being created to help fulfill long-term residential supply on the island; however, it is very difficult to accurately predict future residential supply over the long term. As mentioned earlier, many external factors, such as economic or social factors, could affect the supply and demand for real estate in the future. These factors cannot be controlled by developers who must constantly assess market conditions for their prospective construction and sales periods. Many of these projects are still in the initial planning phases and must still complete governmental requirements before bringing their products to the market. Combine these factors with "internal" events that could affect a developer and predicting which developments will actually make it to market becomes more difficult.

The following information was excerpted from a "Directed Growth Areas Listing and Units" table, dated October 1, 2009. This table listed the long-tem future supply recommendations of the Draft Maui Island Plan, for consideration by the Maui County Council. As shown, the estimated supply for Maui, to the year 2030, is 11,623 housing units. Central Maui has the largest share of future housing units on the island, with 4,850 units planned. The largest component of future

growth in Central Maui is the Wai'ale project, which accounts for over 50 percent of the planned units in Central Maui. The Consultant notes, however, that the future supply of 11,623 housing units island-wide to the year 2030 exclude the subject's 1,500 planned units.

Table 3 – Recommended Long-Term Residential Growth Areas

DIRECTED GROWTH AREAS LISTING AND UNITS
Department of Planning, October 1, 2009

Area	Acres	Assumed Density Per Acre	Units
CENTRAL MAUI			
Wailuku Infill			125
Kahului Infill			500
Waikapu Area	42	6.26	263
Wai'ale Area	384	6.65	2,554
Tropical Plantation Homes	260	4.50	1,170
Pu'unani	53	4.49	238
Total Central Maui	739		4,850
WEST MAUI			
Mahinahina Area	116	6.00	696
Ka'anapali Town	563	2.05	1,154
Lahaina Town North	181	4.42	800
Lahaina Infill	22	11.25	248
Kahoma Area	18	4.89	88
Lahaina Town South	136	4.45	605
Makila Area	20	2.00	40
Total West Maui	1,056		3,631
SOUTH MAUI			
Kihei Mauka			1,500
Revitalization Infill			400
Total South Maui	0		1,900
NORTH MAUI			
Pa'ia Town	46	4.50	207
Total North Maui	46		207
UPCOUNTRY MAUI			
Makawao Expansion	98	2.80	274
Pukalani Expansion	101	5.55	561
Total Upcountry Maui	199		835
EAST MAUI			
Hana Area	100		200
Total East Maui	100		200
ISLAND GRAND TOTAL	**2,140**		**11,623**

New Construction

According to the Maui County Data Book 2009, new single-family construction, which fell from its high in 1988, appeared to recover somewhat in the 1990's and was generally stabile between 2004 and 2007.

Table 4 – New Construction Island of Maui

Year	Number of New Single-Family Units	Five-Year Average
1980	803	
1981	398	
1982	530	
1983	547	
1984	638	
Subtotal	2,916	583
1985	984	
1986	911	
1987	1,119	
1988	1,453	
1989	1,136	
Subtotal	5,603	1,121
1990	1,068	
1991	694	
1992	810	
1993	660	
1994	673	
Subtotal	3,905	781
1995	473	
1996	601	
1997	532	
1998	574	
1999	647	
Subtotal	2,827	565
2000	904	
2001	778	
2002	787	
2003	877	
2004	1,104	
Subtotal	4,450	890

2005	967	
2006	1,008	
2007	1,050	
2008	527	
2009	273	
Subtotal	3,825	765

Source: Maui County Data Books 2002 through 2010

New single-family construction averaged 583 units during the five years between 1980 and 1984. During the next five years, 1985 to 1989, single-family housing starts increased significantly to an average of 1,121 per year. During 1990, house construction was also good at 1,068 units, but declined significantly following the Persian Gulf War and the economic slowdowns on the U.S. mainland and in Japan. Consequently, between 1990 and 1994, there was an average of 781 new single-family units built per year. From 1995 to 1999, construction of these units declined even more, with an average of only 565 units per year. In 2000, the number increased significantly to 904 units and then declined in 2001 to 778 units. The number of units remained nearly identical in 2002 with 787 units. In 2003 this number increased again to 877 units. Single family building permits in 2004 reached a total of 1,104, which is its highest level since the late 1980's, prior to declining to 967 in 2005. A small rebound to 1,008 was realized in 2006, followed by an increase to 1,050 in 2007. In 2008, there was a huge drop in permits issued, to only 527, and a further decrease in 2009 to only 273 permits. (Refer to **Table 4**, starting on Page 30). The average for the past 5 years is 765 units per year.

Currently, revisions to Maui's urban growth boundary are being considered by the County Council. Land located outside the boundary may have a more difficult time becoming entitled, which would translate into less project starts. Without an adequate supply of new construction projects, the resulting shortage of housing typically causes prices in general to move up. As a result, those at the bottom end of the income scale usually find it most difficult to purchase real estate. Historically, supply has lagged demand and is a significant limiting factor in the affordability of real estate in the Maui market.

Maui County Workforce Housing Ordinance

In December 2006, the Maui County Council enacted the Residential Workforce Housing Ordinance. The purpose of the ordinance is to enhance the public welfare by ensuring that the housing needs of the County are addressed. The intent of the policy is to encourage the provision and maintenance of residential workforce housing units, for both purchase and rental, to meet the needs of income-qualified

households for the workforce, students, and special housing target groups.

Essentially, all applicable residential development after the passage of this ordinance, including the subdivision of land and/or the construction of single-family dwelling units; two-family dwelling units; multifamily dwelling units; or hotels; shall be subject to the policy upon final subdivision or building permit approval. Applicable residential development includes, in part: five or more dwelling units, excluding farm labor dwellings or a second farm dwelling, not part of a condominium property regime; five or more new lots; a combination of dwelling units and new lots totaling five or more.

Prior to final subdivision approval or issuance of a building permit for a development, the developer was to enter into a residential workforce housing agreement that required forty percent of the total number of units and/or lots to be sold or rented to residents within established income-qualified groups, when more than fifty percent of the dwelling units and/or new lots in the development were to be offered for sale far less than $600,000. When fifty percent or more of the dwelling units and/or new lots in the development were to be offered for sale for $600,000 or more, fifty percent of the total number of units and/or lots was to be sold or rented to residents within established income-qualified groups.

Landowners wha had already received entitlements, or were at least in the approval or permitting process, were granted an exemption from these requirements; and clearly have an advantage over those who began their entitlement process post-passage. One of the initial concerns to developers was the reduction in sales revenue. Coupled with unprecedented increases in construction costs, potential projects could become financially unfeasible.

Since the passage of this ordinance, there has been a notable drop in new residential construction project starts. Granted, the downward trend of the real estate market, mixed with declining national and local economic conditions, has also led to less construction. However, many in the building industry are of the opinion that the Workforce Housing Ordinance has had the opposite effect from its original intent.

In February 2010, the Maui County Council revisited this ordinance and made several revisions, including reducing the amount of required affordable housing units built on site to 25 percent, provided the average sales price of the market units is projected to be less than $600,000. If the average sales price in the project is $600,000 or more, then 50 percent of the units must be affordably priced. The amended law also clarified the calculation of required affordable

units built off site; based on 50 percent of the total number of on-site market units, regardless of their projected average sales price.

The Olowalu Town Master Plan Development calls for 1,500 residential units. Of this total, the developer will provide 750 homes (single-family and multi-family) to satisfy the County's workforce housing ordinance.

Maui County Water Availability Ordinance

In December 2007, the Maui County Council enacted the "water availability policy", identified as Title 14 of the Maui County Code. The purpose of the ordinance is to acknowledge and affirm that water is a natural and cultural resource that must be protected, preserved and managed as a public trust, and requires verification of a long-term, reliable supply of water before subdivisions are approved. This policy applies to all new subdivisions with the exception of family subdivisions and subdivisions that will not be regulated by a public water system.

In essence, this policy requires developers who want to build a subdivision or condominiums to first prove to Maui County that they have a long-term source of water. The policy stipulates that no subdivision shall be approved, unless prior to submittal of subdivision construction plans, the director shall provide written verificotion of a long-term, relioble supply of water. Written verificotion by the County shall not constitute an assurance, covenant, or warranty by the County of woter source from a private, non-County system.

Mony developers on Maui have been outspoken critics of the ordinance, even calling it a de facto moratorium on housing. Developers have also complained that the ordinance will halt some much-needed new construction. However, proponents of the policy say that the ordinance is a significant step toward getting Maui's water shortfall under control. Furthermore, it closes a long-standing loophole for developers that held the County responsible for providing water service. For example, a developer could go through the entire process of planning, developing and selling the lots in a subdivision without guaranteeing the home buyers that they would receive a water meter from the County.

As of the effective date of this report, the property owner is exploring numerous options regarding water service for Olowalu. These would include creating additional sources in partnership with the County, as well as the development of a private system. Wastewater disposal will likely be accomplished by connection to the County system, however, engineering studies and discussions with the County are ongoing.

RESIDENTIAL DEMAND CHARACTERISTICS

Demand is analyzed from two perspectives: The first is "demographic" demand, the number of units needed for a given market or employment base. Second is "effective" demand, the financial demand equation which involves looking at the number of buyers who would be qualified and interested in purchasing residential real estate.

Population

Population growth on Maui between 1980 and 1990 had been exceptionally high, and had outpaced the County's ability to provide adequate infrastructure and housing for this added number of people. Overall, population growth for the County of Maui during 1980 to 1990 was 41.67 percent. With this growth in population came a surge in real estate prices in the late-1980s. This increase, driven primarily by foreign and domestic investment and speculation, put the price of homes in Maui County well above the reach of many local residents, and affordable housing became a major concern to everyone.

The downturn in the economy between 1991 and 1997 led to the development of lower-priced housing as large land parcels became more affordable to developers. Zero-lot-line zoning was adopted by the County of Maui and the Meadowlands project in Kihei was among the first to be built. Three smaller zero-lot-line subdivisions were developed in West Maui between 1996 and 1998 and were highly successful.

Meanwhile, the population of Maui County continued to grow during the 1990s. Between the 1990 and 2000 censuses the population increased by 28.5 percent, making Maui the fastest growing County in the State of Hawaii. According to Claritas Market Comparison Report (See **Exhibit A** at the end of this report), leading the growth on Maui was the South Maui (Maalaea-Kihei-Wailea-Makena CDPs) region which reflected growth of 49.0 percent increase over the 10-year period. The Central Maui region of Kahului and Wailuku registered growth of 26.5 percent; while the West Maui region indicated a growth factor of 23.3 percent over the same 10-year period. The growth trend has continued since the end of 2000. The 2010 population estimates have indicated growth rates for South and West Maui in the 18 to 21 percent range, while growth in Central Maui has increased by approximately 14.5 percent over the respective population indicated in the 2000 census.

The growth in the number of households between 1990 and 2000 paralleled the population pattern. Household numbers grew in the south, west and central regions at the respective rates of 46.4, 23.9 and 26.4 percent.

According to Resident Population Projections, by County: 2005 to 2035 (State of Hawaii Data Book 2009, Table 1.28), the projected population of Maui County is expected to be 189,300 by 2030 and 198,727 by the year 2035. The 2030 and 2035 estimates represent 47.8 and 55.1 percent increases over the 2000 census numbers, respectively.

Employment and Household Income

The unemployment rate on Maui had been on a decline since 1992 when unemployment was at 8.0 percent. In 2007, the unemployment rate was 2.8 percent. For 2008, this rate rose to 4.5 percent, after seeing month-over-month gains beginning May 2008. This trend continued in 2009, with the average unemployment rate jumping to 8.7 percent. The unemployment rate was 8.8 percent in January 2010 and had climbed to 8.9 percent by March; however, April through July has showed a stable trend, keeping between 8.2 and 8.5 percent. (*Source: State of Hawaii Department of Business, Economic Development & Tourism Monthly Economic Indicators*).

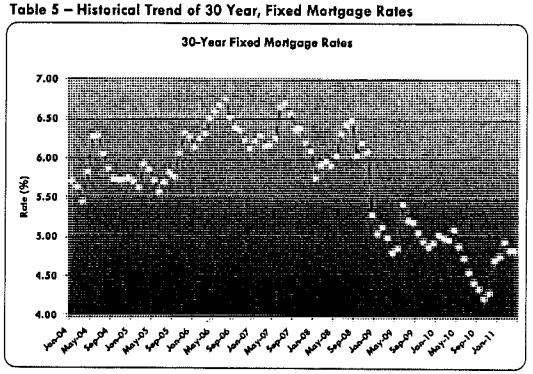
Household income figures have also been increasing. The estimated median annual household income for Maui in 2010 is $76,000 (*Source: U.S. Department of Housing and Urban Development*), a rise of approximately 53 percent over the 1999 median household income of $49,489 (*Source: US Census 2000*) and a 96 percent increase over the 1989 figure of $38,771 (*Source: US Census 1990*). During the 12 year period from 1999 to 2010, this represented an average increase of over 4 percent per year.

By comparison, the average median sales price for a single-family home on Maui went from $252,874 in 1999, up to $498,708 in 2009. This represented an increase of 97 percent over an 11-year period, or an average of over 8 percent per year. Although median prices have fallen since 2006, many potential buyers continue to be priced out of the market.

Mortgage Interest Rates

From late-1991 to 2002, mortgage rates varied from 6.0 to 9.0 percent. In 2003, mortgage rates for a 30-year fixed rate mortgage fell below 6.0 percent for the first time since Freddie Mac began tracking 30-year mortgage rates in 1971. Over the next six years, the monthly interest rate fluctuated between 5.23 and 6.76 percent. However, due to cuts to the Federal Funds Rate in late 2008, interest rates in 2009 dipped below the 5.0 percent level on numerous occasions. The average interest rate for 2009 was 5.04 percent. In 2010, the interest rate averaged 4.69 percent, with the lowest rate seen in October at 4.23 percent. As of April 2011, mortgage rates hovered around 4.8 percent. Records that reach back earlier than Freddie Mac's indicate that this rate is below record lows witnessed in the 1940s, during World War II. (See **Table 5** on following page).

Table 5 – Historical Trend of 30 Year, Fixed Mortgage Rates



Source: Freddie Mac-Primary Mortgage Survey

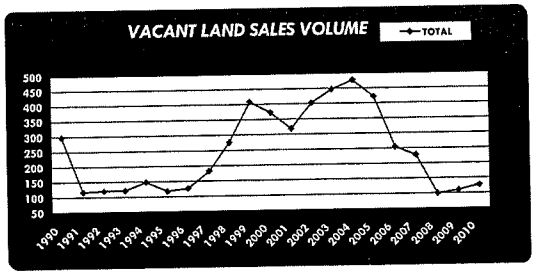
General Residential Sales Activity
Island of Maui

The number of units sold is the most basic indicator of market activity and is useful in helping estimate the number of new units which a specific market segment may be capable of absorbing. The downturn in the economy between 1991 and 1998 led to development of low-priced housing on Maui. Zero-lot-line housing projects were popularized during this period as developers strived to make housing affordable to Maui residents. Since 1998, however, real estate began a strong recovery. As evidenced in the following section, prices and number of sales increased while marketing times decreased, up to 2006. Since then, the market has headed in the opposite direction, with year-to-date 2010 showing some evidence of stabilization. The tables on the following pages illustrate the general market trends over the past 20 years on Maui, from 1990 through 2009.

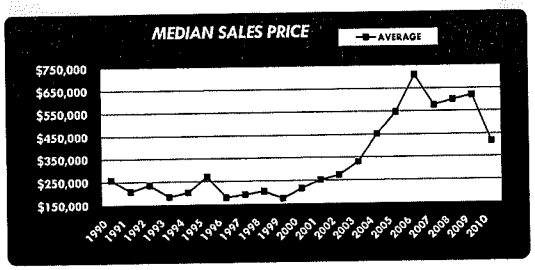
Vacant Land

Sales of vacant land fell sharply after 1990 (298) to a level wavering around 100 to 150 sales for the next 6 years. Weakest sales, in terms of units sold, occurred in 1991 when only 116 properties were sold. In 1998, the number of land sales increased to 276 and in 1999, increased again to 408, reflecting a gain of 48 percent. Sales have fallen slightly since 1999 with 372 sales in the year 2000 and 318 sales in 2001; however, these figures rebounded in 2002, 2003 and 2004 to 402, 447 and 477, respectively. Vacant land sales for 2005 showed a slight decrease at 421 transactions, but dropped 39 percent in 2006, with only 255 sales. This trend continued in 2007, albeit with a more stabilized decrease of 11 percent, at 226 sales. However, in 2008, vacant land sales

decreased significantly by approximately 56 percent with only 99 sales. For 2009, there was a slight uptick of 11 percent, to 110 sales, and in 2010 the upward trend continued with an increase in salees of 15 percent.

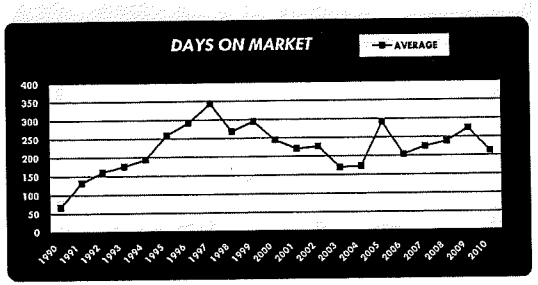


Meanwhile, median prices slowly regained ground from a low of $173,458 in 1999 to $269,691 in 2002, and then sharply increased to $336,690 in 2003, $446,563 in 2004, and $546,081 in 2005. In 2006, the median price jumped approximately 30 percent to $709,000, but retreated by 19 percent in 2007, to $570,438. In 2008, the median sales price slightly increased by almost 4 percent, to $599,470. A 3.4 percent gain was seen in 2009, evidenced by a median of $619,808. However, in 2010 the average median price fell by 32 percent.



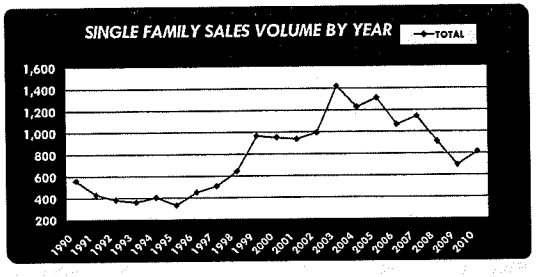
Median monthly days-on-market figures increased steadily from 67 in 1990 to 344 in 1997, but had fallen to 227 in 2002, to 170 days in 2003, increasing slightly to 173 days in 2004. This average escalated in 2005 to 291 days but dropped 29 percent to 204 days in 2006. In 2007, the average marketing time increased 10 percent to 225 days, followed by an increase of 6 percent in 2008 to 239

days. Then, in 2009, marketing time jumped to 274 days, or over 14 percent. In 2010, the average days on market decreased by 22 percent to 213 days.

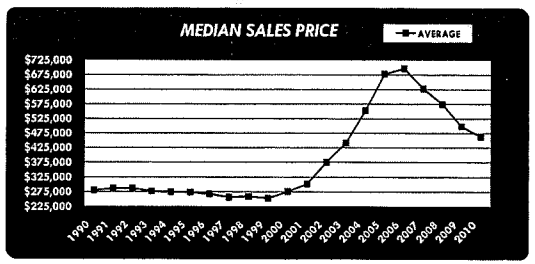


Single-Family

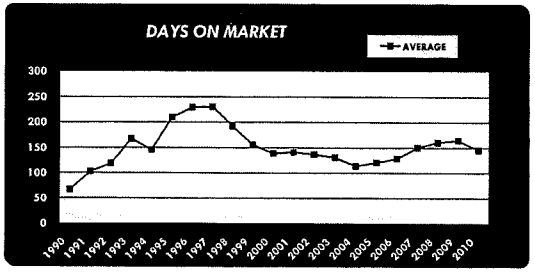
Sales of single-family properties exhibited a decrease after 1990 (560) to a level wavering around 350 to 450 sales for the next 6 years. Weakest sales, in terms of units sold, occurred in 1995 when only 331 properties were sold. In 1997, the number of single-family sales increased to 507 and in 1998, exceeded 1990 results with a figure of 641. The number of sales in 1999 (965 units) was 51 percent more than the number of sales in 1998 (641). Sales were slightly higher in 2000 at 951 units sold, but leveled off in 2001 at 938 units and 997 units in 2002. Sales sharply increased in 2003 to 1,420 transactions, and then decreased slightly in 2004 to 1,228, before climbing to 1,311 transactions in 2005. In 2006, the total sales dropped 18 percent, to 1,066 for the year. A 6 percent increased was realized in 2007, as sales volume totaled 1,138 units. In 2008, sales volume further decreased by 20 percent, to 910 units. A decline of almost 24 percent was seen in 2009, evidenced by only 693 sales. In 2010, the market turned positive with 814 sales, or an increase of 17 percent.



Median prices in 2001 showed a 9 percent increase from $275,958 in the year 2000, and reached a high for the past decade with a median of $301,886. In 2002, the median price increased even more to a level of $375,810, an enormous increase of 24 percent over 2001. Median prices for 2003 indicated an increase of about 17 percent to $441,062; then another large 25 percent increase to $553,167 in 2004. This trend continued in 2005, with a median sales price of $678,321, translating into a 22 percent increase. For 2006, prices continued their climb with a slight increase of 2 percent over the 2005 median. The median price for 2006 averaged approximately $697,450. A decline of 10 percent was seen in 2007, as the average median price was $627,887. The average price further declined in 2008 by 8 percent to $574,760, then $498,708 in 2009, equating to a 13 percent retreat. The year 2010 continued to see a decrease in median prices to $462,821, or an additional 7.2 percent decline.



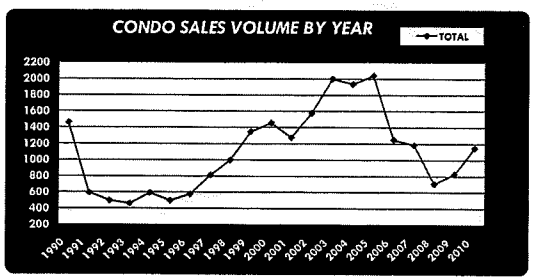
Average monthly days-on-market figures increased steadily from 67 in 1990 to 231 in 1997, but steadily fell to 137 in 2000. It has remained relatively level since that time, except in 2004 when that figure fell to 114 days, before rebounding to 121 days in 2005. The increase continued in 2006 climbing to 129 days, followed by a larger increase to 151 days in 2007. A slight increase was seen in 2008, to 161 days, with 2009 appearing to be stable, at 165 days. In 2010, days on market decreased by 11 percent to 146 days.



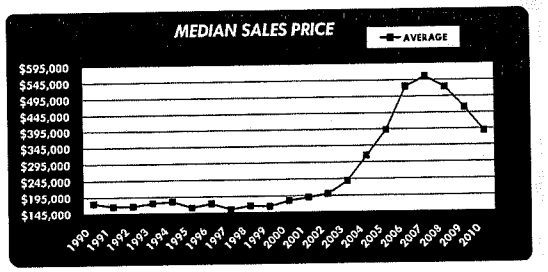
Condominiums

Sales of condominium units fell sharply after 1990 (1,459) to a level wavering between 400 to 600 sales for the next 6 years. Weakest sales, in terms of units sold, occurred in 1993 when only 461 properties were sold. In 1997, however, the number of sales increased to 812 and up to 2,001 units in 2003. 2004 showed a drop in sales, to 1,935 units. This was followed by a record setting year in 2005, with 2,041 units sold. However, sales volume dropped approximately 38 percent to 1,247 units in 2006, followed by a less severe decline of 5 percent in 2007, to 1,183 units. In 2008, sales volume dropped by 40 percent to 707 units. In 2009, however, sales increased by 16 percent to 826 sales, with further increase in 2010 to 1,147 sales, or an increase of almost 39 percent from 2009.

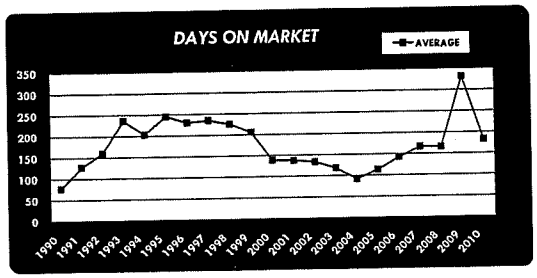
It should be noted that the spike in sales volume between 2003 and 2005 coincides with a flooding of new inventory. During this period, new condominium projects such as Villas at Kenolio and Hale Kanani (Kihei), Villas at Kahana Ridge (Kahana), and Kehalani Gardens and Iliahi (Wailuku) closed on their units.



Median prices remained in a range from $154,296 to $180,392 between 1990 and 2000. However, since then, the average monthly median price increased 5 percent to $189,946 in 2001, 5 percent to $200,020 in 2002, and 19 percent in 2003 to $238,755. 2004 indicated a sharp increase of 31 percent, with an average median price of $314,448, followed by a 24 percent gain in 2005, to $392,314. Despite a drop in sales volume in 2006, the median price increased to $524,758, an approximate 33 percent increase over 2005. This was followed by a more stabilized gain of 6 percent in 2007, to $556,332. In 2008, the averaged median sale price decreased for the first time in 10 years, dropping almost 6 percent, to $523,271. An average median of $461,508 was witnessed in 2009, down almost 12 percent from the previous year, with a further decline in 2010 to $388,614, or another 15 percent decrease.



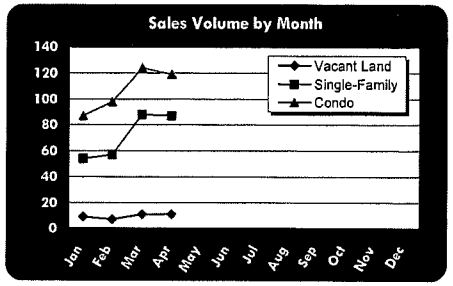
Average monthly days-on-market figures increased steadily from 77 days in 1990 to 230 days in 1996, but had decreased considerably to 133 days by the end of 2002. This figure fell to 118 days in 2003, then to 92 days in 2004, before rebounding to 113 days in 2005. It rose further in 2006, to 142 days, followed by another increase to 166 days in 2007. Days on market remained the same in 2008, but increased to an average of 331 days in 2009. In 2010, the average days on market was 182 days.



Year-to-date 2010 Maui sales figures for vacant land, single-family and condominium units are shown on the next page. Unit sales volume for vacant land, single-family, and condominiums are on-pace to surpass 2009 counts. 2010 average median prices for single-family and condominiums would show a slight decline, while the average median for vacant land would decrease. It should be noted that the average for vacant land in 2009 was bolstered by several months of high medians, where there were numerous closings of house lots in resort areas. Average 2010 marketing times would be lower than 2009 for all categories. It should be noted that the 2010 estimates are based solely on year-to-date sales and should not be interpreted as a forecast of the Maui real estate market.

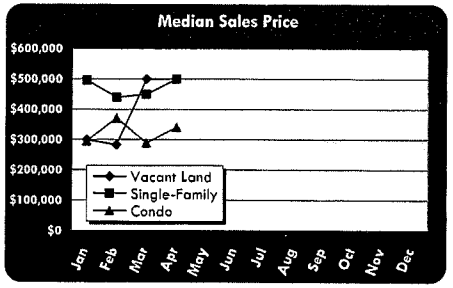
SALES VOLUME BY MONTH

2011	Vacant Land	Single-Family	Condo
Jan	9	54	87
Feb	7	57	98
Mar	11	88	124
Apr	11	87	119
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			



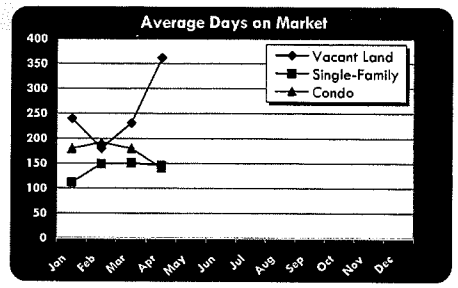
MEDIAN SALES PRICE

2011	Vacant Land	Single-Family	Condo
Jan	$300,000	$495,415	$295,000
Feb	$282,500	$440,000	$371,200
Mar	$500,000	$450,000	$289,000
Apr	$500,000	$500,000	$340,000
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			



AVERAGE DAYS ON MARKET

2011	Vacant Land	Single-Family	Condo
Jan	240	112	180
Feb	180	149	192
Mar	231	151	180
Apr	362	146	141
May			
Jun			
Jul			
Aug			
Sep			
Oct			
Nov			
Dec			



Historical New Project Absorption

In addition to the absorption rates of the individual projects, research was also conducted to give a historical look at the total residential inventory absorbed on a year to year basis. This survey included large projects that are typically put on the open market. These projects included single family residential homes, residential house lots, condominium projects, as well as agricultural subdivisions. It is also known that individual property owners occasianally subdivide tracts of land and sell off the lots to relatives or to a private list of purchasers. These types of projects are difficult to track and have not been included in the survey. The intent of this survey was to provide an indication of the capacity that the real estate market has to absorb new inventory on an annual basis.

In 1999, 671 new units were purchased. This number dropped to 280 in 2000 and steadily climbed each year, up to 2003. In 2003, the real estate market absorbed a total of 852 new housing units, before dropping to 371 units in 2004. However, this drop proved to be temporary as numerous projects in Central and South Maui were completed in 2008, with a total of 850 units closed. These projects included Ohia, Maunaleo, Iliahi, and Kehalani Gardens within the Kehalani Project District as well as the Sand Hills Estates and Legends in the Maui Lani Project District. In addition, Hale Kanani and Wailea Beach Villas were completed in South Maui. There were a few projects in West Maui that were completed in 2005, including Mahanalua Nui Phase IV, Honolua Ridge, Lanikeha, and the Villas at Kahana Ridge.

Subsequent to its peak in mid-2006, the real estate market has been decreasing, in terms of median sales prices. Sales volume has varied, with years of high unit sales volume primarily attributed to affordable housing units entering the market. The most recent example of this was Waikapu Gardens. In 2007 and 2008, this single-family affordable housing project accounted for 20 percent and 29 percent, respectively, of all the new unit closings on Maui.

Over the last 10 years, there has been an average of approximately 592 units sold each year. By dividing the supply available in the market by this average, an estimate of the remaining years of current supply can be made. As previously stated, it was determined that current new supply on Maui totaled approximately 2,300 units. Therefore, there would be about 4 years of remaining inventory. The current downturn of the real estate market has led to lower absorption rates than in previous years. However, this is typical of the real estate market, due to its cyclical nature. Due to currently poor economic conditions, there have been very few new project starts. Upon economic recovery, the lack of remaining inventory will likely lead to pent-up demand once again.

Table 6 – Units Absorbed Per Year (Central Maui)

	Type	Units	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	YTD 2010	Total Closed
KAIMANA	S	179	11	1	1				2						179
GREENS	L	217	104	8											217
IAO PARKSIDE IV-B	C	52	14	5	6	1	1								52
IAO PARKSIDE IV-C	C	52	1	3	5	41									52
NANEA	S	90	70												90
GRAND FAIRWAYS	L	36	31	5											36
IAO PARKSIDE IV-A	C	13	4	7	2										13
GRAND FAIRWAYS NORTH	L	79		57	22										79
WAILUKU PARKSIDE	S	119		31	87	1									119
THE ISLAND SCHULER PHASE I	S	55		1	24	30									55
THE ISLANDMAUI LANI PHASE I	L	44		10	23	10	1								44
OLENA	S	31			7	24									31
THE ISLAND MAUI LANI PH II	L	35				35									35
THE ISLAND SCHULER PH II	S	53				9	44								53
WAILUKU COUNTRY EST	L	184					177	7							184
WAIOLANI ELUA	L	25					22	2							24
BLUFFS - Maui Lani	L	15					6	9							15
- Schuler	S	21						7	14						21
OLENA II	S	32						32							32
LEGENDS	S	143						47	90	3	2				142
OHIA AT KEHALANI	S	140							135	5					140
MAUNALEO AT KEHALANI	S	82							55	27					82
OHIA AT KEHALANI PH II	S	44								44					44
ILIAHI AT KEHALANI	C	92							61	31					92
KEHALANI GARDENS	C	132							83	49					132
LEGENDS PHASE II	S	134								33	99	2			134
WAIOLANI PIKAKE	L/S	36										36			36
WAIKAPU GARDENS	S	411								62	162	180	7		411
KOA AT KEHALANI	L/S	72							16	33	15	5	2	1	72
AKOLEA AT KEHALANI	L/S	97									25	45	21	6	97
SAND HILLS ESTATES	L	108							80	16	1	0	1		98
NA MALA O WAIHEE	L	7									4				4
WAIOLANI MAUKA	L	105									104				104
COTTAGES AT KEHALANI	S	114									6	51	37	19	113
NA HOKU	S	162									22	53	28	37	140
VILLAS AT KEHALANI	C	103										1	13	10	24
MILO COURT AT KEHALANI	C	94												22	22
WAI'OLU ESTATES	L	60													0
HO'OLEA TERRACE	C	174													0

Table 7 – Units Absorbed Per Year (South Maui)

	Type	Units	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	YTD 2010	Total Closed
MAKENA PLACE	C	10	2	2	2	2	1								10
KAMAOLE HEIGHTS	L	40	40												40
MEADOWLANDS II	L	88	63	25											88
WAILEA FAIRWAY VILLAS	C	118	56	62											118
PIILANI VILLAGE PHASE II	S	114			113	1									114
MALUHIA AT WAILEA	C	14			5		1	3	2	2					13
KE ALII KAI	S	96				61	35								96
KENOLIO (KAONOULU) ESTATES	S	51				45	6								51
NA HALE O MAKENA	C	40				13	24	3							40
KEAHOU AT MAKENA	L	7				6		1							7
PIILANI VILLAGE III	S	117					117								117
HONU ALAHELE	L	64					64								64
KILOHANA RIDGE	S	73					69	4							73
KILOHANA HEMA	L	29					28	1							29
VILLAS AT KENOLIO	C	140					61	78	1						140
ONE PALAUEA	L	17					1	8	8						17
ALII VILLAGE	L	27						27							27
KENOLIO MAUKA		12						12							12
HALE KANANI	C	72							70	2					72
WAILEA BEACH VILLAS	C	98							34	63		1			98
WALAKA MAUI (112 WALAKA)	C	18								18					18
KIHEI KAUHALE	L	23								23					23
KAI MAKANI	C	112									96	16			112
KANANI WAILEA	C	38								9	25				34
KAI MALU	C	150								22	86	27	0	2	137
KILOHANA WAENA	L	30									6	3	0	1	10
HOOLEI	C	120									25	66	13	7	111
KE ALII OCEAN VILLAS	C	144									36	34	31	9	110
KAMALI'I ALAYNA	S	92									44	19	14	10	87
PAPALI	C	24										15	1	3	19
MOANA ESTATES	S	90								18	39	20	2		79
HOKULANI GOLF VILLAS	C	152										24	10	5	39
KAI ANI VILLAGE	C	99											1	16	17
KENOLIO MAKAI	S	18												15	15
MALUAKA	L	13											5		5

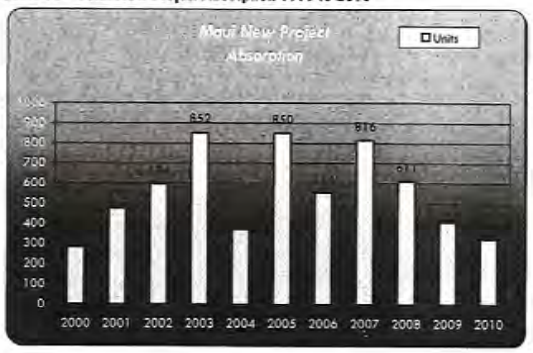
Table 8 – Units Absorbed Per Year (West Maui)

	Type	Units	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	YTD 2010	Total Closed
KAHANA RIDGE	L	228	195			1									228
KAUHALE MAHINAHINA	S	19	19												19
MAHANALUA NUI (I to III)	L	104	33	10	19		41	1							104
VINTAGE	C	73		3	70										73
KE ALII SUB'D III	L	12		7	1	4									12
PINEAPPLE HILL II	L	30		12	8	9	1								30
MAKILA I	L	19				19									19
OLOWALU MAKAI	L	5			1	4									5
OLOWALU MAUKA	L	14				8	6								14
COCONUT GROVE AT KAPALUA	C	36			36										36
PUUNOA SUBDIVISION	L	14			14										14
KAHANA NUI SUB'D (HUA NUI)	L	17			16	1									17
PINNACLE	C	33			5	8	8	12							33
SUMMIT															0
Phase I	C	18			5	11	2								18
Phase II (Pulled off Market)	C	17						17							17
Phase III	C	19					19								19
NAPILI VILLAS PH I	C	100				100									100
NAPILI VILLAS PH II	C	44				44									44
KE ALII SUB'D I	L	15				12	3								15
KAPUA VILLAGE	L	45				10	35								45
NAPILI VILLAS PHIII	C	40					40								40
MAKILA II	L	24						24							24
HONOLUA RIDGE PH I	L	25						17	8						25
HONOLUA RIDGE PH II	L	25							6	10	8				24
VILLAS AT KAHANA RIDGE	MF	117							83	34					117
MAHANALUA NUI IV	L	36					1		31	4					36
LANIKEHA	L	130							58	42	2	2	1		105
KAANAPALI COFFEE ESTATES	L	52								3	3			1	7
OPUKEA	MF	114											37	12	49
HONUA KAI	MF	700										1	166	188	355
THE BREAKERS (WEST MAUI BREAKERS)	MF	114												13	13
HO'ONANEA	MF	100													0
KAANAPALI 10-H	L	18													0

Table 9 – Units Absorbed Per Year (Upcountry/East Maui)

	Type	Units	Year 1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	YTD 2010	Total Closed
HAIKU MAKAI	L	27	4	3											27
MAUNAOLU PLANTATIONS	L	39				27	12								39
RESIDENCES AT KULAMALU	L	57				56	1								57
NORTH SHORE VILLAGE	S	23					22	1							23
RIDGE AT KULAMANU	L	57						57							57
KULAMALU HILLTOP (DOWLING)	L	11							11						11
E PAEPAE PUKOA	L	16									6	6			12
OMAOPIO RIDGE	L	18			1	1	3	1	2	1					9
PIIHOLO SOUTH	L	11										1			1
COTTAGES AT KULAMALU	C	40										3	15	14	32
MAKANI O KULA	L	10													0
OMAOPIO ESTATES	L	20													0
KULA 'I'O	L	35													0

Table 10 – Total New Project Absorption 1999 to 2010



Historical Resale Activity Central and West Maui (Past 11 Years)

According to the Realtors Association of Maui, Multiple Listing Service, there has been an average of 510 sales of condominium, residential and vacant land properties in Central Maui over the past 11 years, and an average of 740 condominium, residential and vacant land sales in West Maui. During this period, the number of vacant land sales in Central Maui ranged from 17 in 2008 to 140 in 2005, with an average of approximately 65 sales each year. Vacant land sales in West Maui ranged from 27 in 2008 to 141 back in 2000. Condominium units in Central Maui ranged from a low of 61 in 2008 to 267 units in 2005, while West Maui sales ranged from 194 in 2008 to 736 in 2003. The average yearly condo sale in West Maui during this period was 539. Sales of single family properties in Central Maui ranged from a high of 519 in 2007 to a low of 201 in 2001.

Central Maui Sales Volume

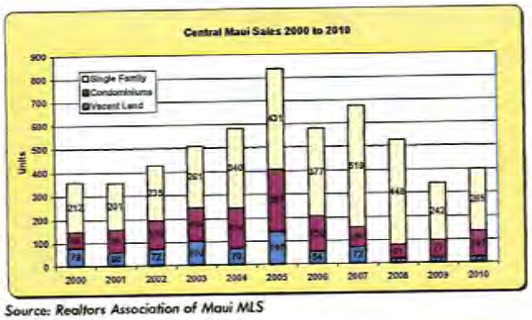
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Vacant Land	79	60	72	103	70	140	54	72	17	21	23	711
Condo	68	95	122	144	174	267	150	84	61	77	112	1,354
Single Family	212	201	235	261	340	431	377	519	448	242	265	3,531
Total	359	356	429	508	584	838	581	675	526	340	400	5,596

West Maui Sales Volume

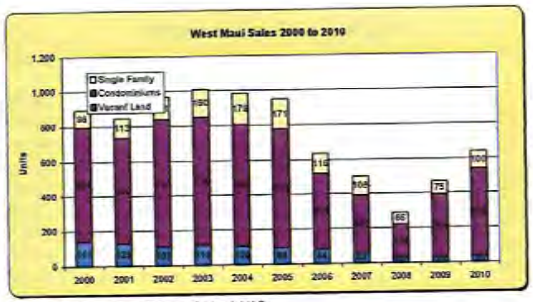
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Vacant Land	141	129	107	112	106	94	84	62	27	28	35	925
Condo	654	605	730	736	699	683	434	330	194	364	503	5,922
Single Family	98	113	131	160	179	171	116	108	66	75	100	1,317
Total	893	847	968	1008	984	948	634	500	287	467	638	8,174

It is obvious that the economic recession that began in 2008 has had a significant adverse impact on the Central Maui market. However,

sales of condominium and single-family homes in West Maui quickly rebounded in 2009 and 2010 from 2008 levels.



Source: Realtors Association of Maui MLS

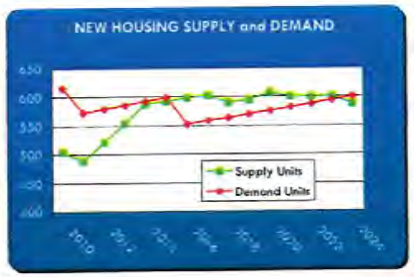


Source: Realtors Association of Maui MLS

County of Maui Housing Demand Model

This model, included as part of the Hawaii Housing Policy Study Update 2003, by SMS Research & Marketing Services, Inc., projected the effect of increasing population and the effect of decreasing household sizes on the supply and demand for residential units. The demand for housing units was calculated by comparing the increase in Maui's population to the average household size during a certain period. As population increases and household sizes remain the same or decrease, this would indicate the need for additional housing units. Conversely, if population decreases while household sizes remain the same; this would indicate a softening in demand for housing units.

According to the projections by SMS, the supply and demand model indicates that up to 2015, demand would be higher than the available supply in the market. However, from 2016 to 2023 this balance will shift and provide a slightly higher supply of product versus demand. Theoretically, only at this point would prices begin to fall due to the oversupply in the market. The total supply that would become available between 2011 and 2024 (the end of the study period) will be 8,119 units, compared with the demand for 8,103 units.



Through this study period, the balance between supply and demand does not significantly shift to either side. However, this indicates that the original deficit of 4,170 units, calculated by SMS in 2003, would not be reduced. By the end of the study period there will still be a need for 4,154 additional resident housing units.

It is also noted that resident housing units (RHU) were said to only account for 70 percent of the total housing units in any given year. According to the Hawaii Housing Policy Study 2003, the remaining units include vacant units which is generally 5 percent of the total and non-resident housing units which account for approximately 25 percent of the total housing unit inventory. Non-resident units are defined as units that are set aside for rental pools and are targeted to transient visitors. These units are not available for County residents on an ongoing basis.

Hawaii Housing Policy Study Update 2006

This study, by SMS Research & Marketing Services, Inc., provided evidence of the need for additional housing in Maui County. According to the report, nearly 45 percent of all Maui County households expressed a desire to move to a new home in the near future, of which, approximately 13 percent stated they wanted to move out of state. As such, effective demand was said to be 40

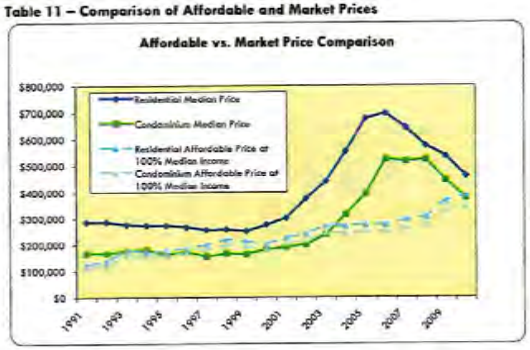
percent of all Maui County households, up from 36 percent from the previous 2003 survey.

Not surprisingly, the report indicated that almost 40 percent of those who expect to move outside of Hawaii made it known that one of their main reasons for leaving was the high price of housing, up from 14 percent in 2003. The 2006 study listed the average monthly mortgage payment for the County of Maui to be $1,820 and an average monthly rent of $1,080. Approximately 46 percent were said to be spending more than 30 percent of their income on housing. Although the study was done during a time of more robust market conditions, prices still appear to be out of reach for many Maui County residents.

Comparison of Affordable And Market Prices

An analysis was done to compare the increase in affordable prices to median prices for residential and condominium units. The affordable price is based on the median income level for the County of Maui and typical mortgage interest rates and loan requirements. This calculation assumed a 95 percent loan-to-value ratio and a 30 percent debt to income level, similar to the assumptions utilized by DHHC. Since 1990, interest rates have dropped from 10.13% to 5.05% as of 2009, and below 5.0% in 2010. As shown in **Table 11,** the single-family and condominium prices which are affordable to earners of the median household income was compared to the median prices of residential and condominium prices in the market.

Table 11 – Comparison of Affordable and Market Prices



As income levels rose from 1990 to 2000, residential properties became more affordable to those earning the County's median income level. Although the disparity significantly narrowed by 1998 and

1999, the median price for a single-family residential property has always been higher than the price that can be afforded by a household earning the County's median income. During this period, the only option was to purchase a condominium unit, which for larger families can be less accommodating. In 2001, the nation's economy hit a recession, which was followed by the lowering of short term interest rates by the government. Consumer money flowed out of the stock market and into bonds and treasuries, which pushed long term interest rates lower. This caused a surge in demand for real estate, which sent prices skyrocketing within a few years.

By 2002, the soaring prices outpaced the County's median income level despite steadily falling interest rates. At the same time, condominium units were found to be a more feasible alternative and sales in this category started to pick up their pace.

By 2004, median sales prices for residential and condominium properties were both higher than what could be afforded by households earning the County's median income level. In 2006, this situation reached critical levels, as prices for both residential and condominium units reached their peak. It did not help that mortgage rates also trended slightly upwards, which lowered the affordability to buyers needing to finance their purchase.

Since 2006, the softening of the real estate market has brought median prices closer to affordable pricing levels; however, as seen in the previous table, there is still a substantial inequality. To help alleviate this situation, more housing units should be brought to the market, especially those geared toward Maui's workforce.

Maui County General Plan 2030

The County of Maui is currently in the process of updating the General Plan, which will establish long-term planning guidelines for Maui County to the year 2030. The first step in this process involved the creation of a Countywide Policy Plan, which provides broad goals, objectives, policies and implementing actions used to develop the Maui Island Plan and Community Plans. The current version of the plan was adopted by the Maui County Council on March 24, 2010.

Although its design is still preliminary in nature, many of the goals, objectives, and policies set forth in the Countywide Policy Plan are inherent in Olowalu Town. The following list represents some of the pertinent characteristics that are consistent with the Countywide Policy Plan:

Protect the Natural Environment
Olowalu Town will build innovative infrastructure systems that are based upon sustainable technologies which minimize adverse impacts

upon the natural environment. Efficient "green" technologies modeled after natural systems are planned with emphasis on conservation, cleaning, and recycling. Olowalu Town's residents will utilize walking for many daily needs thus reducing the number of daily car trips, and will provide residents access to beach parks, playgrounds, hiking, and biking from their homes.

Preserve Local Cultures and Traditions
The Olowalu Master Plan proposes to increase the acreage of the existing Olowalu Cultural Reserve from approximately 75 acres to approximately 110 acres.

Improve Education, Parks and Public Facilities
Approximately 100 acres, or about 17 percent of the project, will be available for active parks, social services, police/fire protection and schools. Schools are planned to be developed within a ¼-mile distance of homes, or within a 5-minute walk. Being located near residential areas and parks affords children the option of walking or bicycling to school. The Olowalu Cultural Reserve (OCR) currently provides educational experiences relating to its archaeological and cultural heritage to school children.

Expand Housing Opportunities for Residents
Olowalu Town will feature on-site affordable housing units. Affordable housing requirements will be addressed in keeping with market needs and the County of Maui's Residential Workforce Housing Policy. Under current conceptual plans, Olowalu Town will provide roughly 500 affordable housing units (less than 120 percent of median income); 500 sub-market housing units (below existing average market prices); and, 500 market rate housing units (above average market prices). As designed, this plan would meet or exceed Maui's existing Workforce Housing Ordinance.

Diversify Transportation Options
Olowalu Town Master Plan is being designed with a connecting network of pedestrian friendly roadways that will offer residential numerous routes for both pedestrian and drivers that are both safe and attractive. The neighborhood block system design will shorten travel routes and encourage walking and/or biking as an alternative to automobiles.

Promote Sustainable Land Use and Growth Management
Olowalu Town is situated within the Urban and Rural Growth Boundary being recommended by the General Plan Advisory Committee and the Maui Planning Commission. The Olowalu Town Master Plan is being predicated upon the design principles of Traditional Neighborhood Design (TND). This design principle promotes the development of communities that are pedestrian

friendly, offer a wide range of housing opportunities, and allow residents to live within walking distance to corner stores, schools, parks, and community centers.

Furthermore, once established, the Urban and Rural Grown Boundaries at Olowalu will help to maintain Olowalu's small town scale. These boundaries will enhance and preserve the town's unique sense of place, maintain compact town centers, preserve pedestrian-friendly streets, prevent sprawl, and ensure habitats are preserved and protected.

Estimated Absorption Rate for Subject

On a larger scale, the overall lack of new project starts within the past few years has some economists foreseeing a potential shortfall in housing upon recovery of the economy. Many real estate analysts are of the opinion that it has become too difficult to feasibly create new housing projects since the passage of ordinances linked to development. Builders and developers have chosen to withdraw from the Maui market, looking for less costly and time consuming opportunities. Tightened lending practices, due to the recent financial reform, have also made it difficult to obtain financing, especially for large developments. Recent housing starts have been about 80 percent less than in the robust years. Due to these factors, there may be less competitive inventory when Olowalu Town Master Plan Development's housing units become available. The development will be strongly targeted towards the workforce market segment, which has seen consistently high demand. As stated earlier, the Olowalu Town Development is planned to contain at least 750 "affordable" units to comply with the County's workforce housing ordinance.

Central Maui has historically housed the largest percentage of the island's workforce population. This is attributed to many factors. First, Kahului Airport and Kahului Harbor are Maui's primary shipping and transportation venues. Furthermore, Kahului has the largest concentration of retail centers, including Kaahumanu Center, Maui Mall, Kahului Shopping Center, and The Maui Marketplace. The University of Hawaii Maui College is also situated in Kahului. Meanwhile, Wailuku is the seat of County government, as well as being home to the State Building and Hoapili Hale, the island's main judicial building. Not coincidently, most of Hawaii's major financial institutions all have their primary branch in Central Maui.

Due to these factors, there has always been more demand for workforce housing in Central Maui than in other regions. However, the overall lack of affordable housing in Central Maui has created the need for many residents to commute daily from outlying areas, such as Upcountry Maui, South Maui and from West Maui, which are also in

short supply of affordable housing. Thus, the Olowalu Town Master Plan Development has the opportunity to offer affordable housing outside of Central Maui.

The Olowalu Town Master Plan Development is planned for approximately 636 acres of land. Preliminarily, the development calls for a total of 1,500 housing units. Of this total, at least 750 residential units will be created to fulfill the affordable housing obligation.

In addition to single-family residential areas and multi-family residential areas, the master plan development will feature areas of live-work, commercial, parks, cultural preserve, as well a community center, schools with associated recreation fields, greenway paths and roads.

According to the Department of Planning "Directed Growth Areas Listing and Units" table, dated October 1, 2009, the forecasted demand of units to 2030 for each region on Maui is as follows:

Region	2030 Demand Units
Central Maui	5,073
West Maui	3,456
South Maui	1,482
North Maui	119
Upcountry Maui	824
East Maui	200

Although overall Maui demand to 2030 was forecasted to be 11,154 housing units, the long-term supply was estimated to be only 11,622 housing units. Based on these figures, even if all of the future supply units were built on Maui, there would be a relatively small island-wide surplus of only 468 housing units by 2030. The surplus in West Maui was projected to be only 175 housing units with the greatest surplus being in South Maui at 418 units. Central Maui was projected to have a deficit of 223 housing units by 2030.

Based on the aforementioned factors, as well as conclusions drawn from the previous supply and demand analysis, the Olowalu Town Master Plan Development is expected to be well received by the market, over the long-term, with especially strong interest foreseen for the affordable units.

Although the Olowalu Town Master Plan Development is delineated as being within West Maui, it is somewhat isolated from the rest of Lahaina, and thus provides a unique community setting away from the more heavily populated areas of West Maui. Olowalu Town will

provide an opportunity for local residents to reside in a small oceanside community that will be available to all working families on the island, unlike other oceanside communities on Maui, such as Wailea, Kaanapali and Kapalua, that are priced beyond the means of these same families. As areas surrounding Lahaina Town, Kihei Town and even Kahului and Wailuku, become more densely populated, Olowalu Town is anticipated to appeal to residents from all areas of Maui desiring a more traditional living environment of a small community.

The following demand projections were made based on capture rates anticipated from different areas of Maui. The capture rates represent the anticipated portion of total demand from the different regions of Maui that may comprise demand for Olowalu Town during the projected 8 to 10 year development period. It is expected that a portion of residents that live in Central Maui but work in West Maui may want to live closer to work. A portion of residents that want to remain in West Maui, but in a smaller neighborhood may also want to reside in Olowalu instead of Lahaina Town. Lastly, a smaller capture rate is also expected from the regions of South Maui, North Maui and Upcountry Maui. This is based on the assumption that homes are equally affordable in Olowalu Town as they are in these other regions of the island for Maui's workforce market.

Region	2030 Demand Units	Capture Rate	2030 Demand Units for Olowalu Town
Central Maui	5,073	15%	760
West Maui	3,456	15%	518
South Maui	1,482	10%	148
North Maui	119	5%	6
Upcountry Maui	824	5%	41
East Maui	200	0%	0
Total:			1,473

In this light, it is the Consultant's opinion that the 1,500 units planned for the Olowalu Town Master Plan Development will be able to be absorbed within a period of 8 to 10 years.

B. COMMERCIAL AND INDUSTRIAL MARKET ANALYSIS

SUPPLY CHARACTERISTICS The following chart represents the existing commercial and industrial developments, as well as proposed projects in Central Maui, South Maui, and West Maui.

Table 12 – Commercial and Industrial Projects in Central Maui, South Maui and West Maui

Project Name	Location	Gross Project Area In Acres	Primary Users
EXISTING (South Maui)			
Kihei Commercial Center	Kihei	16	Commercial, Mixed-use, Light Industrial
Piilani Business Park	Kihei	7	Commercial, Mixed-use, Light Industrial
Kihei Business Park	Kihei	14	Retail & Commercial
	Total	37	
EXISTING (Central Maui)			
Maui Industrial Park, Hana Highway and Dairy Road Industrial Subdivisions	Kahului	136	Mixed-Use, Light Industrial
Wailuku Industrial Park	Wailuku	55	Commercial, Mixed-use, Light Industrial
Kamehameha Parkway Subdivision	Kahului	62	Commercial, Mixed-use, Light Industrial
Maui Business Park, Phase 1A & 1-B	Kahului	78	Commercial, Mixed-use, Light Industrial
Traingle Square Subdivision	Kahului	13	Retail & Commercial
Wakea Industrial Subdivision	Kahului	12	Commercial, Mixed-use, Light Industrial
Central Maui Baseyard	Kahului	15	Light Industrial
Millyard Industrial Subdivision	Wailuku	30	Commercial, Mixed-use, Light Industrial
Waiko Industrial Subdivision	Wailuku	15	Light Industrial
Consolidated Baseyard Subdivision	Wailuku	23	Light Industrial
Maui Lani Village Center	Wailuku	110	Commercial, Mixed-use, Light Industrial
	Total	549	
EXISTING (West Maui)			
Wili Ko Industrial Subdivision	Lahaina	37	Commercial, Mixed-use, Light Industrial
Lahaina Business Park (Phases I and II)	Lahaina	41	Mixed-Use, Light Industrial
	Total	78	
PROPOSED			
Maui Business Park, Phase II	Kahului	179	Commercial, Mixed-Use, Light Industrial
Waikapu Light Industrial	Wailuku	8	Light Industrial
Kaonoulu Business Park	Kihei	75	Commercial, Mixed-Use, Light Industrial
	Total	262	

Maui's Existing Commercial/Industrial Projects

Central Maui has approximately 83 percent of the island's commercial and industrial park land, with the largest amount situated in Kahului, near the harbor and airport. In Kahului, these subdivisions are the Maui (Kahului) Industrial Park; Kamehameha Parkway Subdivision No. 2; Maui Business Park Phase IA and IB; Airport Triangle; and Wakea Industrial Subdivision. Wailuku's industrial projects include the Wailuku Industrial Park, The Millyard, Waiko Baseyard Subdivision, Consolidated Baseyard Subdivision, and Maui Lani Village Center.

West Maui has the second largest amount of commercial and industrial park land on Maui at 12 percent of the total existing

acreage, and South Maui has the least amount of commercial and industrial park land at only 6 percent of the island total.

Kahului

Maui (Kahului) Industrial Park

This leasehold industrial subdivision was developed and owned by Alexander and Baldwin, Inc., in the early 1960's. Most of the land in the Kahului Industrial Park is being leased on a long-term basis to developers and owner-users that have constructed and sub-leased the improvements. Beginning in 1988, A & B began selling the leased fee interest in some of these properties to a select group of lessees. Since that time several other offerings have been made to the lessees of their properties. In fact, many of the lessees have chosen to purchase the leased fee interest in the land rather than renegotiate their respective ground leases. These leased fee sales, according to a representative of Alexander & Baldwin, reflected their estimate of "fee simple" land value.

On Maui, the Kahului Industrial Park subdivision is by far the most established, and enjoys a superior location with respect to harbor and airport facilities, as well as other supporting commercial activities. Occupancy is high, and demand has spurred the development of additional industrial land along Wakea Avenue within this subdivision, as well as other projects in Kahului. According to officials at A&B Properties, their developments in the Kahului Industrial Park have historically had high occupancy rates.

Kamehameha Parkway Subdivision No. 2

This subdivision contains 36 parcels ranging in size from 12,826 square feet to 2.428 acres. In December 1991, A&B Properties sold approximately 16 fee simple parcels in the light industrial Kamehameha Parkway Subdivision No. 2.

There are currently 31 parcels developed in this subdivision, which includes such projects as the Valley Isle Motors, Tesoro, Spee Dee Lube, the HC&S Federal Credit Union, Kula Produce, Kula Community Federal Credit Union, Maui Community Federal Credit Union, The Fairgrounds office building, three medical office buildings, and Service Rentals and Sales.

Triangle Square

In response to the high demand, A&B Properties developed Triangle Square, located makai of the Hana Highway, across the Maui Industrial Park. Lots range between 7,172 square feet to 2.8 acres. Triangle Square is bound by Haleakala Highway, Dairy Road and Hana Highway. This 13-acre, 11-lot subdivision currently includes a Lexus dealership; a BMW dealership; Gas Express; the Kele building anchored by Denny's Restaurant; a small retail center at the corner of

Hana Highway and Dairy Road, and the Triangle Square Apex Building. A Krispy Kreme doughnut outlet was constructed at the corner of Dairy Road and Haleakala Highway. Costco and Kmart are located across Dairy Road from Triangle Square.

All lots in this subdivision are offered as ground leases or build-to-suit only. Three opportunities are currently being advertised including pad sites of 16,190 square feet, 24,873 square feet and 8,600 square feet. None are available for sale.

Maui Business Park

Seventy-six (76) acres were developed starting in 1995 as Phases IA and IB of the Maui Business Park. Phase IA includes 32 light industrial zoned lots ranging in size from 16,801 to 35,522 square feet on about 42 acres of land. Lots were initially priced at an average of $30 to $35 per square foot. Nine (9) parcels immediately sold and ranged from $26.00 to $34.38 per square foot. The only parcel to be sold in 2007 was purchased at a price of $43.77 per square foot for 27,188 square feet. An 8,506 square foot subdivided parcel was sold in October 2008 for $41.15 per square foot; however, there were no sales in 2009. In April 2010, a 16,525 square foot lot sold for $41.45 per square foot.

Improved properties within this phase include a Harley Davidson and automobile dealership; a McDonald's restaurant; a dental practice; a mortuary; a large self-storage center; several commercial office properties; and numerous light industrial facilities. The Maui Marketplace, also part of Phase IA, is patterned after Waikele Center in Oahu and was completed in 1997. It includes tenants such as Lowe's Hardware, Borders Books and Music, Office Max, Old Navy, Pier One Imports and Sports Authority.

Phase IB consists of about 34 acres of land and includes the large Wal Mart and Home Depot sites which were 14.014 acres and 12.701 acres, respectively. The remaining 10 lots are located along Hookele Street and range in size from 17,990 to 45,869 square feet, with an average of 22,817 square feet. Prices for these lots were initially at $26.00 to $27.00 per square foot. In addition to the Wal Mart and Home Depot, some of these parcels have been improved with a veterinary clinic, two professional office buildings, and a self-storage center. A July 2004 conveyance involved the lot at the corner of Puunene Avenue and Hookele Street, which sold for $33.35 per square foot and is now home to Zippy's Restaurant. A 44,823 square foot portion of the Wal Mart site, fronting Pakaula Street, was subdivided and sold in December 2005 for $36.25 per square foot. A three-unit retail center was subsequently built on this lot, with current tenants Panda Express, Verizon Wireless, and Game Stop.

Wailuku

The Millyard

Developed in 1984, all lots in this fee simple, light industrial subdivision have been sold, and improvements have been constructed on 34 parcels. Of the 53 lots in this development, only eight are more than one-half acre in size. The balance of the sites is between 10,055 and 20,119 square feet in size. Due to the unavailability of vacant light industrial land in the Central Maui region, sales in this Wailuku development have increased during the past three years.

Wailuku Industrial Park

This light industrial subdivision was developed by C. Brewer in the late-1970s and it consists of 74 fee simple lots off of Lower Main Street in Wailuku. Lots range from 10,106 square feet to a parcel 3.089 acres in size. Approximately 72 percent of the parcels are less than one-half acre in size. Of the 74 light industrial lots, only two are not utilized for a building or as yard space.

Waiko Baseyard Subdivision

The Waiko Baseyard Subdivision consists of 14.891 acres of land that was subdivided into 19 finished lots in 2005. It is located along Waiko Road in Waikapu Town of Wailuku. The lots range in size from 13,342 to 124,720 square feet. Lot No. 16 was deeded back to Brewer Environmental, Inc. and was not available for sale. Lots No. 17, 18 and 19 were retained by the developer and also not made available for sale. Fourteen (14) lots have sold so far, and only Lot 11 has not sold but is not on the market. It is noted that public records indicate additional sales between $20.00 and $25.00 per square foot; however, according to the developer, these prices were based on an agreement with the prior land owner and considered below-market. The initial sale price in the subdivision was $35.00 per square foot. A July 2008 sale of Lot 1 was at a price of $36.80 per square foot, while the most recent conveyance, in May 2010, was a distress sale of four consolidated lots (Lot 12-A), at $21.25 per square foot.

Consolidated Baseyards Subdivision

This 35-lot light industrial subdivision was completed in 2007 and is located on Waiko Road in the Waikapu area of Wailuku, encompassing 23.164 acres of land. The lots range in size from 10,375 to 85,502 square feet. Twenty-six (26) lots sold in 2006 with prices ranging from $28.16 to $38.00 per square foot with an average price of $32.87. The lowest prices at about $28.00 to $29.00 per square foot were discounted prices offered only to initial buyers. In 2007, eight (8) more lots sold at prices ranging from $27.61 per square foot for a 53,143 square foot lot to $39.97 per square foot for a 13,811 square foot lot. The average price in 2007 was $33.18 per square foot, while the average price in 2008 was

$37.45 per square foot. There was one September 2009 sale; however, this was shown to be between related parties. The next most recent sale was in November 2008, at $36.00 per square foot.

Maui Lani Village Center

Consisting of 78 lots of between 7,545 and 196,185 square feet, Maui Lani Village Center is located off Kuikahi Drive in Wailuku. Completed in 2010, this mixed use subdivision has unique zoning that allows for commercial and residential uses, in addition to industrial uses. There were six closings in late 2009, ranging in price from $50.00 to $55.00 per square foot. There has been one sale in 2010, at $60.00 per square foot. Developer pricing for the remaining inventory is generally between $50 and $60 per square foot.

West Maui

Wili Ko Subdivision

This light industrial subdivision consists of about 37 acres and is one of only two industrial subdivisions serving the entire West Maui region. It contains 19 lots, of which two are owned by Kaanapali Pacific Railroad, Ltd. The remaining lots are all improved with commercial or light industrial facilities. The lots range in size from 10,000 to 40,457 square feet. The majority of the properties in this subdivision contain multi-tenant facilities.

Lahaina Business Park

The Lahaina Business Park is the newest industrial subdivision in Lahaina, situated approximately 800 feet mauka of Honoapiilani Highway. This light industrial subdivision contains a total of 62 lots, including one designated as a "roadway lot". This subdivision was developed in two phases. Phase I consists of 28 lots on approximately 16.1 acres, with lots ranging in size from 15,727 to 34,882 square feet. Phase II, on about 21 acres, has 31 marketable lots ranging from 12,299 to 43,939 square feet, with an average lot size of 22,042 square feet. Access is allowed by way of Keawe Street which runs from Honoapiilani Highway, opposite the Lahaina Cannery Mall.

There were no land sales within the Lahaina Business Park between 2007 and 2009; strong evidence of West Maui's lack of land entitled for light industrial use. However, the economic recession that occurred during this period has caused a substantial decline in land values within this subdivision. There have been three conveyances in 2010 to-date. An April 2010 sale, at $26.00 per square foot, involved five adjoining lots totaling 127,430 square feet. A June 2010 foreclosure sale of one lot was at $26.20 per square foot. Two adjacent lots sold in July 2010 for $30.45 per square foot.

It should be noted that the July 2010 conveyance involved the same two lots in Phase I that had sold for $51.00 per square foot each, in June 2006. This translated into a drop in unit price of about 40 percent over the four-year span.

South Maui

Kihei Commercial Center

The Kihei Commercial Center is one of only two improved industrial areas within the South Maui region. This subdivision originally consisted of three development lots. The first phase of the project, built on approximately 6.667 acres, consists of four (4) industrial buildings. The second lot, located next to the first phase, consists of 4.101 acres and has been improved with Kihei Commercial Plaza, a four-building office and warehouse condominium project.

The other remaining parcel was a 6.128-acre site on Piilani Highway that was further subdivided into six (6) light industrial lots. This subdivision had one sale in each of Years 2004 and 2005. Both sales indicated prices of $27.38 and $28.42 per square foot which were both negotiated in 2004. There were two other sales, in 2006, at $38.14 and $40.57 per square foot, with both lots located along Piilani Highway. The two parcels, Lot 16 and Lot 17, were consolidated into one parcel and were subsequently conveyed as a foreclosure sale in June 2010, at $24.89 per square foot. Lot 15 has been improved with a gas station/convenience store/car wash facility, with additional leasable retail and office spaces. Meanwhile, South Shore Plaza, a three-story commercial retail/office and warehouse complex, was built on Lot 19.

Piilani Business Park

The Piilani Business Park is located along Piilani Highway and Ohukai Road in Kihei, adjacent to the Kihei Commercial Center. This park is a 12-lot light industrial subdivision developed by Blackfield Hawaii.

Currently, a Tesoro gas station/service facility is on the 49,960 square foot (Parcel 11) site at the corner of Piilani Highway and Ohukai Road. The other developments include the Kihei Gateway Plaza (Parcel 10), the Kihei Trade Center (Parcel 5), Miyake Concrete (Parcels 2 and 3), Kihei Trade Center II (Parcel 1), the Kihei Gateway Center (Parcel 4), and Aloha Plaza (Parcels 6 & 7).

Commercial/Industrial Listings

Research has indicated there is currently about 621 acres of commercial and industrial land in Central Maui. However, the vast majority is held by the State of Hawaii, and is situated around the Kahului Airport and Kahului Harbor. Furthermore, although not all of the privately owned parcels in Central Maui have been improved, many are being held by their owners for future development. As such,

only vacant lots listed for sale were deemed to be "available" and considered current supply in Central Maui.

According to the Maui Multiple Listing Service, there are 75 parcels currently available for sale, totaling approximately 40 acres. There are 64 lots for sale, amounting to over 36 acres, within the recently completed Maui Lani Village Center. Wailuku Town has four parcels available, while none of the remaining Central Maui business/industrial parks had more than 2 lots for sale. The 40 acres represents only 6 percent of the overall commercial and industrial land in Central Maui. According to the Maui Multiple Listing Service, West Maui has only five (5) vacant commercial/industrial land parcels listed for sale totaling only 98,974 square feet, or 2.27 acres. South Maui also has five (5) commercial/industrial parcels for sale which totals approximately 7.56 acres. Based on historical absorption, the available acreage is not sufficient to support long-term needs in these regions.

Maui's Proposed Commercial/Industrial Projects

The only proposed light industrial project planned for the Central Maui region is Phase II of the Maui Business Park, consisting of approximately 179 acres. This project will be located to the southeast of Maui Business Park Phase I. This development was still in the initial design stage, with the timing of subdivision construction unknown.

A&B Properties, Inc. intends to redevelop the Kahului Shopping Center and surrounding area into a mixed-use community called the Kahului Town Center. Preliminary plans for the 20 acres call for 442 residential units, 140,000 square feet of retail space and 156,000 square feet of office space. Marketing for Phase I, featuring retail and office condominiums, is currently underway.

Preliminary Plans for A&B's Wai'ale Master Plan Development, which consists of a total of 545 acres, include 23 acres set aside for commercial use and another 16.3 acres for business/light industrial uses. As of current, the developer was still in the process of obtaining entitlements and there was no set timetable for construction of this project.

A 12-acre site at the corner of Maui Lani Parkway and Kaahumanu Avenue is planned for the Maui Lani Shopping Center. This retail project is slated to have a Safeway as its anchor tenant. The project is currently in the entitlement phase, with its environmental assessment having been accepted in August 2010. Maui Lani has other small sites within their project district planned for commercial use; however, the majority has been built as part of their Village Center.

The Kehalani Project District has 20 acres on the eastern side of Honoapiilani Highway set aside for their commercial component. A Conceptual Land Use Map listed approximately 200,000 to 210,000 square feet of commercial space is to be built; however, there were no known plans for this area.

Due to the rapid growth of South Maui and its potential for economic expansion, an additional 88 acres were rezoned from agricultural land in 2005. This proposed light industrial project, preliminarily known as Kaonoulu Business Park, will help accommodate the long-term demand for industrial space in this region. As of current, there were no known design plans or timetable for construction for this subdivision.

DEMAND CHARACTERISTICS

Industrial/Commercial Land Pricing Trend

Up to the Year 2007, there was significant appreciation for commercial/industrial vacant land on Maui, as well as the entire island. This rise in prices was attributed primarily to favorable economic conditions, coupled with the lack of entitled land. On Maui, a majority of the lots in existing commercial/industrial subdivisions have been built-out or are being held by their owners for development in the near-term future. In this light, the Consultant looked to more recently developed parks, Waiko Baseyard, Consolidated Baseyards, Maui Business Parks, and Lahaina Business Parks, for trend evidence within the industrial/commercial market.

There have been very few sales of lots within these parks since 2009; however, it is obvious that there has been a downward trend since 2007. When compared to 2007, 2009 and 2010 sales prices and current listings indicate a decrease in land values of between 5 and 20 percent.

Vacancy Rates

Most of the industrial development in Central Maui consists of owner-user facilities. Conversations with commercial leasing agents revealed that investment-driven warehouse properties have showed an increase in vacancy, as many businesses have shuttered their operations, or relocated to smaller accommodations.

According to a 2010 Maui Retail Market Report by Colliers Monroe Friedlander, Central Maui was the only submarket on the island to post positive net absorption. South Maui and West Maui, which are both heavily populated by visitors, indicated negative net absorption. West Maui revealed the highest vacancy rate of 15.11 percent, while Central Maui was reported to have the lowest vacancy rate at 4.44 percent. The island average stood at 8.52 percent. This is a testament to the strong demand for retail space in Central Maui. As

previously indicated, Central Maui is home to the island's larger retail centers, such as Kaahumanu Shopping Center, Maui Mall, and the Maui Marketplace. West Maui has the second highest inventory of retail space at 914,847 square feet, with the majority of retail space catering to visitors.

Rental Rate Trends

The Colliers Monroe Friedlander report stated retail rents in West Maui stabilized in 2010 and ranged from $3.75 to $5.30 per square foot per month, absolute net. Research of retail center space showed Lahaina Gateway Center had units available between $4.00 and $5.00 per square foot. Lahaina Cannery Mall had space available at negotiable rental rates, and Fairway Shops had spaces available at $3.50 to $4.75 per square foot. Asking retail rents in Central Maui was reported to have fallen 7 percent while South Maui asking retail rents fell more than 10 percent since 2009. Commercial leasing agents indicated that property owners have had to lower expectations and in some cases provide rent reductions, in order to keep their tenants.

Our survey of current listings of competing spaces in the Central Maui neighborhood indicates that rents are lower than a year to two years ago. Whereas warehouse or storage spaces were being rented for upwards of $1.25 to $1.50 per square foot per month on an absolute net basis, current available spaces are clustered within a general range of $0.75 to $1.00 per square foot per month.

Forecasting Demand for Commercial and Industrial Land on Maui

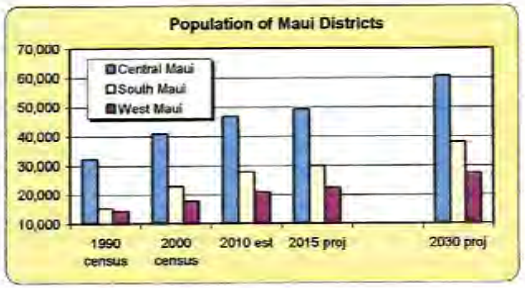
Based on our analysis of the interacting supply and demand factors for commercial and industrial land in Central Maui, the Consultant has analyzed the potential market acceptance of the subject's commercial, industrial and village mixed use areas.

<u>Population Comparison</u>

According to demographic statistics by Claritas, Central Maui's population grew by approximately 26 percent from 32,310 people in the 1990 census to 40,867 people in the most recent census in 2000. West Maui's population grew by approximately 23 percent from 14,392 in the 1990 census to 17,748 in the 2000 census, while South Maui had the largest increase of approximately 49 percent from 15,349 in the 1990 census to 22,874 in the 2000 census.

Central Maui has kept to approximately 32 percent of the total population of Maui County during this period and is still at 32 percent, based on 2010 population estimates. The 2010 estimate indicates a population growth rate of approximately 14 percent over the 2000 census numbers. The population of South Maui and West Maui

accounted for approximately 15 and 14 percent of Maui County's population, respectively, in each of the past census counts. It should be noted that while West Mau has remained at approximately 14 percent, South Maui jumped to almost 20 percent by 2010 estimates. The 2015 population projection for West Maui indicates a growth rate of approximately 7 percent over the 2010 estimate.



To keep up with its very strong demand for commercial or industrial park space, Central Maui has had numerous developments built within the last 10 years. The Waiko Baseyard Subdivision was completed in 2005, with the Consolidated Baseyards Subdivision following in 2006. The Maui Lani Village Center was also completed in early 2010.

The significantly higher amount of land within Central Maui's commercial/industrial parks can be attributed to its proximity to major transportation and shipping facilities located in Kahului. As shown in **Table 13**, based on 2010 population, Central Maui has the lowest number of persons per acre of commercial and/or industrial land (in projects) with a ratio of approximately 85 persons per acre. Meanwhile, West Maui's ratio is approximately 269 persons per acre of land area, while South Maui has the largest ratio, at about 751 persons per acre.

The Consultant is aware of only two proposed commercial industrial parks on Maui that are currently in the planning phase. As previously shown in **Table 12**, A&B Properties' Maui Business Park, Phase II will increase Central Maui's inventory by 179 acres, while the Kaonoulu Business Park is slated to add approximately 75 acres of inventory to the South Maui area. When the proposed developments are taken into consideration, both Central Maui's and South Maui's ratio would fall, while West Maui's ratio would remain the same.

Table 13 – Population to Land Area in Commercial/Industrial Parks

	Central Maui	South Maui	West Maui
Population (2010)	46,795	27,797	20,996
Commercial and Industrial Land Area			
Total acres (in parks)	549	37	78
Persons per acre	**85.2**	**751.3**	**269.2**
Total acres (includes proposed parks)	736	112	78
Persons per Acre (includes proposed parks)	**63.6**	**248.2**	**269.2**

According to analyses based on projected traffic flow through Olowalu Town and population projections for the project, it is estimated that Olowalu Town may contain up to 300,000 square feet of commercial space that will cater to both local residents in the community and the many visitors and commuters that will pass through the town. However, according to the developer, the 300,000 square feet of commercial space also includes many public uses, such as community centers, educational facilities, police and fire stations, medical offices, libraries, post office and cultural centers, churches, etc. Unlike other planned developments where there is a specified amount of land area allocated for commercial or industrial use, the mixture of commercial developments within Olowalu Town is incorporated into the overall "Urban Residential" sector.

Based on the West Maui data provided in Table 13 above, and the projected amount of commercial spaces planned for Olowalu Town, the Appraiser calculated that a population of approximately 4,649 people would be supported by 300,000 square feet of commercial space. The resident population of Olowalu Town is estimated to be 4,200 people based on 1,500 households and 2.7 persons per household. As such, it appears that 300,000 square feet of commercial space should be sufficient to accommodate the population of Olowalu Town.

EXHIBITS

EXHIBIT A

Demographic Reports - Claritas, Inc.

Commercial Space (SF)	300,000 SF
Amount of land needed to support 375,000 SF of commercial space @ 40% lot coverage.	750,000 SF 17.22 Acres
West Maui Persons per Acre of Commercial Land	270
Population that would be supported by the amount of commercial space in Olowalu	4,649
Projected population of Olowalu Town @ 2.7 persons per Household	4,200

Historical Absorption of Commercial & Industrial Land

Recently built subdivisions in Central Maui indicate significant absorption rates. The 11 lots released by the developer of Waiko Baseyard in October 2005 totaled just over five acres and were absorbed within five months. This would indicate an absorption rate of 11.90 acres per year.

Consolidated Baseyards was completed in 2006, with 35 marketable lots totaling approximately 22 acres. There were 27 lots, totaling almost 16 acres, immediately sold between October and December 2006 and January 2007. The remaining eight lots, of approximately 6 acres, were sold in 2007. Overall monthly absorption averaged 1.6 acres, which would translate into about 19 acres per year.

Maui Lani Village Center was completed in early 2010 and features 77 lots, totaling approximately 42 acres. There have been seven closings, amounting to 7.9 acres, within the 19 months that this subdivision has been marketed. This translated into an absorption rate of about five acres per year.

Conversations with the subject's property owners indicated that the 300,000 square feet of commercial space would consist of uses geared more toward neighborhood goods and services providers, in addition to retail and restaurants that cater to both residents and visitors passing through Olowalu Town. It is the Consultant's opinion that the areas would be well suited for a neighborhood commercial retail/office centers, featuring a supermarket and/or drug store as the anchor tenant(s), as well as retail boutique shops and restaurants. Supplementary businesses would cater to the needs of the residents within the Olowalu Town Plan Development and visitors to the area. As explained earlier, the 300,000 square feet of commercial space

also includes many public uses that will serve the Olowalu community as well.

Therefore, although market conditions are currently soft for commercial and industrial segments, it is the Consultant's opinion that there will be stronger demand for the Olowalu Town Master Plan Development's commercial spaces upon economic recovery. Based on the previously stated supply and demand factors, the 300,000 square feet of commercial space is expected to be absorbed well within the estimated 8- to 10-year absorption of the project's 1,500 residential units.

C. CONCLUSION

The following points summarize the supply of real estate in Maui at this time.

RESIDENTIAL SUPPLY COMPONENTS

- There are approximately 2,300 new housing units (single family residential, condominium and residential house lots) currently available in the market or will become available in the short-term future. Based on historical annual absorption rates of the real estate markets, the current short term supply of units is expected to last approximately 4 years (2,300 units of supply ÷ 590 units of average annual absorption).

- Long term supply, as being recommended by the County of Maui Planning Department, the Maui Planning Commission and the General Plan Advisory Committees, is estimated to be 11,623 housing units. Although this count is based on a 20-year span, it is difficult to gauge the timing of these projects until construction actually begins.

  Economic changes, community intervention, market conditions or internal issues with the developers may affect the feasibility of these projects. In reality, some of these projects may never be approved or be built out by 2030. For this reason, the number of units of potential supply that will actually be developed is expected to be lower than the 11,623 units on the list.

COMMERCIAL AND INDUSTRIAL SUPPLY COMPONENTS

- Available commercial and industrial land in Central Maui amounted to approximately 40 acres. Most of the availability, about 36 acres, consists of lots within the recently completed Maui Lani Village Center.

- There are currently no immediate proposed commercial or industrial developments planned for West Maui or South Maui. Proposed commercial and industrial developments in the Central Maui region include the Maui Business Park, Phase II (179 acres), Maui Lani Shopping Center (12 acres), and the Kehalani Project District's commercial component (20 acres). In addition, A&B Properties, Inc. is planning to redevelop the Kahului Shopping Center area into the Kahului Town Center.

The following points summarize the demand for real estate in Maui at this time.

RESIDENTIAL DEMAND COMPONENTS

- Population on Maui between 2000 and 2010 grew by 20.9 percent. Population is expected to increase by almost 58 percent from 2000 to 2035. From 1990 to 2000, Central Maui had a 26.5 percent increase in population, while West Maui and South Maui experienced increases of 23.3 and 49.0 percent, respectively.

- In 2010, the interest rate averaged 4.69 percent, with the lowest rate seen in October at 4.23 percent. As of April 2011, mortgage rates hovered around 4.8 percent. This would typically mean that real estate becomes more affordable to a larger segment of the population. However, the current state of national and local economies, coupled with high unemployment, have prevented many potential market participants from taking advantage of these historically low rates.

- Real estate sales activity in land, single-family and condominium properties dropped considerably in terms of number of sales and median sales price since their peaks in mid-2005. During this same period, marketing times have increased. However, statistics for 2010 appear to show some signs of improvement.

- The Hawaii Housing Policy Study Update 2003 shows that there will be a demand for 8,103 new resident housing units (RHU) from 2011 to 2024.

- The Hawaii Housing Policy Study Update 2003 also estimated a deficit of approximately 3,299 needed resident housing units as of 2010. By the end of the study in 2024, this deficit will increase by approximately 26 percent to 4,154 units.

- Demand for Olowalu Town is anticipated to come from all areas of Maui and not just from West Maui residents. These include the many people that work in West Maui but reside in other regions of the island, as well as those interested in living in an affordable ocean side community.

COMMERCIAL AND INDUSTRIAL DEMAND COMPONENTS

- West Maui had a significant increase in population from the 1990 census to the 200 census with a growth rate of 23 percent. Central Maui also had a significant increase in population from the 1990 to the 2000 census, with a growth

rate of approximately 26 percent. South Maui experienced the greatest increase in population between the 1990 and 2000 census with a growth rate exceeding 40 percent. Increasing population must be followed with the availability of professional services and commercial establishments to support the growth.

- Although the lack of sales activity on Maui can partially be attributed to softened market conditions, there is also a lack of suitable vacant land available for purchase. Therefore it is highly likely that some measure of hidden demand exists. Vacant land prices on Maui overall have decreased. Upon economic recovery, prices are expected to rebound significantly, due to resurgence in demand and limited supply.

- Rental rates for commercial and industrial space have declined since their peaks in 2007. It can be assumed that this trend will reverse course as the economy gains traction.

- West Maui appears to have the second highest ratio of population to acres of finished commercial and industrial land area with South Maui having the highest ratio. This would indicate the continued demand for commercial and industrial land in West Maui and South Maui.

The economic downturn being witnessed across the nation has significantly affected Maui, through a drop in visitor counts and the drastic slowdown of construction. These industries are two of the primary employment forces on the island and their decline has had an adverse impact on the local economy. Unemployment has been on the rise, with many that are still employed stating that job security is a concern. Meanwhile, the heavy losses witnessed in the financial sector since the fourth quarter of 2008 have surely diminished the investment capital for other potential buyers. Combined with a more stringent lending environment, it has become increasingly difficult to purchase and develop real estate, regardless of current market conditions.

At the height of the market, the primary obstacle for buyers was the high asking prices for residential products. Many buyers who did not own a home found it difficult to even come up with enough money for a down payment. Meanwhile, homeowners saw their property values increase to a point where they were able to use their equity appreciation to upgrade to larger, more elaborate accommodations. For many, this option is no longer possible, as the retreat of home prices has caused a significant loss of equity. Currently, the ability of qualified buyers to purchase housing may be more difficult than a few years ago; however, it is fairly safe to assume that as economic conditions improve, housing units within the workforce market segment

will continue to be the most sought after. Local economists have varied opinions as to the timing of the economic recovery, but many have pointed to late-2011 or 2012 for this turnaround.

Had the Olowalu Town Master Plan Development come on-line today, it would have likely been facing the same types of sales difficulties that other ongoing projects are witnessing. However, the subject will still need to go through entitlement, design and construction processes before sales can occur. As such, release of the subject's housing units may be better timed with the economic recovery. Once market conditions improve, the project can expect to see heightened demand, due to its attractive oceanfront community location.

Most importantly, the Olowalu Town Master Plan Development will be targeted heavily toward the workforce market segment. Statistical evidence has clearly shown that regardless of conditions, this market segment has the most demand. Although the pricing of the project units have not been determined, this development will give entry level market participants an opportunity for home ownership.

The property owners continue to work diligently with government agencies in an effort to design a master plan community that represents smart-growth for Olowalu, a once thriving community. As previously discussed, the proposed project is consistent with many of the goals, objectives, policies and implementing actions set forth in the Countywide Policy Plan, which provides a policy framework for the Maui Island Plan and Community Plans. After consideration of current economic and real estate market conditions; forecasts by Hawaii economists; as well as long-term supply and demand recommendations being deliberated for the 2030 General Plan, it is the Consultant's opinion that the Olowalu Town Master Plan Development should be well positioned to capitalize on the recovery of the real estate market and play an important role in providing a long-term solution to the housing needs of Maui's workforce.

Maui County

West Maui

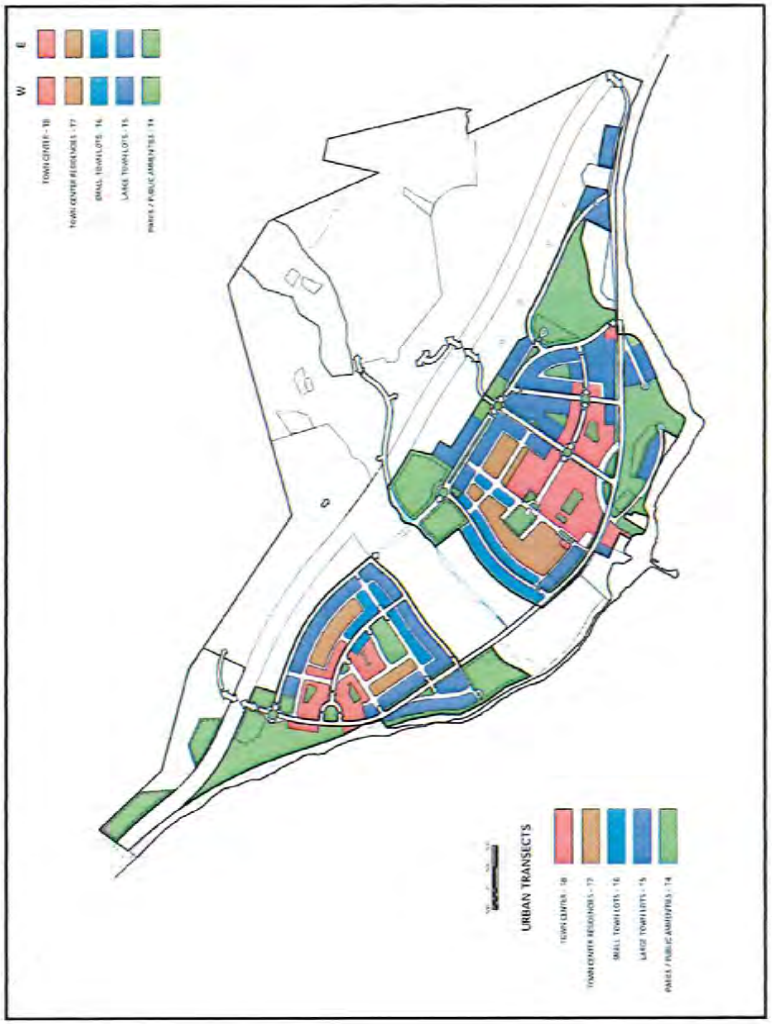


EXHIBIT B

Olowalu Town Conceptual Community Master Plan

ADDENDA

DEFINITIONS

The purpose of this Glossary is to assist the reader in understanding specific terminology used in this report.

Appraisal — (noun) the act or process of developing an opinion of value; an opinion of value (adjective) of or pertaining to appraising and related functions such as appraisal practice or appraisal services.

Cash Equivalent — A price expressed in terms of cash, as distinguished from a price expressed totally or partly in terms of the face amounts of notes or other securities that cannot be sold at their face amounts.

Counseling — Providing competent, disinterested, and unbiased advice and guidance on diverse problems in the broad field of real estate; may involve ony or all aspects of the business such as merchandising, leasing, management, acquisition/disposition planning, financing, development, cost-benefit studies, feasibility analysis, and similar services. Counseling services are often associated with evaluation, but they are beyond the scope of appraisal.

Discounting — A procedure used to convert periodic incomes, cash flows, and reversions into present value; based on the assumption that benefits received in the future are worth less than the same benefits received now.

Extraordinary Assumption — An assumption, directly related to a specific assignment, which, if found to be false, could alter the appraiser's opinions or conclusions. Extraordinary assumptions presume as fact otherwise uncertain information about physical, legal, or economic characteristics of the subject property; or about conditions external to the property such as market conditions or trends; or about the integrity of data used in an analysis. An extraordinary assumption may be used in an assignment only if:

- It is required to properly develop credible opinions and conclusions;
- The appraiser has a reasonable bosis for the extraordinary assumption;
- Use of the extraordinary assumption results in a credible analysis; and
- The appraiser complies with the disclosure requirements set forth in USPAP for extraordinary assumptions.

Fair Value — The cash price that might reasonably be anticipated in a current sale under all conditions requisite to a fair sole. A fair sale means that buyer ond seller are each acting prudently, knowledgeably, and under no necessity to buy or sell-, i.e., other than in a forced or liquidation sale. The appraiser should estimote the cash price that might be received upon exposure to the open market for a reasonable time, considering the property type and local market conditions. ***When a current sale is unlikely-i.e., when it is unlikely that the sale can be completed within 12 months-the appraiser must discount all cash flows generated by the property to obtain the estimate of fair value.*** These cash flows include, but are not limited to, those arising from ownership, development, operating, and sale of the property. The discount opplied shall reflect the appraiser's judgment of what a prudent, knowledgeable purchase under o necessity to buy would be willing to pay to purchase the property in a current sale.

Fee Simple Estate

Absolute ownership encumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat.

Hawaiian Terms

The Hawaiian words "mauka" and "makai" are commonly used in the islands as indicators of direction. The word "mauka" means toward the mountain, and "makai" means toward the ocean.

Highest and Best Use

The reasonably probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value. The four criteria the highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum profitability.

Highest and Best Use of Land or a Site as Though Vacant

Among all reasonable, alternative uses, the use that yields the highest present land value, after payments are made for labor, capital, and coordination. The use of a property based on the assumption that the parcel of land is vacant or can be made vacant by demolishing any improvements.

Highest and Best Use of Property as Improved

The use that should be made of a property as it exists. An existing improvement should be renovated or retained as is so long as it continues to contribute to the total market value of the property, or until the return from a new improvement would more than offset the cost of demolishing the existing building and constructing a new one.

Hypothetical Condition

That which is contrary to what exists, but is supposed for the purpose of analysis. Hypothetical conditions assume conditions contrary to known facts about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in an analysis. A hypothetical condition may be used in an assignment only if:

- Use of the hypothetical condition is clearly required for legal purposes, for purposes of reasonable analysis, or for purposes of comparison;
- Use of the hypothetical condition results in a credible analysis; and
- The appraiser complies with the disclosure requirements set forth in USPAP for hypothetical conditions

Leased Fee Interest

An ownership interest held by a landlord with the rights of use and occupancy conveyed by lease to others. The rights of the lessor (the leased fee owner) and the lessee are specified by contract terms contained within the lease.

Leasehold Interest

The interest held by the lessee (the tenant or renter) through a lease transferring the rights of use and occupancy for a stated term under certain conditions.

Market Rent

The most probable rent that a property should bring in a competitive and open market reflecting all conditions and restrictions of the specified lease agreement including term, rental adjustment and revaluation, permitted uses, use restrictions, and expense obligations; the lessee and lessor each acting prudently and knowledgeably, and assuming consummation of a lease contract as of a specified date and the passing of the leasehold from lessor to lessee under conditions whereby:

- Lessee and lessor are typically motivated.
- Both parties are well informed or well advised, and acting in what they consider their best interests.
- A reasonable time is allowed for exposure in the open market.
- The rent payment is made in terms of cash in United States dollars, and is expressed as an amount per time period consistent with the payment schedule of the lease contract.
- The rental amount represents the normal consideration for the property leased unaffected by special fees or concessions granted by anyone associated with the transaction.

Market Value

The major focus of most real property appraisal assignments. Both economic and legal definitions of market value have been developed and refined. Continual refinement is essential to the growth of the appraisal profession.

The most widely accepted components of market value are incorporated in the following definition:

"The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress."

Market value is defined in the Uniform Standards of Professional Appraisal Practice (USPAP) as follows:

"A type of value, stated as an opinion, that presumes the transfer of a property (i.e., a right of ownership or a bundle of such rights), as of a certain date, under specific conditions set forth in the definition of the term identified by the appraiser as applicable in an appraisal."

The following definition of market value is used by agencies that regulate federally insured financial institutions in the United States:

"The most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:"

- Buyer and seller are typically motivated;
- Both parties are well informed or well advised, and acting in what they consider their best interests;
- A reasonable time is allowed for exposure in the open market;
- Payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and

- The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.

Prospective Market Value Upon Completion of Construction

The prospective future value of a property on the date that construction is completed, based upon market conditions forecast to exist as of the completion date.

Prospective Value Opinion

A forecast of the value expected at a specified future date. A prospective value opinion is most frequently sought in connection with real estate projects that are proposed, under construction, or under conversion to a new use, or those that have not achieved sellout or a stabilized level of long-term occupancy at the time the appraisal report is written.

Report

Any communication, written or oral, of an appraisal, appraisal review, or appraisal consulting service that is transmitted to the client upon completion of an assignment. The types of written reports listed below apply to real property appraisals:

Self-Contained Appraisal Report: A written appraisal report prepared under Standards Rule 2-2(a) of the Uniform Standards of Professional Appraisal Practice. A self-contained appraisal report sets forth the data considered, the appraisal procedures followed, and the reasoning employed in the appraisal, addressing each item in the depth and detail required by its significance to the appraisal and providing sufficient information sa that the client and the users of the report will understand the appraisal and not be misled or confused.

Summary Appraisal Report: A written report prepared under Standards Rule 2-2(b) or 8-2(b). A summary appraisal report contains a summary of all information significant to the solution of the appraisal problem. The essential difference between a self-contained oppraisal report and a summary appraisal report is the level of detail of presentation.

Restricted Appraisal Report: A written report prepared under Standards Rule 2-2(c), 8-2(c), or 10-2(b). A restricted use appraisal report is for client use only. The restricted use appraisal report should contain a brief statement of information significant to the solution of the appraisal problem.

Uniform Standards of Professional Appraisal Practice

Current standards of the appraisal profession, developed for appraisers and the users of appraisal services by the Appraisal Standards Board of The Appraisal Foundation. The Uniform Standards set forth the procedures to be followed in developing an appraisal, analysis, or opinion and the manner in which an appraisal, analysis, or opinion is communicated. They are endorsed by the Appraisal Institute and by other professional appraisal organizations.

LIMITING AND CONTINGENT CONDITIONS
ACM Consultants, Inc.

1. The property is appraised as though free and clear of any or all liens and encumbrances unless otherwise stated in this report. The Consultant will not be responsible for matters of a legal nature that affect either the property being appraised or the title to it. The Consultant assumes that the title is good and marketable, and therefore, will not render any opinions about the title.

2. Legal descriptions referenced in the report were obtained from public documents from the State of Hawaii, Bureau of Conveyances, or were furnished by the client, and were assumed to be correct.

3. It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a nonconformity has been stated, defined, and considered in this appraisal report.

4. It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

5. It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report. Responsible ownership and competent property management are assumed unless otherwise stated in this report.

6. The Consultant has inspected as far as possible, by observation, the land and the improvements; however, it was not possible to personally observe conditions beneath the soil or hidden structurally or by other components. The appraisal assumes that there are no hidden, unapparent, or apparent conditions of the property site, subsoil, or structures or toxic material which would render it more or less valuable. The Consultant and firm have no responsibility for any such conditions or for any expertise or engineering to discover them. All mechanical components are assumed to be in operable condition and status standard for properties of the subject type. Conditions of heating, cooling, ventilation, electrical and plumbing equipment is considered to be commensurate with the conditions of the balance of the improvements unless otherwise stated. No judgment may be made by us as to adequacy of insulation, type of insulation, or energy efficiency of the improvements or equipment, and no representations are made herein as to these matters unless specifically stated and considered in the report.

7. Information provided by third parties including government agencies, financial institutions, realtors, buyers, sellers, property owners and others and contained in this report were obtained from sources considered reliable and believed to be true and correct. However, no warranty is assumed for possible misinformation.

8. All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property. Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

9. The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the appraisal process.

10. If analysis contained in this appraisal involves partial interests in real estate, the value of the fractional interest plus the value of all other fractional interests may or may not equal the value of the entire fee simple estate considered as a whole.

11. Unless otherwise stated in this report, the subject property is appraised without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

12. Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purposed by any person other than the party to whom it is addressed without the written consent of the Consultant, and in any event, only with proper written qualification and only in its entirety.

13. The Consultant(s) or those assisting in preparation of the report will not be asked or required to give testimony in court or hearing because of having made the appraisal, in full or in part, nor engage in post appraisal consultation with client or third parties except under separate and special arrangement and at additional fee. If testimony or deposition is required because of subpoena, the client shall be responsible for any additional time, fees, and charges regardless of issuing party.

14. Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

ACCEPTANCE OF, AND/OR USE OF THIS APPRAISAL REPORT BY CLIENT OR ANY THIRD PARTY CONSTITUTES ACCEPTANCE OF THE ACM CONSULTANTS, INC., CERTIFICATION, LIMITING AND CONTINGENT CONDITIONS. CONSULTANT LIABILITY EXTENDS ONLY TO STATED CLIENT, NOT SUBSEQUENT PARTIES OR USERS OF ANY TYPE, and the total liability of Consultant(s) and firm is limited to the amount of fee received by Consultant.

PROFESSIONAL QUALIFICATIONS

Glenn K. Kunihisa, MAI, CRE

STATE LICENSING

State Certified General Appraiser,
State of Hawaii, License No. CGA 39, July 17, 1991
Expiration: December 31, 2011

PROFESSIONAL AFFILIATIONS

Member, Appraisal Institute, MAI Designation, Hawaii Chapter No. 67
Member, The Counselors of Real Estate, CRE Designation, Hawaii Chapter
Member, International Right of Way Association
Member, National Association of Realtors, Maui Board of Realtors

PROFESSIONAL INVOLVEMENT

Past President – Hawaii Chapter of the Appraisal Institute – 2009
Vice Chairperson – Hawaii Chapter of The Counselors of Real Estate - 2010
Education Chairperson – Hawaii Chapter of the Appraisal Institute – 2004 and 2005
Former Multiple Listing Service (MLS) Committee Member – Realtors Association of Maui

COMMUNITY AFFILIATIONS

St. Anthony Parish School Board
Board Member 1995 to 2008
Board President 1997 and 1998
Alii Community Care, Inc. – A non-profit health care corporation
Board Member 2004 to 2006

EMPLOYMENT

President
ACM Consultants, Inc.
May, 1997 to present

Previously associated with the following:
ACM, Real Estate Appraisers, Inc. - 1986 to 1997
A&B Commercial Company; a division of Alexander & Baldwin, Inc. - 1979 to 1985
Bank of Hawaii - 1976 to 1979

GENERAL EDUCATION

University of Hawaii at Manoa
Master of Business Administration (MBA) - Executive MBA Program V, 1988
Bachelor of Business Administration (BBA), 1976
Iolani School, 1971

LEGAL & CONSULTING

Qualified as an expert witness in the Second Circuit Court of the State of Hawaii
Qualified as an expert in testimony to the State Land Use Commission
Experienced in real estate arbitration assignments in the State of Hawaii

APPRAISAL EDUCATION

Appraisal Institute

Seminar	*Appraisal Curriculum Overview (2-day general)* Honolulu, Hawaii – July 2010

Seminar	*Online Valuation of Green Residential Properties* Chicago, Illinois – July 2010
Seminar	*Hotel Valuation* Honolulu, Hawaii – February 2010
Seminar	*Online Small Hotel/Motel Valuation* Chicago, Illinois – November 2009
Seminar	*Business Practices and Ethics* Honolulu, Hawaii – September 2009
Seminar	*Hawaii Lands, Historical Review* Lihue, Hawaii – August 2009
Seminar	*Appraisal Challenges: Declining Markets and Sales Concessions* Cambria, California – October 2008
Course	*7-Hour National USPAP Update Course* Honolulu, Hawaii – September 2008
Course	*Online 7-Hour National USPAP Equivalent Course* Chicago, Illinois – October 2007
Course	*Valuation of Conservation Easements* Denver, Colorado – October 2007
Seminar	*Uniform Standards for Federal Land Acquisitions ("Yellow Book")* *Practical Applications for Fee Appraisers* Honolulu, Hawaii – December 2006
Seminar	*California Conservation Easements* Sacramento, California – November 2005
Course 400	*7-Hour National USPAP Update Course* Honolulu, Hawaii – October 2005
Seminor	*Case Studies in Limited Partnership and Partial Interest Valuation* Honolulu, Hawaii – May 2005
Seminar	*Appraisal Consulting: A Solutions Approach for Professionals* Honolulu, Hawaii – February 2005
Seminar	*Real Estate Finance, Value and Investment Performance* Honolulu, Hawaii – February 2005
Seminar	*Fannie Mae Residential Presentation* Honolulu, Hawaii - July 2004
Seminar	*Subdivision Analysis* Chicago, Illinois - August 2003
Seminar	*Supporting Capitalization Rates* Chicago, Illinois - August 2003
Seminar	*The Technology Assisted Appraiser* Chicago, Illinois - August 2003
Seminar	*Scope of Work: Expanding Your Range of Services* Chicago, Illinois - August 2003
Course 400	*National Uniform Standards of Professional Practice* Honolulu, Hawaii - May 2003
Course 420	*Business Practices and Ethics* Honolulu, Hawaii - May 2003
Seminar	*The Private Conservation Market* Honolulu, Hawaii - July 2002
Seminar	*Finance Reporting Valuations Parts I and II* Honolulu, Hawaii - July 2002
Seminar	*Future of Appraisal Profession from a Global Perspective* Honolulu, Hawaii - July 2002

Seminar	*Appraisal Office Management* Honolulu, Hawaii - July 2002
Course 540	*Report Writing* Denver, Colorado - December 2000
Seminar	*Partial Interests: Theory and Case Law* Las Vegas, Nevada - July 2000
Seminar	*Easement Valuation* Las Vegas, Nevada - July 2000
Seminar	*Bridging the Gap: Marketability Discounts for Real Estate Interests* Las Vegas, Nevada - July 2000
Course 430	*Standards of Professional Practice, Part C* Honolulu, Hawaii - September 1999
Seminar	*Litigation Skills for the Appraiser: An Overview* Honolulu, Hawaii - May 1998
Seminar	*Special Purpose Properties* Honolulu, Hawaii - September 1997
Seminar	*Highest and Best Use Applications* Honolulu, Hawaii - September 1997
Seminar	*Detrimental Conditions* Honolulu, Hawaii - July 1997
Seminar	*The Appraiser As Expert Witness* Honolulu, Hawaii - August, 1995
Seminar	*How to Appraise FHA-Insured Property* Los Angeles, California - January, 1995
Seminar	*Understanding Limited Appraisals and Reporting Options* Honolulu, Hawaii - August, 1994
Seminar	*Valuation of Leasehold Interests* Honolulu, Hawaii - May, 1993
Seminar	*Valuation of Leased Fee Interests* Honolulu, Hawaii - May, 1993
Seminar	*Valuation Considerations: Appraising Non-Profits* Boston, Massachusetts - July, 1992
Seminar	*Americans With Disabilities Act* Boston, Massachusetts - July, 1992
Seminar	*Valuation in Today's Capital and Financing Markets* Honolulu, Hawaii - June 1992
Seminar	*Arbitration Principles, Procedures and Pitfalls* Honolulu, Hawaii - June, 1992
Seminar	*Institutional Reol Estate in the 1990's* Honolulu, Hawaii - June, 1992
Seminar	*FIRREA and its Impact on Appraisers* Honolulu, Hawaii - June, 1992
Course 410/420	*Standards of Professional Practice, Parts A & B* Honolulu, Hawaii - April, 1991

The American Society of Farm Managers and Rural Appraisers, Inc.

Seminar	*Agricultural Lease Valuation* Honolulu, Hawaii – March 2006

Maui Coastal Land Trust

Seminar	*Understanding the New Tax Incentives: Conservation Easements & Other Charitable Contributions* Wailuku, Hawaii – June 2007

Society of Real Estate Appraisers

Course 101	*Introduction to Appraising Real Property* Dallas, Texas – 1987
Course 102	*Applied Residential Property Valuation* Honolulu, Hawaii - July 1990
Course 201	*Principles of Income Property Appraising* Chicago, Illinois, 1987
Course 202	*Applied Income Property Valuation* San Diego, California - 1988
Seminar	*Professional Practice and the Society of Real Estate Appraisers* Honolulu, Hawaii - 1988
Seminar	*Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies* Honolulu, Hawaii - April, 1988
Seminar	*Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies* Honolulu, Hawaii - April, 1988

American Institute of Real Estate Appraisers

Seminar	*Rates, Ratios and Reasonableness* Honolulu, Hawaii - 1989
Seminar	*Discounted Cash Flow Analysis* Honolulu, Hawaii - 1989
Seminar	*Highest and Best Use* Honolulu, Hawaii - 1989
Seminar	*Capitalization Overview - Part A* Honolulu, Hawaii - 1990
Seminar	*Capitalization Overview - Part B* Honolulu, Hawaii – 1990
Seminar	*Accrued Depreciation* Honolulu, Hawaii - 1990

International Right of Way Association

Course 101	*Appraisal* Las Vegas, Nevada - October, 1998
Course 101	*Negotiation* Las Vegas, Nevada - October 1998

National Business Institute, Inc.

Seminar	*Commercial Real Estate Leasing In Hawaii* Honolulu, Hawaii - 1989

American Arbitration Association

Seminar	*Real Estate Dispute Resolution - Mediation and Arbitration* Kahului, Maui, Hawaii - October, 1990

PROFESSIONAL QUALIFICATIONS
of
Dominic J. Suguitan

STATE LICENSING

State Certified General Appraiser,
State of Hawaii, License No. CGA-576, April 17, 1995
Expiration: December 31, 2011

ASSOCIATION MEMBERSHIPS

General Associate Member - Appraisal Institute

Realtor-Appraiser, National Association of Realtors, Maui Board of Realtors, Inc.

EXPERIENCE AND EDUCATION

Employment

Vice President, Commercial Division
ACM Consultants, Inc. (formerly ACM, Real Estate Appraisers, Inc.)
April, 1991 to present

Previously associated with the following:

Yamaguchi & Yamaguchi, Inc.
Real Estate Appraisers and Consultants

General Education

University of Hawaii at Manoa
Bachelor of Arts Degree, Communications, 1990

Maui Community College, 1985-86

Baldwin High School, 1985

Appraisal Education

Appraisal Institute Courses

"Appraising the Single Family Residence"
Honolulu, Hawaii - January, 1991

"Foundations of Real Estate Appraisal"
Honolulu, Hawaii - February, 1991

Course 1BA – "Capitalization Theory & Techniques, Part A"
San Jose, California - July, 1992.

Course 1BB – "Capitalization Theory & Techniques, Part B"
San Jose, California - July, 1992.

Course I410 – "Standards of Professional Practice, Part A (USPAP)"
Honolulu, Hawaii - April, 1993

Course II420 – "Standards of Professional Practice, Part B (USPAP)"
Honolulu, Hawaii - April, 1993.

Course II430 – "Standards of Professional Practice, Part C (USPAP)"
Honolulu, Hawaii - September, 1999.

Course I400 – "7-Hour National USPAP Update Course"
Honolulu, Hawaii - May, 2003.

Course II420 – "Business Practices and Ethics"
Honolulu, Hawaii - May, 2003

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – November, 2005

Course 520 – "Highest & Best Use and Market Analysis"
Seattle, Washington – September 2006

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – November, 2007

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – September, 2009

"Online Business Practices and Ethics" – Online Course
Chicago, Illinois – November, 2009

Appraisal Institute Seminars

"Data Confirmation and Verification Methods" - Seminar
Honolulu, Hawaii - October, 1995

"Residential Property Construction and Inspection" - Seminar
Honolulu, Hawaii - October, 1995

"Appraisal of Retail Properties" - Seminar
Honolulu, Hawaii - May, 1996

"Detrimental Conditions in Hawaii" - Seminar
Honolulu, Hawaii - July, 1997

"Special Purpose Properties" - Seminar
Honolulu, Hawaii - September, 1997

"Highest and Best Use Applications" - Seminar
Honolulu, Hawaii - September, 1997

"Appraising From Blueprints and Specs" - Seminar
Honolulu, Hawaii - May, 1998

"New Industrial Valuation" - Seminar
Honolulu, Hawaii - October, 1998

"Eminent Domain & Condemnation Appraising" - Seminar
Honolulu, Hawaii - October, 1998

"Online Analyzing Operating Expenses" – Online Seminar
Chicago, Illinois - September, 2001

"Real Estate Disclosure" - Seminar
Honolulu, Hawaii - October, 2001

"Online Internet Search Strategies for R.E. Appraisers" – Online Seminar
Chicago, Illinois - October, 2001

"Online Valuation of Detrimental Conditions in Real Estate" – Online Seminar
Chicago, Illinois - December, 2001

"The Appraisal Institute Commercial Database & AppraiserLoop, Part I" - Seminar
Honolulu, Hawaii - July, 2002

"Statistical Analysis Using the Database, Part I" - Seminar
Honolulu, Hawaii - July, 2002

"The Aftermath: Our World Post-Sept 11" - Seminar
Honolulu, Hawaii - July, 2002

"Statistical Modeling & GIS: Applications for Income Properties" - Seminar
Honolulu, Hawaii - July, 2002

"Real Estate Finance, Value and Investment Performance" – Seminar
Honolulu, Hawaii – February, 2005

"Introduction to GIS Applications for Real Estate Appraisal" – Online Seminar
Chicago, Illinois – August, 2005

"Online Small Hotel/Motel Valuation" – Online Seminar
Chicago, Illinois – October, 2005

"Hawaii Lands, Historical Review"
Kahului, Hawaii – September, 2009

"Online Real Estate Finance Statistics and Valuation Modeling" – Online Seminar
Chicago, Illinois – October, 2009

<u>Society of Real Estate Appraisers</u>

Course 101 – "Introduction to Appraising Real Property"
Tempe, Arizona - June, 1991

APPENDIX L-1.

August 28, 2015 Letter from ACM Consultants, Inc.

ACM
CONSULTANTS, INC.

A Real Estate Valuation, Research & Advisory Group

August 28, 2015

Mr. William Frampton
OLOWALU TOWN LLC
2035 Main Street, Suite 1
Wailuku, Hawaii 96793

Re: A Market Study for the Proposed Olowalu Town Master Plan Development, dated May 2011

Dear Mr. Frampton:

At your request, ACM Consultants, Inc. prepared the subject Market Study for inclusion in the Olowalu Town Master Plan Environmental Impact Statement. The report addressed Alternative 1, the Preferred Alternative. With the adoption of the Maui Island Plan (MIP) in December 2012, Alternative 2 was introduced as a second alternative within the realm of implementation potential. Alternative 2 reflects a master plan concept which follows the MIP's growth boundaries. That is, lands makai of Honoapiilani Highway are not included as part of the Master Plan. Both Alternatives 1 and 2 call for the development of up to 1,500 residential units and between 300,000 to 375,000 square feet of commercial space.

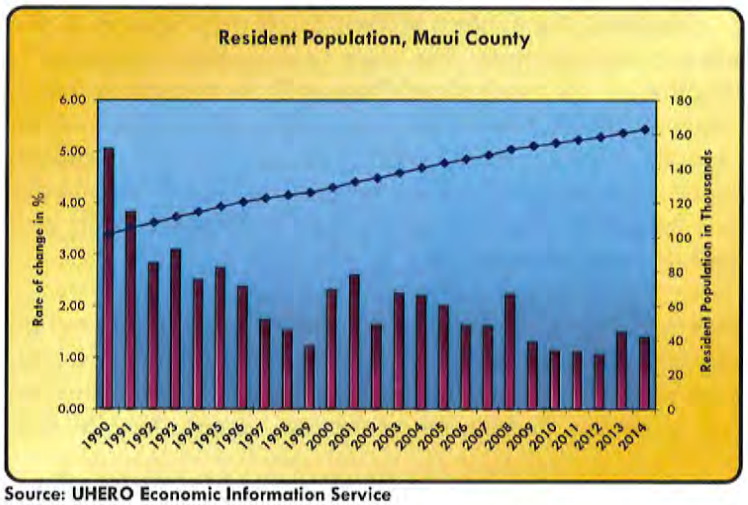
The three objectives of the Market Report were: (i) to define and delineate the market area; (ii) to identify and analyze the current supply and demand conditions specific to the subject's market; and (iii) identify, measure and forecast the effect of anticipated developments or other factors on future supply. You recently asked us to review the above-referenced report (the "Market Report") for two purposes.

First, to determine that the findings, assumptions, analysis and conclusions in the Market Report are still valid, and that no new circumstances have arisen since the preparation of the Market Report that would lead to different conclusions.

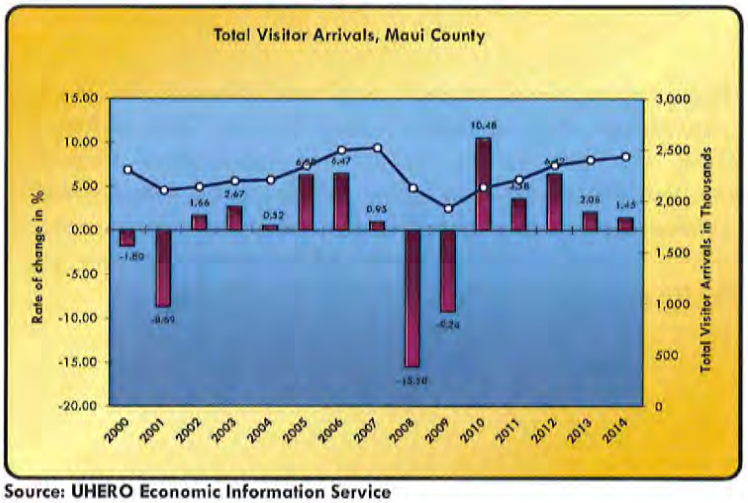
Second, to determine whether the findings, assumptions, analysis and conclusions in the Market Report remain valid if the Olowalu Town Master Plan is built as described as "Alternative 2." Alternative 2 excludes from the OTMP all land areas makai of Honoapilani Highway (approximately 45 acres). The maximum residential unit count under either of the Alternatives is 1,500. You have informed us that the commercial space planned under either Alternative ranges from 300,000 to 375,000 square feet of floor area, which is inclusive of live-work and civic uses, such as community centers, libraries, post offices, cultural centers, churches, fire stations, etc.

With respect to your first request, we confirm that the findings, assumptions, analysis and conclusions in the Market Report remain valid as of the date of this letter. Although statistical data has changed since 2011, our general conclusions that the 1,500 residential units planned for OTMP will be able to be absorbed within a period of 8 to 10 years, and the 300,000 to 375,000 square feet of commercial space can be absorbed well within the estimated 8- to 10-year absorption period still remains valid, barring any catastrophic economic or market event. The fact that economic and real estate market conditions have been steadily improving over the past 3 to 4 years, validates our absorption conclusions. In fact, the supply of housing is currently not keeping pace with the demand for housing which could result in even faster absorption of housing units in OTMP.

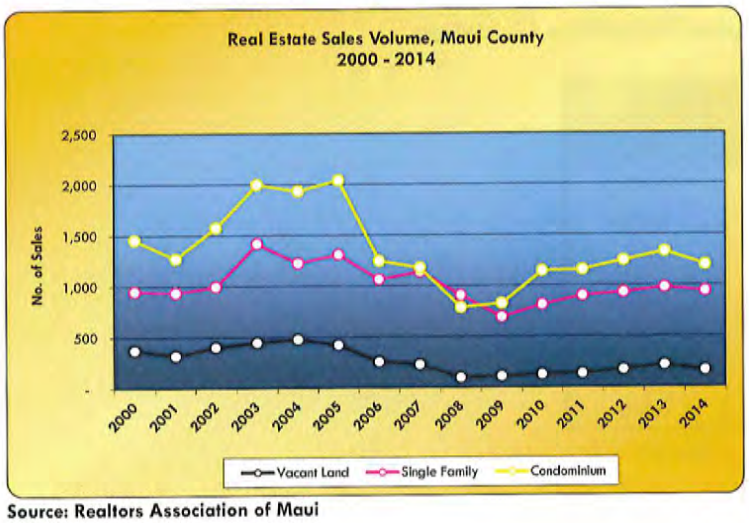
Below are a few graphs and tables that depict a gradually expanding economy and market since 2010-11, including a growing population, increasing visitor arrivals, increased real estate sales volume and increasing median sales prices.



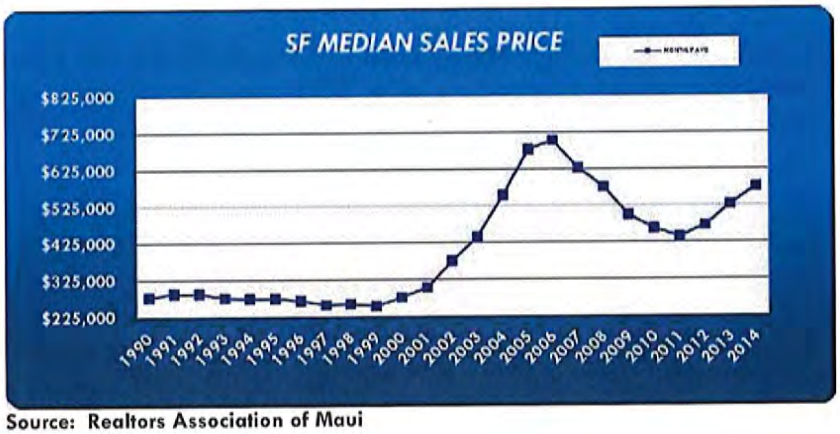
Source: UHERO Economic Information Service



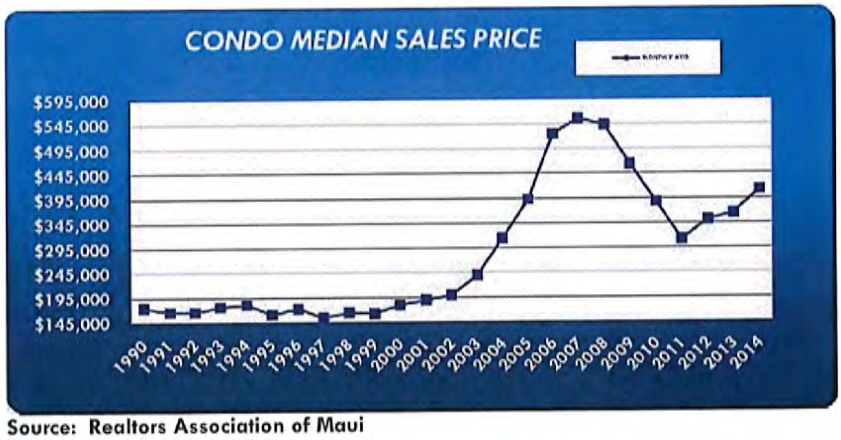
Source: UHERO Economic Information Service



Source: Realtors Association of Maui



Source: Realtors Association of Maui



Source: Realtors Association of Maui

The table below depicts very little change in the family median income from 2009 to 2015, as indicated by the Maui County "Affordable Sales Price Guidelines".

Year	Median Income[1]	Change from Prev. Yr.	
		($)	(%)
2009	$75,400	N/A	N/A
2010	$76,000	$600	0.8%
2011	$76,000	$0	0.0%
2012	$77,100	$1,100	1.4%
2013	$78,600	$1,500	1.9%
2014	$75,800	($2,800)	-3.6%
2015	$75,100	($700)	-0.9%

[1] Maui Island (Except Hana) Median Family Income, as reported in the County of Maui Affordable Sals Price Guidelines.

The following table represents the number of new single-family construction permits over the past 15 years, which clearly shows construction slowed dramatically after 2007, and is still continuing at a relatively slow pace.

Year	# of New SF Units	5-Year Average
2000	842	
2001	767	
2002	807	
2003	889	
2004	1,160	
Sub-total	4,465	893
2005	971	
2006	1,083	
2007	1,062	
2008	535	
2009	280	
Subtotal	3,931	786
2010	212	
2011	203	
2012	251	
2013	329	
2014	331	
Subtotal	1,326	265

Source: Maui County Data Book 2013 and State Data Book 2014.

The following points summarize the supply of real estate in Maui at this time.

- As of July 2015, there were approximately 1,988 active listings in the Realtors Association of Maui Multiple Listing Service for all types of residential properties (single-family, multi-family, and residential house lots) on Maui. By comparison, active listings of residential properties peaked at 3,467 in April 2009.

- There are approximately 871 new housing units currently available in the market. This was determined to be the short term supply of new housing units or vacant lots available for purchase in the market. Of this total, approximately 483 units are located in Central Maui while South Maui has a total of 170 units. West Maui has 164 of the total short term supply, while Upcountry Maui has 68 units.

- Current absorption rates based on August 2015 MLS "Active" listings divided by July 2015 sales calculates to 4 months for residential, 8.5 months for condominiums, and 26 months for land.

ACM acknowledges that the County's Residential Workforce Housing Policy was amended in November 2014 that requires the number of workforce housing units to be equivalent to at least 25 percent of the total number of market rate units, but based on discussions with Messrs Frampton and Ward, ACM understands that the OTMP is still intended to contain 750 housing units that will fall within the "affordable" pricing under the County's "Affordable Sales Price Guidelines."

With respect to your second request, we confirm that the findings, assumptions, analysis and conclusions in the Market Report remain valid whether OTMP is developed as Alternative 1 (the proposal described in the Market Study), or as Alternative 2. From a market perspective, Alternative 2 is a minor variation of Alternative 1. The nature of the OTMP, which will be a small, master-planned community located by the ocean, designed to be pedestrian friendly so that residents can live within walking distance of stores, schools, parks, community centers, places of employment and beaches. These attributes are present under both Alternative 1 and Alternative 2.

As far as the commercial real estate market, West Maui and South Maui has not seen any significant commercial development in the past five years, although Central Maui has seen new commercial development in Maui Lani (Maui Lani Shopping Center, Walgreens, Ace Hardware, Wailuku Federal Credit Union, Oceanic Time Warner, Paradise Beverage, etc.), Kehalani (Foodland, Longs Drugs and McDonalds), and Maui Business Park, Phase II (Target). A new TJ Maxx also recently opened in Maui Mall. As the population and visitor arrivals continue to grow on Maui, demand for commercial space will also continue to increase island-wide. The 300,000 to 375,000 square feet of commercial space planned for OMTP should still be sufficient to accommodate the population of OTMP, and should be able to be absorbed within the estimated 8- to 10-year absorption of the project's 1,500 residential units.

As a final note, this will confirm that Messrs Kunihisa and Suguitan have current and valid licenses as Certified General Appraisers (CGA-039 and CGA-576, respectively). The current expiration dates of these licenses are December 31, 2015.

Respectfully submitted,
ACM Consultants, Inc.

Glenn K. Kunihisa, MAI
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2015

Dominic J. Suguitan
Certified General Appraiser
State of Hawaii, CGA-576
Expiration: December 31, 2015

APPENDIX ~~L~~M.

Assessment of Economic and Fiscal Impact

PREPARED FOR: **MR. BILL FRAMPTON**
OLOWALU TOWN LLC
2073 Wells Street, Suite 201
Wailuku, Hawaii 96793

EFFECTIVE DATE: **August 21, 2015**

ASSESSMENT OF ECONOMIC AND FISCAL IMPACTS, OLOWALU TOWN MASTER PLAN DEVELOPMENT, OLOWALU, ISLAND OF MAUI, HAWAII

ACM CONSULTANTS, INC.

ACM CONSULTANTS, INC.

A Real Estate Appraisal, Research & Advisory Group

August 27, 2015

10-9106B
(Update)

Mr. Bill Frampton
OLOWALU TOWN LLC
2073 Wells Street, Suite 101
Wailuku, Hawaii 96793

Re: An Assessment of Economic and Fiscal Impacts for the proposed Olowalu Town Master Plan Development in Olowalu, Island and County of Maui

Dear Mr. Frampton

In accordance with your request, we have analyzed the proposed Olowalu Town Master Plan Development in Olowalu, District of Lahaina, Island and County of Maui, in order to provide a study of its potential economic and fiscal impacts. This *counseling report*, and the conclusions herein, is based on the on-site inspection of the property, a study of current political and economic conditions, and a historical review of the real estate market in the West Maui region.

The subject consists of approximately 636 acres of land and is currently zoned State Agricultural District. The proposed project is identified as Olowalu Town and will be located along Honoapiilani Highway between Maalaea and Lahaina. Olowalu Town will be a community comprised of residential uses, commercial and civic uses, parks and recreation sites, agricultural uses, and a cultural preserve.

At full build-out, Olowalu Town is expected to be comprised of approximately 1,500 living units, including single-family, multi-family and live-work units, together with 300,000 to 375,000 square feet of commercial and civic space. Within the 1,500 living units, on-site affordable housing units will also be included in compliance with the County of Maui's Residential Workforce Housing Policy.

The focus of this assignment essentially has three parts: (1) to define and delineate the subject and its market area; (2) to identify and analyze potential economic impacts with regard to the project; and (3) identify and analyze potential fiscal impacts with regard to the project.

The following report presents a narrative review of the assessment and our analysis of data along with other pertinent materials on which this report is predicated. It contains data and exhibits gathered in our investigations, and will include a description of the analytical process and our conclusions, as of August 21, 2015.

2073 Wells Street, Suite 100 ◆ Wailuku, Maui, HI 96793 ◆ Telephone: (808) 242-6481 ◆ Fax: (808) 242-1852

Mr. Bill Frampton
August 27, 2015
Page 2

Thank you for allowing us the opportunity to work on this interesting assignment.

Respectfully submitted,
ACM Consultants, Inc.

Glenn K. Kunihisa, MAI
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2015

Dominic J. Suguitan
Certified General Appraiser,
State of Hawaii, CGA-576
Expiration: December 31, 2015

ACM CONSULTANTS, INC.

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PART I – INTRODUCTION

A. EXECUTIVE SUMMARY

Background

The proposed Olowalu Town Master Plan Development is located on both sides of Honoapiilani Highway in Olowalu, Island and County of Maui. The subject is primarily zoned State Agricultural District and consists of approximately 636 acres of land. The project, which is still in its preliminary planning stage, will consist of approximately 1,500 residential units, including single-family, multi-family and live-work units; passive parks and open space, such as cultural preserves, neighborhood parks, and archaeological sites; active parks/community services, such os coastal parks, community centers, schools and police/fire facilities; 300,000 to 375,000 square feet of commercial space (inclusive of live-work and civic uses); and, an on-site wastewater treatment facility. Potable water for the project will be provided by a private water well. According to the Developer, the proposed land uses and alternatives are as follows:

Alternative 1 Existing Land Use	
Agricultural	609 Acres
Conservation	27 Acres
Petition Area for Alternative 1	
Urban	266 acres
Rural Residential	168 acres
Alternative 2 Existing Land Use	
Agricultural	568 Acres
Conservation	22 Acres
Petition Area for Alternative 2	
Urban	228 acres
Rural Residential	168 acres

Preliminary plans call for 400 to 800 single-family units, 600 to 900 multi-family/apartment units, 150 to 200 live-work units, and 75 to 100 Rural residential lots. The Developer has estimated an 8- to 10-year build out for Olowalu Town.

Study Objectives

ACM Consultants, Inc. has been retoined by Olowalu Town LLC to assess the potential economic and fiscal impacts related to this proposed project. In particular, the Consultants studied economic trends and demographics, and supply and demand factors for residential and commercial properties. Residential properties included single-family residences, single-family house lots, and condominium/apartment units. Commercial properties included vacant developable lots as well as improved properties. In the process, they gathered as much information as possible on real

estate activity on Maui while focusing on the West Maui, Central Maui, and the South Maui market.

The objectives of the economic and fiscal impact assessment were as follows: (1) to define and delineate the subject and its market area; (2) to identify and analyze potential economic impacts with regard to the project; and (3) identify and analyze potential fiscal impacts with regard to the project.

Conclusion

The development of this project will generate significant expenditures by the developer of this subdivision, in addition to the eventual homeowners. These investments are expected to favorably impact the Maui economy on a broad scale, and in a multitude of ways.

- ❑ Site work and infrastructure construction for this project will immediately infuse capital into the Maui economy. Numerous consultants will be involved in the initial planning stages, ond the construction trades will benefit from the job creation of this project.
- ❑ Advertising for the project and marketing of the units will benefit graphic artists, advertising companies, newspapers, real estate sales agents, escrow companies, etc.
- ❑ Individual site development will again result in additional work for engineers, architects, material suppliers, equipment rentals and sales, landscaping companies, and other related industries.
- ❑ The new housing units will have an indirect affect on retail businesses, restaurants and service establishments as the expanded work force purchases goods and services. This should pass through the entire community, causing a ripple effect and increase the amount of capital flowing through Maui.
- ❑ Upkeep of the residential, commercial and light industrial buildings will also translate into work for maintenance companies, painting companies, real estate management and leasing groups, etc.
- ❑ Fiscal benefits of this development will include increases in real estate taxes and various fees collected by the County of Maui, as well as additional conveyance tax, income tax and general excise tax inflow for the State of Hawaii.

SUMMARY OF ECONOMIC IMPACTS

From Development Activities	
Total Construction Expenditures	$465,562,500
Total Indirect Sales	$585,677,625
Total Employment	4,770 jobs
Total Payroll	$224,032,728
Total Residents Supported	10,390 residents[1]
Total Households Supported	3,310 units[2]
Total Excise Tax	$42,866,000[3]
At Full Build-Out	
Annual Taxable Property Values	$563,030,000[4]
Annual Property Tax Revenue	$2,011,000[5]
In-Migrant Residents	219 residents
Annual In-Migrant Resident County Expenditures	$(627,000)
Annual In-Migrant Resident Personal Income Tax And Corporate Income Tax	$732,000
Annual In-Migrant Resident General Excise Tax	$319,000
Annual In-Migrant Resident State Expenditures	$(1,428,000)

SUMMARY OF FISCAL IMPACTS, COUNTY OF MAUI

Net Annual Revenues at Full Build-Out	$1,600,000[6]

SUMMARY OF FISCAL IMPACTS, STATE OF HAWAII

Cumulative Net Revenues from Development	$65,164,000[7]
Net Annual Revenues at Full Build-Out	$(377,000)

1 *Revised based on updated population and job estimates gleaned from County and State data.*
2 *Revised based on updated market and affordable home prices.*
3 *Reflects total taxable property value of entire project. Previous figure represented only commercial property value.*
4 *Revised based on updated market value estimates.*
5 *Revised based on updated revenues.*
6 *Revised based on updated revenues and expenditures.*
7 *Revised based on updated excise tax revenues and expenditures.*

B. PURPOSE OF THE REPORT

The purpose of this report, as of August 21, 2015, is to generate an economic and fiscal impact assessment with respect to the proposed Olowalu Town Master Plan Development.

C. INTENDED USE OF THE REPORT

The intended use or function of this report is to provide potential economic and fiscal information and real estate market data to our client to be used in the entitlement process for the Olowalu Town Master Plan Development.

D. SCOPE OF THE REPORT

The Consultant has agreed to provide a current economic and fiscal impact assessment of this project by (1) defining and delineating the market area; (2) identifying and analyzing potential economic impacts with regard to the project; and (3) identifying and analyzing potential fiscal impacts with regard to the project. The assessment will be developed and prepared in conformity with, and subject to, the requirements of the Code of Professional Ethics and the Standards of Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice.

E. STATEMENT OF COMPETENCY

ACM Consultants, Inc. (formerly ACM Real Estate Appraisers, Inc.) has been actively involved in the real estate appraisal and consulting business since 1982. Our business emphasis has focused mainly on the research, consultation and valuation of residential and commercial properties located within the State of Hawaii. The company considers itself competent to conduct an economic and fiscal impact assessment for a proposed master plan development in Olowalu, Island and County of Maui.

F. EXTRAORDINARY ASSUMPTIONS AND HYPOTHETICAL CONDITIONS

As of August 2015, the subject was still in the preliminary stages of planning. A land use map from the Developer provided a visual indication of the proposed layout of the project district. Several discussions were held with the Developer to better understand the housing products and complementary land uses planned for the subject. The Consultant is not liable for any changes in the project plan past this date, nor for information that has not been released or communicated to the Consultant.

The Consultant has no control over economic conditions and other international events that could have an affect upon Hawaii's economy and the Maui real estate market. As a result, this report

has not made any assumptions regarding potential conflicts with other nations, or global external factors affecting economic conditions here.

Estimated construction costs, multipliers, tax rates, interest rates, earnings estimates, demographic information and per capita government expenditures were utilized by the Consultant in determining the economic and fiscal impacts of this proposed residential subdivision. These figures and statistics were obtained through conversations with those active in the construction industry, in addition to the review of various construction budgets, demographic and governmental reports. This consulting report has been based on the assumption that all information gleaned from third party sources is accurate for analytical purposes.

All conclusions in this counseling report have been stated in 2015 dollars, rounded to the nearest $1,000. In doing so, the Consultant has assumed that all construction costs, multipliers, tax rates, interest rates, earnings estimates, demographic information and per capita government expenditures will remain constant throughout the build-out period. Although the cyclical nature of the real estate market would undoubtedly produce varied annual assessments and impacts, for the purposes of this report, they have been reported as unweighted averages. Furthermore, total category impacts may not equate to the sum of the respective sub-categories due to rounding.

The counseling report is also subject to standard "Limiting and Contingent Conditions" located in the pages following.

G. CONFIDENTIALITY PROVISION

The contents of this economic and fiscal impact assessment are confidential. Release of this counseling report by ACM Consultants, Inc. is limited to you and for your preparation and submission of an Environmental Impact Statement for the proposed Olowalu Town Master Plan Development. The intended users of this report include Olowalu Town, LLC. and the appropriate government agencies to which this report will be submitted. Any further release of this report, or portions herein, is strictly prohibited and you shall accept the risk and liability for any such release without the previous written consent of ACM Consultants, Inc. Further, you shall indemnify and defend ACM Consultants, Inc., and its individual consultants/appraisers, from any claims arising out of any such unauthorized disclosure.

H. CERTIFICATION

The undersigned does hereby certify that except as otherwise noted in this appraisal report:

1. The Consultants' compensation is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event.

2. The Consultants have no present or prospective interest in the property that is the subject of this report, and no personal interest or bias with respect to the parties involved. Any "Estimate(s) of Market Value" in the consulting report is not based in whole or in part upon the race, color, or national origin of the prospective owners or occupants of the properties in the vicinity of the property appraised.

3. The Consultants have personally inspected the property, and are signatories of this Certification.

4. To the best of the Consultants' knowledge and belief, all statements of fact and information in this report are true and correct, and the Consultants have not knowingly withheld any significant information.

5. No other person provided significant professional assistance to the person(s) signing this report.

6. The reported analyses, opinions and conclusions are limited only by the reported assumptions and limiting conditions, and are the Consultants' personal unbiased professional analyses, opinions and conclusions.

7. All analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Appraisal Practice.

8. This counseling report is subject to and in conformance with the Code of Professional Ethics and Standards of Professional Conduct of the Appraisal Institute. The analyses, opinions and conclusions of this counseling report have been made in conformity with, and is subject to, the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

9. This counseling report is to be used only in its entirety and no part is to be used without the whole report. All conclusions and opinions concerning the real estate are set forth in the counseling report were prepared by the Consultants whose

signatures appears on the counseling report. No change of any item in the counseling report shall be made by anyone other than the Consultants, and the Consultants shall have no responsibility for any such unauthorized change.

10. The Appraisal Institute, of which the Consultants are members, has a legal right to review this report.

11. The qualifications of the Consultants, including completed educational requirements of their candidacy are located in the Addendum to this report. Any member signing the report has completed the requirements of the Appraisal Institute's continuing education program.

ACM Consultants, Inc.

Glenn K. Kunihisa, MAI
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2015

Dominic J. Suguitan
Certified General Appraiser,
State of Hawaii, CGA-576
Expiration: December 31, 2015

I. LIMITING AND CONTINGENT CONDITIONS

1) This is a Counseling Report which is intended to comply with the reporting requirements set forth under Standards Rule 5 of the Uniform Standards of Professional Appraisal Practice for a Counseling Report. The information contained in this report is specific to the needs of the client and for the intended use stated in this report. The Consultant is not responsible for unauthorized use of this report.

   This report has not been prepared for federally-related mortgage financing purposes, and has not been prepared in compliance with the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

2) No responsibility is assumed for legal or title considerations. Title to the property is assumed to be good and marketable unless otherwise stated in this report.

3) The property analyzed is free and clear of any or all liens and encumbrances unless otherwise stated in this report.

4) Responsible ownership and competent property management are assumed unless otherwise stated in this report.

5) The information furnished by others is believed to be reliable. However, no warranty is given for its accuracy.

6) All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property.

7) It is assumed that there are no hidden or unapparent conditions of the property, subsoil, or structures that render it more or less valuable. No responsibility is assumed for such conditions or for arranging for engineering studies that may be required to discover them.

8) It is assumed that there is full compliance with all applicable federal, state, and local environmental regulations and laws unless otherwise stated in this report.

9) It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a nonconformity has been stated, defined, and considered in this counseling report.

10) It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or

organization have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

11) Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

12) It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report.

13) The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the analysis process.

14) Unless otherwise stated in this report, the subject property is evaluated without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

15) Any proposed improvements are assumed to be completed in a good workmanlike manner in accordance with the submitted plans and specification.

16) The distribution, if any, of the total valuation in this report between land and improvements applies only under the stated program of utilization. The separate allocations for

land and buildings must not be used in conjunction with any other appraisal and are invalid if so used.

17) Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purpose by any person other than the party to whom it is addressed without the written consent of the consultant, and in any event, only with property written qualification and only in its entirety.

18) Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

PART II – DESCRIPTION OF THE PROPOSED DEVELOPMENT

A. LAND USE

The proposed Olowalu Town Master Plan Development is located on both sides of Honoapiilani Highway in Olowalu, Island and County of Maui. The subject is primarily zoned State Agricultural District ond consists of approximately 636 acres of land. The project, which is still in its preliminary planning stage, will consist of approximately 1,500 residential units, including single-family, multi-family and live-work units; passive parks and open space, such as cultural preserves, neighborhood parks, and archaeological sites; active parks/community services, such as coastal parks, community centers, schools and police/fire facilities; 300,000 to 375,000 square feet of commercial space (inclusive of live-work and civic uses); and, an on-site wastewater treatment facility. Potable water for the project will be provided by a private water well. According to the Developer, the proposed land use and alternatives are as follows:

Alternative 1 Existing Land Use	
Agricultural	609 Acres
Conservation	27 Acres
Petition Area for Alternative 1	
Urban	266 acres
Rural Residential	168 acres
Alternative 2 Existing Land Use	
Agricultural	568 Acres
Conservation	22 Acres
Petition Area for Alternative 2	
Urban	228 acres
Rural Residential	168 acres

Preliminary plans call for 400 to 800 single-family units, 600 to 900 multi-family/apartment units, 150 to 200 live-work units, and 75 to 100 rural residential lots. The Developer has estimated an 8- to 10-year build out for Olowalu Town.

B. UNIT TYPES

Preliminary plans called for approximately 400 to 800 single-family units, approximately 600 to 900 multi-family units, and 75 to 100 rural residential lots. For purposes of this analysis, the typical single-family market unit is assumed to include three bedrooms with an average living area of about 2,000 square feet, and the typical multi-family market unit is assumed to include two bedrooms and about 1,200 square feet. The typical single-family

affordable unit is assumed to include three bedrooms with an average living area of about 1,200 square feet, and the typical multi-family affordable unit is assumed to include two bedrooms and about 750 square feet.

C. AFFORDABLE PRICE UNITS

Based on the current County of Maui Workforce Housing Ordinance, the subject will be required to offer at least 25 percent of its proposed 1,500 housing units as on-site affordable units. The current Workforce Housing Ordinance also specifies the following minimum affordable housing unit allocation:

Above Moderote Income (121 to 140%)	20 percent
Moderote Income (101 to 120%)	50 percent
Below Moderate Income (81 to 100%)	30 percent

Based on the Workforce Housing Ordinance, approximately 375 affordable housing units would be required. The developer has proposed to provide 750 units for sale or lease ot affordable housing prices (which would include multi-family rental units). The actual allocation will be based on discussions and agreement with the Maui County Department of Housing and Human Concerns.

D. COMMERCIAL/INDUSTRIAL COMPONENT

Based on preliminary plans, the Olowalu Town Master Plan Development will feature approximately 300,000 to 375,000 square feet of Commercial space, including neighborhood commercial, light industrial and village mixed-use. While some of the economic and fiscal impacts attributed to the development of these areas have been estimated, other impacts are more difficult to account for.

For example, at full build-out, there would be additional revenue to the State of Hawaii in the form of conveyance taxes, should commercial or industrial condominium units be constructed. However, this would not be the case if leasable multi-tenant structures were built. Furthermore, the general excise tax to be paid from ongoing sales within these projects cannot be accurately gauged, without knowing the tenant mix. A retail business would likely have gross revenue very different from a professional office user. Another exomple might be a light industrial space utilized for storage versus a wholesale distribution warehouse. Many of these factors will be determined by future market conditions. As a result, this analysis has conservatively limited its focus to those primary areas of economic impact, with emphasis on the Olowalu Town Master Plan Development's residential component.

PART III – ECONOMIC IMPACTS OF THE PROPOSED DEVELOPMENT

A. ECONOMIC IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Construction of the Subdivision Improvements

The Developer has estimated that vertical construction costs for the single-family units to be approximately $150 per square foot and about $175 per square foot for the multi-family units. Research of projects offering similar entry level housing units revealed this range to be reasonable. On average, the typical three-bedroom single-family unit will have approximately 1,200 square feet of living area, while the living area for the typical two-bedroom multi-family unit will average approximately 750 square feet. Vertical construction expenditures for the 1,500 proposed housing units totaled approximately $297,562,500. It should be noted that this figure included the residential component of the "live/work" units in the Village Mixed-Use area.

Other estimated vertical construction costs from the Developer were as follows: $75,000,000 for the neighborhood commercial and village mixed use areas; $50,000,000 for the internal roadways and utilities; and $15,000,000 for the wastewater treatment facility and R-1 transmission line; $18,000,000 for the new highway and bridge; $5,000,000 for parks improvements; and, $5,000,000 for a small-scale renewable energy system. The construction expenditures for the Olowalu Town Master Plan Development totaled approximately $465,562,500.

Indirect Sales

Development and construction activities will also generate indirect sales, through the supply of goods and services to the various construction companies, in addition to the families of their employees. By the same token, these suppliers and their families will purchase goods and services from other companies. This chain reaction continues over and over, with some of the revenues leaking out of Hawaii's economy with each cycle. Based on State economic multipliers, off-island indirect sales were estimated at about $344,516,250 over the term of the project. Meanwhile, Maui indirect sales were estimated at about $241,161,375 over the term of the project. Indirect sales attributed to the development totaled approximately $585,677,625.

Direct and Indirect Employment

New job opportunities created by this development will start with the design and entitlement process, employing architects, engineers, surveyors, and land use planners. Site work, road work and the installation of utility and drainage lines typically utilize heavy equipment operators, tractor-trailer drivers and utility personnel. Vertical construction of the housing units, commercial buildings, village mixed-use projects and light industrial facilities will employ masons, carpenters, sheet metal workers, roofers, drywall installers, plumbers, electricians and painters. Finish work will require cabinet

makers, carpet and tile installers, interior decorators, and landscapers. Application of State economic multipliers resulted in a forecasted annual average of 186 jobs directly related to the construction of this development.

The increase in construction will also create the need for supplementary companies to strengthen their labor force. These jobs may be from building supply companies, hardware stores, equipment rental companies, and shipping/warehousing companies. In addition, the construction laborers and their families will patronize local goods and services providers. Grocers, restaurants, service stations, auto repair shops, financial institutions, recreational venues, medical facilities and personal care businesses could be considered potential companies that would need to bolster their employee count. Based on State economic multipliers, indirect jobs on Maui were forecasted to average 191 jobs annually, resulting in an estimated annual average of 377 Maui jobs directly and indirectly tied to the development of the project. Meanwhile, indirect employment on Oahu could possibly add an average 100 jobs per year. Employment attributed to the development totaled approximately 4,770 jobs over the term of the project.

Direct and Indirect Payroll

Payroll directly related to the development of the project was estimated to be $10,890,304 per annum, based on statistics gleaned from the State of Hawaii Department of Labor and Industrial Relations (DLIR) and job counts determined in the previous section. It should be noted that most construction positions are expected to be filled by Maui laborers.

Indirect Maui payroll came out to about $7,219,525 per year, while indirect Oahu payroll was around $4,293,444 annually. Total direct and indirect payroll attributed to the development of the subject was forecasted to be close to $224,032,728 over the term of the project.

Population Supported by Project Development

Statistical information obtained from the DLIR indicated Maui residents supported by construction jobs attributed to this development are forecasted to average of 435[8] residents per year, while residents supported by indirect jobs may amount to an average of 446 [9] residents per year.

Oahu residents supported by indirect jobs created by this development were estimated to average 158[10] residents per year. In all, approximately 10,390[11] residents on Maui and Oahu will potentially be supported by the development of this project.

8 Revised based on updated population and jobs data from County and State Data Books.
9 Revised based on updated population and jobs data from County and State Data Books.
10 Revised based on updated population and jobs data from County and State Data Books.
11 Revised based on updated population and jobs data from County and State Data Books.

Housing for Supported Population
Statistical information obtained from the DLIR indicated Maui housing units supported by construction jobs attributed to this development are forecasted to average 138[12] units per year, while housing units supported through indirect jobs would average about 141[13] units per year.

Oahu housing units supported through indirect jobs created by this development were estimated to average 69 units per year. In all, about 3,310 housing units on Maui and Oahu will potentially be supported by the development of this project. It should be noted that this category does not necessarily represent additional housing units needed for direct and indirect employees, but indicates the potential number of households that would be financially linked to monies earned by such workers.

B. ECONOMIC IMPACTS AT FULL BUILD-OUT

Property Values at Full Build-Out
For this analysis, the average **market value** for the single-family units (300 units) was estimated at $825,000[14], while the average **market value** for the multi-family units (450 units) was estimated at $725,000[15]. The average **affordable value** for the single-family units (300 units) was estimated at $430,000[16], while the average **affordable value** for the multi-family units (450 units) was estimated at $280,000[17]. Based on the unit breakdown provided by the Developer, the total property value of the 1,500 units, at full build-out was estimated at approximately $896,130,000[18]. With an estimated 300,000 square feet of potential commercial space in the project, the estimated total property value, based on $175 per square foot, calculates to $52,500,000.

Long Term Employment
In addition to construction related employment, the commercial and industrial components will provide long term employment opportunities. At full build-out this could result in approximately 1,000 jobs just in the commercial and industrial sectors within the project, including employees in live-work units. It is recognized that not all of these jobs would be new, since existing Maui businesses could be relocating to the project.

12 Revised based on updated population and jobs data from County and State Data Books.
13 Revised based on updated population and jobs data from County and State Data Books.
14 Revised estimate based on current real estate market data.
15 Revised estimate based on current real estate market data.
16 Revised estimate based on current Maui County Affordable Sales Price Guidelines.
17 Revised estimate based on current Maui County Affordable Sales Price Guidelines.
18 Revised estimate based on current real estate market data and Affordable Sales Price Guidelines.

PART IV – FISCAL IMPACTS, COUNTY OF MAUI

A. FISCAL IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Development Activities
Typically, the County accumulates revenue from developments in the form of fees, such as for building permits and impacts attributed to the development. In this case, fee revenue would be generated from the construction of the overall Olowalu Town Master Plan Development, as well as from the subsequent development of the individual project lots.

Net Taxable Value, Project Housing Units
For the purpose of this analysis, we have assumed that the Olowalu Town Master Plan Development will feature approximately 600 three-bedroom single-family units and 900 two-bedroom multi-family units. For this analysis, approximately 85 percent of the single family units and 75 percent of the multi family units were assumed to be owner occupied. Accordingly, about 345 market and affordable single-family units and 428 market and affordable multi-family units will be owner-occupied. As such, these homeowners would qualify for the County of Maui homeowner exemption, which currently stands at up to $300,000 per qualified housing unit. The single-family unit owners would be able to claim a $300,000 exemption. Meanwhile, the multi-family unit owners would be exempt for $275,000, or the full value of their property, only owing the County of Maui minimum tax (currently at $150 per year). After deduction of the homeowner exemptions, the net taxable value of the project, including commercial property values, amounted to approximately $563,030,000[19].

B. FISCAL IMPACTS AT FULL BUILD-OUT

At full build-out, County revenue would primarily be generated in the form of real property taxes. As previously discussed, the net taxable value of the project was determined to be about $563,030,000[20], based on market and affordable homes, as well as owner-occupant exemptions. Residential owner-occupants who qualify for the County homeowner exemption are assessed at PITT Code 900 (Homeowner). Currently, this tax class has a mill rate of $2.75 per $1,000 of assessed value. The tax obligation for the owner-occupied single-family units was calculated at $1,052,000[21] per year. The unoccupied and renter-occupied single-family units will be assessed at PITT Code 100 (Improved Residential). Currently, this tax class has a mill rate of $5.40 per $1,000 of assessed value. The tax obligation for the unoccupied and renter-

19 Revised based on updated real property values and tax revenues.
20 Revised based on updated real property values and tax revenues.
21 Revised based on updated real property values and property tax rates.

occupied single-family units amounted to close to $225,000[22] per year.

As previously discussed, the owner-occupied multi-family units will be fully exempt, but still pay the $150 minimum annual property tax. Thus, the tax obligation for the owner occupied multi-family units amounted to about $117,000 per year. Meanwhile, the unoccupied and renter-occupied multi-family units will be assessed at PITT Code 200 (Apartment). Currently, this tax class has a mill rate of $6.00 per $1,000 of assessed value. The tax obligation for the unoccupied and renter-occupied multi-family units was forecasted at $519,000[23] per year. The tax obligation for the commercial spaces amounted to $346,500[24]. The total estimated annual real property tax attributed to the residential and commercial portion of the project is estimated at $2,228,000[25] per year at full build-out.

The Olowalu Town Master Plan Development is slated to be built on the following State of Hawaii Tax Map Keys: (2) 4-8-03, Parcels 005, 071, 072, 084, 098 through 117, 124 and 124. According to the County of Maui Real Property Tax Division, the Developer currently pays approximately $30,972 in property taxes for these parcels. This amount was deducted from the annual revenues at full build-out, as the County will no longer receive this income. The resulting net real property tax revenue at full-build out was estimated to be about $1,600,000 [26] annually.

County of Maui annual expenditures at full build-out were considered to be for general services, infrastructure maintenance and public safety. This would also include upkeep of public recreational facilities, such as the parks to be provided by the project. Assuming that the majority of the development's future residents already live on Maui, some of these expenses would be incurred by the County no matter where they live. As such, there would not necessarily be an additional cost to the County for each resident moving into the Olowalu Town Master Plan Development. Based on demographic statistics for West Maui, it was estimated that the Olowalu Town Master Plan Development will have approximately 4,375 residents. For the purposes of this analysis, it was assumed that 95 percent will be already living on Maui, with the remaining 5 percent, or about 219 residents, being in-migrant residents. The additional cost to the County attributed to these in-migrant residents was estimated to be $586,000 per year, plus debt service of $42,000 per year.

22 Revised based on updated real property values and property tax rates.
23 Revised based on updated real property values and property tax rates.
24 Revised based on updated real property values and property tax rates.
25 Revised based on updated real property values and property tax rates.
26 Revised based on updated tax revenues and expenditures.

Thus, the net revenue attributed to the project, at full build-out, was estimated to be $1,600,000[27] per year. It should be noted that since this project will consist mostly of owner-occupant workforce housing units, its property tax base is significantly reduced by the homeowner exemptions. Furthermore, the County of Maui's property tax system is structured in a way that owner-occupant subdivisions such as the subject are essentially subsidized by revenue received from other property classes. The majority of Maui's property tax revenue is generated by time share, hotel/resort, industrial and commercial properties, which have substantially higher mill rates.

27 Revised based on updated tax revenues and expenditures.

PART V – FISCAL IMPACTS, STATE OF HAWAII

A. FISCAL IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Although the State of Hawaii will recognize revenue from the project through various taxes, including Conveyance Tax, and Personal Income Tax, this analysis will focus on the Excise Tax as the primary additional revenue source.

Excise tax is based on two rates, 4.166 percent for final sales and 0.5 percent for intermediate sales. The cumulative tax expectancy for final sales amounted to about $39,432,023[28], while intermediate sales should be close to $3,434,304. Excise tax attributed to the development totaled approximately $42,866,327[29].

B. FISCAL IMPACTS AT FULL BUILD-OUT

At full build-out, State revenue would be generated by Personal Income Tax, Excise Tox, and Other Revenues. Similar to the previous section, this analysis has focused on Excise Tax. In this case, the Excise Tax to be received from in-migrant residents was estimated to be $319,000 per year. Personal Income Tax and Corporate Income Tax from in-migrant residents was estimated to be $732,000.

Annual expenditures to the State were expected to be from services to residents, and debt service attributed to general improvements. It has been estimated for this analysis that the Olowalu Town Master Plan Development will have 219 in-migrant residents, in addition to 33 in-migrant students. At full build-out, the additional students are estimoted to increase cost to the State by about $406,000 per year. At the same time, annual expenditure for services from in-migrant residents was forecasted at approximately $941,000 and annual general improvement debt service came out to close to around $81,000. Examples of services to residents include operation of civic, health and social services; as well as maintenance to highways, parks and recreational areas. General improvement debt service was based on typical per-capita figures currently carried by residents in Hawaii. Total annual expenditure at full build-out attributed to in-migrant residents was approximately $1,428,000. When deducted from the total annual revenues from the previous paragraph, the net annual revenue at full build-out was forecasted to be negative $377,000.

The negative net annual revenue at full build-out was primarily attributed to the household income levels within this subdivision. Since The Olowalu Town Master Plan Development will be geared

28 Revised based on updates State tax revenues.
29 Revised based on updates State tax revenues.

toward the workforce market segment, annual household income is expected to be on the lower side of the range. As excise tax estimates were based on percentages of household income, it is not surprising that total annual revenues were outpaced by total annual expenditures. In general, State services to workforce residential communities are subsidized by revenues received from the visitor industry, businesses and communities with higher annual household incomes.

Furthermore, as previously discussed, this assessment has not considered all of the potential impacts from the commercial, village mixed-use and industrial areas upon full build-out. There will need to be a significant number of employees for these areas, which would increase State's personal income tax revenues. Granted, many of these positions would be filled by those already in the workforce, yet those coming of working age and transplants from off-island would also be potential employees. With regard to general excise tax, some sales generated by the subject's commercial, village mixed-use and industrial areas may take away from sales of existing businesses. However, new sales will also contribute to the amount of general excise tax collected by businesses.

PART VI – REFERENCES

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EXHIBITS

EXHIBIT A

Copy of County of Maui

Residential Workforce Housing Policy

Chapter 2.96 - RESIDENTIAL WORKFORCE HOUSING POLICY

Sections:

2.96.010 - Purpose.

The purpose of this chapter is to enhance the public welfare by ensuring that the housing needs of the County are addressed. The council finds that there is a critical shortage of affordable housing, making home acquisition by the majority of County resident workers extremely difficult, and creating a shortage of affordable rental units. The resident workforce is leaving the County in search of affordable housing, and new employees are being deterred by the high cost of living. To maintain a sufficient resident workforce in all fields of employment, and to ensure the public safety and general welfare of the residents of the County, resident workforce housing needs must be addressed. It is the intent of this chapter to encourage the provision and maintenance of residential workforce housing units, for both purchase and rental, to meet the needs of income-qualified households for the workforce, students, and special housing target groups.

(Ord. 3418 § 1 (part), 2006)

2.96.020 - Definitions.

Whenever used in this chapter, unless a different meaning clearly appears from the context:

"Community land trust" means a nonprofit organization that acquires land that:

1. Is held in perpetuity;
2. Is primarily for conveyance under a long-term ground lease for the creation of dwelling units that shall be sold or rented to applicants within the income-qualified groups established by this chapter; and
3. Retains an option to purchase any dwelling unit at a price determined by formula that is designed to ensure that the dwelling unit remains affordable in perpetuity.

"Council" means the Maui County council.

"Department" means the department of housing and human concerns.

"Director" means the director of housing and human concerns, County of Maui.

"Disabled" means a person who is determined, by a medical doctor, to have a physical, mental, or emotional impairment that:

1. Is expected to be of long-continued and indefinite duration;
2. Substantially impedes his or her ability to live independently; and
3. Is of such a nature that the ability to live independently could be improved by more suitable housing conditions.

"Division" means the housing division of the department of housing and human concerns, County of Maui.

"Elderly" means a person who has attained the age of sixty-two years.

"Employed" means working for compensation in the County for any number of hours.

"Homeless" means:

1. An individual or family who lacks a fixed, regular, and adequate nighttime residence; or

2. An individual or family who has a primary nighttime residence that is:

   a. A supervised shelter designed to provide temporary living accommodations; or

   b. A place not designed for or ordinarily used as sleeping accommodations for human beings.

"HUD" means the United States Department of Housing and Urban Development.

"Improved land" means land that has necessary infrastructural improvements to support a public use project or a use density of at least a single-family or a two-family residential building per acre, in conformity with state and County zoning laws and building permit requirements.

"Lot" means any improved or unimproved land that has been subdivided.

"Median family income" means the middle income in a series of incomes ranked from smallest to largest as determined by HUD for the County, or as adjusted by the department, for Hana, Lanai, and Molokai.

"Prevailing interest rate" means the average interest rate of two mortgage lenders in the County, acceptable to the director, for a thirty year fixed loan with no discount points.

"Qualified housing provider" means a community land trust, nonprofit agency, or other private or public organization, agency, or entity authorized and designated by the department in accordance with section 2.96.150 to own, develop, construct, administer, operate or otherwise provide residential workforce housing required under this chapter.

"Resident" means a person who meets one of the following criteria:

1. Currently employed in the County;
2. Retired from employment in the County, having worked in the County immediately prior to retirement;
3. A full-time student residing in the County;
4. A disabled person residing in the County who was employed in the County prior to becoming disabled;
5. The parent or guardian of a disabled person residing in the County;
6. A spouse or dependent of any such employee, retired person, student, or disabled person residing in the County; or
7. In the event of the death of the employee, retired person, student, or disabled person, the spouse or dependent of any such person residing in the County.

"Residential workforce housing unit" means a unit or lot to be sold or rented to residents within one of the following income groups as established by the department:

1. "Very low income," which are those households whose gross annual family income is fifty percent or less of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai.
2. "Low income," which are those households whose gross annual family income is more than fifty percent, but not more than eighty percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai.
3. "Below-moderate income," which are those households whose gross annual family income is more than eighty percent, but not more than one hundred percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai.
4. "Moderate income," which are those households whose gross annual family income is more than one hundred percent, but not more than one hundred twenty percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai.

5. "Above-moderate income," which are those households whose gross annual family income is more than one hundred twenty percent, but not more than one hundred forty percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai.

"Special housing target group" means a group of residents that can be demographically defined as having a special or unique housing need, including but not limited to, the elderly, homeless, and disabled.

"Unimproved land" means land not classified as "improved land."

"Wait list area" means Hana, Lanai, Maui (excluding Hana), or Molokai.

(Ord. No. 4177, §§ 1—4, 2014; Ord. No. 3719, § 1, 2010; Ord. 3512 § 1, 2007; Ord. 3418 § 1 (part), 2006)

2.96.030 - Applicability.

A. Any development, including the subdivision of land and/or the construction of single-family dwelling units, two-family dwelling units, multi-family dwelling units, or hotels, as defined in section 19.04.040 of this code, whether constructed at one time or over several years, shall be subject to this chapter upon final subdivision or building permit approval, whichever is applicable and occurs first, if it will result in the creation of the following:

   1. Ten or more lots, lodging units, time share units, or dwelling units, excluding farm labor dwellings or a second farm dwelling, as defined in section 19.04.040 of this code; provided that, such farm labor dwelling or farm dwelling is in full compliance with chapter 205, Hawaii Revised Statutes, and is not part of a condominium property regime, as set forth in chapter 514A, Hawaii Revised Statutes;
   2. A conversion of ten or more hotel units to dwelling units or time share units; or
   3. Any hotel redevelopment or renovation project that increases the number of lodging or dwelling units in a hotel by ten or more.

B. Exemptions. This chapter shall not apply to any development that falls into one or more of the following categories:

   1. A development subject to an affordable housing requirement, evidenced by an executed affordable housing agreement with the County, currently in effect and approved prior to the effective date of this chapter;
   2. A development subject to a change in zoning condition that requires affordable or residential workforce housing, unless the condition expressly allows for the application of the affordable housing or residential workforce housing policy set forth herein;
   3. A subdivision granted preliminary subdivision approval prior to the effective date of this chapter;
   4. A building permit application submitted prior to the effective date of this chapter;
   5. A family subdivision, for immediate family members, as described in subsections 18.20.280.B.1 and B.2 of this code;
   6. A development by a government entity or a community land trust, as approved by the director; or
   7. A development within the boundaries of the Wailuku redevelopment area as defined by the Maui redevelopment agency pursuant to chapter 53, Hawaii Revised Statutes.

C. Adjustment by developer.

   1. A developer of any development subject to this chapter may appeal to the council for a reduction, adjustment, or waiver of the requirements based upon the absence of any

reasonable relationship or nexus between the impact of the development and the number of residential workforce housing units or in-lieu fees/land required.

2. Any such appeal shall be made in writing and filed with the county clerk prior to final subdivision approval or issuance of a building permit for the development, whichever is applicable. Any such appeal shall administratively stay the processing of the development's subdivision or building permit, whichever is applicable, until a decision on the appeal is rendered. The appeal shall set forth in detail the factual and legal basis for the claim of reduction, adjustment, or waiver, and the developer shall bear the burden of presenting substantial evidence to support the appeal, including comparable and relevant technical information.

3. The council, or if the appeal is assigned to a council committee, the council committee shall convene a meeting within forty-five days of the county clerk's receipt of the appeal, to consider the appeal. The council shall approve or disapprove the appeal by resolution within forty-five days from the date the developer has concluded its presentation of evidence supporting the appeal in a council or committee meeting.

4. If the council or a council committee has not convened a meeting within forty-five days of the county clerk's receipt of the appeal, or if the council does not approve or disapprove the appeal by resolution within forty-five days from the date the developer has concluded its presentation of evidence at the council or council committee meeting, the appeal, as submitted by the developer, shall be deemed approved by the council.

5. If a reduction, adjustment, or waiver is granted by the council, any subsequent substantive change or modification in use within the development, as determined by the director, shall invalidate the reduction, adjustment, or waiver previously granted.

D. Adjustment by Director. The director may, subject to council approval by resolution, authorize a reduction, adjustment, or waiver of any provision of this chapter.

(Ord. No. 4177, § 5, 2014; Ord. 3546 § 1, 2008; Ord. 3418 § 1 (part), 2006)

2.96.040 - Residential workforce housing requirements.

A. Developers shall be required to provide a number of residential workforce housing units equivalent to at least twenty-five percent, rounding up to the nearest whole number, of the total number of market rate lots, lodging units, time share units, or dwelling units, excluding farm labor dwellings or a second farm dwelling, as defined in section 19.04.040 of this code, created. If a developer satisfies the requirements of this chapter through subsection (B)(3) and the units shall remain available only to income-qualified groups in perpetuity, the developer shall provide at least twenty percent, rounding up to the nearest whole number, of the total number of market rate lots, lodging units, time share units, or dwelling units, excluding farm labor dwellings or a second farm dwelling, as defined in section 19.04.040 of this code, created.

B. Prior to final subdivision approval or issuance of a building permit for a development subject to this chapter, the department shall require the developer to enter into a residential workforce housing agreement. The agreement shall set forth the method by which the developer satisfies the requirements of this chapter. The requirements may be satisfied by one or a combination of the following, which shall be determined by the director and stated in the agreement:

1. Offer for sale, single-family dwelling units, two-family dwelling units, or multi-family dwelling units as residential workforce housing within the community plan area;

2. Offer for rent, multi-family dwelling units as residential workforce housing units within the community plan area;

3. In lieu of directly selling or renting units pursuant to subsections (B)(1) or (B)(2) the developer may convey such units to a qualified housing provider subject to department approval pursuant to section 2.96.150; or

4. In lieu of providing residential workforce housing units, the residential workforce housing requirement may be satisfied by payment of a fee, by providing improved land, or by providing unimproved land in accordance with the following:

a. The in-lieu fee per residential workforce housing unit required by this chapter shall be equal to the difference in unit costs for a three bedroom, single-family, dwelling unit, at one hundred percent and a three bedroom, single-family, dwelling unit at one hundred sixty percent of median income, for a family of four, pursuant to HUD affordable sales price guidelines, or as adjusted by the department for Hana, Lanai, and Molokai.

b. Any dedication of improved or unimproved land in-lieu of residential workforce housing units shall be subject to the approval of the director and the council by resolution.

C. Income group distribution.

1. Unless an exemption is granted by the director, the percentage of ownership units within each income group shall be as follows:

a. Thirty percent of the ownership units shall be for "below-moderate income" residents.

b. Fifty percent of the ownership units shall be for "moderate income" residents.

c. Twenty percent of the ownership units shall be for "above-moderate income" residents.

2. Unless an exemption is granted by the director, the percentage of rental units within each income group shall be as follows:

a. One-third of the rental units shall be for "very low income" and "low income" residents.

b. One-third of the rental units shall be for "below-moderate income" residents.

c. One-third of the rental units shall be for "moderate income" residents.

(Ord. No. 4177, § 6, 2014; Ord. No. 3719, § 2, 2010; Ord. 3438 § 1, 2007: Ord. 3418 § 1 (part), 2006)

2.96.050 - Residential workforce housing credits.

A. Credits may be given under the following circumstances:

1. One residential workforce housing credit shall be given for every single-family dwelling unit, two-family dwelling unit, or multi-family dwelling unit constructed and sold at affordable rates, in excess of the residential workforce housing required by section 2.96.040; and

2. Credits may be issued for a one hundred percent affordable project developed pursuant to section 201H-38, Hawaii Revised Statutes, provided that one residential workforce housing credit shall be given, upon request by the developer, for every single-family dwelling unit, two-family dwelling unit, or multi-family dwelling unit constructed and sold at affordable rates, in excess of fifty percent of the total number of units constructed and sold at affordable rates in the project. Credits shall not be issued for projects developed pursuant to section 201H-38, Hawaii Revised Statutes, that are not one hundred percent affordable.

B. The credit may be used in any community plan area.

C. The credit may satisfy the requirement for any type of unit constructed.

D. The credit may satisfy the requirement for a unit in any income group.

E. The credit may be used for a future development, but may not be used for an affordable housing or residential workforce housing unit owed at the time the credit is given.

F. The number of credits issued shall be set forth in the residential workforce housing agreement.

(Ord. No. 4177, § 7, 2014; Ord. 3418 § 1 (part), 2006)

2.96.060 - Residential workforce housing restrictions-ownership units.

A. Timing of completion.

1. Residential workforce housing units shall be made available for occupancy either before or concurrently with market rate units at the same ratio required of the development.

2. Certificates of occupancy shall not be issued and/or final inspections shall not be passed for the market rate units unless certificates of occupancy are issued and/or final inspections are passed for the residential workforce housing units concurrently or sooner.

B. Deed restrictions.

1. The ownership units within each income group shall be subject to the deed restrictions contained in this section for the following periods:

a. "Below-moderate income," ten years.

b. "Moderate income," eight years.

c. "Above-moderate income," five years.

2. For the deed-restricted period, the following shall apply:

a. The unit must be owner-occupied.

b. The owner must notify the department upon a decision to sell.

c. Upon the owner's decision to sell, the County shall have the first option to purchase the unit from the owner; said option shall be available to the County for a period of one hundred and twenty days from receipt of written notice from the owner and shall not apply to sales by reason of foreclosure.

d. Upon sale of the unit, the deed-restricted shall remain in full force and effect for the remainder of the deed restriction period that commenced at the time of the initial sale.

e. Under special circumstances an owner of a residential workforce housing unit may appeal to the department for a waiver of the owner-occupancy deed restriction; these circumstances would include, but are not limited to, assignment to active duty military or short-term contracts for off-island employment.

f. Resale. The maximum resale price shall be established by the department using the following guidelines:

1. An appraisal of the property shall be required before occupancy.

2. A second appraisal shall be required upon a decision to sell the unit.

3. Twenty-five percent of the difference between the two appraisals shall be added to the owner's purchase price.

C. Sales price - dwelling units. The sales price of a new dwelling unit shall be established by the department based on current HUD price guidelines.

(Ord. No. 4177, § 8, 2014; Ord. 3418 § 1 (part), 2006)

2.96.070 - Residential workforce housing restrictions - rental units.

A. Timing of completion. Residential workforce housing units shall be made available for occupancy either prior to or concurrently with market rate units at the same ratio required of the development. Certificates of occupancy shall not be issued and/or final inspections shall not be passed for the

market rate units unless certificates of occupancy are issued and/or final inspections are passed for the residential workforce housing units concurrently or sooner.

B. Vacancies. Any rental unit vacancy must be filled by an applicant in the appropriate income group to better maintain an equal distribution of rentals across the "very low income" and "low income," "below-moderate income," and "moderate income" groups.

C. Deed restrictions.

1. The rental unit must remain affordable for thirty years from the initial occupancy.

2. For the thirty-year affordability period, the following shall apply:

a. The owner must notify the department upon a decision to sell the rental development and the County shall have the first option to purchase the rental development from the owner; said option shall be available to the County for a period of one hundred and twenty days from receipt of written notice from the owner and shall not apply to sales by reason of foreclosure.

b Any new owner must comply with the deed restrictions.

3. Within 90 days of the expiration of the thirty-year affordability period, the owner shall offer the County the right to purchase the property at market value as determined by the owner.

D. Rental rates. The monthly rental rates shall be set by the department based on HUD income limits.

(Ord. No. 4177, § 9, 2014; Ord. 3418 § 1 (part), 2006)

2.96.080 - Residential workforce housing agreement.

A. Before final subdivision approval or issuance of a building permit, the developer shall enter into a residential workforce housing agreement that sets forth the detailed terms and conditions of compliance with the residential workforce housing policy, including but not limited to:

1. Sales or rental periods for the residential workforce housing units, which specify procedures for the release of units from the residential workforce housing requirements should units not be sold or rented following the expiration of the sales or rental periods;

2. Identification of the number, type, and location of units;

3. Designation of units for specific income and/or special housing target groups;

4. Marketing process for the residential workforce housing units;

5. Eligibility of income-qualified households;

6. Provision for residential workforce housing credits, as applicable;

7. Payment of in-lieu fees or provision of in-lieu land; and

8. Resale restrictions, which may include buy-back provisions, shared equity, and encumbrances.

B. The residential workforce housing agreement shall be recorded with the bureau of conveyances of the State of Hawaii or the land court of the State as the case may be, so that the terms and conditions of the agreement run with the land and bind and constitute notice to all subsequent grantees, assignees, mortgagees, lienors, and any other persons who claim an interest in such property. The agreement shall be enforceable by the County by appropriate action at law or suit in equity, against the developer, its successors, and assignees.

(Ord. 3418 § 1 (part), 2006)

2.96.090 - Applicant selection process - ownership units.

A. Wait List Procedure.

1. The developer, its partner, or its management company shall establish wait lists of interested applicants by development.

2. Prior to initiating the wait list, the developer, its partner, or its management company shall publish in at least five issues of a newspaper of general circulation within the County, a public notice that shall contain all information that is relevant to the establishment of the wait list. The public shall also be informed in a like manner, of any decision that would substantially affect the maintenance and use of the wait list.

3. Selection for purchase shall be made by a lottery administered by the developer, its partner, or its management company and overseen by the department, subject to the applicant meeting the eligibility criteria established in subsection (B).

B. Eligibility criteria. In order to be eligible for a residential workforce housing unit, an applicant must meet the following criteria:

1. Be a citizen of the United States or a permanent resident alien who is a resident of the County.

2. Be eighteen years of age or older.

3. Have a gross annual family income (not to include the income of minors) which does not exceed one hundred forty percent of the County's area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai. Initial determination for compliance with the maximum gross annual family income provision shall be made by the developer, its partner, or its management company for the initial sale of residential workforce housing units, on the basis of the information provided on the ownership application. The ownership application will be completed when a specific unit is being considered. Final determination for compliance with the maximum gross annual family income provision shall be made by the prospective lender at the time the applicant's income verification data is received.

4. Have assets that do not exceed one hundred forty percent of the County's area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai. Assets shall include all cash, securities, stocks, bonds and real property. Real property shall be valued at fair market value less liabilities on such real property.

5. For a period of three years before the submittal of the ownership application, have not had an interest of fifty percent or more in real property in fee or leasehold in the United States, where the unit or land is deemed suitable for dwelling purposes, unless the applicant is selling an affordable unit and purchasing a different affordable unit that is more appropriate for the applicant's family size.

6. Pre-qualify for a loan with the applicant's choice of lender.

C. Notification of Change. Each applicant shall be responsible for notifying the developer, its partner, or its management company in writing of any changes in mailing address, telephone number, fax number, and/or e-mail address. If an applicant fails to properly notify the developer, its partner, or its management company of such changes and the developer, its partner, or its management company is unable to contact the applicant, the developer, its partner, or its management company shall remove the applicant's name from the wait list.

D. Selection priority.

1. Residents on the wait list shall receive first priority for the available units. Nonresidents on the wait list may purchase a residential workforce housing unit once the wait list has been exhausted of all residents.

2. The developer, its partner, or its management company may do a mass mailing of housing applications to applicants on the wait list.

3. The residential workforce housing units must be offered to residents in the order in which their names were drawn in the lottery, provided that there is a unit available in the income group for

which they qualify. Nonresidents will be offered residential workforce housing units in the order in which their names were drawn in the lottery.

4. In the event that units are not sold within the first ninety days after they are offered for sale, and the developer has made a good faith effort, as determined by the director, to contact and qualify applicants on the wait list, the sale of remaining units shall be conducted as follows:

a. For the next ninety-day period, units shall be offered for sale to the next-higher income preference group, at the original sales price. For example, units targeted for families earning up to one hundred twenty percent of the median income may be sold to families earning up to one hundred forty percent of the median income. All other eligibility criteria shall apply.

b. Units shall be offered to the next higher income group every ninety days until the units are sold or there are no more income groups available.

c. Units shall then be offered to nonresidents on the wait list in the order in which their names were drawn in the lottery, for the next ninety-day period, provided that the applicant's income is within the residential workforce housing income groups.

d. Any units that remain unsold may be offered at market rate without deed restrictions. Upon the sale of the unit, the County shall receive fifty percent of the difference between the original sales price of the unit and the actual market rate sales price, for deposit into the affordable housing fund. In this event, the developer shall still be deemed to have satisfied the requirement for producing a residential workforce housing unit.

5. The developer shall submit copies of the following information to the department to verify the sale of residential workforce housing units to eligible buyers:

a. Applicant's completed ownership application.

b. Executed sales contract.

c. Pre-qualification notice from lender.

d. All signed federal and state tax returns used to determine eligibility, or any other documents used to determine eligibility by the lender.

e. Escrow company's settlement statement.

6. An owner of a residential workforce housing unit that is being resold must sell the unit to an income-qualified household and notify the department of the sale. The department shall verify the sales price.

(Ord. No. 4177, § 10, 2014; Ord. 3418 § 1 (part), 2006)

2.96.100 - Applicant selection process—rental units.

A. Wait List Procedure.

1. The developer, its partner, or its management company shall establish wait lists of interested applicants by rental development;

2. Prior to initiating the wait list, the developer, its partner, or its management company shall initiate the wait list process by publishing in at least five issues of a newspaper of general circulation within the County, a public notice that shall contain all information that is relevant to the establishment of the wait list. The public shall also be informed in a like manner, of any decision that would substantially affect the maintenance and use of the wait list; and

3. Selection for rental units shall be made by a lottery administered by the developer, its partner, or its management company and overseen by the department, subject to the applicant meeting the eligibility criteria established in subsection B of this section.

B. Eligibility Criteria. The eligibility criteria for rentals shall be established on a project-by-project basis by the director in the following manner:

1. If the project is receiving federal and/or state assistance, the applicable federal and/or state eligibility criteria shall apply; and

2. If the project is not receiving federal and/or state assistance, all eligibility criteria in section 2.96.090.B of this chapter shall apply, except for section 2.96.090.B.6 of this chapter.

C. Notification of Change. Each applicant shall be responsible for notifying the developer, its partner, or its management company in writing of any changes in mailing address, telephone number, fax number, and/or e-mail address. If an applicant fails to properly notify the developer, its partner, or its management company of such changes and the developer, its partner, or its management company is unable to contact the applicant, the applicant's name shall be removed from the applicable wait list.

D. Selection Priority.

1. Residents on the wait list shall receive first priority for the available units. Nonresidents on the wait list may rent a residential workforce housing unit once the wait list has been exhausted of all residents.

2. The developer, its partner, or its management company may do a mass mailing of housing applications to applicants on the wait list.

3. The residential workforce housing units shall be offered to residents in the order in which their names were drawn in the lottery, provided that there is a unit available in the income group for which they qualify. Nonresidents will then be offered residential workforce housing units in the order in which their names were drawn in the lottery, provided that there is a unit available in the income group for which they qualify.

4. The developer, its partner, or its management company shall submit copies of the following information to the department to verify the rental of residential workforce housing units to eligible renters:

a. Applicant's completed final rental application;

b. Executed rental lease; and

c. All signed federal and state tax returns used to determine eligibility, or any other documents used to determine eligibility by the developer, its partner, or its management company.

5. The developer, its partner, or its management company shall maintain a wait list for the development after all of the units are rented, which shall be used to fill any vacancy.

6. Any rental unit vacancy shall be filled by an applicant in the same income group as the original tenant to maintain an equal distribution of rentals across the "very low income" and "low income," "below-moderate income," and "moderate income" groups.

7. An owner of a residential workforce housing rental development intending to sell the development shall notify the department in writing prior to the closing of the sale, and shall provide documentation to the department that the prospective new owner acknowledges and is aware of the terms, conditions, and restrictions encumbering the development as set forth in section 2.96.070.

(Ord. 3546 § 2, 2008; Ord. 3418 § 1 (part), 2006)

2.96.110 - Review requirements.

A. The council shall review this chapter every two years.

B. The director shall provide an annual report to the council on the status of the housing policy that shall include the following:

1. The number of units built for sale and rent, categorized by number of bedrooms, income group, and sales price if for sale;

2. The number of purchasers who resold units, categorized by number of bedrooms, income group, and sales price; and

3. The number of developers, their partner(s), or their management companies maintaining a wait list, and the number of applicants on each wait list.

C. For rental developments, the developer, its partner, or its management company shall submit an annual report of rental units to the department that includes the following:

1. The tenant's move-in date; and

2. The income group of the tenant or family.

(Ord. 3418 § 1 (part), 2006)

2.96.120 - Rules.

The director shall adopt administrative rules to implement this chapter, pursuant to chapter 91, Hawaii Revised Statutes, within one hundred eighty days after the effective date of the ordinance codified in this chapter.

(Ord. 3418 § 1 (part), 2006)

2.96.130 - Property assessment value.

The annual tax assessed value, as determined by the County, will take into account the limited resale value of the residential workforce housing property.

(Ord. 3418 § 1 (part), 2006)

2.96.140 - Incentives.

A. For developments subject to this chapter, and under the jurisdiction of the development services administration of the department of public works, decisions on permits will be made by all departments within sixty days of the date the permit application is deemed complete by the development services administration. Decisions on permits that require review by any outside agency will be made within thirty days of receipt by the development services administration of the last approval from an outside agency; provided that decisions on applications that require special management area permit review, or environmental review pursuant to chapter 343, Hawaii Revised Statutes, shall be issued within ninety days of completion of the applicable review.

B. For developments subject to this chapter, and if applicable, the council will schedule the initial meeting for such application within six months of the referral to the appropriate committee. The council will vote to approve or deny the application within one year of the referral to committee.

(Ord. No. 4177, § 11, 2014; Ord. 3418 § 1 (part), 2006)

2.96.150 - Qualified housing providers.

Where the department determines that such an agreement will further the purposes of this chapter, the department shall enter into an agreement, on a project-by-project basis, with a qualified housing provider. Such an agreement may provide, without limitation, that the qualified housing provider shall:

A. Receive, own, manage, rent, operate and sell residential workforce housing units provided by developers pursuant to section 2.96.040.

B. Receive land and in-lieu fees provided by developers pursuant to subsection 2.96.040(B)(4).

C. Receive disbursements from the affordable housing fund and other funds provided for the purposes of this chapter.

D. Administer the selection processes under sections 2.96.090 and 2.96.100 subject to the department's oversight.

1. Where a qualified housing provider receives, owns, develops, rents, operates or sells residential workforce housing units, such units shall be rented or sold to applicants qualified under this chapter, as set forth in the qualified housing provider's agreement with the department.

2. Selection of purchasers or renters for a qualified housing provider's units shall be made in accordance with sections 2.96.090 and 2.96.100 of this chapter or with other selection processes permitted under the qualified housing provider's agreement with the department.

3. All qualified housing provider rentals or sales shall be on terms, conditions, and restrictions set forth in the agreement, which shall be at least as restrictive as the terms, conditions and restrictions applicable to developer rentals or sales under this chapter, and may be more restrictive.

4. All qualified housing provider agreements shall require detailed reports to the department, on no less than an annual basis, of the qualified housing provider's implementation of, and compliance with, the agreement. This report shall include an annual financial audit.

(Ord. No. 4177, § 10[12], 2014; Ord. 3418 § 1 (part), 2006)

EXHIBIT B

Selected Pages from County of Maui
2015 Affordable Sales Price Guidelines

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

SINGLE FAMILY

Effective: May 1, 2015

Percentage of Median Income															
Very Low		Low Income		Gap Income		Moderate		Moderate		Moderate		Moderate		Moderate	
50% & Below		50% to 60%		60% to 70%		70% to 80%		80% to 100%		100% to 120%		120% to 140%		140% to 160%	
Prevailing Int. Rate	No. of Bedrooms	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
4.000%	1	$144,000	$173,000	$202,000	$231,000	$259,000	$288,000	$318,000	$347,000	$376,000	$405,000	$434,000	$463,000	$492,000	$521,000
	2	$173,000	$207,000	$242,000	$276,000	$311,000	$345,000	$381,000	$415,000	$451,000	$485,000	$520,000	$554,000	$590,000	$624,000
	3	$187,000	$224,000	$262,000	$299,000	$337,000	$374,000	$412,000	$449,000	$488,000	$525,000	$563,000	$600,000	$638,000	$675,000
	4	$194,000	$233,000	$272,000	$311,000	$350,000	$389,000	$428,000	$467,000	$506,000	$545,000	$584,000	$623,000	$662,000	$701,000
4.125%	1	$142,000	$171,000	$200,000	$228,000	$257,000	$285,000	$314,000	$342,000	$371,000	$399,000	$428,000	$456,000	$485,000	$513,000
	2	$171,000	$205,000	$240,000	$274,000	$308,000	$342,000	$377,000	$411,000	$446,000	$480,000	$514,000	$548,000	$583,000	$617,000
	3	$185,000	$222,000	$259,000	$296,000	$333,000	$370,000	$407,000	$444,000	$481,000	$518,000	$555,000	$592,000	$629,000	$666,000
	4	$192,000	$230,000	$269,000	$307,000	$346,000	$384,000	$423,000	$461,000	$500,000	$538,000	$577,000	$615,000	$654,000	$692,000
4.250%	1	$141,000	$169,000	$198,000	$226,000	$254,000	$282,000	$311,000	$339,000	$367,000	$395,000	$424,000	$452,000	$480,000	$508,000
	2	$169,000	$203,000	$237,000	$271,000	$305,000	$339,000	$373,000	$407,000	$441,000	$475,000	$509,000	$543,000	$577,000	$611,000
	3	$183,000	$219,000	$256,000	$293,000	$329,000	$366,000	$402,000	$439,000	$475,000	$512,000	$548,000	$585,000	$621,000	$658,000
	4	$190,000	$228,000	$266,000	$304,000	$342,000	$380,000	$418,000	$456,000	$494,000	$532,000	$570,000	$608,000	$646,000	$684,000
4.375%	1	$139,000	$167,000	$195,000	$223,000	$251,000	$279,000	$307,000	$335,000	$363,000	$391,000	$419,000	$447,000	$475,000	$503,000
	2	$167,000	$201,000	$234,000	$268,000	$301,000	$335,000	$368,000	$402,000	$435,000	$469,000	$502,000	$536,000	$569,000	$603,000
	3	$181,000	$216,000	$252,000	$289,000	$325,000	$361,000	$397,000	$433,000	$469,000	$505,000	$541,000	$577,000	$613,000	$649,000
	4	$187,000	$225,000	$262,000	$300,000	$337,000	$375,000	$412,000	$450,000	$487,000	$525,000	$562,000	$600,000	$637,000	$675,000
4.500%	1	$138,000	$165,000	$193,000	$220,000	$248,000	$275,000	$303,000	$330,000	$358,000	$385,000	$413,000	$440,000	$468,000	$495,000
	2	$165,000	$198,000	$231,000	$264,000	$297,000	$330,000	$363,000	$396,000	$429,000	$462,000	$495,000	$528,000	$561,000	$594,000
	3	$178,000	$214,000	$249,000	$285,000	$321,000	$356,000	$392,000	$428,000	$463,000	$499,000	$534,000	$570,000	$606,000	$641,000
	4	$185,000	$222,000	$259,000	$296,000	$333,000	$370,000	$407,000	$444,000	$481,000	$518,000	$555,000	$592,000	$629,000	$666,000
4.625%	1	$136,000	$163,000	$190,000	$217,000	$244,000	$271,000	$299,000	$326,000	$353,000	$380,000	$407,000	$434,000	$461,000	$488,000
	2	$163,000	$196,000	$228,000	$261,000	$293,000	$326,000	$358,000	$391,000	$423,000	$456,000	$488,000	$521,000	$553,000	$586,000
	3	$176,000	$211,000	$246,000	$281,000	$316,000	$351,000	$386,000	$421,000	$456,000	$491,000	$526,000	$561,000	$596,000	$631,000
	4	$182,000	$219,000	$255,000	$292,000	$328,000	$365,000	$401,000	$438,000	$474,000	$511,000	$547,000	$584,000	$620,000	$657,000
4.750%	1	$135,000	$161,000	$188,000	$214,000	$241,000	$268,000	$294,000	$321,000	$348,000	$374,000	$401,000	$427,000	$454,000	$481,000
	2	$161,000	$193,000	$225,000	$258,000	$290,000	$322,000	$354,000	$386,000	$418,000	$451,000	$483,000	$515,000	$547,000	$579,000
	3	$174,000	$208,000	$243,000	$277,000	$312,000	$347,000	$381,000	$416,000	$451,000	$485,000	$520,000	$554,000	$589,000	$624,000
	4	$180,000	$216,000	$252,000	$288,000	$324,000	$360,000	$396,000	$432,000	$468,000	$504,000	$540,000	$576,000	$612,000	$648,000
4.875%	1	$134,000	$159,000	$185,000	$211,000	$237,000	$264,000	$290,000	$316,000	$342,000	$369,000	$395,000	$421,000	$447,000	$474,000
	2	$159,000	$191,000	$222,000	$254,000	$286,000	$318,000	$349,000	$381,000	$413,000	$445,000	$476,000	$508,000	$540,000	$572,000
	3	$172,000	$205,000	$240,000	$274,000	$308,000	$342,000	$376,000	$410,000	$445,000	$479,000	$513,000	$547,000	$581,000	$616,000
	4	$178,000	$213,000	$249,000	$284,000	$320,000	$355,000	$391,000	$426,000	$462,000	$497,000	$533,000	$568,000	$604,000	$639,000
5.000%	1	$133,000	$157,000	$182,000	$208,000	$233,000	$259,000	$285,000	$311,000	$336,000	$362,000	$388,000	$414,000	$439,000	$465,000
	2	$157,000	$188,000	$219,000	$251,000	$282,000	$313,000	$344,000	$376,000	$407,000	$438,000	$469,000	$501,000	$532,000	$563,000
	3	$170,000	$202,000	$237,000	$271,000	$304,000	$338,000	$371,000	$405,000	$438,000	$472,000	$506,000	$539,000	$573,000	$607,000
	4	$176,000	$210,000	$245,000	$280,000	$315,000	$350,000	$385,000	$420,000	$455,000	$490,000	$525,000	$560,000	$595,000	$630,000

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

MULTI-FAMILY

Effective: May 1, 2015

Percentage of Median Income															
Very Low		Low Income		Gap Income		Moderate		Moderate		Moderate		Moderate		Moderate	
50% & Below		50% to 60%		60% to 70%		70% to 80%		80% to 100%		100% to 120%		120% to 140%		140% to 160%	
Prevailing Int. Rate	No. of Bedrooms	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
4.000%	1	$143,000	$172,000	$201,000	$230,000	$258,000	$287,000	$316,000	$345,000	$374,000	$403,000	$431,000	$460,000	$489,000	$518,000
	2	$172,000	$206,000	$241,000	$275,000	$309,000	$343,000	$378,000	$412,000	$447,000	$481,000	$515,000	$549,000	$584,000	$618,000
	3	$186,000	$223,000	$260,000	$297,000	$335,000	$372,000	$409,000	$446,000	$483,000	$520,000	$557,000	$594,000	$631,000	$668,000
	4	$193,000	$231,000	$270,000	$308,000	$347,000	$385,000	$424,000	$462,000	$501,000	$539,000	$578,000	$616,000	$655,000	$693,000
4.125%	1	$141,000	$170,000	$198,000	$227,000	$255,000	$284,000	$312,000	$341,000	$369,000	$398,000	$426,000	$455,000	$483,000	$512,000
	2	$170,000	$204,000	$238,000	$272,000	$306,000	$340,000	$374,000	$408,000	$442,000	$476,000	$510,000	$544,000	$578,000	$612,000
	3	$184,000	$220,000	$257,000	$294,000	$330,000	$367,000	$404,000	$440,000	$477,000	$514,000	$550,000	$587,000	$624,000	$660,000
	4	$191,000	$229,000	$267,000	$305,000	$343,000	$381,000	$419,000	$457,000	$495,000	$533,000	$571,000	$609,000	$647,000	$685,000
4.250%	1	$140,000	$168,000	$196,000	$224,000	$252,000	$280,000	$308,000	$336,000	$364,000	$392,000	$420,000	$448,000	$476,000	$504,000
	2	$168,000	$201,000	$235,000	$268,000	$302,000	$336,000	$369,000	$403,000	$437,000	$470,000	$504,000	$538,000	$571,000	$605,000
	3	$182,000	$217,000	$254,000	$290,000	$327,000	$363,000	$399,000	$436,000	$472,000	$508,000	$545,000	$581,000	$617,000	$654,000
	4	$189,000	$226,000	$264,000	$302,000	$339,000	$377,000	$415,000	$453,000	$490,000	$528,000	$566,000	$604,000	$641,000	$679,000
4.375%	1	$139,000	$166,000	$193,000	$221,000	$248,000	$276,000	$303,000	$331,000	$358,000	$386,000	$413,000	$441,000	$468,000	$496,000
	2	$166,000	$199,000	$232,000	$265,000	$298,000	$331,000	$364,000	$397,000	$430,000	$463,000	$496,000	$529,000	$562,000	$595,000
	3	$179,000	$214,000	$250,000	$286,000	$321,000	$357,000	$393,000	$429,000	$464,000	$500,000	$536,000	$571,000	$607,000	$643,000
	4	$186,000	$223,000	$260,000	$297,000	$334,000	$371,000	$408,000	$445,000	$482,000	$519,000	$556,000	$593,000	$630,000	$667,000
4.500%	1	$138,000	$164,000	$191,000	$218,000	$245,000	$272,000	$299,000	$326,000	$353,000	$380,000	$407,000	$434,000	$461,000	$488,000
	2	$164,000	$197,000	$230,000	$262,000	$295,000	$328,000	$360,000	$393,000	$426,000	$458,000	$491,000	$524,000	$556,000	$589,000
	3	$177,000	$212,000	$247,000	$283,000	$318,000	$353,000	$389,000	$424,000	$459,000	$495,000	$530,000	$565,000	$601,000	$636,000
	4	$184,000	$220,000	$257,000	$294,000	$330,000	$367,000	$404,000	$440,000	$477,000	$514,000	$550,000	$587,000	$624,000	$660,000
4.625%	1	$136,000	$162,000	$189,000	$215,000	$242,000	$268,000	$295,000	$321,000	$348,000	$374,000	$401,000	$427,000	$454,000	$480,000
	2	$162,000	$194,000	$226,000	$258,000	$290,000	$323,000	$355,000	$387,000	$419,000	$452,000	$484,000	$516,000	$548,000	$580,000
	3	$175,000	$209,000	$244,000	$278,000	$313,000	$348,000	$383,000	$417,000	$452,000	$487,000	$522,000	$556,000	$591,000	$626,000
	4	$181,000	$217,000	$253,000	$289,000	$325,000	$361,000	$397,000	$433,000	$469,000	$505,000	$541,000	$577,000	$613,000	$649,000
4.750%	1	$135,000	$160,000	$186,000	$212,000	$238,000	$264,000	$290,000	$316,000	$342,000	$368,000	$394,000	$420,000	$446,000	$472,000
	2	$160,000	$192,000	$224,000	$256,000	$288,000	$320,000	$352,000	$384,000	$416,000	$448,000	$480,000	$512,000	$544,000	$576,000
	3	$173,000	$207,000	$241,000	$276,000	$310,000	$345,000	$379,000	$414,000	$448,000	$483,000	$517,000	$552,000	$586,000	$621,000
	4	$179,000	$215,000	$250,000	$286,000	$322,000	$358,000	$393,000	$429,000	$465,000	$501,000	$537,000	$572,000	$608,000	$644,000
4.875%	1	$134,000	$158,000	$183,000	$209,000	$234,000	$260,000	$285,000	$311,000	$336,000	$362,000	$387,000	$413,000	$438,000	$464,000
	2	$158,000	$190,000	$221,000	$253,000	$284,000	$316,000	$347,000	$379,000	$410,000	$442,000	$473,000	$505,000	$536,000	$568,000
	3	$171,000	$204,000	$238,000	$271,000	$305,000	$338,000	$372,000	$405,000	$439,000	$472,000	$506,000	$539,000	$573,000	$606,000
	4	$177,000	$212,000	$247,000	$282,000	$317,000	$352,000	$387,000	$422,000	$457,000	$492,000	$527,000	$562,000	$597,000	$632,000
5.000%	1	$133,000	$156,000	$180,000	$204,000	$228,000	$252,000	$276,000	$300,000	$324,000	$348,000	$372,000	$396,000	$420,000	$444,000
	2	$156,000	$187,000	$218,000	$249,000	$280,000	$311,000	$342,000	$373,000	$404,000	$435,000	$466,000	$497,000	$528,000	$559,000
	3	$169,000	$201,000	$234,000	$268,000	$301,000	$335,000	$368,000	$402,000	$435,000	$469,000	$502,000	$536,000	$569,000	$603,000
	4	$175,000	$208,000	$242,000	$277,000	$312,000	$346,000	$381,000	$416,000	$450,000	$485,000	$519,000	$554,000	$589,000	$623,000

ADDENDA

DEFINITIONS

The purpose of this Glossary is to assist the reader in understanding specific terminology used in this report.

Appraisal — (noun) the act or process of developing an opinion of value; an opinion of value (adjective) of or pertaining to appraising and related functions such as appraisal practice or appraisal services.

Cash Equivalent — A price expressed in terms of cash, as distinguished from a price expressed totally or partly in terms of the face amounts of notes or other securities that cannot be sold at their face amounts.

Counseling — Providing competent, disinterested, and unbiased advice and guidance on diverse problems in the broad field of real estate; may involve any or all aspects of the business such as merchandising, leasing, management, acquisition/disposition planning, financing, development, cost-benefit studies, feasibility analysis, and similar services. Counseling services are often associated with evaluation, but they are beyond the scope of appraisal.

Discounting — A procedure used to convert periodic incomes, cash flows, and reversions into present value; based on the assumption that benefits received in the future are worth less than the same benefits received now.

Extraordinary Assumption — An assumption, directly related to a specific assignment, which, if found to be false, could alter the consultant's opinions or conclusions. Extraordinary assumptions presume as fact otherwise uncertain information about physical, legal, or economic characteristics of the subject property; or about conditions external to the property such as market conditions or trends; or about the integrity of data used in an analysis. An extraordinary assumption may be used in an assignment only if:

- It is required to properly develop credible opinions and conclusions;
- The consultant has a reasonable basis for the extraordinary assumption;
- Use of the extraordinary assumption results in a credible analysis; and
- The consultant complies with the disclosure requirements set forth in USPAP for extraordinary assumptions.

Fair Value — The cash price that might reasonably be anticipated in a current sale under all conditions requisite to a fair sale. A fair sale means that buyer and seller are each acting prudently, knowledgeably, and under no necessity to buy or sell-, i.e., other than in a forced or liquidation sale. The consultant should estimate the cash price that might be received upon exposure to the open market for a reasonable time, considering the property type and local market conditions. ***When a current sale is unlikely-i.e., when it is unlikely that the sale can be completed within 12 months-the consultant must discount all cash flows generated by the property to obtain the estimate of fair value.*** These cash flows include, but are not limited to, those arising from ownership, development, operating, and sale of the property. The discount applied shall reflect the consultant's judgment of what a prudent, knowledgeable purchase under o necessity to buy would be willing to pay to purchase the property in a current sale.

Fee Simple Estate

Absolute ownership encumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat.

Hawaiian Terms

The Hawaiian words "mauka" and "makai" are commonly used in the islands as indicators of direction. The word "mauka" means toward the mountain, and "makai" means toward the ocean.

Highest and Best Use

The reasonably probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value. The four criteria the highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum profitability.

Highest and Best Use of Land or a Site as Though Vacant

Among all reasonable, alternative uses, the use that yields the highest present land value, after payments are made for labor, capital, and coordination. The use of a property based on the assumption that the parcel of land is vacant or can be made vacant by demolishing any improvements.

Highest and Best Use of Property as Improved

The use that should be made of a property as it exists. An existing improvement should be renovated or retained as is so long as it continues to contribute to the total market value of the property, or until the return from a new improvement would more than offset the cost of demolishing the existing building and constructing a new one.

Hypothetical Condition

That which is contrary to what exists, but is supposed for the purpose of analysis. Hypothetical conditions assume conditions contrary to known facts about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in an analysis. A hypothetical condition may be used in an assignment only if:

- Use of the hypothetical condition is clearly required for legal purposes, for purposes of reasonable analysis, or for purposes of comparison;
- Use of the hypothetical condition results in a credible analysis; and
- The consultant complies with the disclosure requirements set forth in USPAP for hypothetical conditions

Leased Fee Interest

An ownership interest held by a landlord with the rights of use and occupancy conveyed by lease to others. The rights of the lessor (the leased fee owner) and the lessee are specified by contract terms contained within the lease.

Leasehold Interest

The interest held by the lessee (the tenant or renter) through a lease transferring the rights of use and occupancy for a stated term under certain conditions.

Market Rent

The most probable rent that a property should bring in a competitive and open market reflecting all conditions and restrictions of the specified lease agreement including term, rental adjustment and revaluation, permitted uses, use restrictions, and expense obligations; the lessee and lessor each acting prudently and knowledgeably, and assuming consummation of a lease contract as of a specified date and the passing of the leasehold from lessor to lessee under conditions whereby:

- Lessee and lessor are typically motivated.
- Both parties are well informed or well advised, and acting in what they consider their best interests.
- A reasonable time is allowed for exposure in the open market.
- The rent payment is made in terms of cash in United States dollars, and is expressed as an amount per time period consistent with the payment schedule of the lease contract.
- The rental amount represents the normal consideration for the property leased unaffected by special fees or concessions granted by anyone associated with the transaction.

Market Value

The major focus of most real property appraisal assignments. Both economic and legal definitions of market value have been developed and refined. Continual refinement is essential to the growth of the appraisal profession.

The most widely accepted components of market value are incorporated in the following definition:

"The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress."

Market value is defined in the Uniform Standards of Professional Appraisal Practice (USPAP) as follows:

"A type of value, stated as an opinion, that presumes the transfer of a property (i.e., a right of ownership or a bundle of such rights), as of a certain date, under specific conditions set forth in the definition of the term identified by the consultant as applicable in an appraisal."

The following definition of market value is used by agencies that regulate federally insured financial institutions in the United States:

"The most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:"

- Buyer and seller are typically motivated;
- Both parties are well informed or well advised, and acting in what they consider their best interests;
- A reasonable time is allowed for exposure in the open market;

- Payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and
- The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.

Prospective Market Value Upon Completion of Construction

The prospective future value of a property on the date that construction is completed, based upon market conditions forecast to exist as of the completion date.

Prospective Value Opinion

A forecast of the value expected at a specified future date. A prospective value opinion is most frequently sought in connection with real estate projects that are proposed, under construction, or under conversion to a new use, or those that have not achieved sellout or a stabilized level of long-term occupancy at the time the appraisal report is written.

Report

Any communication, written or oral, of an appraisal, appraisal review, or appraisal consulting service that is transmitted to the client upon completion of an assignment. The types of written reports listed below apply to real property appraisals:

Self-Contained Appraisal Report: A written appraisal report prepared under Standards Rule 2-2(a) of the Uniform Standards of Professional Appraisal Practice. A self-contained appraisal report sets forth the data considered, the appraisal procedures followed, and the reasoning employed in the appraisal, addressing each item in the depth and detail required by its significance to the appraisal and providing sufficient information so that the client and the users of the report will understand the appraisal and not be misled or confused.

Summary Appraisal Report: A written report prepared under Standards Rule 2-2(b) or 8-2(b). A summary appraisal report contains a summary of all information significant to the solution of the appraisal problem. The essential difference between a self-contained appraisal report and a summary appraisal report is the level of detail of presentation.

Restricted Appraisal Report: A written report prepared under Standards Rule 2-2(c), 8-2(c), or 10-2(b). A restricted use appraisal report is for client use only. The restricted use appraisal report should contain a brief statement of information significant to the solution of the appraisal problem.

Uniform Standards of Professional Appraisal Practice

Current standards of the appraisal profession, developed for consultants and the users of appraisal services by the Appraisal Standards Board of The Appraisal Foundation. The Uniform Standards set forth the procedures to be followed in developing an appraisal, analysis, or opinion and the manner in which an appraisal, analysis, or opinion is communicated. They are endorsed by the Appraisal Institute and by other professional appraisal organizations.

LIMITING AND CONTINGENT CONDITIONS
ACM Consultants, Inc.

1. The property is appraised as though free and clear of any or all liens and encumbrances unless otherwise stated in this report. The Consultant will not be responsible for matters of a legal nature that affect either the property being appraised or the title to it. The Consultant assumes that the title is good and marketable, and therefore, will not render any opinions about the title.

2. Legal descriptions referenced in the report were obtained from public documents from the State of Hawaii, Bureau of Conveyances, or were furnished by the client, and were assumed to be correct.

3. It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a nonconformity has been stated, defined, and considered in this appraisal report.

4. It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

5. It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report. Responsible ownership and competent property management are assumed unless otherwise stated in this report.

6. The Consultant has inspected as far as possible, by observation, the land and the improvements; however, it was not possible to personally observe conditions beneath the soil or hidden structurally or by other components. The appraisal assumes that there are no hidden, unapparent, or apparent conditions of the property site, subsoil, or structures or toxic material which would render it more or less valuable. The Consultant and firm have no responsibility for any such conditions or for any expertise or engineering to discover them. All mechanical components are assumed to be in operable condition and status standard for properties of the subject type. Conditions of heating, cooling, ventilation, electrical and plumbing equipment is considered to be commensurate with the conditions of the balance of the improvements unless otherwise stated. No judgment may be made by us as to adequacy of insulation, type of insulation, or energy efficiency of the improvements or equipment, and no representations are made herein as to these matters unless specifically stated and considered in the report.

7. Information provided by third parties including government agencies, financial institutions, realtors, buyers, sellers, property owners and others and contained in this report were obtained from sources considered reliable and believed to be true and correct. However, no warranty is assumed for possible misinformation.

8. All engineering is assumed to be correct. Any plat plans and illustrative material in this report are included only to assist the reader in visualizing the property. Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

9. The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the appraisal process.

10. If analysis contained in this appraisal involves partial interests in real estate, the value of the fractional interest plus the value of all other fractional interests may or may not equal the value of the entire fee simple estate considered as a whole.

11. Unless otherwise stated in this report, the subject property is appraised without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

12. Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purposed by any person other than the party to whom it is addressed without the written consent of the Consultant, and in any event, only with proper written qualification and only in its entirety.

13. The Consultant(s) or those assisting in preparation of the report will not be asked or required to give testimony in court or hearing because of having made the appraisal, in full or in part, nor engage in post appraisal consultation with client or third parties except under separate and special arrangement and at additional fee. If testimony or deposition is required because of subpoena, the client shall be responsible for any additional time, fees, and charges regardless of issuing party.

14. Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

ACCEPTANCE OF, AND/OR USE OF THIS APPRAISAL REPORT BY CLIENT OR ANY THIRD PARTY CONSTITUTES ACCEPTANCE OF THE ACM CONSULTANTS, INC., CERTIFICATION, LIMITING AND CONTINGENT CONDITIONS. CONSULTANT LIABILITY EXTENDS ONLY TO STATED CLIENT, NOT SUBSEQUENT PARTIES OR USERS OF ANY TYPE, and the total liability of Consultant(s) and firm is limited to the amount of fee received by Consultant.

PROFESSIONAL QUALIFICATIONS

Glenn K. Kunihisa, MAI

STATE LICENSING

State Certified General Appraiser,
State of Hawaii, License No. CGA 39, July 17, 1991
Expiration: December 31, 2015

PROFESSIONAL AFFILIATIONS

Member, Appraisal Institute, MAI Designation, Hawaii Chapter No. 67
Member, National Association of Realtors, Maui Board of Realtors

PROFESSIONAL INVOLVEMENT

Past President – Hawaii Chapter of the Appraisal Institute – 2009
Past Chair – Hawaii Chapter of The Counselors of Real Estate - 2011

COMMUNITY AFFILIATIONS

St. Anthony Parish School Board
Board Member 1995 to 2008
Board President 1997 and 1998
Alii Community Care, Inc. – A non-profit health care corporation
Board Member 2004 to 2006

EMPLOYMENT

President, ACM Consultants, Inc.
May, 1997 to present

Previously associated with the following:
ACM, Real Estate Appraisers, Inc. - 1986 to 1997
A&B Commercial Company; a division of Alexander & Baldwin, Inc. - 1979 to 1985
Bank of Hawaii - 1976 to 1979

GENERAL EDUCATION

University of Hawaii at Manoa
Master of Business Administration (MBA) - Executive MBA Program V, 1988
Bachelor of Business Administration (BBA), 1976
Iolani School, 1971

LEGAL & CONSULTING

Qualified as an expert witness in the Second Circuit Court of the State of Hawaii
Qualified as an expert in testimony to the State Land Use Commission
Experienced in real estate arbitration assignments in the State of Hawaii

APPRAISAL EDUCATION

Appraisal Institute

Seminar	*7-Hour National USPAP Update Course* Las Vegas, Nevada – September 2013
Seminar	*Marketability Studies: Advanced Considerations & Applications* Las Vegas, Nevada – June 2013
Seminar	*Marketability Studies: Six-Step Process & Basic Applications* Las Vegas, Nevada – June 2013
Course	*Fundamentals of Separating Real Property, Personal Property and Intangible Business Assets* Honolulu, Hawaii – July 2012

Course	*Online 7-Hour National USPAP Equivalent Course* Chicago, Illinois – December 2011
Seminar	*Appraisal Curriculum Overview (2-day general)* Honolulu, Hawaii – July 2010
Seminar	*Online Valuation of Green Residential Properties* Chicago, Illinois – July 2010
Seminar	*Hotel Valuation* Honolulu, Hawaii – February 2010
Seminar	*Online Small Hotel/Motel Valuation* Chicago, Illinois – November 2009
Seminar	*Business Practices and Ethics* Honolulu, Hawaii – September 2009
Seminar	*Hawaii Lands, Historical Review* Lihue, Hawaii – August 2009
Seminar	*Appraisal Challenges: Declining Markets and Sales Concessions* Cambria, California – October 2008
Course	*7-Hour National USPAP Update Course* Honolulu, Hawaii – September 2008
Course	*Online 7-Hour National USPAP Equivalent Course* Chicago, Illinois – October 2007
Course	*Valuation of Conservation Easements* Denver, Colorado – October 2007
Seminar	*Uniform Standards for Federal Land Acquisitions ("Yellow Book")* *Practical Applications for Fee Appraisers* Honolulu, Hawaii – December 2006
Seminar	*California Conservation Easements* Sacramento, California – November 2005
Course 400	*7-Hour National USPAP Update Course* Honolulu, Hawaii – October 2005
Seminar	*Case Studies in Limited Partnership and Partial Interest Valuation* Honolulu, Hawaii – May 2005
Seminar	*Appraisal Consulting: A Solutions Approach for Professionals* Honolulu, Hawaii – February 2005
Seminar	*Real Estate Finance, Value and Investment Performance* Honolulu, Hawaii – February 2005
Seminar	*Fannie Mae Residential Presentation* Honolulu, Hawaii - July 2004
Seminar	*Subdivision Analysis* Chicago, Illinois - August 2003
Seminar	*Supporting Capitalization Rates* Chicago, Illinois - August 2003
Seminar	*The Technology Assisted Appraiser* Chicago, Illinois - August 2003
Seminar	*Scope of Work: Expanding Your Range of Services* Chicago, Illinois - August 2003
Course 400	*National Uniform Standards of Professional Practice* Honolulu, Hawaii - May 2003
Course 420	*Business Practices and Ethics* Honolulu, Hawaii - May 2003
Seminar	*The Private Conservation Market* Honolulu, Hawaii - July 2002

Seminar	*Finance Reporting Valuations Parts I and II* Honolulu, Hawaii - July 2002
Seminar	*Future of Appraisal Profession from a Global Perspective* Honolulu, Hawaii - July 2002
Seminar	*Appraisal Office Management* Honolulu, Hawaii - July 2002
Course 540	*Report Writing* Denver, Colorado - December 2000
Seminar	*Partial Interests: Theory and Case Law* Las Vegas, Nevada - July 2000
Seminar	*Easement Valuation* Las Vegas, Nevada - July 2000
Seminar	*Bridging the Gap: Marketability Discounts for Real Estate Interests* Las Vegas, Nevada - July 2000
Course 430	*Standards of Professional Practice, Part C* Honolulu, Hawaii - September 1999
Seminar	*Litigation Skills for the Appraiser: An Overview* Honolulu, Hawaii - May 1998
Seminar	*Special Purpose Properties* Honolulu, Hawaii - September 1997
Seminar	*Highest and Best Use Applications* Honolulu, Hawaii - September 1997
Seminar	*Detrimental Conditions* Honolulu, Hawaii - July 1997
Seminar	*The Appraiser As Expert Witness* Honolulu, Hawaii - August, 1995
Seminar	*How to Appraise FHA-Insured Property* Los Angeles, California - January, 1995
Seminar	*Understanding Limited Appraisals and Reporting Options* Honolulu, Hawaii - August, 1994
Seminar	*Valuation of Leasehold Interests* Honolulu, Hawaii - May, 1993
Seminar	*Valuation of Leased Fee Interests* Honolulu, Hawaii - May, 1993
Seminar	*Valuation Considerations: Appraising Non-Profits* Boston, Massachusetts - July, 1992
Seminar	*Americans With Disabilities Act* Boston, Massachusetts - July, 1992
Seminar	*Valuation in Today's Capital and Financing Markets* Honolulu, Hawaii - June 1992
Seminar	*Arbitration Principles, Procedures and Pitfalls* Honolulu, Hawaii - June, 1992
Seminar	*Institutional Real Estate in the 1990's* Honolulu, Hawaii - June, 1992
Seminar	*FIRREA and its Impact on Appraisers* Honolulu, Hawaii - June, 1992
Course 410/420	*Standards of Professional Practice, Parts A & B* Honolulu, Hawaii - April, 1991

The American Society of Farm Managers and Rural Appraisers, Inc.

Seminar	*Agricultural Lease Valuation* Honolulu, Hawaii – March 2006

Maui Coastal Land Trust

Seminar	*Understanding the New Tax Incentives: Conservation Easements & Other Charitable Contributions* Wailuku, Hawaii – June 2007

Society of Real Estate Appraisers

Course 101	*Introduction to Appraising Real Property* Dallas, Texas – 1987
Course 102	*Applied Residential Property Valuation* Honolulu, Hawaii - July 1990
Course 201	*Principles of Income Property Appraising* Chicago, Illinois, 1987
Course 202	*Applied Income Property Valuation* San Diego, California - 1988
Seminar	*Professional Practice and the Society of Real Estate Appraisers* Honolulu, Hawaii - 1988
Seminar	*Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies* Honolulu, Hawaii - April, 1988

American Institute of Real Estate Appraisers

Seminar	*Rates, Ratios and Reasonableness* Honolulu, Hawaii - 1989
Seminar	*Discounted Cash Flow Analysis* Honolulu, Hawaii - 1989
Seminar	*Highest and Best Use* Honolulu, Hawaii - 1989
Seminar	*Capitalization Overview - Part A* Honolulu, Hawaii - 1990
Seminar	*Capitalization Overview - Part B* Honolulu, Hawaii – 1990
Seminar	*Accrued Depreciation* Honolulu, Hawaii - 1990

International Right of Way Association

Course 410	*Reviewing Appraisals in Eminent Domain* San Diego, California – February 2011
Course 101	*Appraisal* Las Vegas, Nevada - October 1998
Course 101	*Negotiation* Las Vegas, Nevada - October 1998

National Business Institute, Inc.

Seminar	*Commercial Real Estate Leasing In Hawaii* Honolulu, Hawaii - 1989

American Arbitration Association

Seminar	*Real Estate Dispute Resolution - Mediation and Arbitration* Kahului, Maui, Hawaii - October, 1990

PROFESSIONAL QUALIFICATIONS
of
Dominic J. Suguitan

STATE LICENSING

State Certified General Appraiser,
State of Hawaii, License No. CGA-576, April 17, 1995
Expiration: December 31, 2015

ASSOCIATION MEMBERSHIPS

Candidate for Designation - Appraisal Institute

Associate Member, Realtors Association of Maui

EXPERIENCE AND EDUCATION

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ACM Consultants, Inc. (formerly ACM, Real Estate Appraisers, Inc.)
April, 1991 to present

Previously associated with the following:

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General Education

University of Hawaii at Manoa
Bachelor of Arts Degree, Communications, 1990

Maui Community College, 1985-86

Baldwin High School, 1985

Appraisal Education

Appraisal Institute Courses

"Appraising the Single Family Residence"
Honolulu, Hawaii - January, 1991

"Foundations of Real Estate Appraisal"
Honolulu, Hawaii - February, 1991

Course 1BA – "Capitalization Theory & Techniques, Part A"
San Jose, California - July, 1992.

Course 1BB – "Capitalization Theory & Techniques, Part B"
San Jose, California - July, 1992.

Course I410 – "Standards of Professional Practice, Part A (USPAP)"
Honolulu, Hawaii - April, 1993

Course II420 – "Standards of Professional Practice, Part B (USPAP)"
Honolulu, Hawaii - April, 1993.

Course II430 – "Standards of Professional Practice, Part C (USPAP)"
Honolulu, Hawaii - September, 1999.

Course I400 – "7-Hour National USPAP Update Course"
Honolulu, Hawaii - May, 2003.

Course II420 – "Business Practices and Ethics"
Honolulu, Hawaii - May, 2003

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – November, 2005

Course 520 – "Highest & Best Use and Market Analysis"
Seattle, Washington – September 2006

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – November, 2007

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – September, 2009

"Online Business Practices and Ethics" – Online Course
Chicago, Illinois – November, 2009

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – December, 2011

Course 844 – "Residential & Commercial Valuation of Solar"
Albuquerque, New Mexico – February, 2013

"Online General Appraiser Report Writing and Case Studies" – Online Course
Appraisal Institute, October, 2013

"7-Hour National USPAP Update Course" – Online Course
McKissock, December, 2013

"Advanced Concepts & Case Studies"
San Diego, California – May, 2014

Appraisal Institute Seminars

"Data Confirmation and Verification Methods" - Seminar
Honolulu, Hawaii - October, 1995

"Residential Property Construction and Inspection" - Seminar
Honolulu, Hawaii - October, 1995

"Appraisal of Retail Properties" - Seminar
Honolulu, Hawaii - May, 1996

"Detrimental Conditions in Hawaii" - Seminar
Honolulu, Hawaii - July, 1997

"Special Purpose Properties" - Seminar
Honolulu, Hawaii - September, 1997

"Highest and Best Use Applications" - Seminar
Honolulu, Hawaii - September, 1997

"Appraising From Blueprints and Specs" - Seminar
Honolulu, Hawaii - May, 1998

"New Industrial Valuation" - Seminar
Honolulu, Hawaii - October, 1998

"Eminent Domain & Condemnation Appraising" - Seminar
Honolulu, Hawaii - October, 1998

"Online Analyzing Operating Expenses" – Online Seminar
Chicago, Illinois - September, 2001

"Real Estate Disclosure" - Seminar
Honolulu, Hawaii - October, 2001

"Online Internet Search Strategies for R.E. Appraisers" – Online Seminar
Chicago, Illinois - October, 2001

"Online Valuation of Detrimental Conditions in Real Estate" – Online Seminar
Chicago, Illinois - December, 2001

"The Appraisal Institute Commercial Database & AppraiserLoop, Part I" - Seminar
Honolulu, Hawaii - July, 2002

"Statistical Analysis Using the Database, Part I" - Seminar
Honolulu, Hawaii - July, 2002

"The Aftermath: Our World Post-Sept 11" - Seminar
Honolulu, Hawaii - July, 2002

"Statistical Modeling & GIS: Applications for Income Properties" - Seminar
Honolulu, Hawaii - July, 2002

"Real Estate Finance, Value and Investment Performance" – Seminar
Honolulu, Hawaii – February, 2005

"Introduction to GIS Applications for Real Estate Appraisal" – Online Seminar
Chicago, Illinois – August, 2005

"Online Small Hotel/Motel Valuation" – Online Seminar
Chicago, Illinois – October, 2005

"Hawaii Lands, Historical Review"
Kahului, Hawaii – September, 2009

"Online Real Estate Finance Statistics and Valuation Modeling" – Online Seminar
Chicago, Illinois – October, 2009

"Online An Introduction to Valuing Commercial Green Buildings" – Online Seminar
Chicago, Illinois – August 2011

"Online Rates and Ratios: Making sense of GIMs, OARs, and DCF" – Online Seminar
Chicago, Illinois – August 2011

"Online Forecasting Revenue" – Online Seminar
Chicago, Illinois – August 2011

Society of Real Estate Appraisers

Course 101 – "Introduction to Appraising Real Property"
Tempe, Arizona - June, 1991

APPENDIX ~~L-1~~N.

Agricultural Interviews

OLOWALU NUI HYDROPONIC TOMATO FARM
FARM INFORMATION

Interview with: Karl Casco, Owner of Casco Chicken Farm
Interview date: October 26, 2011
Interviewed by: Bill Frampton, Frampton & Ward, LLC
Tessa Munekiyo Ng, Munekiyo & Hiraga, Inc.

The interview with Karl Casco took place via telephone conference on October 26, 2011. Mr. Casco is the owner of the Casco Chicken Farm. The following summary is based on the interview with Mr. Casco as well as documentation on lease terms and water usage from Olowalu Water Company (OWC).

Farm Overview

Mr. Casco leases approximately four (4) acres of land from Olowalu Elua Associates on a portion of TMK (2) 4-8-003:114. The Casco Chicken Farm is located mauka of Honoapi'ilani Highway and is accessed by an unpaved roadway. Mr. Casco relocated his rooster farm from Puunoa, Lahaina to Olowalu in 2009 due to nuisance complaints from neighbors at the former location. The chicken farm operated for four (4) years at Puunoa.

Mr. Casco's lease with Olowalu Elua was signed in April 2009 was for two (2) years, with subsequent renewal in one (1) year increments. Current monthly rent for the 4-acre property is $600; the farm operation is responsible for paying for its water usage. Between January and August 2011, the rooster farm has used an average of 113,000 gallons of water per month. The average monthly water bill paid by the farm during this time period, before the recent OWC rate increase in September 2011, was approximately $86 per month (Olowalu Water Company, 2011). Mr. Casco noted that water is used for the animals at his farm; the farm's water usage increases during the hot and dry summer months.

The Casco Chicken Farm raises approximately 250 roosters; there are no hens at the farm. The farm acquires chicks to raise from hens that Mr. Casco used to own but gave away to others. In addition, Mr. Casco raises goats and some pigs. There are currently about 15 goats at the farm. The goats roam within the fenced areas of the farm and help to control the grass growing on the property. There are just five (5) pigs at the farm currently. The roosters are the primary focus of the farm while the goats are raised to help with additional costs and control the grass. The pigs are raised on just a small-scale, intermittent basis.

The farm utilizes most of its land, with the exception of about half an acre near the east side of the property. Approximately 80 percent of the active farm area is used for raising animals. The remaining 20 percent is used for operational buildings and facilities. Facilities at the chicken farm include a perimeter fence, underground irrigation, and housing for the roosters. The initial relocation and start-up costs to establish the farm in Olowalu totaled approximately $12,000. This included the relocation costs as well as the costs to clear the lands, erect the perimeter fence, and install the underground irrigation.

Mr. Casco experimented with growing a few crops at his farm in the past. He was particularly interested in growing sod and gross. However, there is a lot of nut grass growing in the soil, making sod and grass cultivation very challenging. Currently Mr. Casco focuses on raising the roosters and other animals at the farm and does not grow any crops.

The Casco Chicken Farm is thought to be the largest rooster operation on Maui. There are a few other smaller chicken farms on the island, including two (2) in Olowalu. One of the farms in Olowalu is within the Olowalu Cultural Reserve.

Locational Advantages and Disadvantages

Mr. Casco reports that primary advantage of the farm's current location in Olowalu is the isolation. There are no residential neighbors in close proximity to the property, which is a major advantage for the chicken farm in particular. Noise associated with rooster crowing can be a nuisance to nearby residents. As such, the isolation at Olowalu limits the potential for nuisance complaints.

The primary disadvantage of the farm's location in Olowalu is the threat of fire hazard. The Olowalu region receives minimal rainfall and is characterized by dry vegetation that serves as fuel hazard for fires. Mr. Casco is concerned about the threat of fire to his farm. He has cut the trees around the perimeter of his farm to create a fire break in case there is a fire. If a fire were to threaten the farm, Mr. Casco would move all of the roosters to the center of the farm and turn on the sprinklers to try to protect the farm and the animals.

In addition to the fire threat, Mr. Casco also notes that the unpaved access road to the farm is in poor condition.

Farm Production, Sales, and Operations

The Casco Chicken Farm sells its roosters primarily in the Philippines. Mr. Casco takes two (2) trips to the Philippines per year to sell the roosters. In addition to sales in the Philippines, the farm does sell some roosters locally in Hawaii. The majority of the farm's sales within the State are on Oahu, however, Mr. Casco does sell roosters on Maui and Molokai as well. The farm typically sells approximately half of the roosters on the farm each year.

Mr. Casco also sells the goats and pigs on his farm. The sales of these animals take place at his farm. Goats sell for approximately $250 while pigs can sell for about $200 each. At one point, Mr. Casco was selling between four (4) and five (5) goats per month.

The revenues from rooster, goat, and pig sales allow the farm to break even financially. The sales help to cover the lease payments, water bill, and feed. As previously

mentioned, the current lease is $600 per month and the water bill has averaged $86 per month between January and August 2011. The water costs for the farm, however, are highly seasonal. During some months, the water bill has exceeded $150 or even $200. The cost of feed is approximately $800 per month.

Mr. Casco noted that the pigs themselves are not profitable. Raising pigs is very labor intensive, particularly if slop food is used. Mr. Casco purchases feed for his pigs. The cumulative cost of the feed during the time the pig is raised is higher than what Mr. Casco can sell the pig for. For this reason, the farm just has a few pigs on an intermittent basis.

The Casco Chicken Farm does not have any employees. Mr. Casco runs the farm by himself, with the help of some friends and relatives. Mr. Casco's son and friends volunteer their time to help at the farm when needed.

Mr. Casco does not have plans to expand the farm's operations in Olowalu at this time due to the cost of expansion and the uncertainty with the lease. The farm is leasing the property on a year-by-year basis. As such, Mr. Casco does not want to invest money to expand with these uncertain conditions. If he were to have a three (3) or four (4) year lease, Mr. Casco would consider expanding.

Nuisance

If residential or commercial uses were developed in areas surrounding the Casco Chicken Farm, nuisance complaints associated with noise would be anticipated. Roosters naturally crow and there aren't many mitigation measures to control this noise.

Relocation

Mr. Casco understands that there are plans for future development in Olowalu. He has attended community meetings for the Olowalu Town project and likes the Master Plan's provision of parks and open space as well as access to the ocean. He believes that parks and shoreline access are needed in the community and are very important to the way of life in Hawaii.

The Casco Chicken Farm does not have replacement land currently available if they were required to relocate from Olowalu. Mr. Casco indicated that he would look at other areas on the island and would relocate somewhere if there were no plans for development in the foreseeable future. Mr. Casco would be willing to relocate to locations where the farm can plan to stay for a lengthy period of time, such as 50 years. This would make the investment in relocation and establishing the farm worth it. If the farm were to relocate, Mr. Casco would also consider other types of farming at that time. He mentioned that he would like to do sod and grass farming, which was not feasible in Olowalu.

When the Casco Chicken Farm relocated to Olowalu, the relocation and start up costs totaled $12,000. These costs were high because the farm was only given a one (1) month notice to relocate. As such, all of the improvements to the land at Olowalu had to be done very quickly and was very labor intensive. Mr. Casco noted that a longer relocation period, such as six (6) months, would make the relocation process much more affordable. This would allow for Mr. Casco to do the improvements and relocation slowly over time. Due to the nature of the farm, the relocation process would not result in the loss of animals or sales.

PROPOSED OLOWALU NUI HYDROPONIC TOMATO FARM
FARM INFORMATION
AGRICULTURAL IMPACT ASSESSMENT

Interview with: Connie Applegate, Owner and Manager of Olowalu Nui Hydroponic Tomato Farm

Interview date: October 19, 2011

Interviewed by: Bill Frampton, Frampton & Ward, LLC
Tessa Munekiyo Ng, Munekiyo & Hiraga, Inc.

The interview with Connie Applegate took place at the Olowalu Nui Hydroponic Tomato Farm (Olowalu Nui) on October 19, 2011. Ms. Applegate is the owner and manager of the Olowalu Nui farm. Her late husband, Jon Applegate, owned the farm prior to his passing in June 2011. The following summary is based on the interview with Ms. Applegate as well as documentation on farm operations provided by Ms. Applegate and Olowalu Water Company (OWC).

Farm Overview

The Olowalu Nui farm leases approximately four (4) acres of land from Olowalu Elua Associates on a portion of TMK No. (2) 4-8-003:115. The farm is located north of Olowalu Stream and mauka of Honoapi`ilani Highway, accessed by an unpaved road.

Olowalu Nui originated in Hana, where the farm cultivated seven (7) acres of land for seven (7) years. In 2001, the Olowalu Nui relocated to Olowalu and began leasing land from Olowalu Elua Associates. The initial lease began with a 5 year term that was extended for another 5 years. Over the first 10 years of the lease, the tomato farm paid heavily subsidized rents to Olowalu Elua. Rent payments totaled approximately $300 per year and Olowalu Elua paid for the non-potable water used by the farm.

In January 2011, Olowalu Nui entered into a new one-year lease for the land in Olowalu. Under the current lease, the farm paid $500 per month in rent over the first six (6) months of the lease and $900 per month during the last (6) months of the lease. Olowalu Nui is also now responsible for paying for all of its water use provided by the Olowalu Water Company (OWC). Between January and August 2011, Olowalu Nui has used an average of 433,000 gallons of non-potable water per month, with an average monthly water bill of $330 (Olowalu Water Company, 2011). The average monthly water bill, however, represents costs prior to OWC's rate increase in September 2011.

Olowalu Nui grows tomatoes using hydroponics, a method of growing plants that uses mineral nutrient solutions in water, without soil. In addition to tomatoes, the farm grows a small amount of lettuce, basil, parsley, cilantro, and other herbs using hydroponics. These crops are grown in five (5) greenhouses on the property. Olowalu Nui also has approximately 200 citrus trees, as well as 600 coconut, banana, papaya, and mango trees. Within the farm, approximately two (2) acres are used for fruit trees and 1.5 acres are used for hydroponic crops in greenhouses. The remaining 0.5 acre is used for accessory farm operational facilities such as a small office, parking, and storage.

In addition to the operation at Olowalu, Ms. Applegate grows seeds and plants on a small-scale basis at her home.

Locational Advantages and Disadvantages

Ms. Applegate reports that advantages of their current location in Olowalu include proximity to major markets, solar radiation, and water availability. The farm's location provides excellent access to West, South, and Central Maui. In addition, being located on the south-facing slopes of the West Maui Mountains, the region receives ample sunlight, which is good for tomato crops. Water availability through OWC is also an advantage of the location. Olowalu Nui is also set back from Honoapi`ilani Highway and is isolated from other users.

The primary disadvantage of the farm's location in Olowalu is the threat of fire hazard. The Olowalu region receives minimal rainfall and is characterized by dry vegetation that serves as fuel hazard for fires. Olowalu Nui has first hand experience with the fire risk in the region; in 2007 a wildfire destroyed the entire farm. All of the farm's greenhouses and crops were lost. Another disadvantage of Olowalu is the strong winds in the area. Olowalu Nui has planted banana trees to serve as a windbreak for the property. Ms. Applegate also mentioned that the Olowalu Nui property does not currently have access to potable water.

Farm Production, Sales, and Operations

Olowalu Nui suffered a major setback in 2007 when a wildfire destroyed the entire property, including the greenhouses the farm had built. The farm was profitable in 2007 prior to the fire. However, the fire caused $600,000 damages and losses from plant production. Since the fire, the farm has been operating at a loss due to low production from the fire. Olowalu Nui built new greenhouses and repaired its facilities in 2010 and early 2011. Another new greenhouse was prepared for construction earlier this year. However, construction of that greenhouse was put on hold when Mr. Applegate passed away. Beyond the additional greenhouse, Olowalu Nui does not have plans for further expansion at this time.

Since completing repairs and improvements in 2010 and 2011, the farm is hoping to return to profitability in the next few months. In 2010, the gross sales for the farm was $163,078.00.

The farm sells its crops to restaurants and retail stores in West, Central, and South Maui. The farm in Olowalu is centrally located to these various destinations. The coconut trees are sold to landscaping companies.

The operation at Olowalu Nui is very labor intensive. Olowalu Nui employs one (1) full-time worker and one (1) part-time employee. In addition, the farm hires eight (8) outside contract workers on a part-time basis. The farm does not hire seasonal workers. Monthly payroll for all labor averages approximately $8,000 to $10,000.

Nuisance

If residential or commercial uses were developed in areas surrounding the Olowalu Nui farm as part of Olowalu Town, Ms. Applegate does not anticipate significant nuisance complaints from future neighbors over the operations at the farm. This is in large part to the type of farming practiced at Olowalu Nui. Hydroponic farming does not involve spraying of chemicals or fertilizers; instead, mineral nutrient solutions in the water are used to grow the crops. Olowalu Nui also rarely sprays chemicals on its tree crops. The farm uses the water from the hydroponic crops to also irrigate the fruit trees on the property. The farm does not generate noise or produce odors. Banana trees have been planted along the border of the property to serve as a windbreak. These trees would also serve as a buffer or barrier between the farm and neighboring uses.

While complaints from actual farm operations are not anticipated, Ms. Applegate noted that the unpaved access road from Honoapi`ilani Highway to the farm site does generate dust that may be considered a nuisance to neighboring properties. This dust nuisance, however, could be easily mitigated through paving of the access road, which is owned by Olowalu Elua Associates.

Relocation

Ms. Applegate indicated that Olowalu Nui does not have replacement land in Olowalu or elsewhere on Maui if the farm was forced to move from Olowalu. Assuming comparable replacement land could be found, Ms. Applegate estimates that the cost to relocate would be approximately $50,000. In addition to the actual relocation costs of disassembling and reassembling farm equipment, Olowalu Nui would lose revenues from crop production during the relocation period. Disassembling and reassembling the hydroponic facilities and farm would take approximately six (6) months. For tomatoes, it takes 60 days from the time a seed is planted to harvest a crop. As such, the total relocation time, including the time it would take to start producing crops again, would be at least eight (8) months. To minimize the relocation time, Olowalu Nui could build and set up the nurseries at the new location, move the crops over, and then disassemble the existing facility. This, however, would not allow for reusing the existing infrastructure at the current location.

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Photos of Olowalu Nui Hydroponic Tomato Farm
(Photos provided by Frampton & Ward, LLC)

PHOTO NO.1: Photo of One (1) of Olowalu Nui's Five (5) Greenhouses at the Farm

PHOTO NO. 2: Photo of One (1) of Olowalu Nui's Five (5) Greenhouses at the Farm

PHOTO NO. 3: Photo of Tomato Crop Grown Using Hydroponics in One of Olowalu Nui's Greenhouses

PHOTO NO. 4: Photo of Lettuce and Other Crops Grown Using Hydroponics in One of Olowalu Nui's Greenhouses

APPENDIX N-1.

Proposed Olowalu Town Master Plan: Impacts on Agriculture

PROPOSED OLOWALU TOWN MASTER PLAN: IMPACTS ON AGRICULTURE

PROPOSED OLOWALU TOWN MASTER PLAN: IMPACTS ON AGRICULTURE

PREPARED FOR:
Olowalu Town, LLC
and Olowalu Ekolu, LLC

PREPARED BY:
Plasch Econ Pacific LLC

April 2015

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APPENDIX

State and County Goals, Objectives, Policies and Guidelines
Related to Agricultural Lands A-1

EXECUTIVE SUMMARY

1. PROPOSED DEVELOPMENT

Olowalu Town, LLC and Olowalu Ekolu, LLC propose to re-establish a community at Olowalu as envisioned in the Olowalu Town Master Plan (the **"Project"**). This Project is envisioned to become a small-scale, mixed-use livable community that will provide a variety of uses including residential, commercial/business, agricultural, civic, social, parks, and open space.

There are two alternatives for the Project: (1) Alternative 1 includes land both *makai* and *mauka* of the existing Honoapi'ilani Highway, and (2) Alternative 2 includes just the *mauka* lands. Alternative 1 will encompass about 636 acres, including a 434-acre **"Petition Area"** proposed for State redistricting from Agricultural to Urban and Rural. Alternative 2 will encompass about 591 acres, including a 396-acre Petition Area.

2. AGRICULTURAL CONDITIONS

Olowalu has favorable agronomic conditions for growing low-elevation commercial crops. Alternative 1 includes about 532 acres of high-quality farmland, of which about 504 acres will be developed (409 acres are in the Petition Area, and about 95 acres of agricultural land for roads, parks, etc.). Alternative 2 includes about 495 acres of high-quality farmland, of which about 468 acres will be developed (374 acres are in the Petition Area, and about 94 acres of agricultural land for roads, parks, etc.). Some of the better soils are stony.

Olowalu benefits from high solar radiation, exceeding 500 calories per square centimeter per day. Ample water is available to irrigate crops, and the water rate is competitive with many other farm areas in Hawai'i. Also, Olowalu is a reasonable trucking distance to Kahului.

However, Olowalu is isolated from other farm areas, so is poorly located for developing synergistic relationships with other farms on Maui. Also, occasional strong winds could cause crop damage if the crops are not protected by windbreaks, and wildfires will continue to be a threat as long as vegetation remains dry and overgrown.

3. OLOWALU NUI FARM

a. Farm Operations

Olowalu Nui Farm is located on about 4 acres of leased land in the western portion of the Project site. The farm grows tomatoes and other vegetables hydroponically in greenhous-

es, and also grows various fruit and palm trees on adjoining land. Employment has been cut to a single owner-operator.

b. Impacts on Olowalu Nui Farm

Most of Olowalu Nui Farm is located on the fringe of the Project in an area that is planned for (1) single-family homes on rural lots, (2) a rural park, (3) portions of an interior road, and (4) a portion of the realigned Honoapi'ilani Highway. The Highway will cause the loss of some trees in the southwest corner of the farm. Thus, as currently planned, the Project would require Olowalu Nui Farm to relocate eventually.

Assuming suitable land can be found nearby—which might include Project land near Olowalu Stream that is planned for farming—Olowalu Nui Farm estimates that the cost to relocate the hydroponic component of the farm would be about $50,000. Also, the farm could lose up to 8 months of production and its associated revenues before newly planted crops are producing at the new location. An alternative would be for the farm to invest in new facilities at the new location; move the crops to the new site; then disassemble the facilities at the current location. This option would maintain production but the capital costs would be higher.

Most or all of the fruit trees would probably be lost since moving them would be expensive, but the palm trees could be sold.

c. Recommended Mitigation for Olowalu Nui Farm

The Project developers have discussed the proposed Master Plan with the owner of Olowalu Nui Farm, and will continue to engage the owner in discussions as plans for the Project progress. Consistent with their current approach, it is recommended that the developers remain flexible regarding two alternatives:

- Modify the Project plan so that Olowalu Nui Farm can continue at its current location, and possibly provide some additional farmland to offset land that will be lost to roads in the Project.
- Assist with the cost to relocate Olowalu Nui Farm to an agricultural lot near Olowalu Stream, with new facilities built before the move so that production and revenues can be maintained during the transition.

For either location, Olowalu Nui Farm would be compatible with nearby homes given the inherent nature of hydroponic and orchard farming.

4. PALM TREE FARMS

Two palm tree farms are located within the Alternative 1 Project site. Both are low-revenue and unprofitable operations located on high-value oceanfront land. However, because of the County's low property taxes on land that is actively farmed, farming can be a cost-effective approach for holding land for future high-value use.

Both farm owners regard their farms as temporary operations that will continue until the the affected land is needed for the planned Project development. The farms will then be closed and not relocated. The loss in palm-tree production is likely to be offset by other palm-tree farms on Maui or other islands.

5. OLOWALU CULTURAL RESERVE

The Olowalu Cultural Reserve holds a 99-year lease to about 75 acres of the Project site. The organization is restoring former irrigation systems and lo'i for taro cultivation, and is planting other native crops. Currently, about 5 acres are used to demonstrate how crops are cultivated.

Project plans include expanding the Reserve, which will allow more varieties and greater quantities of native crops to be grown at the Reserve.

6. OTHER AGRICULTURAL ACTIVITIES

In addition to the formal agricultural leases, there are three informal agricultural uses within the Petition Area.

a. Ranching

The landowner allows a subsistence cattle rancher to graze about 20 head on about 200 acres located *mauka* of Honoapi'ilani Highway. In this same area, the landowner allows a retired rancher to graze a few head of horses. There are no formal leases for use of this land, and no rent is charged.

The two ranching activities are regarded as temporary land uses that are mutually beneficial to the ranchers and the landowner. For the ranchers, the landowner provides grazing land and range feed at no cost to the ranchers. For the landowner, the grazing controls vegetation and reduces the fire hazard at no cost to the landowner.

b. Fruit Stand and Garden

A juice and fruit stand is located on the *mauka* side of Honoapi'ilani Highway near Olowalu General Store. In addition to the roadside stand, the operator grows a variety of fruits on about 0.75 acre of abutting land, and sells the fruit at the roadside stand. Rent is not charged for the operation.

c. Recommended Mitigation

The Project developers will inform the ranchers and fruit seller of progress on the Project, and will provide ample notice regarding when they will have to vacate the land so that development can proceed as planned.

7. ABUTTING AGRICULTURAL ACTIVITIES

a. Olowalu Mauka Subdivision

Olowalu Mauka Subdivision is a 14-lot agricultural subdivision designed for large-lot residential use with comparatively expensive homes as well as agricultural use on a portion of each lot (i.e., **"country estates"**).

Impact on Farming Activity

At full development of the Project, single-family homes on rural lots (a half-acre or larger) will border the six lower-elevation lots in the Olowalu Mauka Subdivision. Portions of some of these agricultural lots are likely to be used for commercial farming and vegetable gardens. Similarly, portions of some of the rural lots may be used for vegetable gardens.

These two abutting uses are compatible as indicated by the many communities on Maui and throughout Hawai'i that have single-family homes on rural lots next to country estates. In such situations, farmers generally limit voluntarily their agricultural activities to those that are compatible with nearby homes. Thus, no adverse agricultural impacts are anticipated. Specifically, the residential use of homes on rural lots is not expected to interfere with existing or future farming activities in the Olowalu Mauka Subdivision. Also, farming activities are not expected to cause significant nuisance problems or other adverse impacts on new homes and their residents.

In any case, Hawai'i's Right-to-Farm Act gives farmers the right to farm if they were operating before neighboring properties were developed, provided that their farm activity does not threaten public health or safety.

Recommended Mitigation

Since adverse impacts are not expected on existing or likely farming within the Olowalu Mauka Subdivision, no mitigating measures are recommended.

b. Olowalu Makai Subdivision

Existing and Potential Farming Activity

Olowalu Makai Subdivision is an oceanfront, 5-lot agricultural subdivision designed for country estates.

Impact on Farming Activity

The existing and likely farming activities at Olowalu Makai Subdivision are compatible with nearby homes. This indicates that the Project components that will be near this subdivision are likely to be compatible with this same farming activity. In particular, a new park, new homes on large town lots, and new farming activity are not expected to interfere with existing or future farming activity within the Olowalu Makai Subdivision. Also, the

existing farming activities are expected to have little or no nuisance issues or other adverse impacts on park use, residential use of new homes, or new farming activity.

In any event, the Hawai'i's Right-to-Farm Act gives farmers the right to farm if they were operating before neighboring properties were developed, provided that their farming activity does not threaten public health or safety.

Recommended Mitigation

Since adverse impacts are not expected on existing or likely farming activity within the Olowalu Makai Subdivision, no mitigating measures are recommended.

c. Foothills

Potential Ranch Activity

The Olowalu foothills are State-owned lands designated Agricultural. Cattle grazing would be possible in those areas having moderate slopes, provided that water and paddock fencing are provided. Although returns from cattle operations are unlikely to be sufficient to justify the cost of the improvements, grazing can be a cost-effective approach to reducing vegetation and, in turn, the fire hazard associated with dry vegetation.

Impact on Potential Grazing Activity

The potential for grazing cattle in the Olowalu foothills would not be affected by the Project as indicated by the fact that grazing operations near homes and farm areas is common on Maui and throughout Hawai'i with little or no adverse impacts. In fact, cattle would benefit the Project by reducing the fire hazard to homes and farms.

Recommended Mitigation

Since the Project would not affect the potential for grazing cattle in the Olowalu foothills, no mitigating measures are recommended.

8. NEW OLOWALU FARMING ACTIVITY

a. Field Farming

Farming Operations

About 28 acres in the center of the Project site along Olowalu Stream are planned for agriculture, of which about 27 acres are high-quality farmland. Subtracting land for homes and other improvements, about 27 acres will remain available for farming.

Assuming typical field farming of vegetables, annual production of food crops from 27 acres could total over 650,000 pounds, thereby contributing to food self-sufficiency and food security. Farm employment could total about three full-time equivalent farm jobs.

Nuisance Issues

The planned farm area along Olowalu Stream will border single-family homes on small town lots, large town lots, and rural lots. The close proximity of farms and homes can create nuisance issues for residents, such as noisy farm equipment in the early morning, airborne dust from field plowing, odors from fertilizer and chemicals, airborne crop-protection products drifting toward homes, etc. It should be noted, however, that prevailing tradewinds at Olowalu blow offshore, not toward homes.

At the same time, nuisance complaints from nearby residents can cause farmers to change their operations to address the complaints. Also, farms near homes have greater risk of crop and equipment theft than farms that are hidden from view or for which access is difficult.

Recommended Mitigation

To reduce nuisance issues, the following are recommended:

- Security fencing between farms and homes.
- Stands of trees to provide buffers between farms and homes.
- Farm practices that minimize nuisance issues (e.g., no noisy equipment during early hours, dust control, no use of products that cause strong odors, restrictions on the use of crop-protection products in order to prevent airborne chemicals from drifting toward homes, etc.)
- Notification to homebuyers to inform them of nearby farms, potential nuisance issues, and the Right to Farm Act.

Regarding the last item, the intent is to have new residents embrace the fact that nearby farms will be part of the ambiance of the Olowalu community.

b. Hydroponic Farming

A strong and well-established trend has developed to grow vegetables and melons hydroponically in greenhouses. Such farming would allow increased vegetable and melon production in Hawai'i while using much less land and water than is required for field farming. Also, good soils are not required for hydroponic farming, thereby allowing this type of farming to be located in areas having poor soils. Furthermore, farming inside greenhouses eliminates or reduces many of the nuisance issues normally associated with field farming including: load noises from farm equipment, dust from recently plowed fields, odors from fertilizers, drifting of sprayed products, and risk of theft.

Assuming that hydroponic farming at Olowalu would use technology already common in Hawai'i, their production could reach nearly 4.6 million pounds per year. This is equivalent to about 190 acres used in field farming, or about 7 times the potential production of field farming these lands. For comparison, about 400 acres of vegetables and melons were harvested from all of Maui County in 2008 (the latest year that acreage was reported), or

about 200 acres farmed. Consequently, hydroponic farming on 27 acres at Olowalu would nearly double the production of vegetables and melons by Maui County farmers. Furthermore, hydroponic farming would offset about 40% of the high-quality farmland lost to Project development. Hydroponic farming of 27 acres could generate about 14 jobs.

c. Home and Community Gardens

In addition to commercial farming as discussed above, future Olowalu residents will have access to good agricultural land to grow food and nursery crops for family and friends. Residents of rural lots can have home gardens, and all residents will have access to community gardens. Although such farming is largely a lifestyle choice, the food produced increases self-sufficiency.

9. GROWTH OF DIVERSIFIED CROP FARMING

The Project will result in a loss of good farmland to development. As discussed below, this loss, in combination with other projects (i.e., the cumulative impact), is too small to affect the growth of diversified-crop farming on Maui or statewide.

a. Loss of Farmland

Olowalu

The Project will commit about 500 acres of high-quality farmland now in the Agricultural District to a non-agricultural use, or about 0.7% of the 72,100 acres of high-quality farmland on Maui. If the Project is not developed as planned, then the land is likely to be subdivided for country estates. This would also result in a loss of farmland.

All Maui Projects

The County's *Maui Island Plan* allows for the eventual development of about 3,540 acres of high-quality farmland, or about 4.9% of the island-wide supply of such land. In practice, the loss of good agricultural land will be less than 3,540 acres since not all approved projects will be built in the foreseeable future. Also, the loss will be gradual, depending on demand for new homes and visitor units.

b. Supply of Farmland

Island of Maui

Maui Island has about 242,700 acres in the State Agricultural District, of which about 72,100 acres are high-quality farmland. The accounting of high-quality farmland excludes land used for country estates and golf courses.

For the entire County (Maui, Moloka'i and Lāna'i), about 42,500 acres are in crop, most of which is on Maui Island. Thus, over 29,600 acres are available for farming (72,100 acres – 42,500 acres). Much of this land is now used for grazing cattle. Assuming that all projects shown in the 2014 Maui County Regional Maps are eventually approved and built, then over 26,000 acres of high-quality farmland on Maui would remain available for farming (29,600 acres – 3,540 acres). However, farming much of this land would require major water improvements, including wells, stream diversions, and delivery systems.

Statewide

Statewide, the remaining supply of available farmland released by plantation agriculture exceeds 170,000 acres. This is about double the amount of land in crop—about 87,700 acres. The supply of available farmland is vast because of the statewide contraction and closure of many sugarcane and pineapple plantations during the past four decades, combined with the subsequent slow growth of diversified-crop farming (all crops other than sugarcane and pineapple). In the late 1980s, Hawai'i had 19 plantations: now, just two remain.

c. Trends in Diversified Crop Acreage

Hawai'i has a long history of strong support for the agriculture industry. However, since 1983 (over 30 years ago), no significant growth in diversified-crop acreage has occurred, with the single exception of seed crops which have increased at an average rate of about 290 acres per year since 1992. Following the O'ahu plantation closures, vegetable and melon acreage expanded on O'ahu, but this was followed by declines on the Neighbor Islands.

d. Agricultural Outlook by Type of Crop

Food Crops, Field Farming

Hawai'i is about 33% self-sufficient in fresh produce (i.e., vegetables, melons and fruits) while using about 15,000 acres of land. Given competition from low-cost imports, a realistic level of self-sufficiency may be about 50%. This would require about 7,500 acres of additional farmland.

The island of Maui would require about 1,100 acres of additional farmland for 50% self-sufficiency in fresh produce. With intensive farming (such as hydroponic farming), land requirements would be reduced greatly.

Food Crops, Hydroponic Farming

In advanced economies—such as Europe, the U.S. mainland, and Hawai'i—a strong and well-established trend has developed to grow vegetables and melons hydroponically in greenhouses. Although the capital cost of constructing hydroponic farms is high, hydroponic

farming in greenhouses provides many advantages over traditional field farming, including but not limited to the following: (1) higher-quality and more consistent produce, (2) year-round production, (3) secure production unaffected by droughts and storms, (4) far higher yields due to controlled conditions, (5) much less land required because of the higher yields, (6) no need to use good farmland, (7) much less water, (8) no pesticide or herbicide spraying because of the controlled environment, (9) less labor and less difficulty in attracting workers because of better working conditions, (10) less crop and equipment theft because operations are inside buildings, (11) lower energy requirements, and (12) lower transportation costs if the farm is located near major markets.

If Hawai'i vegetable farmers are to remain competitive with mainland hydroponic farmers, they will be compelled to turn increasingly to hydroponic farming in greenhouses. This suggests that large agricultural fields, soil quality, developing irrigation systems, and microclimates will be of less significance for food production in the future.

Feed Crops

If feed crops could be grown in Hawai'i and priced competitively against mainland imports, they could replace some of the grains and hay that are now being imported to the state. Unfortunately, a number of commercial attempts in Hawai'i to grow grains and alfalfa have not been successful. The major problems have been (1) pests, particularly birds that eat the grains before they are harvested; (2) humidity that is too high for some feed crops (e.g. problems with mold, smut fungus, insufficient drying of alfalfa, etc.); (3) high winds that cause stalks to lean over and break (lodge); and (4) high production costs compared to mainland farms. Nevertheless, large-scale attempts to grow feed crops continue.

Biofuel Crops

Over the past 20+ years, a number of companies have explored biofuel crops to take advantage of the vast acreage released from sugar and pineapple, and a number of biofuel plantations have been proposed and continue to be proposed. To date, no large single-purpose biofuel plantations have been developed in Hawai'i, largely due to high capital costs, combined with per-acre returns that are low compared to other crops. Developing profitable biofuel plantations has become more difficult with the sharp decline in energy prices.

Rather than growing a biofuel crop on farmland, a more promising alternative would be to produce biofuel from algae. One of the advantages of algae is its high yield of vegetable oil and high returns per acre. Also, good farmland is not required for algae since it is grown in ponds. The water source can include wastewater, brackish water, or even seawater.

Another promising energy alternative that is likely to threaten the profitability of Hawai'i biofuel crops is liquified natural gas shipped from the mainland. As a result of technological advances with hydrofracking, the supply is abundant, the gas is inexpensive (the equivalent of about $30 per barrel on the mainland), and clean compared to many alternatives.

Olowalu would be a poor location for a biofuel plantation because of insufficient acreage, high land costs, and low rainfall. And if HC&S were to be converted to a biofuel plantation, hauling biomass from Olowalu to HC&S's Pu'unēnē processing facilities would add significant costs.

Export Crops

The potential export market for crops is far larger than the Hawai'i market. However, the history of agricultural efforts in Hawai'i reveals that the successful development of major new export crops requiring large amounts of land is difficult and infrequent. With the exception of seed corn and other seed crops, acreages of the major export crops have not grown significantly since the mid-1980s.

e. Impact on the Growth of Diversified Crop Farming

In summary, the Project will result in a relatively small loss of high-quality farmland of which there is a large supply, both on Maui and statewide. Furthermore, the demand for Hawai'i farmland has increased slowly over the past 30 years. Moreover, the trends toward hydroponic farming indicate that high-quality farmland will be of less significance for food production in the future. As a result, ample farmland will remain available to accommodate future diversified-crop farming, food self-sufficiency, and food security.

10. OFFSETTING BENEFITS

The loss of about 500 acres of high-quality farmland (less than 0.7% of the island supply)—along with the possible relocation of a hydroponic farm; the relocation of hobby ranching operations; the loss of a fruit stand and small garden and; for Alternative 1, the planned loss of two temporary palm-tree operations—will be offset by the following benefits of the Project:

- Construction Activity
  - Construction jobs associated with Project development.
  - Indirect jobs generated by purchases of goods and services by construction companies and families of construction workers.
  - State tax revenues (excise taxes, personal income taxes, corporate income taxes, etc.) paid by construction companies and workers, and by companies and families supported by construction activity.
- Operations, Full Development
  - About 1,500 new homes for Maui residents, of which about 50% will be available for affordable housing and senior living.
  - Commercial space for new restaurants, stores, services, etc.
  - New public and quasi-public facilities, including, community centers, schools, a library, a museum, medical facilities, etc.

  - New recreational facilities, including ball fields, playgrounds, camping areas, bikeways, etc.
  - New parks.
  - Improved access to the beach.
  - Preservation of about 28 acres of farmland for small farmers.
  - Expansion of the Olowalu Cultural Center.
  - Reduced risk of wildfires since dry unmanaged vegetation will be replaced by irrigated and maintained vegetation.
  - Off-site jobs generated by purchases of goods and services by Project businesses and residents.
  - State tax revenues (excise, personal income, corporate income taxes, etc.) paid by Project businesses and residents, as well as by off-site businesses and residents supported by Project operations.
  - County tax revenues (property taxes, etc.) paid by Project businesses and residents, as well as by off-site businesses and residents supported by Project operations.

11. CONSISTENCY WITH STATE AND CITY POLICIES

a. Availability of Lands for Agriculture

The *Hawai'i State Constitution*, the *Hawai'i State Plan*, the *State Agriculture Functional Plan*, the *County of Maui 2030 General Plan*, the County's *Maui Island Plan (Draft)*, and the County's *West Maui Community Plan* call directly or implicitly for preserving the economic viability of plantation agriculture and promoting the growth of diversified agriculture. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured.

With regard to plantation agriculture, the cultivation of sugarcane at the Project site ceased in 1999 for reasons unrelated to the proposed Project.

With regard to diversified crop farming, Olowalu Nui Farm will lose some of the acreage now used for tree crops, but this can be offset by replacement land within the Project site. Project plans may have to be adjusted to allow the hydroponic component of the farm to remain in place, or assistance may be provided to allow the farm to relocate to Project lands that are planned for agriculture. The two ranching activities, both of which are hobby operations, will have to relocate. The small fruit stand and garden will have to relocate or close. For Alternative 1, the two temporary palm-tree operations will close as planned. Finally, Project plans call for preserving about 77 acres of high-quality farmland, including about 27 acres planned for small farmers and about 50 acres for other uses (parks, bikeways and greenways, and expanding the existing Olowalu Cultural Reserve).

However, about 504 acres of high-quality farmland will be used for non-agricultural activities with Alternative 1, and about 468 acres with Alternative 2. These are relatively

small losses which, in combination with other planned and proposed projects, will not limit the anticipated growth of diversified-crop farming.

b. Conservation of Agricultural Lands

In addition to the above, State and City policies call for conserving and protecting prime agricultural lands, including protecting farmland from urban development.

In compliance with these policies, Maui County conserves and protects the prime agricultural lands located outside Urban, Small Town, and Rural Growth Boundaries as defined in the *Maui Island Plan*. These Boundaries were defined by the County to guide future urban and rural development on Maui while protecting lands located outside the Boundaries.

For Alternative 2, the urban and rural components are located within the Urban and Rural Growth Boundaries. As such, these areas do not include the agricultural lands identified by the County for protection. For Alternative 1, the Urban and Rural components *mauka* of Honoapi'ilani Highway are located within these Boundaries, while the *makai* components are outside the Boundaries.

It should also be noted that many of the State and County agricultural policies were written before the major contraction of plantation agriculture, and assume implicitly that profitable agricultural activities eventually will be available to utilize all available agricultural lands. This has proven to be a questionable assumption in view of the enormity of the contraction of plantation agriculture, the abundant supply of farmland that came available for diversified agriculture, and the slow growth in the amount of land being utilized for diversified agriculture.

Furthermore, discussions in the *Agriculture State Functional Plan* recognize that redesignation of lands from Agricultural to Urban should be allowed "... upon a demonstrated change in economic or social conditions, and where the requested redesignation will provide greater benefits to the general public than its retention in ...agriculture;" that is, when an "overriding public interest exists." The enormous contraction of plantation agriculture, which resulted in the supply of agricultural land far exceeding demand, constitutes a major change in economic conditions. Another ongoing change is the trend toward hydroponic farming to grow a variety of vegetable crops. Compared to field farming, hydroponic farms use far less land and water, and they can be located on low-quality farmland or even on urban land. Moreover, the Project will provide community benefits that far exceed the benefits of leaving the land in agriculture (currently, about six full- and part-time jobs), or the cost of relocating the Olowalu Nui Farm (if needed) and the hobby operations to new locations.

In practice, development of the Project is expected to have no significant impact on agricultural activity since Olowalu Nui Farm Farm is expected to continue operations at its current location or at a new location. Also, ample land is available on Maui and statewide to accommodate the anticipated growth of diversified agriculture.

c. Important Agricultural Lands

Chapter 205 of Hawai'i Revised Statutes mandates the Counties to recommend to the State Land Use Commission certain lands for designation as Important Agricultural Lands ("IAL"). Presumably, this would include the higher-quality farmlands on Maui. However, State law does not allow the Counties to recommend lands for IAL designation that are within County-defined Urban and Rural Growth Boundaries.

The Urban and Rural components of Alternative 1 that are *mauka* of the existing Honoapi'ilani Highway, and all of the Urban and Rural components of Alternative 2, are within the Maui County Growth Boundaries. As such, these lands cannot be recommended by the County for IAL designation. However, the Urban and Rural components of Alternative 1 that are *makai* of the Highway are eligible for designation as IAL.

d. County of Maui Land-Use Plans

The *Maui Island Plan* (2012) shows the urban and rural components of Alternative 2 within the Urban and Rural Growth Boundaries. However, the *makai* lands in Alternative 1 are outside the Boundaries.

The current *West Maui Community Plan* (1996) designates most of the Project site as Agriculture (AG), with comparatively small amounts of land designated Conservation (C) and Public/Quasi-Public (P). However, it is anticipated that the County will change the *West Maui Community Plan* to conform with the *Maui Island Plan*.

PROPOSED OLOWALU TOWN MASTER PLAN: IMPACTS ON AGRICULTURE

1. INTRODUCTION

Olowalu Town, LLC and Olowalu Ekolu, LLC propose to re-establish a community at Olowalu as envisioned in the Olowalu Town Master Plan (the **"Project"**). There are two alternatives for the Project: (1) Alternative 1 includes land both *makai* and *mauka* of the existing Honoapi'ilani Highway, and (2) Alternative 2 includes just the *mauka* lands.

This report addresses the impacts of both alternatives on agriculture. The material below gives the following information for each alternative, as relevant: the Project location, landownership, description, and the land classifications and required approvals; the agricultural conditions at the Project site; past agricultural uses; the agricultural impacts of the Project on current farming and livestock operations; the impact of the Project on the growth of diversified crop farming; benefits of the Project that would offset adverse agricultural impacts; and consistency of the Project with State and County agricultural policies related to agricultural land. Maps are at the end of the report. The Appendix summarizes State and County goals, objectives, policies and guidelines related to agricultural lands.

2. PROJECT INFORMATION

a. Project Location

Olowalu is located in West Maui's on Honoapi'ilani Highway, about 6 miles southeast of Lahaina, and about 7 miles west-by-north of Mā'alaea (see Figures 1 and 2). Alternative 1 encompasses all or portions of the following Tax Map Keys: (2) 4-8-003: 84, 98 through 118, and 124 (see Figure 3). Alternative 2 includes the same TMKs with the exception of 4-8-003: 124

b. Land Ownership

All but one of the parcels in the Project are owned by Olowalu Elua Associates LLC. The 16.1-acre oceanfront parcel abutting and to the north-northwest of Olowalu Stream (TMK (2) 4-8-003:124) is owned by Olowalu Ekolu LLC.

c. Project Description

The Olowalu Town Master Plan will serve as a guide to re-establish a viable community at Olowalu. The Plan was developed as an alternative to an agricultural subdivision for

large-lot residential use (i.e., **"country estates"**), which which would otherwise be the likely use of most of the land. By 2023 (subject to development approvals and market conditions), the Project is envisioned to become a small-scale, mixed-use livable community that will provide a variety of uses including residential, commercial/business, agricultural, civic, social, parks, and open space. As such, it will serve as a center for housing, employment, and recreation. Residents will live within walking and biking distance of small stores, schools, parks, employment opportunities, gathering centers, beaches/shoreline, and other social and civic resources. Honoapi'ilani Highway will be realigned inland away from its existing and more environmentally sensitive coastal route.

Alternative 1

Alternative 1 encompasses about 636 acres categorized into a range of zones which transition from the central Neighborhood Town Centers (i.e. Urban) to Rural to Agriculture to Natural (see Figure 4). The **"Petition Area"** proposed for State redistricting from Agricultural to Urban and Rural covers about 434 acres. Land uses appropriate for each zone are as follows:

— Town Center (Urban): 266 acres

The Town Center will include a variety of higher density housing, including 400 to 800 single-family homes on small to large lots (3,500 to 10,000 sq. ft.), 600 to 900 apartments and townhouses, and 150 to 200 mixed-use live/work units.

The Town Center will also feature 300,000 to 375,000 sq. ft. of commercial space, including retail stores and shops, restaurants, offices, a theater, small-scale lodging, etc. These will serve local residents as well as visitors passing through Olowalu.

Public and quasi-public facilities will include community centers, schools, a library, a museum, a cultural center, police and fire stations, a post office, and medical facilities.

The Town Center will also feature multi-purpose ball fields, playgrounds, camping areas, passive parks, plazas and squares, bikeways and greenways.

— Rural: 168 acres

Rural areas will feature 75 to 100 single-family homes on half-acre or larger lots, multi-purpose ball fields, parks, community centers, cultural areas, camping, bikeways and greenways.

— Agriculture: 175 acres

The Agriculture areas will include a number of uses. About 28 acres will be used for about 14 small farms and related homes (about 2 acres per lot). About 89 acres will be used for parks, cultural areas, bikeways and greenways. Some of

this land will be used to expand the existing Olowalu Cultural Reserve. About 58 acres will be used for roads.

— Conservation: 27 acres

Conservation areas will include passive and minimally active parks, cultural areas, and greenways.

In total, about 1,500 residential dwelling units will be built, with the majority of homes being located within the urban zones where residents will have easy access to daily goods and services. These homes will be offered to families with a wide-range of income levels, and will include both rentals and fee-simple ownership. About 50% of the homes are planned for affordable housing and senior living. Workforce housing will be provided in keeping with requirements of Chapter 2.96 of the Maui County Code relating to Residential Workforce Housing Policy. Remaining homes will be sold or rented at market prices and rates.

Planned recreational and cultural improvements include:

— Enhanced access to the existing government beach reserve along the Olowalu shoreline.

— Expanded stream-side parks that provide *mauka-makai* access and related passive park experiences along the Olowalu Stream.

— A comprehensive greenway system for walking, jogging and biking.

— A *mauka* community park connected to the greenway system.

— Expansion of the Olowalu Cultural Reserve.

— Enhancement of camping facilities (Camp Olowalu).

— Shoreline parks.

— Neighborhood parks.

Alternative 2

Alternative 2 encompasses about 591 acres, all of which are *mauka* of the existing highway (see Figure 5). The Petition Area proposed for State redistricting from Agricultural to Urban and Rural covers about 396 acres. The land-use allocations are as follows:

— Town Center (Urban): 228 acres (down 38 acres from Alternative 1)

— Rural: 168 acres (no change from Alternative 1)

— Agriculture: 173 acres (down 2 acres from Alternative 1)

— Conservation: 22 acres (down 5 acres from Alternative 1)

For this alternative, the Petition Area proposed for State redistricting from Agricultural to Urban and Rural covers about 396 acres.

d. Land Classifications and Required Approvals

Current land classifications of the Project site and proposed changes are as follows:

— State Districts

- Alternative 1
  + Current: About 609 acres are designated as Agricultural, and about 27 acres are designated Conservation (see Figure 6). The Conservation lands are located along the shoreline and in *mauka* areas.
  + Proposed (see Figure 7)
    - Petition Area: about 434 acres would be re-districted from the Agricultural District to Urban (about 266 acres) and Rural (about 168 acres.)
    - About 175 acres would remain Agricultural, and about 27 acres would remain Conservation.
- Alternative 2
  + Current: About 568 acres are designated as Agricultural, and about 22 acres are designated Conservation.
  + Proposed
    - Petition Area: about 396 acres would be re-districted from the Agricultural District to Urban (about 228 acres) and Rural (about 168 acres.)
    - About 173 acres would remain Agricultural, and about 22 acres would remain Conservation.

— Maui Island Plan

- Alternative 1
  + Current: Land uses *mauka* of Honoapi'ilani Highway are consistent with the *Maui Island Plan*, with the urban and rural Project components located within the Urban and Rural Growth Boundaries (see Figure 8). However, the *makai* portion of Alternative 1 is outside the Boundaries.
  + Proposed: The Plan would be amended to add Urban Growth Boundaries *makai* of the highway.
- Alternative 2:
  + Current: All of Alternative 2 is consistent with the *Maui Island Plan*.
  + Proposed: No change.

— West Maui Community Plan

- Current: Mostly designated Agriculture, with some Conservation, Park and Open Space (see Figure 9).

- Proposed: Designated Project District with land uses consistent with Figure 4 (Alternative 1) or Figure 5 (Alternative 2).

— Zoning

- Current: Mostly designated Agricultural and, for Alternative 1, some R-3 Residential and A-3 Apartment.
- Proposed: Zoned Project District consistent with Figure 4 (Alternative 1) or Figure 5 (Alternative 2).

— Special Management Area (SMA) Use Permit

- Current: Areas *makai* of Honoapi'ilani Highway and some areas *mauka* of the highway are in the SMA.
- Proposed: SMA Use permits consistent with Figure 4 (Alternative 1) or Figure 5 (Alternative 2).

3. AGRICULTURAL CONDITIONS

a. Soil Association

According to the 1972 soil survey by the U.S. Natural Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service SCS), the Project site has soils comprised of Pulehu-Ewa-Jaucas association (see Figure 10). These soils were developed in alluvium washed from basic igneous rock, coral, and seashells. They are found in alluvial fans and in basins, and consist of deep soils that are well-drained and excessively drained, and have a moderately fine texture to coarse-textured subsoil or underlying material. Slopes range from nearly level to moderate.

Pulehu soils comprise about 40% of the association, Ewa soils about 15%, and Jaucas soils 10%. Alae, Iao, Kealia, and Puuone soils make up the rest. Pulehu soils have a surface layer of dark-brown, friable silt loam. Their substratum is dark-brown and dark yellowish-brown alluvium weathered from basic igneous rock. Ewa soils have a surface layer and subsoil of dark reddish-brown, friable silty clay loam. Their substratum is alluvium weathered from basic igneous rock. Jaucas soils have a pale-brown calcareous sand surface layer. Their substratum is yellowish-brown sand weathered from coral and seashells.

Historically these soils have been used for sugarcane, truck crops, and pasture.

b. Soil Types and Characteristics

The 1972 NRCS soil survey further indicates that the Project site has 14 soil types (see Figure 11). These soils and their NRCS soil ratings (explained in the next subsection) are as follows:

— Rated I: 133 acres and 116 acres for Alternatives 1 and 2, respectively; 100 acres and 84 acres for the two Petition Areas, respectively

- EaA ('Ewa Silty Clay Loam, 0 to 3% slopes): 25 acres for Alternatives 1 and 2; 21 acres for both Petition Areas; rated I (irrigated)

  This soil derived from basic igneous rock, and occurs on alluvial fans and terraces. Soil depth exceeds 60 inches, and in places roots penetrate to a depth of 5 feet or more. In a representative profile the surface layer is dark reddish-brown silty clay loam about 18 inches thick. The subsoil, about 42 inches thick, is dark reddish-brown and dark-red silty clay loam that has sub-angular blocky structure. The substratum is coral limestone, sand, or gravelly alluvium.

  The soil is neutral in the surface layer and subsoil. Permeability is moderate, runoff is slow, and the erosion hazard is slight.

  Historically, this soil has been used for sugarcane, truck crops, and pasture.

- PsA (Pulehu Clay Loam, 0 to 3% slopes): 66 acres and 64 acres for Alternatives 1 and 2, respectively; 37 acres and 36 acres for the two Petition Areas, respectively; rated I (irrigated)

  This soil derived from basic igneous rock, and occurs on alluvial fans, stream terraces, and in basins.

  In a representative profile the surface layer is dark brown clay loam about 21 inches thick. This is underlain by dark-brown, dark grayish-brown, and brown, massive and single grain, stratified loam, loamy sand, fine sandy loam, and silt loam about 39 inches thick. Below this is coarse, gravelly or sandy alluvium. In places roots penetrate to a depth of 5 feet or more.

  The soil is neutral in the surface layer and neutral to mildly alkaline below the surface layer. Permeability is moderate, runoff is slow, and the erosion hazard is no more than slight. Low areas are subject to flooding.

  Historically, this soil has been used for sugarcane, truck crops, and pasture.

- PpA (Pulehu Silt Loam, 0 to 3% slopes): 42 acres and 27 acres for Alternatives 1 and 2, respectively; 42 acres and 27 acres for the two Petition Areas, respectively; rated I (irrigated)

  This soil is similar to PsA except that the texture is silt loam. Historically, this soil has been used for sugarcane.

— Rated II: 267 acres and 251 acres for Alternatives 1 and 2, respectively; 204 acres and 191 acres for the two Petition Areas, respectively

- PtA (Pulehu Cobbly Clay Loam, 0 to 3% slopes): 209 acres and 194 acres for Alternatives 1 and 2, respectively; 170 acres and 157 acres for the two Petition Areas, respectively; rated IIs (irrigated)

  This soil is similar to PSA except that it is cobbly. Historically, this soil has been used for sugarcane.

- PtB (Pulehu Cobbly Clay Loam, 3 to 7% slopes): 58 acres and 57 acres for Alternatives 1 and 2, respectively; 34 acres for both Petition Areas, respectively; rated IIe (irrigated)

  On this soil, runoff is slow and the erosion hazard is slight. Historically, this soil has been used for sugarcane.

— Rated VI: 132 acres for both Alternatives; and 98 acres for both Petition Areas

- WyC (Wainee Extremely Stony Silt Clay, 7 to 15%slopes): 132 acres for both Alternatives; and 98 acres for both Petition Areas; rated VIs

  This soil derived from weathered basic igneous rock, and occurs on smooth, moderately sloping, alluvial fans.

  In a representative profile, stones cover 3 to 15% of the surface. The surface layer is dark reddish-brown silty clay about 12 inches thick, and stones make up 10 to 15% of the volume. The subsoil, 24 inches thick, consists of dark reddish-brown silty clay that has sub-angular blocky structure. Gravel, cobblestones, and stones make up 30 to 80 percent of the volume. The substratum. is dark-brown silty clay. As much as 80 to 90% of this layer is gravel, cobblestones, and stones. Roots penetrate to a depth of 5 feet or more.

  This soil is neutral in the surface layer and subsoil. Permeability is moderately rapid, runoff is slow to medium, and the erosion hazard is slight to moderate.

  Historically, this soil has been used for sugarcane and some pasture.

— Rated VII: 96 acres and 85 acres for Alternatives 1 and 2, respectively; 29 acres and 22 acres for the two Petition Areas, respectively

- JaC (Jaucas Sand, 0 to 15% slopes): 14 acres and 6 acres for Alternatives 1 and 2, respectively; 9 acres and 2 acres for the two Petition Areas, respectively; rated VIIs

  This calcareous soil occurs as narrow strips on coastal plains, adjacent to the ocean. It developed in wind and water deposited sand from coral and seashells. In most places the slope does not exceed 7%.

  In a representative profile the soil is single grain, pale brown to very pale brown, sandy, and more than 60 inches deep. In many places the surface layer

is dark brown as a result of accumulation of organic matter and alluvium. Also, roots can penetrate to a depth of 5 feet or more.

The soil is neutral to moderately alkaline throughout the profile. Permeability is rapid, and runoff is very slow to slow. The hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed. Workability is slightly difficult because the soil is loose and lacks stability for use of equipment.

Historically, this soil has been used for pasture, sugarcane, and truck crops.

- KMW (Kealia Silt Loam, 0 to 1% slopes): 3 acres for both Alternatives and both Petition Areas; rated VIIw

  This soil is found on coastal flats.

  In a representative profile the surface layer is dark reddish-brown silt loam about 3 inches thick. Below this are stratified layers of silt loam, loam, and fine sandy loam. A brackish water table occurs at a depth of 12 to 40 inches. The subsurface layers are dark reddish brown to dark reddish gray in the upper part and dark grayish brown to black near the zone of the water table.

  The soil has a high concentration of salts and is moderately alkaline. Permeability is moderately rapid, and runoff is slow to very slow. Because of poor drainage, ponding occurs in low areas after a heavy rain. When the soil dries, salt crystals accumulate on the surface. The soil has a brackish water table that fluctuates with the tides: the water table is nearer the surface along the shoreline than in inland areas. The hazard of water erosion is no more than slight, but the hazard of wind erosion is severe when the soil is dry and the surface layer becomes loose and fluffy.

  Historically, this soil has been used for pasture, but has low grazing value. It is not used for crops because of poor drainage and high salt content.

- rRS (Rough Broken and Stony Land): 18 acres and 17 acres for Alternatives 1 and 2, respectively; 1 acre for both Petition Areas; rated VIIs

  This soil is found in very steep, stony gulches. The soil material is generally less than 20 inches deep over saprolite or bedrock. About 3 to 25 percent of the surface is covered with stones, and there are a few rock outcrops. Runoff is rapid, and geologic erosion is active.

  Historically, this soil has been used for pasture.

- rRK (Rock Lands): 6 acres for both Alternatives; none for both Petition Areas; rated VIIs

This soil is made up of areas where exposed rock covers 25 to 90% of the surface, and is characterized by rock outcrops and very shallow soils. The rock outcrops are mainly basalt and andesite. In many areas, the soil material is very sticky and very plastic, and has high shrink-swell potential. Slopes are nearly level to very steep.

Historically, this soil has been used for pasture.

- rSM (Stony Alluvial Land, 3 to 15% slopes): 55 acres and 53 acres for Alternatives 1 and 2, respectively; 16 acre for both Petition Areas; rated VIIs

  This soil consists of stones, boulders, and soil deposited by streams along the bottoms of gulches and on alluvial fans.

  Historically, this soil has been used for pasture.

— Rated VIII: 8 acres and 6 acres for Alternatives 1 and 2, respectively; 1 acre for both Petition Areas;

- rRO (Rock Outcrop): 4 acres for both Alternatives; none for both Petition Areas; rated VIIIs

  This soil occurs consists of areas where exposed bedrock covers more than 90% of the surface. The rock outcrops are mainly basalt and andesite. Slopes range from gentle to precipitous.

  This land type is not suited for agricultural use.

- BS (Beaches): 2 acres for Alternative 1 and none for Alternative 2; none for both Petition Areas; rated VIIIw

  This soil occurs in sandy, gravelly, and cobbly areas that are washed and rewashed by ocean waves. They consist mainly of light-colored sands derived from coral and seashells. A few of the beaches, however, are dark colored because their sands are from basalt and andesite.

  Beaches have no value for agriculture.

— Not Rated: 2 acres for both Alternatives; 1 acre for both Petition Areas

- W (Water): 2 acres for both Alternatives; 1 acre for both Petition Areas; not rated

  Areas mapped as water includes streams and reservoirs.

c. Soil Ratings

Three classification systems are commonly used to rate soils in Hawai'i: (1) Land Capability Grouping, (2) Agricultural Lands of Importance to the State of Hawai'i, and (3) Overall Productivity Rating.

Land Capability Grouping (NRCS Rating)

The 1972 Land Capability Grouping by the NRCS rates soils according to eight levels, ranging from the highest classification level "I" to the lowest "VIII." The NRCS ratings for soil type are given in the previous subsection. The farming limitations for each soil rating listed are as follows:

— Rating I

Soils Rated I have few limitations that restrict their use.

— Rating II

These soils have moderate limitations that reduce the choice of plants or which require moderate conservation. The subclassification "s" indicates that the limitation is due to stoniness, unfavorable texture, shallow soils, or low water-holding capacity. The subclassification "e" indicates that the soils are subject to erosion if they are cultivated and not protected.

— Rating VI

These soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range.

— Rating VII

These soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range. The subclassification "w" indicates that the limitation is due to excess water.

— Rating VII

These soils have limitations that preclude their use for commercial plant production.

In Figure 11, the higher-quality soils (Rated I and II) are: EaA, PsA, PpA, PtA, and PtB. For each alternative, approximate acreages by NRCS soil rating and Project component are as follows:

Alternative 1: NRCS Soil Ratings

Component	I	II	VI to VIII & Unrated	Total
Urban (Petition Area)	80	162	24	266
Rural (Petition Area)	20	42	106	168
Agricultural	33	60	82	175
Conservation	0	2	25	27
Project Total	133	266	237	636

Alternative 2: NRCS Soil Ratings

Component	I	II	VI to VIII & Unrated	Total
Urban (Petition Area)	64	148	16	228
Rural (Petition Area)	20	43	105	168
Agricultural	32	59	82	173
Conservation	0	2	20	22
Project Total	116	252	223	591

Agricultural Lands of Importance in the State of Hawai'i (ALISH)

ALISH ratings were developed in 1977 by the NRCS, the University of Hawai'i (UH) College of Tropical Agriculture and Human Resources, and the State Department of Agriculture. This system classifies land into three broad categories: (a) Prime agricultural land which is land that is best-suited for the production of crops because of its ability to sustain high yields with relatively little input and with the least damage to the environment; (b) Unique agricultural land which is non-Prime agricultural land used for the production of specific high-value crops; and (c) Other agricultural land which is non-Prime and non-Unique agricultural land that is important to the production of crops.

The ALISH soil ratings are mapped in Figure 12. For each alternative, approximate acreages of each soil rating by Project component are as follows:

Alternative 1: ALISH Soil Ratings

Component	Prime	Other	Unclassified	Total
Urban (Petition Area)	76	152	38	266
Rural (Petition Area)	18	38	112	168
Agricultural	25	62	88	175
Conservation	1	1	25	27
Rounding	-1	-1	2	0
Project Total	119	252	265	636

Alternative 2: ALISH Soil Ratings

Component	Prime	Other	Unclassified	Total
Urban (Petition Area)	76	152	0	228
Rural (Petition Area)	18	38	112	168
Agricultural	25	61	87	173
Conservation	0	1	21	22
Project Total	119	252	220	591

Overall Productivity Rating (LSB Rating)

In 1967, the UH Land Study Bureau (LSB) developed for Maui the Overall Productivity Rating, which classifies soils according to five levels, with "A" representing the class of highest productivity and "E" the lowest.

The LSB soil ratings are mapped in Figure 13. For each alternative, approximate acreages of each soil rating by Project components are as follows:

Alternative 1: LSB Soil Ratings

Component	A	B	E	Total
Urban (Petition Area)	205	50	11	266
Rural (Petition Area)	25	119	24	168
Agricultural	33	76	66	175
Conservation	7	2	18	27
Rounding	0	-2	2	0
Project Total	270	245	121	636

Alternative 2: LSB Soil Ratings

Component	A	B	E	Total
Urban (Petition Area)	167	50	11	228
Rural (Petition Area)	25	119	24	168
Agricultural	31	75	67	173
Conservation	3	2	17	22
Rounding	1	-1	0	0
Project Total	227	245	119	591

In Figure 14, the numbers and letters attached to the LSB soil ratings carry information about soil characteristics and irrigation. For the predominate ratings:

— A71i indicates that these soils were irrigated, and are non-stony, moderately fine and well-drained

— B72i indicates that the soils were irrigated, and are stony, moderately fine and well-drained.

— B87i indicates that the soils were irrigated, and are stony to very stony, fine and well-drained.

— E73 indicates that the soils were not irrigated, and are rocky and well-drained.

— E95 indicates that the soils were not irrigated, and are non-stony to rocky, and well-drained.

Summary Evaluation of Soil Quality

By Project component, the above soil rating systems indicate the following approximate acreages of high-quality farmland for each alternative:

Alternative 1: Summary Soil Ratings

Component	NRCS I or II	ALISH Prime or Unique	LSB A or B	High-quality Farmland
Urban (Petition Area)	242	76	255	255
Rural (Petition Area)	62	18	144	154
Agricultural	93	25	109	123
Project Total	397	119	508	532

Alternative 2: Summary Soil Ratings

Component	NRCS I or II	ALISH Prime or Unique	LSB A or B	High-quality Farmland
Urban (Petition Area)	212	76	217	220
Rural (Petition Area)	63	18	144	154
Agricultural	91	25	106	121
Project Total	366	119	467	495

In this report, the term **"high-quality farmland"** is used to describe land that meets one or more of the soil-rating criteria listed in the above table. For Olowalu, high-quality farmland is mapped in Figure 15.

For comparison, the total Maui Island supply of high-quality farmland in the Agricultural District is 72,100 acres, including about 39,300 acres with NRCS ratings of I or II; about 59,400 acres with ALISH ratings of Prime or Unique; and about 47,600 acres with LSB ratings of A or B. This accounting excludes about 2,300 acres of high-quality farmland used for country estates and golf courses.

Regarding the Olowalu agricultural lands, about 95 acres of high-quality farmland will be used for roads, parks, cultural areas, bikeways, and greenways. Thus, for Alternative 1, about 504 acres of farmland will be developed (409 acres in the Petition Area + 95 acres in the Agricultural District). About 28 acres of high-quality farmland will remain undeveloped (123 acres in the Agricultural District – 95 acres developed). The undeveloped high-quality farmland will be used for Small Farms.

Corresponding figures for Alternative 2 are about 468 acres of high-quality farmland will be developed (374 acres in the Petition Area + 94 acres in the Agricultural District),

resulting in about 27 acres of high-quality farmland remaining in the Agricultural District (121 acres in the Agricultural District – 94 acres developed).

For comparison, the loss of about 500 acres of high-quality farmland amounts to less than 0.7% of the 72,100-acre supply of high-quality farmland on Maui Island.

d. Elevation and Slopes

The Project site ranges in elevation from sea level to about 410 feet for *mauka* farmland and 460 feet for non-farmland.

Near the shoreline, the topography is generally flat to slightly sloping. Proceeding *mauka*, the slopes gradually increase, with the farmlands reaching about 9% at the higher elevations.

e. Climatic Conditions

Hawai'i has a mild *semi*tropical climate that is due primarily to three factors: (1) Hawai'i's mid-Pacific location near the Tropic of Cancer, (2) the surrounding warm ocean waters that vary little in temperature between the winter and summer seasons, and (3) the prevailing northeasterly tradewinds that bring air having temperatures that are close to those of the surrounding waters.

Solar Radiation

The Project site receives considerable sunshine, with average daily insulation exceeding 500 calories per square centimeter per day.

Rainfall

Annual rainfall at Olowalu averages about 11 inches near the shoreline and about 14 inches near the foothills. Most of this rainfall occurs during the winter rainy season (November through March), while the summer months are hot and dry.

Temperatures

Temperatures at Olowalu range from an average low of 63°F in the winter to an average high of 86°F in the summer.

Winds

The prevailing tradewinds blow down from Olowalu Valley then offshore at a mean speed of about 16 miles per hour (measured at 50 meters altitude). Occasional strong winds can cause crop damage if unprotected by windbreaks.

f. Wildfires

Beginning in 1999 after the closure of sugarcane operations in West Maui, much of the lands at Olowalu reverted to dry grassland and shrub land, thereby providing fuel for wildfires. Several large wildfires have in fact occurred. In 2007, a wildfire destroyed the greenhouses and crops at Olowalu Nui Farms (see Subsection 5.a).

g. Irrigation Water

Overview

The agricultural water system at Olowalu originally was designed by sugar companies to deliver surface water and groundwater to irrigate sugarcane using furrow irrigation, which typically required an average of about 10,000 gallons per acre per day with all arable land in crop. For comparison, most diversified crops use about 4,000 gallons per day, often with half of the arable land in crop and half remaining fallow to control pests and restore the soil.

Currently, Olowalu Water Company, Inc. (OWC) supplies (1) potable water to the limited number of residential and commercial users at Olowalu, and (2) non-potable water to farmers. Founded in 1999, OWC is a private water company (ID# 209) regulated by the Public Utilities Commission (PUC).

Project plans are to significantly reduce or eliminate potable groundwater to irrigate crops and, instead, to rely on surface water, non-potable groundwater, and treated wastewater. The existing and planned water systems are shown in Figure 16.

Olowalu Ditch

Some time before 1911, Olowalu Company built the Olowalu Ditch to deliver surface water diverted from Olowalu Stream (Tom Nance Water Resource Engineering, and Carol Wilcox). The diversion dam is at the 502-foot elevation, and a 1.1-mile-long conveyance ditch and tunnel system deliver water to a lined open reservoir at the 360-foor elevation. The system has three additional reservoirs at lower elevations, none of which are lined and one of which is still in use. Olowalu Company installed a second diversion at a lower elevation, but it was abandoned before 1950 and was subsequently destroyed by storms.

The Olowalu Ditch had a capacity of 11 mgd and, for the 56-year period from 1911 to 1967, diverted about 4 to 5 million gallons per day (mgd), an average of 4.8 mgd, a median of 4.08 mgd, and over 2 mgd for 98% of the days. In June 2010, an estimated 2 mgd were diverted from the stream, but less than 0.9 mgd were delivered to the storage reservoir. The difference was lost due to leakage in transit, with over half of the diverted water returning to the stream.

Portions of the irrigation system are reported to be in good condition, but some portions are in disrepair. With proper maintenance, including cleaning sediment and debris and

repairing leaks, the Olowalu Ditch should be able to deliver sufficient water to supply the irrigation needs of the Project. However, farming on the scale of the former plantation would likely require costly improvements and significant upgrades to the ditch, with the cost depending on the volume of water required and the corresponding improvements needed.

The OWC estimates that more than $1 million would be required to restore the ditch sufficiently to support extensive farming at Olowalu. Improvements costing $1 million could be feasible provided that at least 600,000 gallons or more of additional water per day could be sold at a rate of 90¢ or more per 1,000 gallons, and assuming that the improvements would be financed with a 20-year loan at 6% interest, and with at least 40¢ used for debt service and, at most, 50¢ used for operations and maintenance of the water system.

Groundwater Wells

Olowalu Company and Pioneer Mill Co., which merged with Olowalu Company in 1931, also built skimming wells to tap basal groundwater on the property:

— State Well No. 4937-01, also known as Olowalu Shaft and Pump N, was developed in 1905, and consists of four horizontal tunnels and seven drilled wells.

— State Well 4837-01, also known as "0" Pump, was developed in 1933, and has a 230-foot long horizontal tunnel.

Increased withdrawals in the 1970s using high-capacity pumps caused significant salinity increases in both wells. Currently, both wells are unused but remain available as a backup in case surface water is insufficient. Both wells are capable of producing slightly brackish water, provided that pumping rates are modest—on the order of 1 mgd for each well.

In 2000, the Olowalu Elua Well was developed to provide potable water for homes in Olowalu. This well—which is located approximately 4,500 feet inland from the ocean at an elevation of 205 feet, and 100 feet west of Olowalu Stream—taps a confined aquifer that provides fresh water with very low chloride. The capacity of the well is approximately 360,000 gallons per day, but may be capable of producing about 600,000 gallons per day.

According to the Hawai'i Commission on Water Resource Management, the estimated sustainable yield of the Olowalu Aquifer is 2 mgd. However, a U.S. Geological Survey (USGS) study suggest that the Olowalu Aquifer may have a developable supply on the order of 7 mgd. In either case, the sustainable yield indicates that wells could provide substantially more water than is drawn by the Olowalu Elua Well.

Treated Wastewater

An on-site wastewater treatment plant within the Project site will discharge R-1 rated (tertiary-quality) water to irrigate crops, parks, and landscaped open spaces. State regula-

tions allow R-1 water to be used to irrigate any crop with any type of irrigation system. At full build-out of the Project, about 0.245 mgd of R-1 water will be available to farmers.

Distribution System

Non-potable water is currently delivered to agricultural customers located in areas where the distribution system is in good condition. Additional farming at Olowalu will require repairing, upgrading, and extending the distribution system, including adding new water lines and new storage facilities.

Water Rates

In recent years, OWC has encountered financial losses from its potable and non-potable water services—approximately $44,000 in 2010. In effect, OWC has been subsidizing its farmers and domestic customers. In view of these losses, the PUC recently approved a rate increase of about 25% in 2011 for both potable and non-potable water service at Olowalu, followed by another increase of nearly 15% effective March 12, 2011.

The current rate for non-potable water at Olowalu is $1.09 per thousand gallons, and $0.55 for bulk users (farms of at least 50 acres using over 1,000,000 gallons per month). This bulk rate is typical for many irrigation system in Hawai'i, and is about 55% the $1.00 rate charged by the County of Maui.

h. Road Access

Honoapi'ilani Highway provides access to the Project site. Former plantations roads and some paved roads provide access to areas within the Project site.

i. Current Land Uses at Olowalu

Current land uses within the Project site and on abutting Olowalu properties are shown in Figures 2 and 17, and include the following:

- Project Site
  - Agriculture, both Alternatives
    - + Olowalu Nui Farms (hydroponic tomatoes and other crops)
    - + Cattle grazing in the foothills
  - Agriculture, only Alternative 1
    - + Olowalu Elua Associates, LLC (Palm Tree Farm)
    - + Olowalu Ekolu, LLC (Palm Tree Farm)
  - Olowalu Cultural Reserve

  - Fallow land (former sugarcane, much of which was subsequently used for seed corn, some for a sod and grass farm, some for a plant nursery, some for vegetable crops, and some for gamecocks.)
- Abutting Properties
  - Residential
    - + Plantation Manager's House and other plantation-era single-family homes
    - + Olowalu *makai* Subdivision (5 agricultural lots)
    - + Camp Olowalu (formerly known as Camp Pecusa)
    - + Kapa'iki Village (single-family residences reminiscent of the plantation era)
    - + Olowalu *mauka* Subdivision (14 agricultural lots)
  - Olowalu General Store
  - Olowalu Church
  - Historic Structures, No Longer in Use
    - + Olowalu Wharf
    - + Olowalu Sugar Mill

j. Surrounding Land Uses

As shown in Figure 1, Olowalu is somewhat isolated from other communities and farm areas in West Maui:

- *mauka* are Olowalu Valley and the West Maui Mountains.
- About 2 miles toward Lahaina are the fallow sugarcane fields and the community of Launiupoko.
- About 2 miles toward Mā'alaea are the fallow sugarcane fields of Ukumehame.

k. Locational Advantages and Disadvantages

Maui Island Market

Farmers in Olowalu are well-situated for supplying the Maui Island market because of the short trucking distance to Kahului (about 17 miles), which is the island's commercial, industrial, distribution and transportation center. While the Maui Island market is significant, it is comparatively small: in 2010, Maui Island had a *de facto* population of about 190,160 residents and visitors.

Honolulu Market

All Maui farmers are at a disadvantage when competing against O'ahu farmers in supplying the Honolulu market due to the inter-island shipping costs, delays and extra handling. In comparing barge and air-cargo services, shipping by barge is less expensive and

larger loads can be shipped, but the shipments are slow and infrequent. Air service is faster and frequent, but it is far more expensive and capacities are limited.

In 2010, O'ahu had a *de facto* population of about 1,039,100 residents and visitors—over five times larger than the Maui market.

Mainland Market

Compared to Hawai'i, the mainland market is enormous: in 2010, the U.S. population totaled 308.7 million. In supplying this market with products that can be carried by container ship—e.g., products having long shelf-lives such as coffee, nuts, and canned fruit—farmers on Maui are competitive with farmers on O'ahu and the other islands. Even though freight from Maui must first be barged to Honolulu then transferred onto a container ship, Matson's overseas shipping service includes inter-island barge service at no additional fee: except for some minor port charges, Matson charges a common fare for all islands.

In the case of fresh products that must be shipped by air to the mainland—e.g., products having short shelf-lives such fresh vegetables and fruits—farmers on Maui are at a disadvantage compared to farmers on O'ahu because most mainland air cargo is shipped via Honolulu International Airport. Compared to farmers on O'ahu, Maui farmers encounter additional costs, delays, and handling to cover inter-island air-cargo service and transferring the fresh produce from small inter-island aircraft to large overseas aircraft.

However, overseas air-cargo service from Maui has improved somewhat because the current generation of aircraft can depart from the short runway at Kahului with a full load of passengers and a full load of cargo in the hold. This direct service allows farmers on Maui to be more competitive in mainland markets. However, the lift capacity from Maui is limited by the number of direct flights.

In the U.S. mainland market, Hawai'i farmers must also compete against farmers on the mainland and in Mexico, Central and South America, Southeast Asia, etc. Most of the competing farm areas have lower production and delivery costs than Hawai'i does. Competing against Mexico is particularly difficult given the North America Free Trade Agreement (NAFTA) and Mexico's proximity to major U.S. markets.

Summary of Locational Advantages

In terms of location, farmers in Central Maui are well-situated to supply the small Maui Island market. And compared to other farmers in Hawai'i, they can also compete reasonably well in supplying mainland markets, as long as their products have long shelf-lives and so can be shipped by surface vessel.

However, compared to farmers on O'ahu, they are at a disadvantage in supplying the Honolulu market. Furthermore, they are at a disadvantage supplying mainland markets if

their products have short shelf-lives and so must be shipped by air. Also, farmers on Maui are at a disadvantage in competing against the low-cost producers who supply mainland markets.

l. Synergy With Other Farm Areas

Figures 18 through 20 show the location of high-quality farmland on Maui based on the ALISH soil ratings, the LSB soil ratings, and the combined soil ratings (see page 13). As indicated, the large concentrations of high-quality farmland—as well as most farming activity—are located in Central Maui and West Maui.

In contrast, Olowalu has a comparatively small and isolated amount of farmland. Thus, Olowalu is poorly located for developing synergistic relationships with other Maui farms.

m. Potential Crops

Most if not all of the crops grown commercially by farmers on lower elevation fields in Hawai'i could be grown commercially at Olowalu. These crops include but are not limited to bell peppers, bittermelon, broccoli, celery, Chinese cabbage, citrus, daikon, eggplant, flowers and nursery products, green onions, head cabbage, herbs, lettuces, melons, mustard cabbage, Oriental squash, papaya, romaine, squash, string beans, sweet corn, tomatoes and zucchini.

n. Summary

Olowalu has favorable agronomic conditions for growing low-elevation commercial crops. Alternative 1 includes about 532 acres of high-quality farmland, of which about 504 acres will be developed (409 acres are in the Petition Area, and about 95 acres of agricultural land for roads, parks, etc.). Alternative 2 includes about 495 acres of high-quality farmland, of which about 468 acres will be developed (374 acres are in the Petition Area, and about 94 acres of agricultural land for roads, parks, etc.). Some of the better soils are stony.

Olowalu benefits from high solar radiation, exceeding 500 calories per square centimeter per day. Ample water is available to irrigate crops, and the water rate is competitive with many other farm areas in Hawai'i. Also, Olowalu is a reasonable trucking distance to Kahului.

However, Olowalu is isolated from other farm areas, so is poorly located for developing synergistic relationships with other farms on Maui. Also, occasional strong winds could cause crop damage if the crops are not protected by windbreaks, and wildfires will continue to be a threat as long as vegetation remains dry and overgrown.

4. PAST AGRICULTURAL USES

a. Hawaiian Crops Prior to Plantation Agriculture

As the largest and deepest valley in southwest Maui, Olowalu was well-suited for the ahupua'a system which allowed an estimated 2,000 Hawaiians to thrive at Olowalu before western contact (Ainsworth, 2003; Smith, undated; and Lee-Grieg and Hammatt, 2012). Taro was grown in numerous lo`i on the wetter upper valley floor and, to a lesser extent, along Olowalu Stream. Sweet potatoes were grown on the dry slopes. Breadfruit and coconuts were grown along the coast. Other Olowalu crops included dry-land taro, banana, sugarcane, coconut, kukui, ti, kava, wauke, 'olonā, pili, naio, and more. The sea provided fish, and the forest supplied wood for canoes and housing.

In 1855—seven years after the Great Mahele which established a system of private land ownership, and 5 years after foreigners were granted the right to own land—Hawaiians legally claimed ownership of 50 kuleana in Olowalu, which included about 115 acres of arable land. Most of the kuleana were located along Olowalu Stream and along the coastline. The Hawaiians continued their traditional agricultural practices, although sometimes in a more Western manner. For example, a hui of Olowalu taro growers, formed the Taro Planting Company. By1866, only 13 Hawaiians stated they owned kuleana land at Olowalu.

b. Sugarcane

The sugar industry came early to Olowalu, lasted about 135 years, and changed agricultural activity dramatically from small-scale subsistence farming to large-scale plantation agriculture. In 1864, King Kamehameha V (Lot Kapuāiwa with a full name of Lota (Lot) Liholiho Kapuāiwa Kalanimakua Kalanikupuapaikalaninui Ali'iolani Kalani-a-Kekūanaō'a) then ruler of the Hawaiian Kingdom, leased his personally owned crown lands at Olowalu and Ukumehame to the newly-formed West Maui Sugar Company (also called the West Maui Sugar Association), and invested his own funds in the new plantation (Ainsworth, undated; Lee-Greig and Hammatt, 2012; Dorrance and Morgan, 2005). Following financial difficulties, the plantation was sold in 1874 to the owners of Pioneer Mill Plantation, but continued to operate as a separate plantation for a short period.

In anticipation of the Reciprocity Treaty (1876) which allowed sugar to be exported to the United States duty free, Maui businessmen acquired lands at Olowalu and Ukumehame in 1875, formed the Olowalu Plantation, and began growing sugarcane there in 1876.

Anther group of businessmen formed Olowalu Company, and acquired the plantation in 1881. This company survived for about 50 years. By modern standards, the plantation was small: only about 645 acres were farmed in 1930. Also, Olowalu was said to have kipikua (pickax) lands because, in the early years, it was necessary to use a pick and shovel to cultivate the stony soils.

In 1931, Olowalu Company merged with Pioneer Mill Company (PMCo), increasing PMCo's plantation to more the 14,000 acres. Sugarcane operations at Olowalu continued for another 68 years when Amfac/JMB Hawaii, the parent company of PMCo, decided to close the plantation effective 1999. PMCo was forced to close because low sugar prices undermined its profitably. Sugar prices were low largely because of competition from mainland producers of high-fructose corn syrup which began commercial production in the 1970s (Decision Analysts Hawai'i, Inc., 1981 and 1989). Statewide, the low sugar prices forced the closure of 13 of the 14 plantations that operated in 1980. The only survivor is the large Hawaiian Commercial and Sugar Co. (HC&S) plantation in Central Maui.

When PMCo closed, about 500 acres of sugarcane were being cultivated at Olowalu. Since 1999, most of the fields have remained fallow.

c. Recent Agricultural Activities

Following the closure of PMCo, several agricultural endeavors were attempted on portions of former sugarcane lands in Olowalu. The unsuccessful ones are discussed below, while the ones that survived are discussed in Sections 5 through 8. The locations of both the successful operations and unsuccessful ones are shown in Figure 17.

Monsanto Company: Seed Corn

Based in Missouri, Monsanto Company is a multinational agricultural biotechnology corporation with 2011 revenues of $11.8 billion. It is one of a number of seed companies which choose Hawai'i to conduct much of their research because the year-round growing conditions allow three crops per year instead of just one as in most other areas, and Hawai'i and the U.S. provide a supportive legal environment. The seeds derived from research in Hawai'i are distributed throughout the world, and contribute to feeding billions of people. In Hawai'i, the seed companies generally are the highest bidders for land, labor and other agricultural resources on O'ahu, Kauai, Moloka'i and Maui. Monsanto has operations on all four islands mentioned. On O'ahu, the company recently purchased considerable land in Kunia, and invested in a number of large buildings.

Monsanto Hawaii leased about 215 acres at Olowalu for the 2002-to-2004 period, then extended the lease to 2007 (Tremble, 2011). Beginning in 2004, 4 or 5 acres were used to grow seed corn, but Monsanto ended the lease early in 2005.

Grass and Sod Farm

A grass and sod farm was established in 2001 on about 5 acres of leased land located *mauka* of Honoapi'ilani Highway, near the former Olowalu Landfill (Tremble, 2011). The farmer attempted to grow grass and sod for landscaping companies. However, the business was unsuccessful and the farm was abandoned in 2004 after 3 years of effort.

Plant Nursery

For about a 1-year period from 2002 to 2003, a plant nursery was attempted on about 2 acres of leased land located *makai* of Honoapi'ilani Highway, north of the Olowalu General Store (Tremble, 2011). The effort was abandoned, largely because of costly fire-protection improvements required by the County.

Casco Gamefarm

From 2009 to 2013, Casco Gamefarm—also known as Happy Happy Rooster Farm—raised gamecocks as well as a few goats and pigs. The farm was located on about 4 acres of leased land in the western portion of the Project site (portions of TMK (2) 4-8-003:114 and TMK (2) 4-8-003:115)—see Figures 3 and 17.

After operating in Lahaina for about 4 years, the Farm relocated to Olowalu in 2009 because the Lahaina neighbors complained about the early morning rooster crowing. The Olowalu site was selected because of its isolation.

With about 250 roosters, the operation may have been the largest gamefarm on the island. Most of the roosters were sold in the Philippines. The Farm was run as a hobby, and provided no paid employment. For the first three years, the landowner did not charge Casco Gamefarm for the use of the land or water.

OCR Affiliated Farms

From 2012 to 2013, about 4 acres of land were made available to farmers affiliated with the Olowalu Cultural Reserve. The farms (not shown in Figure 17) were located *makai* of the Casco Gamefarm and *mauka* of Honoapi'ilani Highway (a portion of TMK (2) 4-8-003:114). Vegetables, bananas, and papaya were grown on the site. To help the farmers achieve initial success, no rent was charged. However, the endeavor was not sustained.

5. OLOWALU NUI FARM

a. Farm Operations

Type of Farm

Olowalu Nui Farm, registered as Olowalu Nui Hydroponic Tomato Farm, grows tomatoes and other vegetables hydroponically in greenhouses, and also grows various fruit and palm trees on adjoining land (see Figures 21 and 22 for photographs of the farm).

History

In 1994, Jon Applegate started the farm on 7 acres of land in Hana to supply a variety of high-quality tomatoes for his Italian-themed restaurants on Maui, especially tomatoes for

fried green tomato recipes. He soon realized that other restaurants on the island were interested in purchasing his tomatoes, so he expanded his farm operations. In 2001, he sold the Hana property and moved to Olowalu to be closer to his restaurants, which included three restaurants in Kā'anapali: Basil Tomatoes Italian Grille, Giovani's Tomato Pie, and Jonny's Burger Joint.

Mr. Applegate passed away in 2011, after which the farm has been managed by his widow.

Location

Olowalu Nui Farm is on about 4 acres of leased land in the western portion of the Project site (portions of TMK (2) 4-8-003:115 and TMK (2) 4-8-003:117)—see Figures 3 and 17.

Advantages and Disadvantages

Major advantages of the site include (1) a reasonable trucking distance to both West Maui and Central Maui, and (2) high solar radiation and hot conditions which are good for growing tomatoes and other crops.

The major disadvantage of the site is the risk of fire. In 2007, the farm suffered a major setback when a wildfire destroyed the greenhouses and crops, causing $600,000 in damages. Another disadvantage of the site are the occasional strong winds which can damage greenhouses and crops. Also, the dry, hot conditions at Olowalu and inside the greenhouses attract spider mites which have damaged crops. The mites are controlled by spraying soap and other non-toxic solutions.

Land Use

About 2.7 acres are used for the greenhouses, office, storage sheds, open storage, and parking. About 1.7 acres are used for fruit and palm trees, excluding the bananas used for windbreaks. The remainder of the property is used for windbreaks or is vacant.

Lease Term and Rent

The initial lease began with a 5-year term which was extended for another 5 years. Since 2011, the lease has been extended in 1-year increments.

For the farm's first 10 years at Olowalu, the landowner charged rent of $300 per year ($75 per acre per year), which is well below market for farmland. In effect, the landowner provided an implicit and substantial subsidy to Olowalu Nui Farms.

In late 2012, the rent for the 4 acres was $900 per month ($2,700 per acre per year).

Improvements

Olowalu Nui Farm grows vegetable and herb crops in five greenhouses having a combined area of 20,000 to 25,000 sq. ft. (about half an acre). The greenhouses are equipped with water systems designed for hydroponic farming.

Other improvements include a small office building and storage areas.

Water Usage and Rate

The farm uses an average of about 14,200 gallons of non-potable water per day to irrigate its crops, or less than 3,600 gallons per acre per day for the 4 acres. Water discharged from the hydroponic farm is recycled to irrigate fruit and palm trees.

For the farm's first 10 years at Olowalu, the landowner provided water at no charge, another implicit and substantial subsidy to Olowalu Nui Farm. The current water rate is given in Subsection 3.g.

Crops

Crops grown hydroponically by Olowalu Nui Farm have included: four varieties of tomatoes which are the primary crop; 20 varieties of leafy lettuce; cucumber; peppers; basil; parsley; cilantro; and other herbs. The produce is sold to high-end restaurants on Maui.

Next to the greenhouses, Olowalu Nui Farm grows about 200 citrus trees (lime and lemon), and about 600 apple-banana, papaya, mango, and palm trees. The banana trees are dual purpose: they provide fruit and serve as a windbreak for the farm.

Market

The farm sells its fresh vegetables and fruits to restaurants and grocery stores in West, Central, and South Maui. In addition, some of the crop is sold onsite. The palms are sold to Maui landscapers and individuals. Marketing is by word of mouth.

Employment

In the past, Olowalu Nui Farm employed a fulltime manager, a few full-time workers, and part-time workers. The farm did not employ seasonal workers inasmuch as hydroponic farming provides steady production, regardless of the season. Training was provided by the farm.

Currently, the farm is run by the owner without help from hired workers.

Profitability

The farm has been profitable in some years, but has struggled in others. As mentioned, greenhouses and crops were lost to fire in 2007. After the fire, the farm operated at a loss

due to the cost of rebuilding greenhouses combined with low production. Many of the major improvements were completed in 2011. In 2012, revenues were low because spider mites inside the greenhouses damaged crops. Since then, the farm has returned to profitability.

b. Impacts on Olowalu Nui Farm

Most of Olowalu Nui Farm is located on the fringe of the Project in an area that is planned for (1) single-family homes on rural lots, (2) a rural park, (3) portions of an interior road, and (4) a portion of the realigned Honoapi'ilani Highway—see Figures 4, 5 and 17. The Highway will cause the loss of some trees in the southwest corner of the farm. Thus, as currently planned, the Project would require Olowalu Nui Farm to relocate eventually.

Assuming suitable land can be found nearby—which might include Project land near Olowalu Stream that is planned for farming—Olowalu Nui Farm estimates that the cost to relocate the hydroponic component of the farm would be about $50,000. This cost covers the effort to disassembling the greenhouses and equipment, move them, then reassembling them at the new location. After operations cease at the existing location, the farm could lose up to 8 months of production and its associated revenues before newly planted crops are producing at the new location (about 6 months for the move plus about 2 months before new plants are producing).

An alternative would be for the farm to invest in new facilities at the new location; move the crops to the new site; then disassemble the facilities at the current location. This option would maintain production but the capital costs would be higher.

Most or all of the fruit trees would probably be lost since moving them would be expensive, but the palm trees could be sold.

c. Recommended Mitigation for Olowalu Nui Farm

The Project developers have discussed the proposed Master Plan with the owner of Olowalu Nui Farm, and will continue to engage the owner in discussions as plans for the Project progress. Consistent with their current approach, it is recommended that the developers remain flexible regarding two alternatives:

- Modify the Project plan so that Olowalu Nui Farm can continue at its current location, and possibly provide some additional farmland to offset land that will be lost to roads in the Project.
- Assist with the cost to relocate Olowalu Nui Farm to an agricultural lot near Olowalu Stream, with new facilities built before the move so that production and revenues can be maintained during the transition.

For either location, Olowalu Nui Farm would be compatible with nearby homes inasmuch as:

— No tractors or harvesters are used that generate loud noises.
— No fields are plowed, so dust from plowing is not generated.
— No toxic chemicals are sprayed to control pests at the hydroponic farm.
— The fruit trees are sprayed to control pests, but rarely.
— No strong odors are generated.
— The banana trees serve as a windbreak and also provide a buffer that reduces the small amount of noise that is generated at the farm, and help prevent airborne chemicals from drifting beyond the farm.

6. PALM TREE FARMS

As shown in Figure 17, two palm tree farms are located within the Alternative 1 Project site. Details on the two farms are as follows (Trimble, 2011):

— Olowalu Elua, LLC Palm Tree Farm
- Located on land *makai* of Honoapi'ilani Highway and east of Olowalu Wharf (TMK (2) 4-8- 003:084).
- Owned by Olowalu Elua, LLC, the larger of the two owners of the Project site.
- About 10 acres farmed.
- Revenues of about $3,000 per year generated by selling trees to Maui landscapers and individuals.
- Expense of about $5,400 per year for about 6 million gallons of water.
- No information on farming costs.
- Support for less than a single full-time-equivalent job.

— Olowalu Ekolu, LLC Palm Tree Farm
- Located on land *makai* of Honoapi'ilani Highway, and abutting and to the north-northwest of Olowalu Stream (TMK (2) 4-8-003:124).
- Owned by Olowalu Ekolu, LLC, the smaller of the two owners of the Project site.
- About 10 acres farmed.
- Revenues of about $4,700 per year generated by selling trees to Maui landscapers and individuals.
- Expense of about $5,400 per year for about 6 million gallons of water.
- Expense of about $9,000 per year for a company to manage and maintain the farm.
- Support for less than a single full-time-equivalent job.

As indicated, both farms are low-revenue and unprofitable operations which are located on high-value oceanfront land. However, because of the County's low property taxes on land that is actively farmed, farming can be a cost-effective approach for holding land for a future high-value use.

Both farm owners regard their farms as temporary operations that will continue until the affected land is needed for the planned Project development. The farms will then be closed and not relocated. The loss in palm-tree production is likely to be offset by other palm-tree farms on Maui or other islands.

7. OLOWALU CULTURAL RESERVE

Olowalu Cultural Reserve ("**OCR**") was founded in 1999 as a community-based, non-profit organization with the purpose of supporting and promoting the revitalization of traditional Hawaiian culture by providing cultural and educational experiences for Hawai'i residents and visitors. The organization holds a 99-year lease on about 74 acres of land within the valley and along the stream to the ocean (see Figure 17). This land once held a thriving Native Hawaiian village and, as such, is rich in historical resources including numerous significant archaeological and cultural sites. It has been set aside and designated as a Cultural Reserve to serve as a culturally sensitive "sanctuary" providing a glimpse into Hawaii's past, and making it an ideal environment for programs aimed at restoring and revitalizing Hawaiian customs and practices.

The OCR organization is restoring former irrigation systems and lo'i for taro cultivation, and is planting other native crops. Currently, about 5 acres are used to demonstrate the cultivation of taro, sweet potato, breadfruit, banana, sugarcane, kukui, ti, kava, and many other crops.

Project plans include expanding the Reserve, which will allow more varieties and greater quantities of native crops to be grown at the Reserve.

8. OTHER AGRICULTURAL ACTIVITIES

In addition to the formal agricultural leases, there are three informal agricultural uses within the Petition Area.

a. Ranching

The landowner allows a subsistence cattle rancher to graze about 20 head on about 200 acres located *mauka* of Honoapi'ilani Highway. In this same area, the landowner allows a retired rancher to graze a few head of horses. There are no formal leases for use of this land, and no rent is charged.

The two ranching activities are regarded as temporary land uses that are mutually beneficial to the ranchers and the landowner. For the ranchers, the landowner provides grazing land and range feed at no cost to the ranchers. For the landowner, the grazing controls vegetation and reduces the fire hazard at no cost to the landowner.

b. Fruit Stand and Garden

A juice and fruit stand is located on the *mauka* side of Honoapi'ilani Highway near Olowalu General Store. In addition to the roadside stand, the operator grows a variety of fruits on about 0.75 acre of abutting land, and sells the fruit at the roadside stand. The operator provides a Proof of Insurance and pays for water, but does not pay rent.

c. Recommended Mitigation

The Project developers will inform the ranchers and fruit seller of progress on the Project, and will provide ample notice regarding when they will have to vacate the land so that development can proceed as planned.

9. ABUTTING AGRICULTURAL ACTIVITIES

a. Olowalu Mauka Subdivision

Existing and Potential Farming Activity

Olowalu *mauka* Subdivision is a 14-lot agricultural subdivision that was developed about 10 years ago. The lots range in size from about 3.1 acres to about 6.1 acres. This project was designed for large-lot residential use with comparatively expensive homes as well as agricultural use on a portion of each lot (i.e., country estates). At least half the lots now have homes.

Tax records indicate that two lots have commercial farming (TMKs (2) 4-8-003: 092 and (2) 4-8-003: 094). In the future, a number of the lot owners are likely to use a portion of their lot for a vegetable garden or a small commercial farm, or they may lease some of their land to commercial farmers.

Impact on Farming Activity

At full development of the Project, single-family homes on rural lots (a half-acre or larger) will border the six lower-elevation lots in the Olowalu *mauka* Subdivision. As mentioned, portions of some of these agricultural lots are likely to be used for commercial farming and vegetable gardens. Similarly, portions of some of the rural lots may be used for vegetable gardens.

These two abutting uses are compatible as indicated by the many communities on Maui and throughout Hawai'i that have single-family homes on rural lots next to country estates. In such situations, farmers generally limit voluntarily their agricultural activities to those that are compatible with nearby homes. Thus, no adverse agricultural impacts are anticipated. Specifically, the residential use of homes on rural lots is not expected to interfere with existing or future farming activities in the Olowalu *mauka* Subdivision. Also, farming activities are not expected to cause significant nuisance problems or other adverse impacts on new homes and their residents.

In any case, Hawai'i's Right-to-Farm Act gives farmers the right to farm if they were operating before neighboring properties were developed, provided that their farm activity does not threaten public health or safety.

Recommended Mitigation

Since adverse impacts are not expected on existing or likely farming within the Olowalu Mauka Subdivision, no mitigating measures are recommended.

b. Olowalu Makai Subdivision

Existing and Potential Farming Activity

Olowalu *makai* Subdivision is an oceanfront, 5-lot agricultural subdivision that was developed about 10 years ago, and which was designed for country estates. The lots range in size from about 2 acres to about 4.6 acres.

Two of the lots have tax assessments that indicate commercial agricultural activity. The oceanfront lot abutting and to the southeast of Olowalu Stream (TMK (2) 4-8-003: 121) has a home and less than 2 acres that are used mostly to grow palm trees. Even though this agricultural activity is a low-value use of high-value oceanfront land, such a use provides benefits of lower property taxes while being compatible with the adjoining and nearby homes. Once the Project is developed, land uses surrounding this lot will be as follows (see Figure 4):

— Lahaina side: Olowalu Stream and a Project oceanfront park.

— Mā'alaea side: an existing oceanfront agricultural lot (currently vacant with no home or commercial agricultural activity).

— *mauka* side: the current Honoapi'ilani Highway which will be converted to an access road and, *mauka* of the road, portions of the Project area planned for small farms.

The oceanfront lot bordering and northwest of the Plantation Manger's House (TMK (2) 4-8-003: 120) has no home, but about 1 acre is used for growing crops. Once the Project is developed, land uses surrounding this lot will be as follows:

— Lahaina side: an existing agricultural lot and home.

— Mā'alaea side: the existing Plantation Manager's House.

— *mauka* side: the current Honoapi'ilani Highway which will be converted to an access road and, *mauka* of the road, Project single-family homes on large town lots.

Regarding the remaining three oceanfront lots in the Olowalu *makai* Subdivision, two have large homes with little or no space for commercial agriculture. However, the second lot southeast of Olowalu Stream (TMK (2) 4-8-003: 122) is vacant. In the future, it is likely that this lot will be used for an oceanfront home, and possibly a home garden or a small commercial farm (about an acre).

Impact on Farming Activity

As mentioned above, the existing and likely farming activities at Olowalu *makai* Subdivision are compatible with nearby homes. This indicates that the Project components that will be near this subdivision are likely to be compatible with this same farming activity. In particular, a new park, new homes on large town lots, and new farming activity are not expected to interfere with existing or future farming activity within the Olowalu *makai* Subdivision. Also, the existing farming activities are expected to have little or no nuisance issues or other adverse impacts on park use, residential use of new homes, or new farming activity.

In any event, the Hawai'i's Right-to-Farm Act gives farmers the right to farm if they were operating before neighboring properties were developed, provided that their farming activity does not threaten public health or safety.

Recommended Mitigation

Since adverse impacts are not expected on existing or likely farming activity within the Olowalu Makai Subdivision, no mitigating measures are recommended.

c. Foothills

Potential Ranch Activity

The Olowalu foothills are State-owned lands designated Agricultural. Portions of the foothills were used for grazing cattle in the past, but County tax records indicate no current or recent commercial agricultural use of these lands.

Cattle grazing in the foothills would be possible in those areas having moderate slopes, provided that water and paddock fencing are provided. Although returns from cattle

operations are unlikely to be sufficient to justify the cost of the improvements, grazing can be a cost-effective approach to reducing vegetation and, in turn, the fire hazard associated with dry vegetation.

Impact on Potential Grazing Activity

The potential for grazing cattle in the Olowalu foothills would not be affected by the Project as indicated by the fact that grazing operations near homes and farm areas is common on Maui and throughout Hawai'i with little or no adverse impacts. In fact, cattle would benefit the Project by reducing the fire hazard to homes and farms.

Recommended Mitigation

Since the Project would not affect the potential for grazing cattle in the Olowalu foothills, no mitigating measures are recommended.

10. NEW OLOWALU FARMING ACTIVITY

a. Field Farming

Farming Operations

About 28 acres in the center of the Project site along Olowalu Stream are planned for agriculture (see Figures 4 and 5). Project plans call for selling about 14 two-acre farm lots to farmers. About 27 acres are high-quality farmland as defined on page 13. Subtracting land for homes and other improvements, about 27 acres will remain available for farming (based on 2,000 sq. ft per lot x 14 lots).

Possible crops include those which are already commercial grown on Maui, including but are not limited to those listed in Subsection 3.m. The economic feasibility of commercial farming at Olowalu is indicated by (1) the favorable agronomic conditions discussed in Section 3, and (2) the commercial success of farms that grow crops at comparable locations on Maui and other Neighbor Islands.

It is assumed that all or nearly all of the 27 acres will be farmed, resulting in an average of about 13.5 acres in crop. This is based on an average of about 50% of the land kept fallow in order to control pests and restore the soil, a percentage which is typical of vegetable farming in many parts of Hawai'i.

An average of about 54,000 gallons of water per day would be required to irrigate 13.5 acres in crop (based on an average of about 4,000 gallons of water per acre per day). Water sources available for farming include surface water from Olowalu Ditch, R-1 water from the planned wastewater treatment plant, and brackish water from two groundwater wells (see Subsection 3.g).

Assuming typical field farming of vegetables, annual production of food crops from 27 acres could total over 650,000 pounds, thereby contributing to food self-sufficiency and food security (based on harvesting two crops per year per field, and 12,000 pounds per harvested acre). Farm employment could total about three full-time equivalent farm jobs (based on about 10 acres supporting one job).

Nuisance Issues

As shown in Figures 4 and 5, the planned farm area along Olowalu Stream will border single-family homes on small town lots, large town lots, and rural lots. The close proximity of farms and homes can create nuisance issues for residents, such as noisy farm equipment in the early morning, airborne dust from field plowing, odors from fertilizer and chemicals, airborne crop-protection products drifting toward homes, etc. It should be noted, however, that prevailing tradewinds at Olowalu blow offshore, not toward homes.

At the same time, nuisance complaints from nearby residents can cause farmers to change their operations to address the complaints. Also, farms near homes have greater risk of crop and equipment theft than farms that are hidden from view or for which access is difficult.

Recommended Mitigation

To reduce nuisance issues, the following are recommended:

— Security fencing between farms and homes.

— Stands of trees to provide buffers between farms and homes.

— Farming practices that minimize nuisance issues (e.g., no noisy equipment during early hours, dust control, no use of products that cause strong odors, restrictions on the use of crop-protection products in order to prevent airborne chemicals from drifting toward homes, etc.)

— Notification to homebuyers to inform them of nearby farms, potential nuisance issues, and the Right to Farm Act.

Regarding the last item, the intent is to have new residents embrace the fact that nearby farms will be part of the ambiance of the Olowalu community.

b. Hydroponic Farming

As discussed below in Subsection 11.e, a strong and well-established trend has developed to grow vegetables and melons hydroponically in greenhouses. Such farming would allow increased vegetable and melon production in Hawai'i while using much less

land and water than is required for field farming. Also, good soils are not required for hydroponic farming, thereby allowing this type of farming to be located in areas having poor soils. Furthermore, farming inside greenhouses eliminates or reduces many of the nuisance issues normally associated with field farming including: load noises from farm equipment, dust from recently plowed fields, odors from fertilizers, drifting of sprayed products, and risk of theft.

The existing Olowalu Nui Farms is just one of many such hydroponic farms in Hawai'i. Others are listed in Subsection 11.e.

Assuming that hydroponic farming at Olowalu would use technology already common in Hawai'i, their production could reach nearly 4.6 million pounds per year (based on farming about 27 acres of land, and 170,000 pounds per acre farmed). This is equivalent to about 190 acres used in field farming, or about 7 times the potential production of field farming these lands (based on the assumption in Subsection 10.a.). For comparison, about 400 acres of vegetables and melons were harvested from all of Maui County in 2008 (the latest year that acreage was reported), or about 200 acres farmed (assuming two crops per year on average). Consequently, hydroponic farming on 27 acres at Olowalu would nearly double the production of vegetables and melons by Maui County farmers. Furthermore, hydroponic farming would offset about 40% of the high-quality farmland lost to Project development (190 acres equivalent ÷ 495 acres of good farmland lost to development for Alternative 1 or 468 acres for Alternative 2).

Hydroponic farming on 27 acres could generate about 14 jobs (based on 2 acres to support one job).

c. Home and Community Gardens

In addition to commercial farming as discussed above, future Olowalu residents will have access to good agricultural land to grow food and nursery crops for family and friends. Residents of rural lots can have home gardens, and all residents will have access to community gardens. Although such farming is largely a lifestyle choice, the food produced increases self-sufficiency.

11. GROWTH OF DIVERSIFIED CROP FARMING

The Project will result in a loss of good farmland to development. As discussed below, this loss of farmland, in combination with other projects (i.e., the cumulative impact), is too small to affect the growth of diversified-crop farming on Maui or statewide. Diversified crops include all crops other than sugarcane and pineapple (e.g., vegetables, fruits, melons, herbs, organic crops, coffee, nuts, flowers, feed, energy, etc.)

a. Loss of Farmland

Olowalu

The Project will commit about 500 acres of high-quality farmland now in the Agricultural District to a non-agricultural use, or about 0.7% of the 72,100 acres of high-quality farmland on Maui (see Subsection 3.n). Olowalu's comparatively small share of the good farmland on Maui is visually apparent in Figures 18 through 20.

If the Project is not developed as planned, then the land is likely to be subdivided for country estates. This would also result in a loss of farmland.

All Maui Projects

The 2014 Maui County Regional Maps list 124 development projects for Maui Island that (1) have all major entitlements (Maui Island Plan, Community Plan, and County zoning); (2) are partially entitled (Maui Island Plan and Community Plan); or (3) are included only in the Maui Island Plan. These projects would supply nearly 30,000 homes and over 2,000 additional visitor units. This compares with the County's projected demand for Maui Island of about 34,000 new homes by 2030, and about 8,200 new visitor units. As indicated, the planned supply of new homes is less than projected demand.

Figure 20 shows the projects (bordered in red), including residential-oriented agricultural subdivisions, that will result in the loss of high-quality farmland in the State Agricultural District. In total, 32 projects will result in the loss of about 3,540 acres of high-quality farmland, or about 4.9% of the 72,100-acre island-wide supply of such land.

In practice, the loss of good agricultural land will be less than 3,540 acres since not all approved projects will be built in the foreseeable future. Also, the loss will be gradual, depending on demand for new homes and visitor units.

b. Supply of Farmland

Island of Maui

Maui Island has about 242,700 acres in the State Agricultural District, including farmed land and fallow farmland; farmland and low-quality agricultural land used for grazing cattle, country estates, golf coures, solar farms, etc.; lava land; and gulch land.

The supply of high-quality farmland is shown in Figures 18 through 20 based on the ALISH soil ratings, the LSB soil ratings, and the combined soil ratings (see page 13). As mentioned above, Maui Island has about 72,100 acres of high-quality farmland in the Agricultural District. This accounting and Figure 20 exclude about 2,300 acres of high-quality farmland used for country estates and golf courses.

For the entire County (Maui, Moloka'i and Lāna'i), about 42,500 acres are in crop, most of which is on Maui Island. This includes about 35,500 acres used to grow sugarcane in Central Maui by Hawaiian Commercial and Sugar Co. (HC&S), about 1,700 acres to grow food crops for the Hawai'i market (vegetables, melons, pineapple, and other fruits), and about 5,300 acres for other crops (e.g., seed crops, coffee, flowers and nursery products, etc.).

Thus, over 29,600 acres are available for farming (72,100 acres – 42,500 acres). Much of this land is now used for grazing cattle. Assuming that all projects shown in the 2014 Maui County Regional Maps are eventually approved and built, then over 26,000 acres of high-quality farmland on Maui would remain available for farming (29,600 acres – 3,540 acres). However, farming much of this land would require major water improvements, including wells, stream diversions, and delivery systems.

Subject to demand, the land that is the most realistic to use for new farms on Maui is that land that was recently used for plantation agriculture. Much of this land has access to irrigation water, although irrigation systems may have to be repaired. Since 1990, the contraction and eventual closure of Pioneer Mill (sugarcane) and Maui Pineapple Co. released over 19,000 acres of good farmland in Central and West Maui. While some of this former plantation land was planted in other crops (e.g., seed corn and coffee), and some was developed for homes, most of it remains available for farming.

Statewide

Statewide, Hawai'i has over 1.9 million acres in the State Agricultural District. The remaining supply of available farmland released by plantation agriculture exceeds 170,000 acres. This is about double the amount of land in crop—about 87,700 acres. About 15,000 acres of the 87,700 acres are used for food crops grown mostly for the Hawai'i market, while about 72,700 acres are used for crops grown primarily for export (sugar, seeds, macadamia nuts, coffee, flowers, etc.).

The supply of available farmland is vast because of the statewide contraction and closure of many sugarcane and pineapple plantations during the past four decades, combined with the subsequent slow growth of diversified-crop farming (all crops other than sugarcane and pineapple)—see Figure 23. In the late 1980s, Hawai'i had 19 plantations: 14 sugarcane and five pineapple. Now, just two remain: the large HC&S plantation in Central Maui, and Dole's small pineapple plantation on O'ahu.

c. Trends in Diversified Crop Acreage

Hawai'i has a long history of strong support for the agriculture industry. However, since 1983 (over 30 years ago), no significant growth in diversified-crop acreage has occurred, with the single exception of seed crops which have increased at an average rate of

about 290 acres per year since 1992 (Figure 23 shows the growth of diversified-crop acreage). Following the O'ahu plantation closures, vegetable and melon acreage expanded on O'ahu, but this was followed by declines on the Neighbor Islands.

d. Limiting Factors

A great many crops can be grown in Hawai'i's year-round subtropical climate, and a number of them can be grown profitably in volumes requiring a few hundred acres. However, the modest growth in land requirements for diversified crops reflects the fact that few crops can be grown profitably on a large scale.

The primary factors that have limited the growth of diversified agriculture in Hawai'i are listed below:

— Hawai'i's subtropical climate is not well-suited to the commercial production of major crops that grow better in the temperate mainland climates.

— For certain crops, special hybrids adapted to Hawai'i's subtropical climate are yet to be developed.

— For some crops, local varieties are not perfect substitutes for imports (e.g., premium-priced sweet Maui onions versus inexpensive storage onions).

— Crop pests are more prevalent and more expensive to control in Hawai'i than they are on the mainland where the cold winters kill many pests.

— Fruit-fly infestations prevent exportation of many crops, or require expensive treatment.

— Most soils in Hawai'i have low nutrient levels and therefore require high expenditures for fertilizer.

— Hawai'i suffers from high farm-labor costs, largely because the agriculture industry must compete against the visitor industry and related industries for its labor.

— Compared to many other farm areas that supply U.S. markets, the cost of shipping agricultural supplies and equipment to Hawai'i is high, as is the cost of exporting produce from Hawai'i to mainland markets. High shipping costs are due to Hawai'i's remote location and to Federal regulations that require use of American-built ships and U.S. crews between U.S. ports.

— For a number of crops, consumption volumes in Hawai'i are too small to support large, efficient farms (i.e., the volumes are too small to realize economies of scale).

— Trends toward crops that are certified as safe and toward a single supplier of many food items favor large farms.

— Hawai'i farmers must compete against highly efficient mainland and foreign farms which, in a number of cases, can deliver produce to Hawai'i more cheaply than can local producers. This is due to economies of scale and, in comparison to Hawai'i, low costs for land, labor, supplies, fertilizer, pest control, equipment, etc.

— Some crops cannot be produced profitably in the summer due to competition from low-cost fruit and vegetable imports from California, other states, and Mexico.

e. Agricultural Outlook by Type of Crop

Food Crops, Field Farming

The publication "Statistics of Hawai'i Agriculture" indicates that Hawai'i is about 33% self-sufficient in fresh produce (i.e., vegetables, melons and fruits) while using about 15,000 acres of land. Based on current farming practices in Hawai'i, 100% self-sufficiency in fresh produce would require about 45,000 acres statewide (15,000 acres x 3), or about 30,000 additional acres. Given competition from low-cost imports, a realistic level of self-sufficiency may be about 50%. This would require about about 7,500 acres of additional farmland.

In 2010, Maui Island had about 12.4% of the State's population of residents and visitors (U.S. Census and *State of Hawai'i Data Book*). Thus, Maui Island would require about 2,800 acres for 50% self-sufficiency in fresh produce (12.4% of 22,500 acres), or about 1,100 additional acres (2,800 acres – 1,700 acres currently used for food crops). With intensive farming (such as hydroponic farming), land requirements would be reduced greatly.

Food Crops, Hydroponic Farming

In advanced economies—such as Europe, the U.S. mainland, and Hawai'i—a strong and well-established trend has developed to grow vegetables and melons hydroponically in greenhouses. Many of the tomatoes, cucumbers, peppers, and lettuces sold in our supermarkets are grown hydroponically in greenhouses by Hawaii and mainland farmers. For the United States as a whole, most of the tomatoes sold in supermarkets are now grown hydroponically.

Although the capital cost of constructing hydroponic farms is high, hydroponic farming in greenhouses provides many advantages over traditional field farming, including but not limited to the following:

— Higher-quality and more consistent produce.

— Year-round production, including high yields during winter months.

— Secure production unaffected by droughts and storms.

— Far higher yields due to controlled conditions (for advanced technology computer control of temperature, humidity, CO2 level, water and nutrient applications, and air pressure to keep pests out of the greenhouse).

— Much less land required because of the higher yields (with advanced technology as low as 2% of field farming).

— No need to use good farmland because the farms can be placed on low-quality farmland, industrial land, or even on rooftops of large buildings.

— Much less water (as low as 5% of field farming).

— No pesticide or herbicide spraying because of the controlled environment.

— Less labor and less difficulty in attracting workers because of better working conditions.

— Less crop and equipment theft because operations are inside buildings.

— Lower energy requirements.

— Lower transportation costs if the farm is located near major markets.

Commercial hydroponic farms in Hawai'i and crops grown include, but are not limited to:

— Green Growers (Hau'ula, O'ahu) is a 2.5-acre outdoor hydroponic farm supplying tomatoes.

— Kamuela (Big Island) supplies tomatoes.

— Kaua'i Fresh Farms (Kīlauea, Kaua'i) supplies tomatoes and lettuces.

— May's Wonder Gardens (Hale'iwa, O'ahu) is an outdoor hydroponic farm supplying lettuces.

— Olowalu Nui Farms (Olowalu, Maui) supplies tomatoes, leafy lettuce, cucumbers, peppers, and herbs.

— Waipoli Hydroponic Greens (Kula, Maui) is an outdoor hydroponic farm supplying lettuces and watercress.

In addition to the above farms, many of the vegetables sold in Hawai'i come from large mainland hydroponic farms. For example, Houweling's Tomatoes of Oxnard, California supplies many of the tomatoes and cucumbers sold in Hawai'i markets, including Costco, Foodland, Times and Safeway. Their 125-acre farm has six greenhouses having a combined area of about 30 Costco Warehouse stores. Windset Farms recently built a similar 128-acre farm in Santa Maria, California. And Eurofresh recently built America's largest hydroponic farm on 318 acres in Wilcox, Arizona.

If Hawai'i vegetable farmers are to remain competitive with mainland hydroponic farmers, they will be compelled to turn increasingly to hydroponic farming in greenhouses. Hydroponic faming represents the future of vegetable farming in Hawai'i. This suggests that large agricultural fields, soil quality, developing irrigation systems, and microclimates will be of less significance for food production in the future. With hydroponic farming, it would be

theoretically possible for Hawai'i farmers to increase vegetable production sufficiently to achieve 100% self-sufficiency while reducing the acreage now used to grow vegetables.

Feed Crops

If feed crops could be grown in Hawai'i and priced competitively against mainland imports, they could replace some of the grains and hay that are now being imported to the state. Unfortunately, a number of commercial attempts in Hawai'i to grow grains and alfalfa have not been successful. The major problems have been (1) pests, particularly birds that eat the grains before they are harvested; (2) humidity that is too high for some feed crops (e.g. problems with mold, smut fungus, insufficient drying of alfalfa, etc.); (3) high winds that cause stalks to lean over and break (lodge); and (4) high production costs compared to mainland farms.

Nevertheless, Big Island Dairy is growing corn on about 800 acres to feed its cows. Also on the Big Island, Clover Leaf Dairy (the only other dairy in the islands) attempted to grow corn, but winds caused the stalks to lean, rendering them nearly impossible to harvest. They also attempted forage sorghum, but it turned moldy and smutty because of the high humidity.

Biofuel Crops

Over the past 20+ years, a number of companies have explored biofuel crops to take advantage of the vast acreage released from sugar and pineapple, and a number of biofuel plantations have been proposed and continue to be proposed.

In Koloa, Kaua'i, Green Energy Team is building a $90 million biomass-to-energy facility having a capacity to generate 6.7 megawatts of electricity. The facility will burn wood chips from: short-rotation trees grown on 2,000 acres, invasive trees (e.g., albizia), eucalyptus trees, agricultural waste, and possibly trees from Kokee that were cut down and removed due to scorching from a 2012 fire. The facility is scheduled to open in 2015.

Also on Kaua'i, Hawai'i BioEnergy is planning a 14,000-acre biofuel plantation that will convert eucalyptus and/or other feedstock into about 10 million gallons of fuel to burn at the Kahe Generating Station on O'ahu. The plantation will be located on the windward side of the island which benefits from high rainfall.

In Ka'ū on the Big Island, 'Āina Koa Pono LLC plans to develop a 12,000-acre plantation which would cost $450 million for the processing facility, and would produce about 24 million gallons of biofuel, including about 16 million gallons that would be sold to Hawaiian Electric Light Company at a rate subsidized by electric customers on O'ahu and Maui. The biorefinery will initially process existing invasive plants, eucalyptus trees, and local green waste. Over the long term, the company is working with other organizations to

select an appropriate crop. Two advantages of locating a biofuel plantation in Ka'ū are (1) low land costs compared to other farm areas in Hawai'i, and (2) high rainfall which reduces or eliminates the need for irrigation.

A number of other companies in Hawai'i already burn biomass to generate electricity, are planning on burning biomass to generate electricity, or are planning to convert biomass to create a biofuel. For these cases; the feedstock is not from a biofuel plantation, but is often a byproduct from another operation—such as bagasse from sugarcane (e.g., HC&S on Maui), green waste from yards (e.g., HPOWER on O'ahu), green waste from farms, and unused wood from commercial forest operations.

To date, no large single-purpose biofuel plantations have been developed in Hawai'i, largely due to high capital costs, combined with per-acre returns that are low compared to such alternatives as food crops, sugarcane, seed corn, etc. Developing profitable biofuel plantations has become more difficult with the sharp decline in energy prices. The price of oil has fallen from about $115 per barrel in June 2014 to less than $45 in March 2015. The price decline is a result of (1) increased oil supplies (fracking and horizontal drilling has allowed the U.S. to nearly double production from 2009 to 2015 and become the largest oil producer in the world); and (2) slower growth in demand for oil due to slower economic growth, increased efficiencies, and the switch to alternative fuels.

Rather than growing a biofuel crop on farmland, a more promising alternative would be to produce biofuel from algae. One of the advantages of algae is its high yield of vegetable oil (about 5,000 gallons to 15,000 gallons per acre per year), and the corresponding high returns per acre. Also, good farmland is not required for algae since it is grown in ponds. The water source can include wastewater, brackish water, or even seawater. High yields are achieved in areas having (1) high solar radiation, (2) access to a source of nutrients (such as a wastewater treatment plant), and (3) access to carbon dioxide to stimulate growth.

Another promising energy alternative that is likely to threaten the profitability of Hawai'i biofuel crops is liquified natural gas shipped from the mainland. This alternative is being explored by the State, Hawaiian Electric Company, Hawai'i Gas, and others. Natural gas is now abundant in the U.S. and elsewhere because of increased yields from advanced hydrofracking technology. In addition to being abundant, natural gas is inexpensive, clean compared to many alternatives, and the source is secure. For the U.S. mainland, the price of liquified natural gas is the equivalent of about $30 per barrel (Ritenbaugh).

Olowalu would be a poor location for a biofuel plantation because of insufficient acreage, high land costs, and low rainfall. And if HC&S were to be converted to a biofuel plantation, hauling biomass from Olowalu to HC&S's Pu'unēnē processing facilities would add significant costs.

Export Crops

The potential export market for crops is far larger than the Hawai'i market. In 2010, the U.S. population was 308.7 million, compared to Hawai'i's resident-plus-visitor population of 1.54 million. To take advantage of this large potential, Hawai'i farmers continue to explore various export crops on lands released from plantation agriculture. Over the next 20+ years, one or more of these crops may prove to be successful and may grow into a major export crop.

However, the history of agricultural efforts in Hawai'i reveals that the successful development of major new export crops requiring large amounts of land is difficult and infrequent. For example, over the past 50+ years, Hawai'i farmers have explored numerous possibilities for additional export crops, but they have developed overseas markets for just one such diversified crop that requires more than 10,000 acres (macadamia nuts at 18,000 acres in 2010); two that require more than 5,000 acres (coffee at 9,000 acres and seed crops at 7,040 acres); and only four crops or crop categories that require more than 1,000 acres each (flowers/nursery products at 2,695 acres, papaya at 2,000 acres, tropical specialty fruits at 1,480 acres (2008 data), and bananas at 1,300 acres). Tropical specialty fruits include longan, lychee, mango, star fruit (carambola), rambutan, etc. For most of these crops, only a portion of the acreage is used to supply overseas market. And with the exception of seed corn and other seed crops, acreages of these export crops have not grown significantly since the mid-1980s.

In terms of acreage, the greatest success occurred with macadamia nut orchards on the Big Island in the late 1970s and early 1980s, coffee on Kaua'i in the late 1980s, and seed crops since the early 1990s. The success with macadamia nuts was driven largely by C. Brewer's market development efforts, combined with tax-shelter advantages which ended in 1986. In 1987, Alexander and Baldwin planted about 4,850 acres in coffee on Kaua'i, which was subsequently reduced to about 3,100 acres due to orchard losses caused by Hurricane 'Iniki in 1992. The operation has reported losses in most years. Flowers and other crops showed promise in the past, but acreage has declined in recent years due to competition from lower-cost foreign producers.

As mentioned earlier, the only major export crop that has exhibit sustained growth in recent decades has been seed corn and other seed crops: acreage has grown at a modest rate of about 290 acres per year since 1992. Unlike other crops, the success of seed crops in Hawai'i has not been driven by profitable farm operations in Hawai'i, but by the research needs of very large multi-national companies that develop seeds in Hawai'i to sell to farmers throughout the world.

f. Impact on the Growth of Diversified Crop Farming

In summary, the Project will result in a relatively small loss of high-quality farmland of which there is a large supply, both on Maui and statewide. Furthermore, the demand for Hawai'i farmland has increased very slowly over the past 30 years. Moreover, the trends toward hydroponic farming indicate that high-quality farmland will be of less significance to food production in the future. As a result, ample farmland will remain available to accommodate future diversified-crop farming, food self-sufficiency, and food security.

12. OFFSETTING BENEFITS

The loss of about 500 acres of high-quality farmland (less than 0.7% of the island supply)—along with the possible relocation of a hydroponic farm; the relocation of hobby ranching operations; the loss of a fruit stand and small garden and; for Alternative 1, the planned loss of two temporary palm-tree operations—will be offset by the following benefits of the Project:

— Construction Activity

- Construction jobs associated with Project development.
- Indirect jobs generated by purchases of goods and services by construction companies and families of construction workers.
- State tax revenues (excise taxes, personal income taxes, corporate income taxes, etc.) paid by construction companies and workers, and by companies and families supported by construction activity.

— Operations, Full Development

- About 1,500 new homes for Maui residents, of which about 50% will be available for affordable housing and senior living.
- Commercial space for new restaurants, stores, services, etc.
- New public and quasi-public facilities, including, community centers, schools, a library, a museum, medical facilities, etc.
- New recreational facilities, including ball fields, playgrounds, camping areas, bikeways, etc.
- New parks.
- Improved access to the beach.
- Preservation of about 28 acres of farmland for small farmers.
- Expansion of the Olowalu Cultural Center.
- Reduced risk of wildfires since dry unmanaged vegetation will be replaced by irrigated and maintained vegetation.

- Off-site jobs generated by purchases of goods and services by Project businesses and residents.
- State tax revenues (excise, personal income, corporate income taxes, etc.) paid by Project businesses and residents, as well as by off-site businesses and residents supported by Project operations.
- County tax revenues (property taxes, etc.) paid by Project businesses and residents, as well as by off-site businesses and residents supported by Project operations.
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13. CONSISTENCY WITH STATE AND COUNTY POLICIES

a. Availability of Land for Agriculture

The *Hawai'i State Constitution*, the *Hawai'i State Plan*, the *State Agriculture Functional Plan*, the *County of Maui 2030 General Plan*, the County's *Maui Island Plan*, and the County's *West Maui Community Plan* call directly or implicitly for preserving the economic viability of plantation agriculture and promoting the growth of diversified agriculture. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured.

With regard to plantation agriculture, the cultivation of sugarcane at the Project site ceased in 1999 for reasons unrelated to the proposed Project.

With regard to diversified crop farming, Olowalu Nui Farm will lose some of the acreage now used for tree crops, but this can be offset by replacement land within the Project site. Project plans may have to be adjusted to allow the hydroponic component of the farm to remain in place, or assistance may be provided to allow the farm to relocate to Project lands that are planned for agriculture. The two ranching activities, both of which are hobby operations, will have to relocate. The small fruit stand and garden will have to relocate or close. For Alternative 1, the two temporary palm-tree operations will close as planned. Finally, Project plans call for preserving about 77 acres of high-quality farmland, including about 27 acres planned for small farmers and about 50 acres for other uses (parks, bikeways and greenways, and expanding the existing Olowalu Cultural Reserve).

However, about 504 acres of high-quality farmland will be used for non-agricultural activities with Alternative 1, and about 468 acres with Alternative 2. These are relatively small losses which, in combination with other planned and proposed projects, will not limit the anticipated growth of diversified-crop farming (see Section 11).

b. Conservation of Agricultural Land

In addition to the above, State and City policies call for conserving and protecting prime agricultural lands, including protecting farmland from urban development.

In compliance with these policies, Maui County conserves and protects the prime agricultural lands located outside Urban, Small Town, and Rural Growth Boundaries as defined in the *Maui Island Plan*. These Boundaries were defined by the County to guide future urban and rural development on Maui while protecting lands located outside the Boundaries.

For Alternative 2, the urban and rural components are located within the Urban and Rural Growth Boundaries (see Figures 5 and 8). As such, these areas do not include the agricultural lands identified by the County for protection. For Alternative 1, the Urban and Rural components *mauka* of Honoapi'ilani Highway are located within these Boundaries, while the *makai* components are outside the Boundaries (see Figures 4 and 8).

It should also be noted that many of the State and County agricultural policies were written before the major contraction of plantation agriculture, and assume implicitly that profitable agricultural activities eventually will be available to utilize all available agricultural lands. This has proven to be a questionable assumption in view of the enormity of the contraction of plantation agriculture, the abundant supply of farmland that came available for diversified agriculture, and the slow growth in the amount of land being utilized for diversified agriculture (see Section 11 and Figure 23).

Furthermore, discussions in the *Agriculture State Functional Plan* recognize that redesignation of lands from Agricultural to Urban should be allowed "... upon a demonstrated change in economic or social conditions, and where the requested redesignation will provide greater benefits to the general public than its retention in ...agriculture;" that is, when an "overriding public interest exists." The enormous contraction of plantation agriculture, which resulted in the supply of agricultural land far exceeding demand, constitutes a major change in economic conditions. Another ongoing change is the trend toward hydroponic farming to grow a variety of vegetable crops. Compared to field farming, hydroponic farms use far less land and water, and they can be located on low-quality farmland or even on urban land. Moreover, the Project will provide community benefits (see Section 12) that far exceed the benefits of leaving the land in agriculture (currently, about six full- and part-time jobs), or the cost of relocating the Olowalu Nui Farm (if needed) and the hobby operations to new locations.

In practice, development of the Project is expected to have no significant impact on agricultural activity since Olowalu Nui Farm Farm is expected to continue operations at its current location or at a new location. Also, ample land is available on Maui and statewide to accommodate the anticipated growth of diversified agriculture (see Section 11).

c. Important Agricultural Lands

Chapter 205 of Hawai'i Revised Statutes mandates the Counties to recommend to the State Land Use Commission certain lands for designation as Important Agricultural Lands

("**IAL**"). Presumably, this would include the higher-quality farmlands on Maui. However, State law does not allow the Counties to recommend lands for IAL designation that are within County-defined Urban and Rural Growth Boundaries.

The Urban and Rural components of Alternative 1 that are *mauka* of the existing Honoapi'ilani Highway, and all of the Urban and Rural components of Alternative 2, are within the Maui County Growth Boundaries. As such, these lands cannot be recommended by the County for IAL designation. However, the Urban and Rural components of Alternative 1 that are *makai* of the Highway are eligible for designation as IAL.

d. County of Maui Land-Use Plans

As mentioned above, the *Maui Island Plan* (2012) shows the urban and rural components of Alternative 2 within the Urban and Rural Growth Boundaries. However, the *makai* lands in Alternative 1 are outside the Boundaries.

The current *West Maui Community Plan* (1996) designates most of the Project site as Agriculture (AG), with comparatively small amounts of land designated Conservation (C) and Public/Quasi-Public (P)—Figure 9. However, it is anticipated that the County will change the *West Maui Community Plan* to conform with the *Maui Island Plan*.

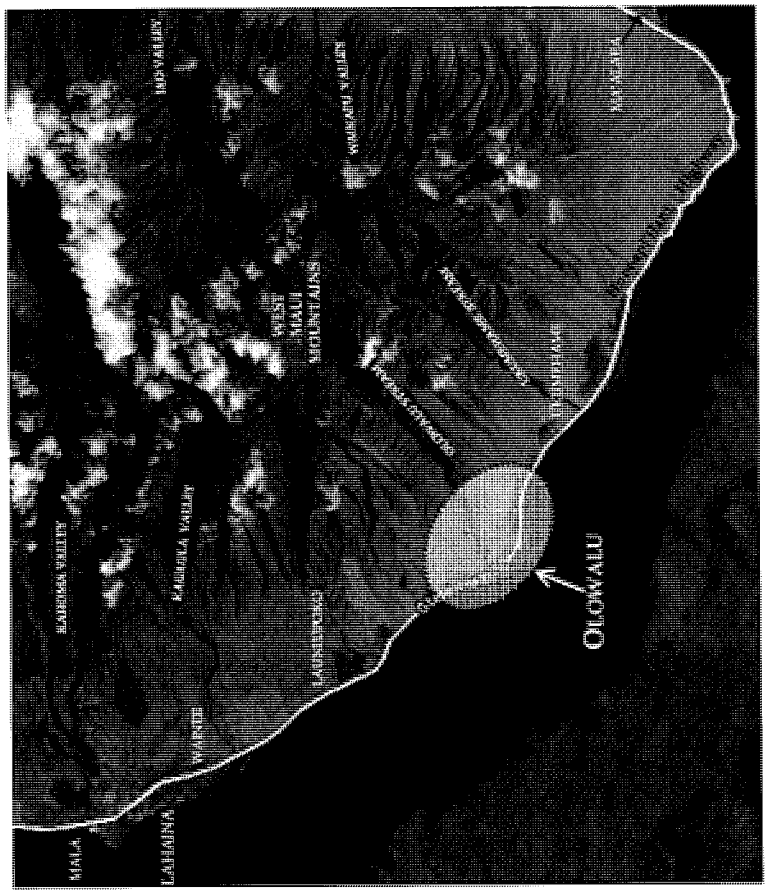

Figure 1. Project Location

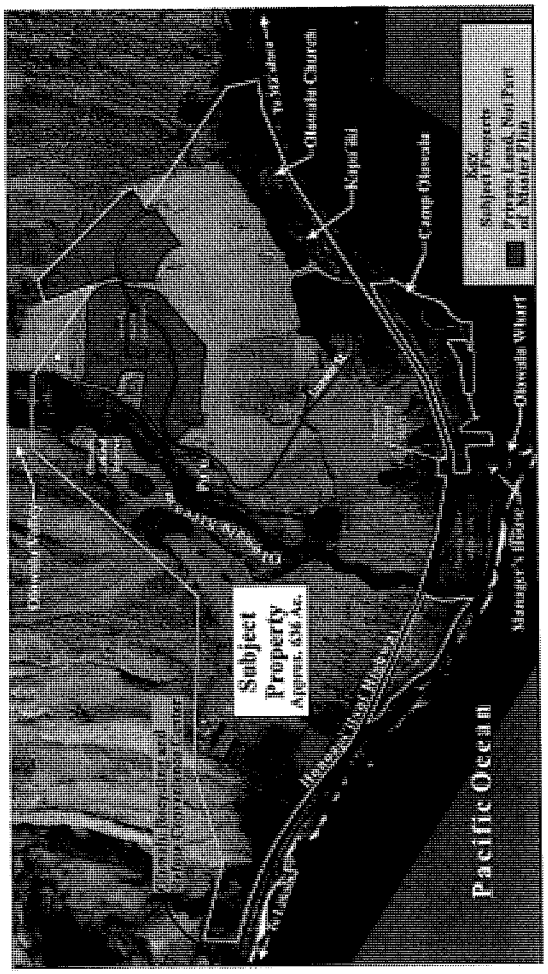

Figure 2. Project Aerial Photograph

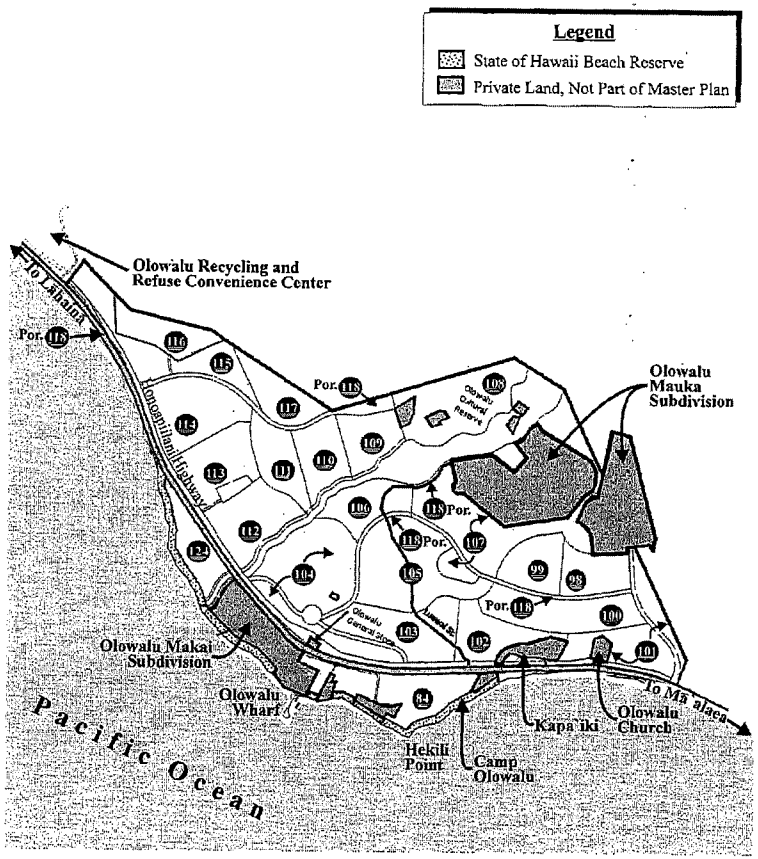

Figure 3. Project TMKs

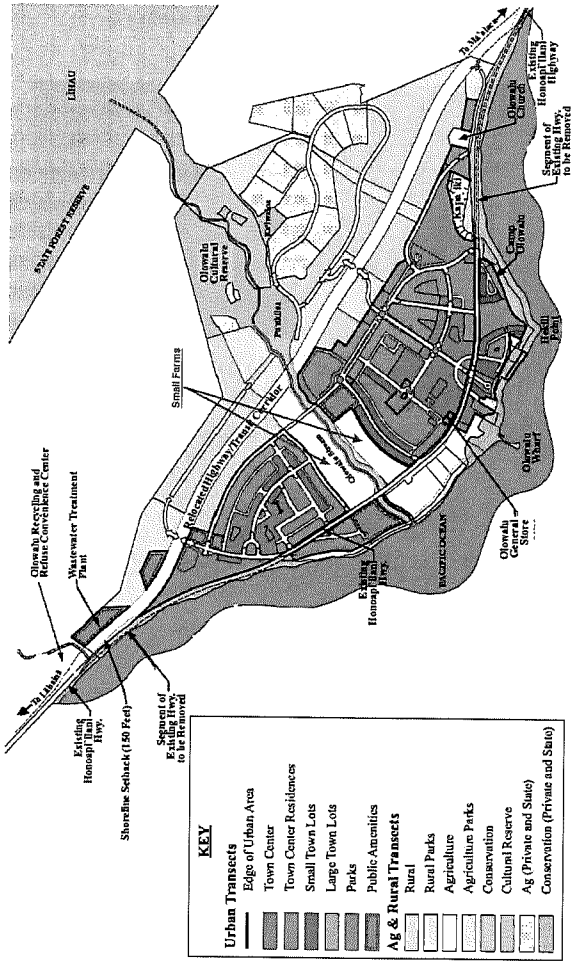

Figure 4. Project Master Plan, Alternative 1

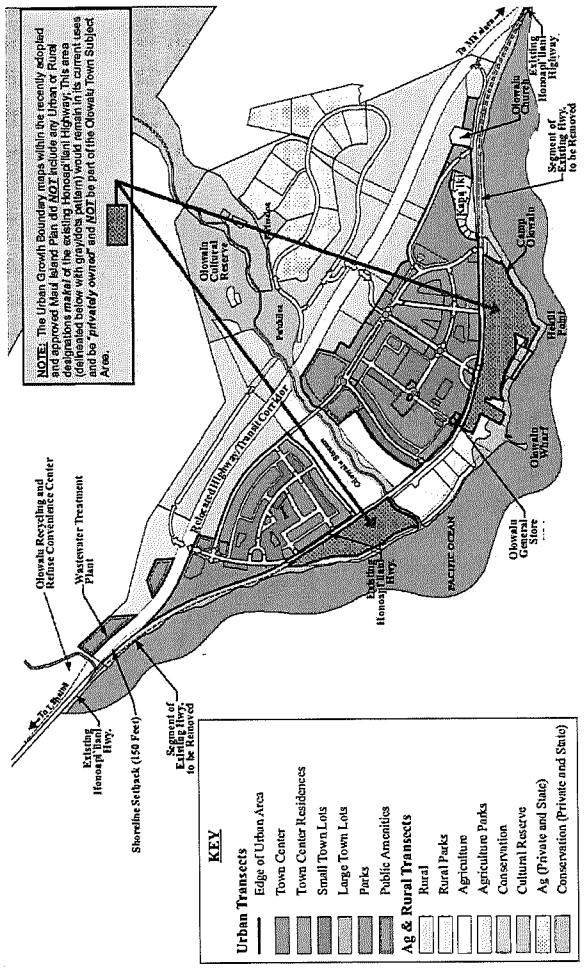

Figure 5. Project Master Plan, Alternative 2

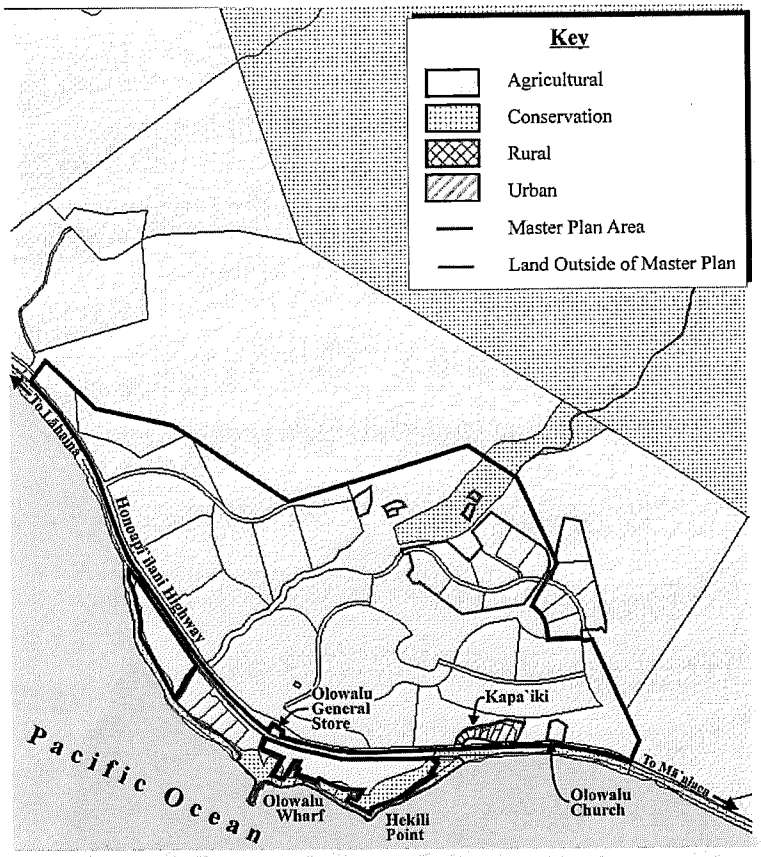

Figure 6. Project State Districting, Existing

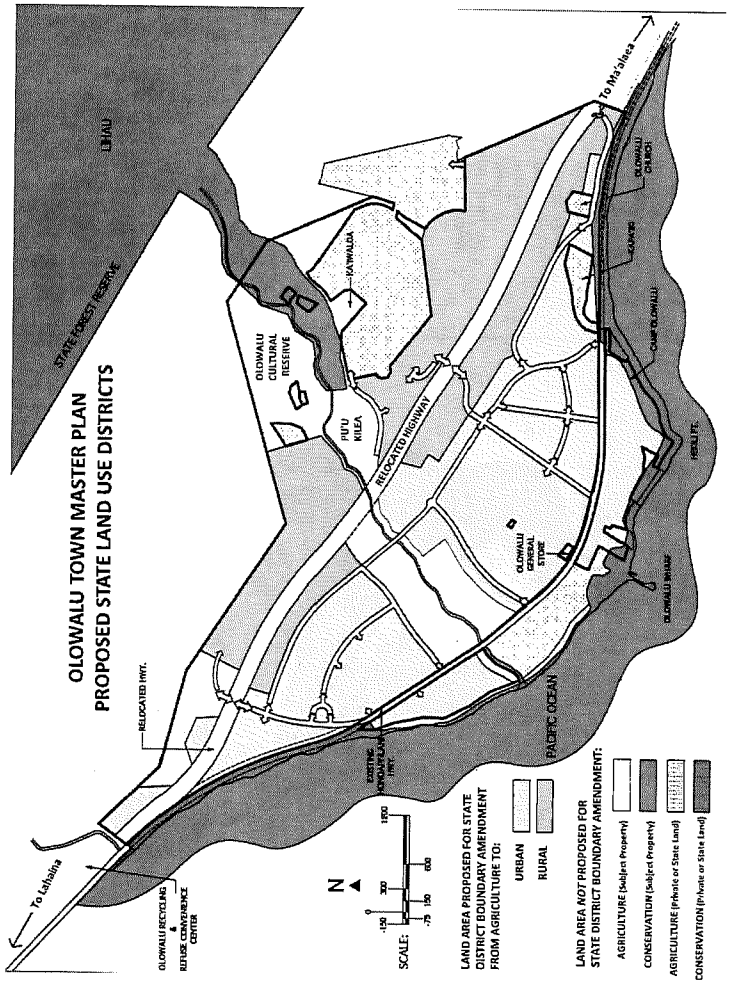

Figure 7. Project State Districting, Proposed for Alternative 1

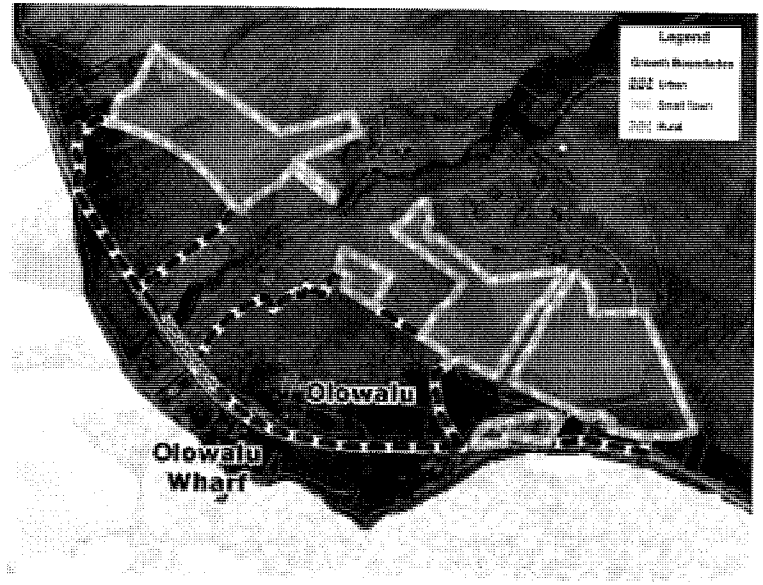

Figure 8. Project Land Use Designations, Maui Island Plan

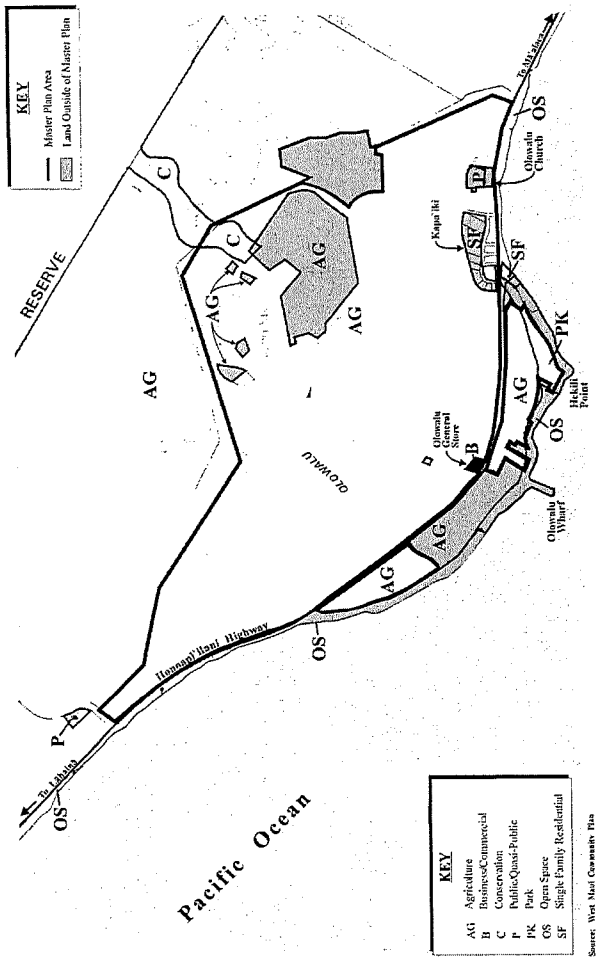

Figure 9. Project Land Use Designations, West Maui Community Plan

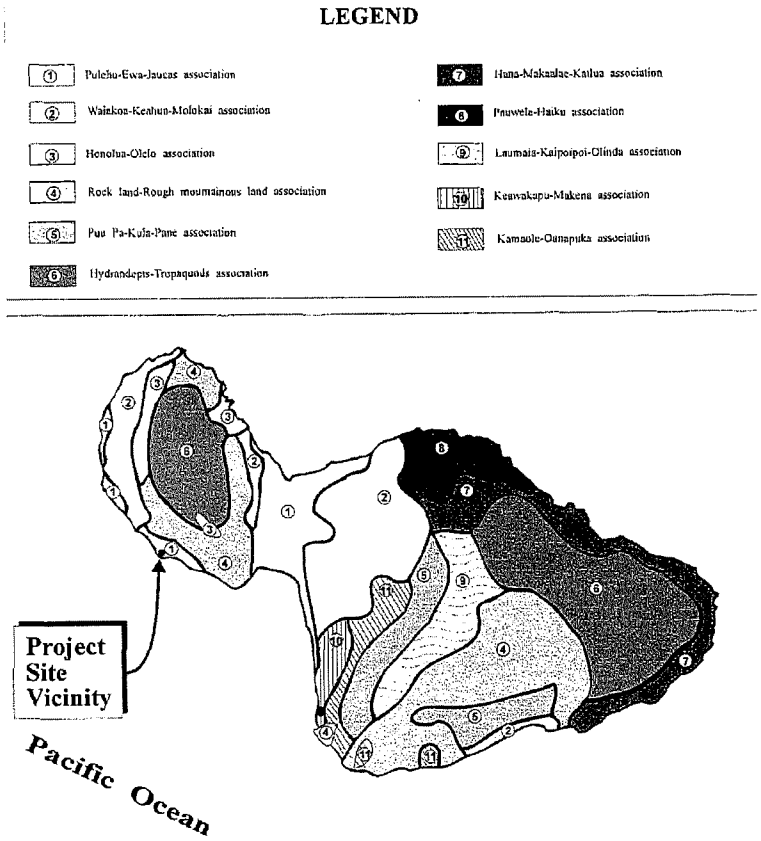

Figure 10. Maui General Soils Map

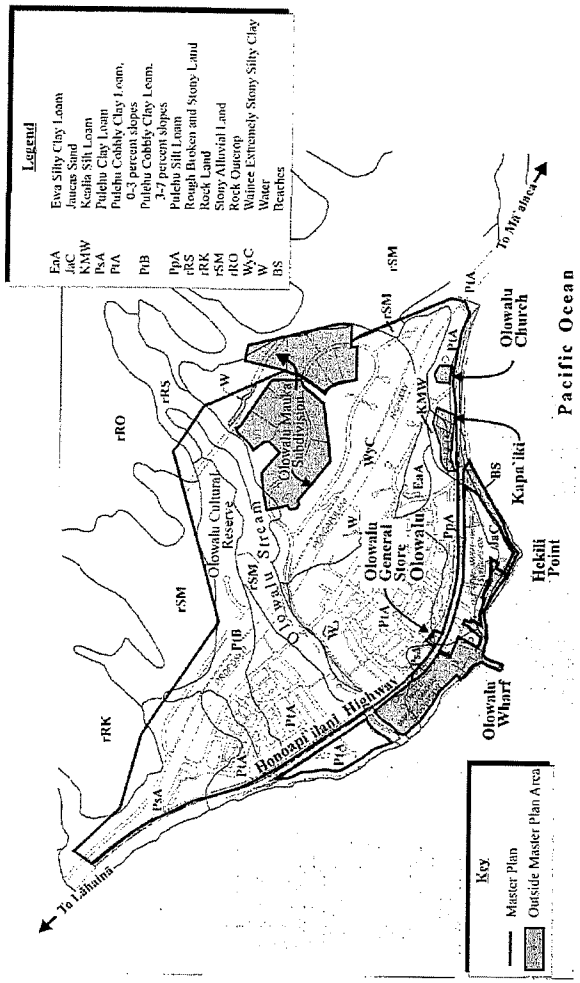

Figure 11. Project Soils Map

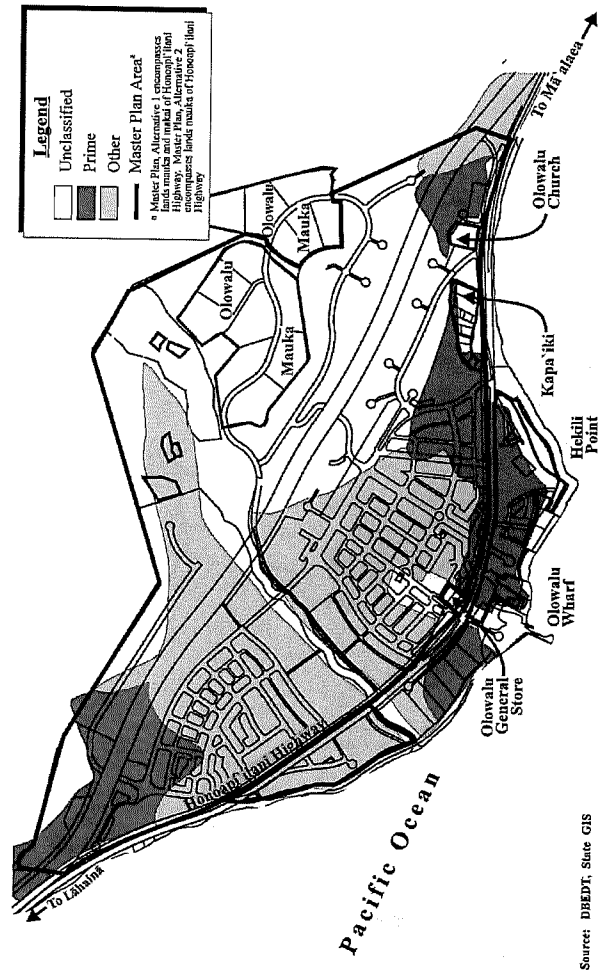

Figure 12. Project ALISH Map

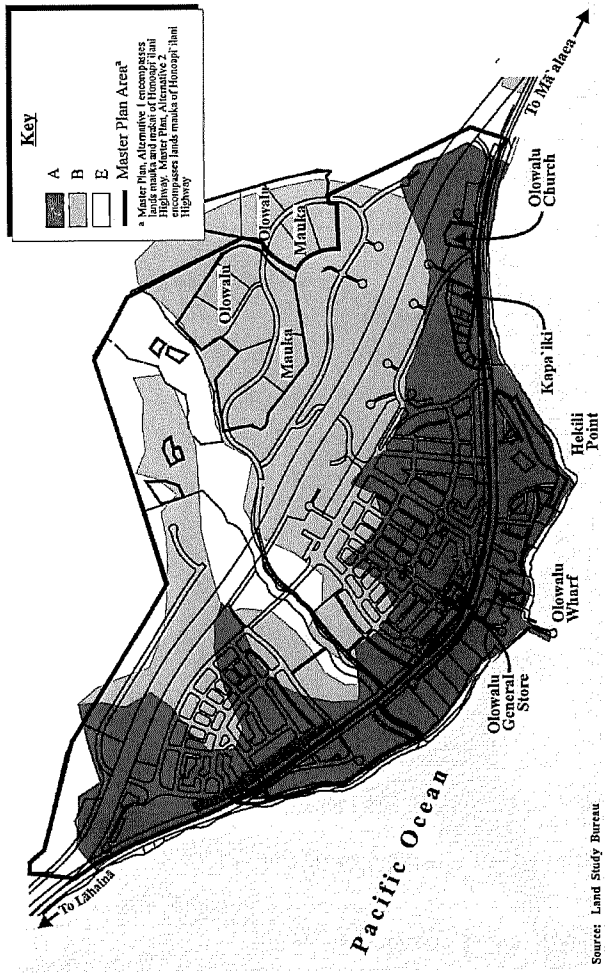

Figure 13. Project LSB Map, General Ratings

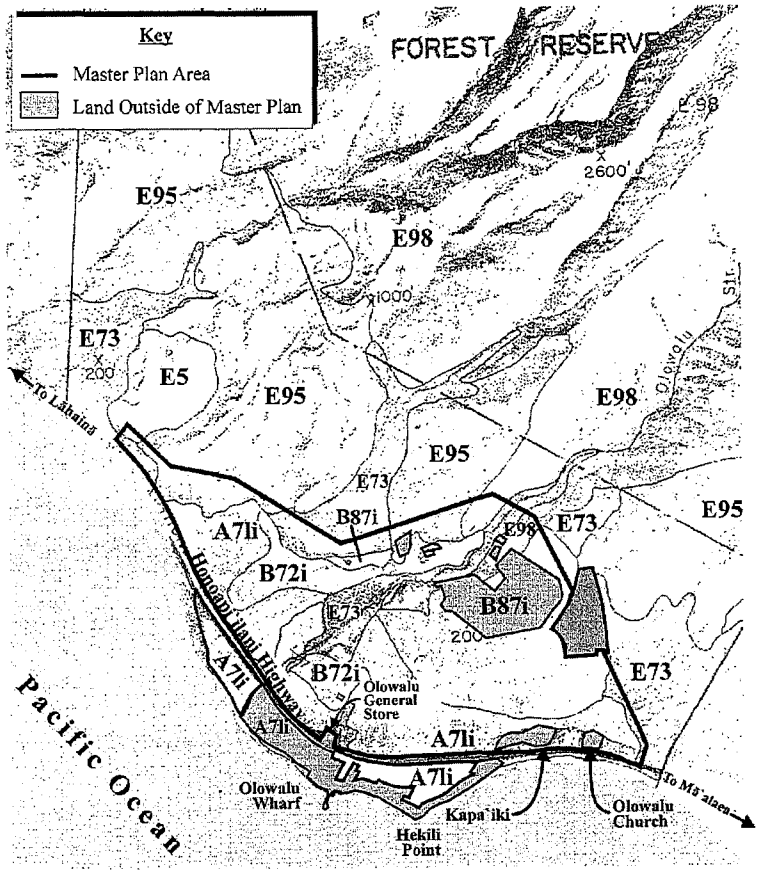

Figure 14. Project LSB Map, Detailed Ratings

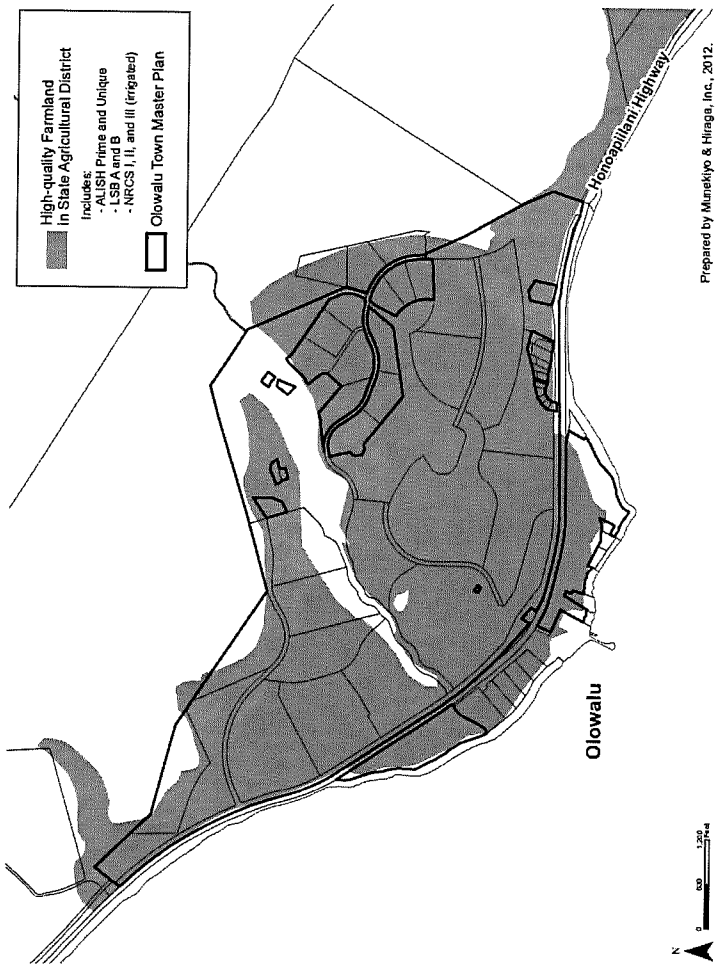

Figure 15. High-quality Farmland, Olowalu

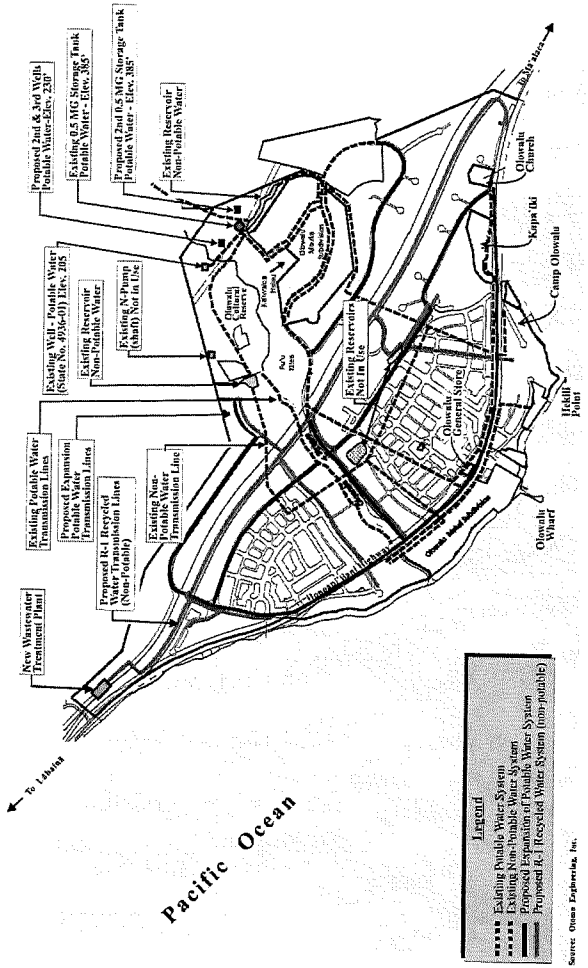

Figure 16. Project Water Systems, Existing and Planned

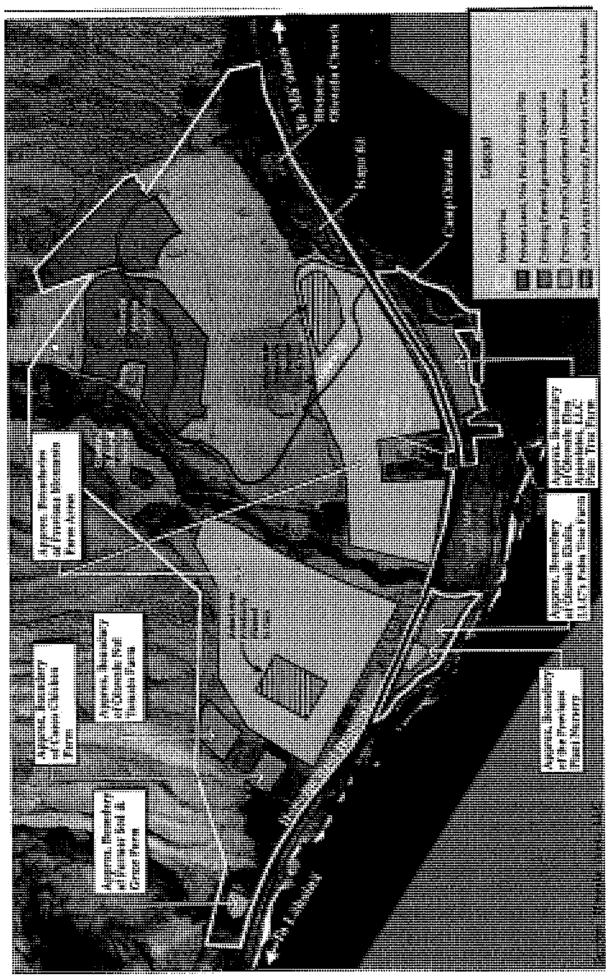

Figure 17. Olowalu Agricultural Operations, Recent and Existing

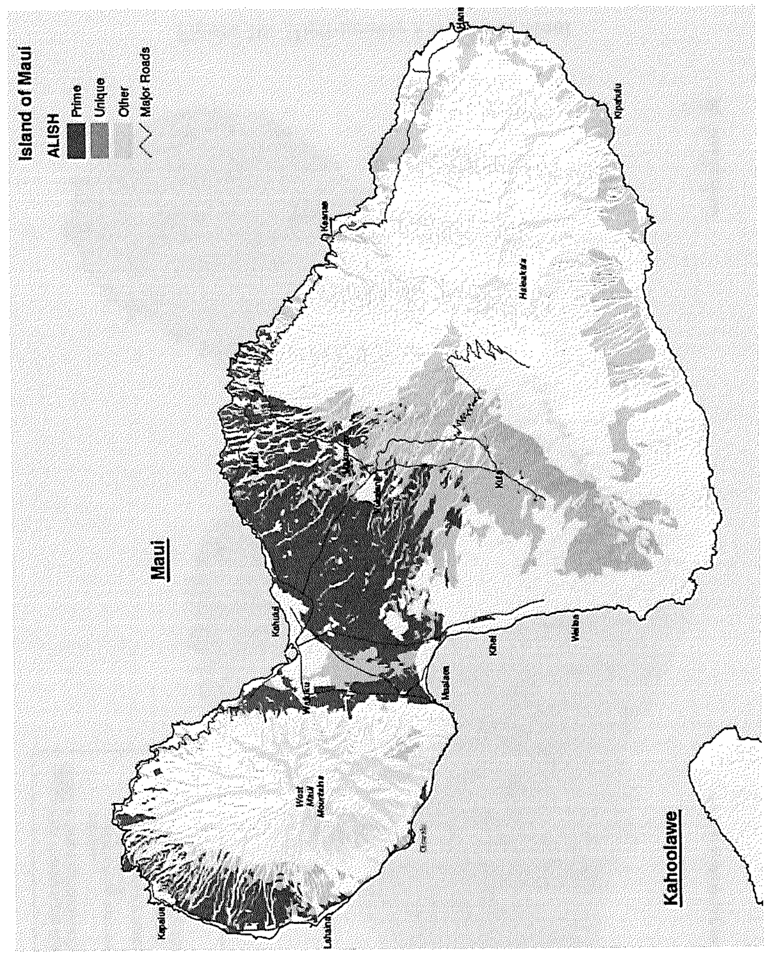

Figure 18. Maui ALISH Map

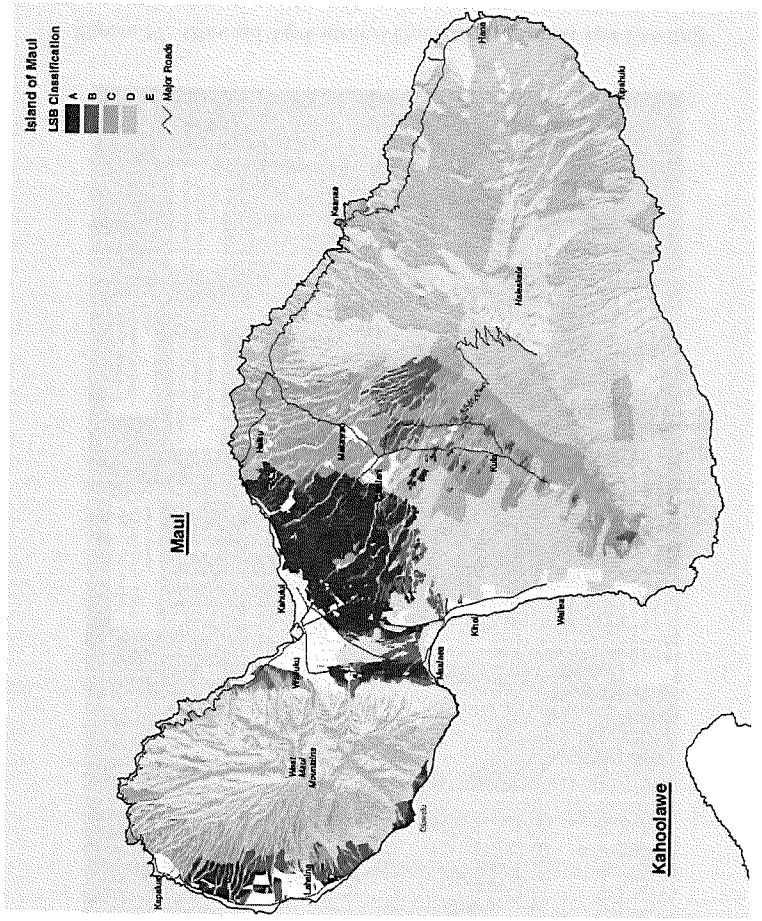

Figure 19. Maui LSB Map

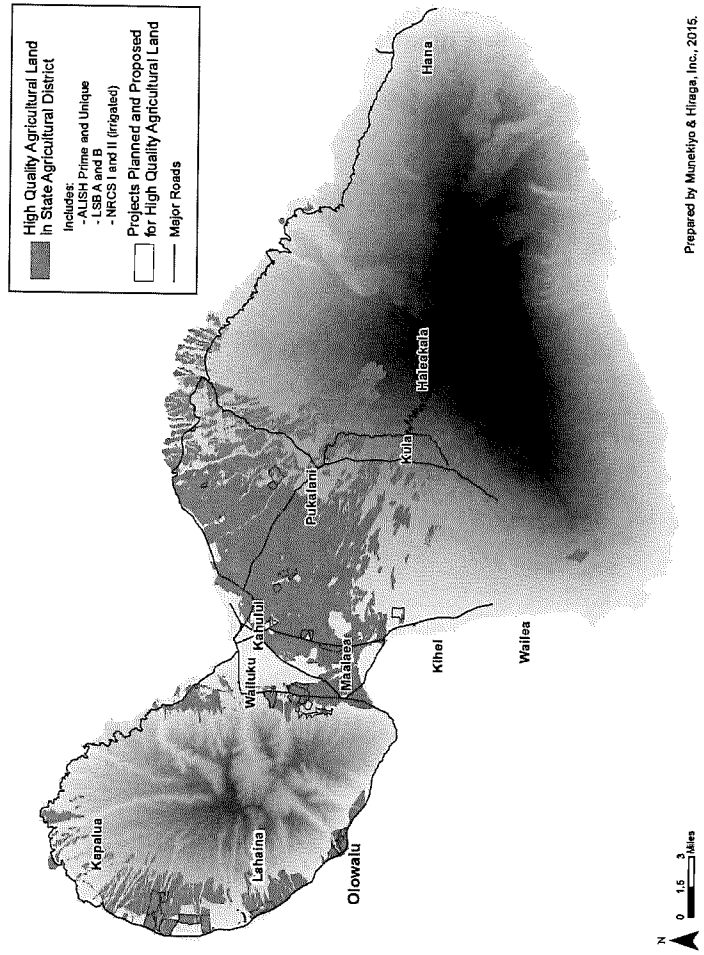

Figure 20. High-quality Farmland, Maui

Figure 21. Olowalu Nui Farm, Exterior

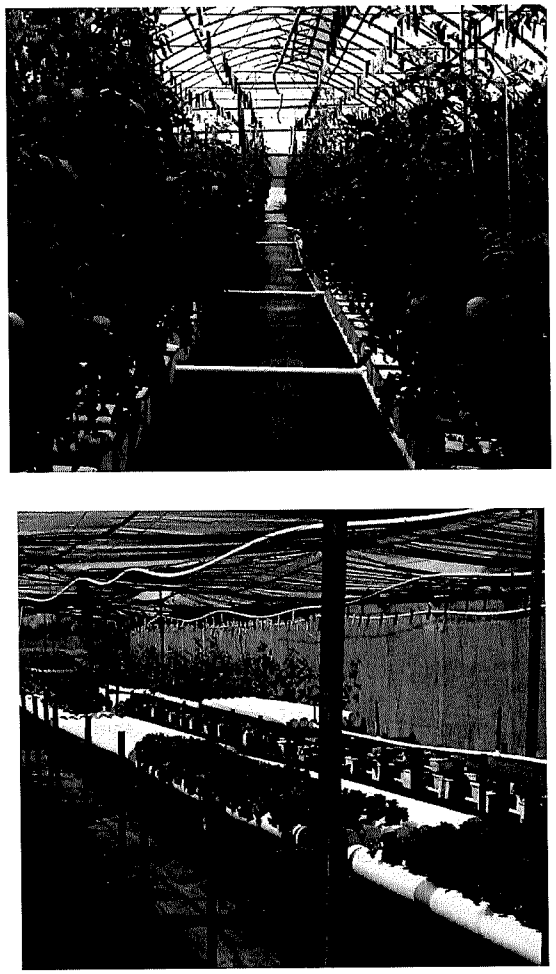

Figure 22. Olowalu Nui Farm, Interior

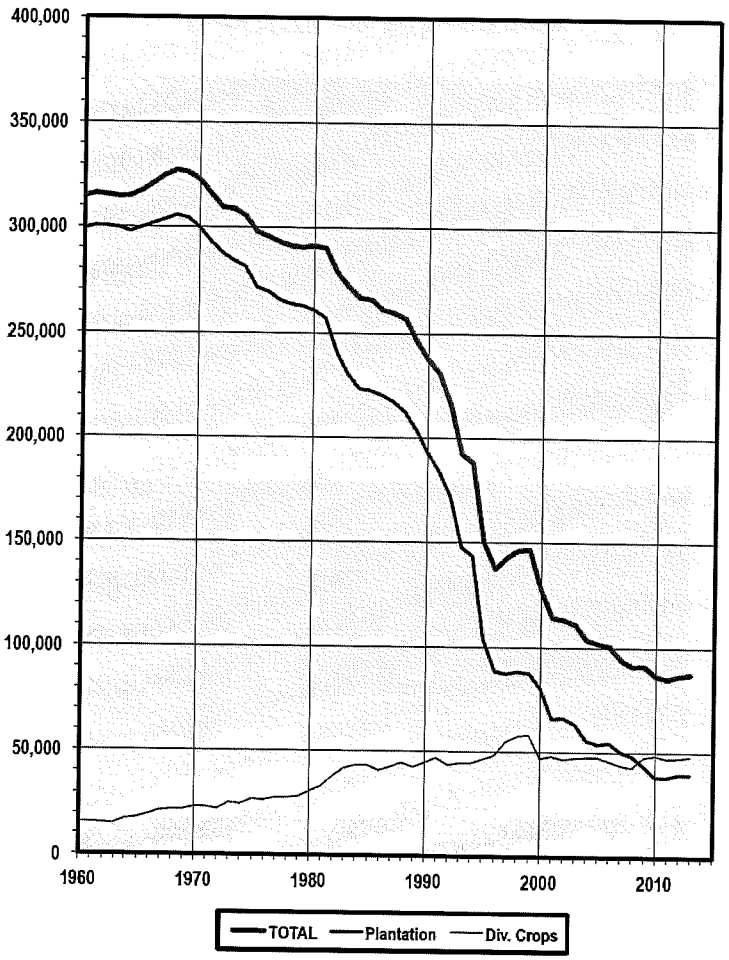

Figure 23. Acreage in Crop, Statewide: 1960 to 2013

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APPENDIX

STATE AND COUNTY GOALS, OBJECTIVES, POLICIES AND GUIDELINES RELATED TO AGRICULTURAL LANDS

1. HAWAI'I STATE CONSTITUTION (Article XI, Section 3):

...to conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands...

2. HAWAI'I STATE PLAN (Chapter 226, Hawaii Revised Statutes, as amended):

Section 226-7 Objectives and policies for the economy--agriculture.

(a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:

(1) Viability in Hawaii's sugar and pineapple industries.

(2) Growth and development of diversified agriculture throughout the State.

(3) An agriculture industry that continues to constitute a dynamic and essential component of Hawaii's strategic, economic, and social well-being.

(b) To achieve the agricultural objectives, it shall be the policy of the State to:

(2) Encourage agriculture by making best use of natural resources.

(10) Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.

(16) Facilitate the transition of agricultural lands in economically nonfeasible agricultural production to economically viable agricultural uses.

Section 226-103 Economic priority guidelines.

(c) Priority guidelines to promote the continued viability of the sugar and pineapple industries:

(1) Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries.

(d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:

(1) Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands.

(10) Support the continuation of land currently in use for diversified agriculture.

Section 226-104 Population growth and land resources priority guidelines.

(b) Priority guidelines for regional growth distribution and land resource utilization:

(2) Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

3. AGRICULTURAL STATE FUNCTIONAL PLAN (1991)

(Functional plans are guidelines for implementing the State Plan. They are approved by the Governor, but not adopted by the State Legislature.)

Objective H: Achievement of Productive Agricultural Use of Lands Most Suitable and Needed for Agriculture.

Policy H(2): Conserve and protect important agricultural lands in accordance with the Hawaii State Constitution.

Action H(2)(a): Propose enactment of standards and criteria to identify, conserve, and protect important agricultural lands and lands in agricultural use.

Action H(2)(c): Administer land use district boundary amendments, permitted land uses, infrastructure standards, and other planning and regulatory functions on important agricultural lands and lands in agricultural use, so as to ensure the availability of agriculturally suitable lands and promote diversified agriculture.

4. COUNTY OF MAUI 2030 GENERAL PLAN, COUNTYWIDE POLICY PLAN (2010)

Countywide goals, objectives, policies and actions

F. Strengthen the Local Economy

Objective

2. Diversify and expand sustainable forms of agriculture and aquaculture.

Policies

b. Prioritize the use of agricultural land to feed the local population, and promote the use of agriculture lands for sustainable and diversified agricultural activities.

e. Support ordinances, programs, and policies that keep agricultural land and water available and affordable to farmers.

Implementing Actions

c. Create agricultural parks in areas distant from genetically modified crops.

J. Promote Sustainable Land Use and Growth Management

Objective

2. Improve planning for and management of agricultural lands and rural areas.

Policies

a. Protect prime, productive, and potentially productive agricultural lands to maintain the islands' agricultural and rural identities and economies.

c. Discourage developing or subdividing agriculturally designated lands when non-agricultural activities would be primary uses.

Implementing Actions

a. Inventory and protect prime, productive, and potentially productive agricultural lands from competing non-agricultural land uses.

5. MAUI ISLAND PLAN, GENERAL PLAN 2030 (2012)

Core Values

E. Preserve rural and agricultural lands and encourage sustainable agriculture.

Agricultural Lands

Goal

7.1 Maui Island will have a prosperous agricultural industry and will protect agricultural lands.

Objective

7.1.1 Significantly reduce the loss of productive agricultural lands.

Policies

7.1.1.a Allow, where appropriate, the clustering of development on agricultural lands when approved as a CSD (Conservation Subdivision Design) plan or similar approval mechanism.

7.1.1.b Require, where appropriate, the review and approval of CSD plans prior to the subdivision of agricultural land.

7.1.1.c Discourage developing or subdividing productive agricultural lands for

residential uses in which the residence would be the primary use and any agricultural activities would be secondary uses.

7.1.1.e Focus urban growth, to the extent practicable, away from productive and important agricultural lands.

7.1.1.f Strongly discourage the conversion of productive and important agricultural lands (such as sugar, pineapple, and other produce lands) to rural or urban use, unless justified during the General Plan update, or when other overriding factors are present.

7.1.1.h Provide incentives for landowners to preserve and protect agricultural lands from development through the use of TDR/PDR, tax credits, easement programs, or similar means.

7.1.1.i Promote the use of U.S.D.A. Farm and Ranch Lands Protection Program grants to fund the acquisition of conservation easements on eligible agricultural lands.

7.1.1.j Require all major developments adjacent to agricultural lands to provide an appropriate and site-specific agricultural protection buffer as part of a required site plan.

7.1.1.k Support and promote the viability of Maui's agricultural businesses through property tax incentives and other programs and subsidies.

7.1.1.l Encourage future community plan efforts to identify lands within the County Agricultural zoning district that are primarily being used for large-lot residential or rural use and consider such lands for reclassification to an appropriate County Rural zone.

6. COUNTY OF MAUI, WEST MAUI COMMUNITY PLAN (1996)

A. Intended Effects of the West Maui Community Plan

5. Encourage infill in order to protect agriculture and mauka open spaces.

B. Goals, Objectives, Policies and Implementing Actions

LAND USE

Objectives and policies for the West Maui Region in General

3. Ensure that appropriate lands are available to support the region's present and future agricultural activities.

5. Preserve the current State Agricultural District boundaries in the planning region,

in accordance with this Community Plan and its land use map.

6. Special Permits in the State Agricultural District may be allowed only: (1) to accommodate public and quasi-public uses; (2) public facility uses such as utility installation, landfills and sewer treatment plants whose location is determined by technical considerations; (3) uses which are clearly accessory and subordinate to a principal agricultural use on the property; and (4) extractive industries such as quarrying, where the operation does not adversely affect the environment or nearby agricultural uses.

7. Provide for specific criteria for the subdivision of lands designated for agricultural use in order to control the potential loss of productive agricultural lands and the open space resource.

Implementing Actions

5. Establish and enforce agricultural subdivision criteria.

ENVIRONMENT

Objectives and policies

2. Preserve agricultural lands and open space with particular emphasis on natural coastal areas along major highways.

ECONOMIC ACTIVITY

Goal

A diversified economy that ... supports the existing ... agricultural industr(y).

Objectives and policies

1. Promote a diversified economic base which offers long-term employment to West Maui residents, and maintains overall stability in economic activity in the areas of:

   f. Agriculture.

2. Provide for the preservation and enhancement of agriculture.

   a. Maintain the land acreage required to sustain present and future agricultural operations and open space.

   b. Prevent urbanization of agricultural lands to the greatest extent possible.

   c. Encourage maintenance and development of water sources for agricultural activities which do not conflict with domestic demand for potable water.

   d. Discourage use of agricultural lands for non-agricultural purpose.

   e. Adopt ordinances to establish appropriate standards for agricultural lands.

SOCIAL INFRASTRUCTURE

Recreation and Open Space

Objectives and Policies

3. Provide resource-oriented regional park facilities and public access along the shoreline for picnicking, camping, informal play, swimming, sunbathing, and other coastal-related activities along coastal lands makai of the existing or future realigned coastal highways ..., except for the agriculture designated lands makai of the highway at Olowalu.

7. REFERENCES

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APPENDIX N-2.

June 1, 2015 Letter from Plasch Econ Pacific LLC

Plasch Econ Pacific LLC
Bruce Steven Plasch, Ph.D., President

ECONOMIC CONSULTING: Economic Development • Land Economics • Feasibility & Valuations • Benefits & Impacts

June 1, 2015

Ms. Colleen Suyama
MUNEKIYO HIRAGA
305 High St., Suite 104
Wailuku, Hawai`i 96793

Re: "Proposed Olowalu Town Master Plan: Impacts on Agriculture," April 2015

Dear Colleen:

Further to your email of May 29, 2015, my agricultural report on Olowalu—"Proposed Olowalu Town Master Plan: Jmpacts on Agriculture," April 2015—addresses both Alternative 1 (Preferred Alternative in the Draft EIS) and Alternative 2 (Maui Island Plan without the makai lands).

Sincerely,

Bruce S. Plasch

Bruce S. Plasch
President

1655 Kamole Street • Honolulu, HI 96821 • Office: (808) 373-9364 • Fax: (808) 373-9590 • E-mail: bplasch@hawaii.rr.com

APPENDIX O.

County of Maui, Department of Housing and Human Concerns 2015 Affordable Guidelines

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: May 1, 2015

2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedrooms	50% $37,550	60% $45,060	70% $52,570	80% $60,080	90% $67,590	100% $75,100	110% $82,610	120% $90,120	130% $97,630	140% $105,140	150% $112,650	160% $120,160
4.000%	1	$144,900	$173,880	$202,860	$231,840	$260,820	$289,800	$318,780	$347,760	$376,740	$405,650	$434,630	$463,610
	2	$175,950	$211,140	$246,330	$281,520	$316,710	$351,900	$387,090	$422,280	$457,470	$492,575	$527,765	$562,955
	3	$207,000	$248,400	$289,800	$331,200	$372,600	$414,000	$455,400	$496,800	$538,200	$579,500	$620,900	$662,300
	4	$238,050	$285,660	$333,270	$380,880	$428,490	$476,100	$523,710	$571,320	$618,930	$666,425	$714,035	$761,645
4.125%	1	$142,730	$171,290	$199,780	$228,340	$256,900	$285,460	$314,020	$342,510	$371,070	$399,630	$428,190	$456,750
	2	$173,315	$207,995	$242,590	$277,270	$311,950	$346,630	$381,310	$415,905	$450,585	$485,265	$519,945	$554,625
	3	$203,900	$244,700	$285,400	$326,200	$367,000	$407,800	$448,600	$489,300	$530,100	$570,900	$611,700	$652,500
	4	$234,485	$281,405	$328,210	$375,130	$422,050	$468,970	$515,890	$562,695	$609,615	$656,535	$703,455	$750,375
4.250%	1	$140,630	$168,700	$196,840	$224,980	$253,120	$281,190	$309,330	$337,470	$365,610	$393,680	$421,820	$449,960
	2	$170,765	$204,850	$239,020	$273,190	$307,360	$341,445	$375,615	$409,785	$443,955	$478,040	$512,210	$546,380
	3	$200,900	$241,000	$281,200	$321,400	$361,600	$401,700	$441,900	$482,100	$522,300	$562,400	$602,600	$642,800
	4	$231,035	$277,150	$323,380	$369,610	$415,840	$461,955	$508,185	$554,415	$600,645	$646,760	$692,990	$739,220
4.375%	1	$138,530	$166,250	$193,970	$221,690	$249,340	$277,060	$304,780	$332,500	$360,220	$387,940	$415,590	$443,310
	2	$168,215	$201,875	$235,535	$269,195	$302,770	$336,430	$370,090	$403,750	$437,410	$471,070	$504,645	$538,305
	3	$197,900	$237,500	$277,100	$316,700	$356,200	$395,800	$435,400	$475,000	$514,600	$554,200	$593,700	$633,300
	4	$227,585	$273,125	$318,665	$364,205	$409,630	$455,170	$500,710	$546,250	$591,790	$637,330	$682,755	$728,295
4.500%	1	$136,500	$163,800	$191,100	$218,400	$245,700	$273,000	$300,370	$327,670	$354,970	$382,270	$409,570	$436,870
	2	$165,750	$198,900	$232,050	$265,200	$298,350	$331,500	$364,735	$397,885	$431,035	$464,185	$497,335	$530,485
	3	$195,000	$234,000	$273,000	$312,000	$351,000	$390,000	$429,100	$468,100	$507,100	$546,100	$585,100	$624,100
	4	$224,250	$269,100	$313,950	$358,800	$403,650	$448,500	$493,465	$538,315	$583,165	$628,015	$672,865	$717,715
4.625%	1	$134,540	$161,420	$188,370	$215,250	$242,200	$269,080	$295,960	$322,910	$349,790	$376,740	$403,620	$430,500
	2	$163,370	$196,010	$228,735	$261,375	$294,100	$326,740	$359,380	$392,105	$424,745	$457,470	$490,110	$522,750
	3	$192,200	$230,600	$269,100	$307,500	$346,000	$384,400	$422,800	$461,300	$499,700	$538,200	$576,600	$615,000
	4	$221,030	$265,190	$309,465	$353,625	$397,900	$442,060	$486,220	$530,495	$574,655	$618,930	$663,090	$707,250
4.750%	1	$132,580	$159,110	$185,640	$212,170	$238,700	$265,230	$291,690	$318,220	$344,750	$371,280	$397,810	$424,340
	2	$160,990	$193,205	$225,420	$257,635	$289,850	$322,065	$354,195	$386,410	$418,625	$450,840	$483,055	$515,270
	3	$189,400	$227,300	$265,200	$303,100	$341,000	$378,900	$416,700	$454,600	$492,500	$530,400	$568,300	$606,200
	4	$217,810	$261,395	$304,980	$348,565	$392,150	$435,735	$479,205	$522,790	$566,375	$609,960	$653,545	$697,130
4.875%	1	$130,690	$156,870	$182,980	$209,160	$235,270	$261,380	$287,560	$313,670	$339,850	$365,960	$392,140	$418,250
	2	$158,695	$190,485	$222,190	$253,980	$285,685	$317,390	$349,180	$380,885	$412,675	$444,380	$476,170	$507,875
	3	$186,700	$224,100	$261,400	$298,800	$336,100	$373,400	$410,800	$448,100	$485,500	$522,800	$560,200	$597,500
	4	$214,705	$257,715	$300,610	$343,620	$386,515	$429,410	$472,420	$515,315	$558,325	$601,220	$644,230	$687,125
5.000%	1	$128,870	$154,630	$180,390	$206,150	$231,910	$257,740	$283,500	$309,260	$335,020	$360,780	$386,540	$412,300
	2	$156,485	$187,765	$219,045	$250,325	$281,605	$312,970	$344,250	$375,530	$406,810	$438,090	$469,370	$500,650
	3	$184,100	$220,900	$257,700	$294,500	$331,300	$368,200	$405,000	$441,800	$478,600	$515,400	$552,200	$589,000
	4	$211,715	$254,035	$296,355	$338,675	$380,995	$423,430	$465,750	$508,070	$550,390	$592,710	$635,030	$677,350
5.125%	1	$127,050	$152,460	$177,870	$203,280	$228,690	$254,100	$279,510	$304,920	$330,330	$355,740	$381,150	$406,490
	2	$154,275	$185,130	$215,985	$246,840	$277,695	$308,550	$339,405	$370,260	$401,115	$431,970	$462,825	$493,595
	3	$181,500	$217,800	$254,100	$290,400	$326,700	$363,000	$399,300	$435,600	$471,900	$508,200	$544,500	$580,700
	4	$208,725	$250,470	$292,215	$333,960	$375,705	$417,450	$459,195	$500,940	$542,685	$584,430	$626,175	$667,805
5.250%	1	$125,230	$150,290	$175,350	$200,410	$225,470	$250,530	$275,590	$300,650	$325,710	$350,770	$375,760	$400,820
	2	$152,065	$182,495	$212,925	$243,355	$273,785	$304,215	$334,645	$365,075	$395,505	$425,935	$456,280	$486,710
	3	$178,900	$214,700	$250,500	$286,300	$322,100	$357,900	$393,700	$429,500	$465,300	$501,100	$536,800	$572,600
	4	$205,735	$246,905	$288,075	$329,245	$370,415	$411,585	$452,755	$493,925	$535,095	$576,265	$617,320	$658,490

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

SINGLE FAMILY

Effective: May 1, 2015

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50% $31,850	60% $45,960	70% $52,570	80% $60,080	90% $67,590	100% $75,100	110% $82,610	120% $90,120	130% $97,630	140% $105,140	150% $112,650	160% $120,160
5.375%	1	$123,550	$148,260	$172,870	$197,610	$222,320	$247,030	$271,740	$296,450	$321,160	$345,870	$370,580	$395,290
	2	$150,025	$180,030	$210,035	$239,965	$269,960	$299,965	$329,970	$359,975	$389,980	$419,985	$449,990	$479,995
	3	$176,500	$211,800	$247,100	$282,300	$317,600	$352,900	$388,200	$423,500	$458,800	$494,100	$529,400	$564,700
	4	$202,975	$243,570	$284,165	$324,845	$365,240	$405,835	$446,430	$487,025	$527,620	$568,215	$608,810	$649,405
5.500%	1	$121,800	$146,160	$170,590	$194,950	$219,310	$243,670	$268,030	$292,390	$316,750	$341,110	$365,470	$389,830
	2	$147,900	$177,480	$207,145	$236,725	$266,305	$295,885	$325,465	$355,045	$384,625	$414,205	$443,785	$473,365
	3	$174,000	$208,800	$243,700	$278,500	$313,300	$348,100	$382,900	$417,700	$452,500	$487,300	$522,100	$556,900
	4	$200,100	$240,120	$280,255	$320,275	$360,295	$400,315	$440,335	$480,355	$520,375	$560,395	$600,415	$640,435
5.625%	1	$120,190	$144,200	$168,210	$192,290	$216,300	$240,310	$264,320	$288,400	$312,410	$336,420	$360,500	$384,510
	2	$145,945	$175,100	$204,255	$233,495	$262,650	$291,805	$320,960	$350,200	$379,355	$408,510	$437,750	$466,905
	3	$171,700	$206,000	$240,300	$274,700	$309,000	$343,300	$377,600	$412,000	$446,300	$480,600	$515,000	$549,300
	4	$197,455	$236,900	$276,345	$315,905	$355,350	$394,795	$434,240	$473,800	$513,245	$552,690	$592,250	$631,695
5.750%	1	$118,510	$142,240	$165,970	$189,630	$213,360	$237,090	$260,750	$284,480	$308,210	$331,870	$355,600	$379,330
	2	$143,905	$172,720	$201,535	$230,265	$259,080	$287,895	$316,625	$345,440	$374,255	$402,985	$431,800	$460,615
	3	$169,300	$203,200	$237,100	$270,900	$304,800	$338,700	$372,500	$406,400	$440,300	$474,100	$508,000	$541,900
	4	$194,695	$233,680	$272,665	$311,535	$350,520	$389,505	$428,375	$467,360	$506,345	$545,215	$584,200	$623,185
5.875%	1	$116,900	$140,350	$163,730	$187,110	$210,490	$233,870	$257,250	$280,630	$304,010	$327,390	$350,770	$374,220
	2	$141,950	$170,425	$198,815	$227,205	$255,595	$283,985	$312,375	$340,765	$369,155	$397,545	$425,935	$454,410
	3	$167,000	$200,500	$233,900	$267,300	$300,700	$334,100	$367,500	$400,900	$434,300	$467,700	$501,100	$534,600
	4	$192,050	$230,575	$268,985	$307,395	$345,805	$384,215	$422,625	$461,035	$499,445	$537,855	$576,265	$614,790
6.000%	1	$115,360	$138,480	$161,490	$184,550	$207,690	$230,720	$253,820	$276,920	$299,950	$323,050	$346,080	$369,180
	2	$140,080	$168,130	$196,095	$224,145	$252,195	$280,160	$308,210	$336,260	$364,225	$392,275	$420,240	$448,290
	3	$164,800	$197,800	$230,700	$263,700	$296,700	$329,600	$362,600	$395,600	$428,500	$461,500	$494,400	$527,400
	4	$189,520	$227,470	$265,305	$303,255	$341,205	$379,040	$416,980	$454,940	$492,775	$530,725	$568,560	$606,510
6.125%	1	$113,820	$136,640	$159,390	$182,140	$204,890	$227,710	$250,460	$273,210	$295,960	$318,760	$341,530	$364,280
	2	$138,210	$165,920	$193,545	$221,170	$248,795	$276,506	$304,130	$331,755	$359,380	$387,090	$414,715	$442,340
	3	$162,600	$195,200	$227,700	$260,200	$292,700	$325,300	$357,800	$390,300	$422,800	$455,400	$487,900	$520,400
	4	$186,990	$224,480	$261,855	$299,230	$336,605	$374,096	$411,470	$448,845	$486,220	$523,710	$561,085	$598,460
6.250%	1	$112,350	$134,820	$157,290	$179,760	$202,230	$224,700	$247,170	$269,640	$292,110	$314,580	$337,050	$359,520
	2	$136,425	$163,710	$190,995	$218,280	$245,565	$272,850	$300,135	$327,420	$354,705	$381,990	$409,275	$436,560
	3	$160,500	$192,600	$224,700	$256,800	$288,900	$321,000	$353,100	$385,200	$417,300	$449,400	$481,500	$513,600
	4	$184,575	$221,490	$258,405	$295,320	$332,235	$369,150	$406,065	$442,980	$479,895	$516,810	$553,725	$590,640
6.375%	1	$110,880	$133,070	$155,190	$177,380	$199,570	$221,760	$243,950	$266,070	$288,260	$310,450	$332,640	$354,830
	2	$134,640	$161,585	$188,445	$215,390	$242,335	$269,280	$296,225	$323,085	$350,030	$376,975	$403,920	$430,865
	3	$158,400	$190,100	$221,700	$253,400	$285,100	$316,800	$348,500	$380,100	$411,800	$443,500	$475,200	$506,900
	4	$182,160	$218,615	$254,955	$291,410	$327,865	$364,320	$400,775	$437,115	$473,570	$510,025	$546,480	$582,935
6.500%	1	$109,410	$131,320	$153,230	$175,070	$196,980	$218,890	$240,730	$262,640	$284,550	$306,390	$328,300	$350,210
	2	$132,855	$159,460	$186,065	$212,585	$239,190	$265,795	$292,315	$318,920	$345,525	$372,045	$398,650	$425,255
	3	$156,300	$187,600	$218,800	$250,100	$281,400	$312,700	$343,900	$375,200	$406,500	$437,700	$469,000	$500,300
	4	$179,745	$215,740	$251,735	$287,615	$323,610	$359,605	$395,485	$431,480	$467,475	$503,355	$539,350	$575,345
6.625%	1	$108,010	$129,640	$151,270	$172,830	$194,460	$216,020	$237,650	$259,280	$280,840	$302,470	$324,100	$345,660
	2	$131,155	$157,420	$183,685	$209,865	$236,130	$262,310	$288,575	$314,840	$341,020	$367,285	$393,550	$419,730
	3	$154,300	$185,200	$216,100	$246,900	$277,800	$308,600	$339,500	$370,400	$401,200	$432,100	$463,000	$493,800
	4	$177,445	$212,980	$248,515	$283,935	$319,470	$354,890	$390,425	$425,960	$461,380	$496,915	$532,450	$567,870

2015

AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

SINGLE FAMILY

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$37,550	$45,060	$52,570	$60,080	$67,590	$75,100	$82,610	$90,120	$97,630	$105,140	$112,650	$120,160
6.750%	1	$106,680	$127,960	$149,310	$170,660	$191,940	$213,290	$234,640	$255,920	$277,270	$298,620	$319,970	$341,250
	2	$129,540	$155,380	$181,305	$207,230	$233,070	$258,995	$284,920	$310,760	$336,685	$362,610	$388,535	$414,375
	3	$152,400	$182,800	$213,300	$243,800	$274,200	$304,700	$335,200	$365,600	$396,100	$426,600	$457,100	$487,500
	4	$175,260	$210,220	$245,295	$280,370	$315,330	$350,405	$385,480	$420,440	$455,515	$490,590	$525,665	$560,625
6.875%	1	$105,280	$126,350	$147,420	$168,490	$189,560	$210,560	$231,630	$252,700	$273,770	$294,840	$315,910	$336,910
	2	$127,840	$153,425	$179,010	$204,595	$230,180	$255,680	$281,265	$306,850	$332,435	$358,020	$383,605	$409,105
	3	$150,400	$180,500	$210,600	$240,700	$270,800	$300,800	$330,900	$361,000	$391,100	$421,200	$451,300	$481,300
	4	$172,960	$207,575	$242,190	$276,805	$311,420	$345,920	$380,535	$415,150	$449,765	$484,380	$518,995	$553,495
7.000%	1	$103,950	$124,740	$145,530	$166,320	$187,110	$207,970	$228,760	$249,550	$270,340	$291,130	$311,920	$332,710
	2	$126,225	$151,470	$176,715	$201,960	$227,205	$252,535	$277,780	$303,025	$328,270	$353,515	$378,760	$404,005
	3	$148,500	$178,200	$207,900	$237,600	$267,300	$297,100	$326,800	$356,500	$386,200	$415,900	$445,600	$475,300
	4	$170,775	$204,930	$239,085	$273,240	$307,395	$341,665	$375,820	$409,975	$444,130	$478,285	$512,440	$546,595
7.125%	1	$102,690	$123,200	$143,710	$164,290	$184,800	$205,310	$225,890	$246,400	$266,910	$287,490	$308,000	$328,580
	2	$124,695	$149,600	$174,505	$199,495	$224,400	$249,305	$274,295	$299,200	$324,105	$349,095	$374,000	$398,990
	3	$146,700	$176,000	$205,300	$234,700	$264,000	$293,300	$322,700	$352,000	$381,300	$410,700	$440,000	$469,400
	4	$168,705	$202,400	$236,095	$269,905	$303,600	$337,295	$371,105	$404,800	$438,495	$472,305	$506,000	$539,810
7.250%	1	$101,430	$121,660	$141,960	$162,260	$182,490	$202,790	$223,090	$243,320	$263,620	$283,920	$304,220	$324,450
	2	$123,165	$147,730	$172,380	$197,030	$221,595	$246,245	$270,895	$295,460	$320,110	$344,760	$369,410	$393,975
	3	$144,900	$173,800	$202,800	$231,800	$260,700	$289,700	$318,700	$347,600	$376,600	$405,600	$434,600	$463,500
	4	$166,635	$199,870	$233,220	$266,570	$299,805	$333,155	$366,505	$399,740	$433,090	$466,440	$499,790	$533,025
7.375%	1	$100,170	$120,190	$140,210	$160,230	$180,250	$200,270	$220,360	$240,380	$260,400	$280,420	$300,440	$320,460
	2	$121,635	$145,945	$170,255	$194,565	$218,875	$243,185	$267,580	$291,890	$316,200	$340,510	$364,820	$389,130
	3	$143,100	$171,700	$200,300	$228,900	$257,500	$286,100	$314,800	$343,400	$372,000	$400,600	$429,200	$457,800
	4	$164,565	$197,455	$230,345	$263,235	$296,125	$329,015	$362,020	$394,910	$427,800	$460,690	$493,580	$526,470
7.500%	1	$98,910	$118,720	$138,530	$158,270	$178,080	$197,820	$217,630	$237,440	$257,180	$276,990	$296,800	$316,540
	2	$120,105	$144,160	$168,215	$192,185	$216,240	$240,210	$264,265	$288,320	$312,290	$336,345	$360,400	$384,370
	3	$141,300	$169,600	$197,900	$226,100	$254,400	$282,600	$310,900	$339,200	$367,400	$395,700	$424,000	$452,200
	4	$162,495	$195,040	$227,585	$260,015	$292,560	$324,990	$357,535	$390,080	$422,510	$455,055	$487,600	$520,030
7.625%	1	$97,720	$117,250	$136,850	$156,380	$175,910	$195,440	$214,970	$234,570	$254,100	$273,630	$293,160	$312,760
	2	$118,660	$142,375	$166,175	$189,890	$213,605	$237,320	$261,035	$284,835	$308,550	$332,265	$355,980	$379,780
	3	$139,600	$167,500	$195,500	$223,400	$251,300	$279,200	$307,100	$335,100	$363,000	$390,900	$418,800	$446,800
	4	$160,540	$192,625	$224,825	$256,910	$288,995	$321,080	$353,165	$385,365	$417,450	$449,535	$481,620	$513,820
7.750%	1	$96,530	$115,850	$135,170	$154,490	$173,810	$193,130	$212,380	$231,700	$251,020	$270,340	$289,660	$308,980
	2	$117,215	$140,675	$164,135	$187,595	$211,055	$234,515	$257,890	$281,350	$304,810	$328,270	$351,730	$375,190
	3	$137,900	$165,500	$193,100	$220,700	$248,300	$275,900	$303,400	$331,000	$358,600	$386,200	$413,800	$441,400
	4	$158,585	$190,325	$222,065	$253,805	$285,545	$317,285	$348,910	$380,650	$412,390	$444,130	$475,870	$507,610
7.875%	1	$95,410	$114,450	$133,560	$152,670	$171,710	$190,820	$209,860	$228,970	$248,010	$267,120	$286,230	$305,270
	2	$115,855	$138,975	$162,180	$185,385	$208,505	$231,710	$254,830	$278,035	$301,155	$324,360	$347,565	$370,685
	3	$136,300	$163,500	$190,800	$218,100	$245,300	$272,600	$299,800	$327,100	$354,300	$381,600	$408,900	$436,100
	4	$156,745	$188,025	$219,420	$250,815	$282,095	$313,490	$344,770	$376,165	$407,445	$438,840	$470,235	$501,515
8.000%	1	$94,290	$113,120	$131,950	$150,850	$169,680	$188,510	$207,410	$226,240	$245,070	$263,970	$282,800	$301,630
	2	$114,495	$137,360	$160,225	$183,175	$206,040	$228,905	$251,855	$274,720	$297,585	$320,535	$343,400	$366,265
	3	$134,700	$161,600	$188,500	$215,500	$242,400	$269,300	$296,300	$323,200	$350,100	$377,100	$404,000	$430,900
	4	$154,905	$185,840	$216,775	$247,825	$278,760	$309,695	$340,745	$371,680	$402,615	$433,665	$464,600	$495,535

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COUNTY OF MAUI

Effective: May 1, 2015

2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$37,550	$45,060	$52,570	$60,080	$67,590	$75,100	$82,610	$90,120	$97,630	$105,140	$112,650	$120,160
8.125%	1	$93,170	$111,790	$130,410	$149,030	$167,720	$186,340	$204,960	$223,580	$242,200	$260,820	$279,510	$298,130
	2	$113,135	$135,745	$158,355	$180,965	$203,660	$226,270	$248,880	$271,490	$294,100	$316,710	$339,405	$362,015
	3	$133,100	$159,700	$186,300	$212,900	$239,600	$266,200	$292,800	$319,400	$346,000	$372,600	$399,300	$425,900
	4	$153,065	$183,655	$214,245	$244,835	$275,540	$306,130	$336,720	$367,310	$397,900	$428,490	$459,195	$489,785
8.250%	1	$92,050	$110,460	$128,870	$147,350	$165,760	$184,170	$202,580	$220,990	$239,400	$257,810	$276,220	$294,630
	2	$111,775	$134,130	$156,485	$178,925	$201,280	$223,635	$245,990	$268,345	$290,700	$313,055	$335,410	$357,765
	3	$131,500	$157,800	$184,100	$210,500	$236,800	$263,100	$289,400	$315,700	$342,000	$368,300	$394,600	$420,900
	4	$151,225	$181,470	$211,715	$242,075	$272,320	$302,565	$332,810	$363,055	$393,300	$423,545	$453,790	$484,035
8.375%	1	$91,000	$109,200	$127,400	$145,600	$163,800	$182,000	$200,200	$218,400	$236,600	$254,800	$273,000	$291,200
	2	$110,500	$132,600	$154,700	$176,800	$198,900	$221,000	$243,100	$265,200	$287,300	$309,400	$331,500	$353,600
	3	$130,000	$156,000	$182,000	$208,000	$234,000	$260,000	$286,000	$312,000	$338,000	$364,000	$390,000	$416,000
	4	$149,500	$179,400	$209,300	$239,200	$269,100	$299,000	$328,900	$358,800	$388,700	$418,600	$448,500	$478,400
8.500%	1	$89,950	$107,940	$125,930	$143,920	$161,910	$179,900	$197,890	$215,880	$233,870	$251,860	$269,850	$287,840
	2	$109,225	$131,070	$152,915	$174,760	$196,605	$218,450	$240,295	$262,140	$283,985	$305,830	$327,675	$349,520
	3	$128,500	$154,200	$179,900	$205,600	$231,300	$257,000	$282,700	$308,400	$334,100	$359,800	$385,500	$411,200
	4	$147,775	$177,330	$206,885	$236,440	$265,995	$295,550	$325,105	$354,660	$384,215	$413,770	$443,325	$472,880
8.625%	1	$88,900	$106,750	$124,530	$142,310	$160,090	$177,870	$195,650	$213,430	$231,210	$248,990	$266,770	$284,620
	2	$107,950	$129,625	$151,215	$172,805	$194,395	$215,985	$237,575	$259,165	$280,755	$302,345	$323,935	$345,610
	3	$127,000	$152,500	$177,900	$203,300	$228,700	$254,100	$279,500	$304,900	$330,300	$355,700	$381,100	$406,600
	4	$146,050	$175,375	$204,585	$233,795	$263,005	$292,215	$321,425	$350,635	$379,845	$409,055	$438,265	$467,590
8.750%	1	$87,920	$105,490	$123,130	$140,700	$158,270	$175,840	$193,410	$211,050	$228,620	$246,190	$263,760	$281,330
	2	$106,760	$128,095	$149,515	$170,850	$192,185	$213,520	$234,855	$256,275	$277,610	$298,945	$320,280	$341,615
	3	$125,600	$150,700	$175,900	$201,000	$226,100	$251,200	$276,300	$301,500	$326,600	$351,700	$376,800	$401,900
	4	$144,440	$173,305	$202,285	$231,150	$260,015	$288,880	$317,745	$346,725	$375,590	$404,455	$433,320	$462,185

Maximum affordable sales price is based on the following factors:

$75,100 Median family income as established by the U.S. Department of Housing and Urban Development (HUD).
30 Number of years for a fixed-rate mortgage loan with no discount points
30% Percentage of gross monthly income for housing expenses (principle and interest payment only)
5% Percentage of the purchase price for downpayment.

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$37,550	$45,060	$52,570	$60,080	$67,590	$75,100	$82,610	$90,120	$97,630	$105,140	$112,650	$120,160
4.000%	1	$130,410	$156,520	$182,560	$208,670	$234,710	$260,820	$286,930	$312,970	$339,080	$365,120	$391,160	$417,270
	2	$158,355	$190,060	$221,680	$253,385	$285,005	$316,710	$348,415	$380,035	$411,740	$443,360	$474,980	$506,685
	3	$186,300	$223,600	$260,800	$298,100	$335,300	$372,600	$409,900	$447,100	$484,400	$521,600	$558,800	$596,100
	4	$214,245	$257,140	$299,920	$342,815	$385,595	$428,490	$471,385	$514,165	$557,060	$599,840	$642,620	$685,515
4.125%	1	$128,450	$154,140	$179,830	$205,520	$231,210	$256,900	$282,590	$308,280	$333,970	$359,660	$385,350	$411,110
	2	$155,975	$187,170	$218,365	$249,560	$280,755	$311,950	$343,145	$374,340	$405,535	$436,730	$467,925	$499,205
	3	$183,500	$220,200	$256,900	$293,600	$330,300	$367,000	$403,700	$440,400	$477,100	$513,800	$550,500	$587,300
	4	$211,025	$253,230	$295,435	$337,640	$379,845	$422,050	$464,255	$506,460	$548,665	$590,870	$633,075	$675,395
4.250%	1	$126,560	$151,830	$177,170	$202,510	$227,780	$253,050	$278,390	$303,730	$329,070	$354,340	$379,610	$404,950
	2	$153,680	$184,365	$215,135	$245,905	$276,590	$307,275	$338,045	$368,815	$399,585	$430,270	$460,955	$491,725
	3	$180,800	$216,900	$253,100	$289,300	$325,400	$361,500	$397,700	$433,900	$470,100	$506,200	$542,300	$578,500
	4	$207,920	$249,435	$291,065	$332,695	$374,210	$415,725	$457,355	$498,985	$540,615	$582,130	$623,645	$665,275
4.375%	1	$124,670	$149,660	$174,580	$199,500	$224,420	$249,340	$274,330	$299,250	$324,170	$349,160	$374,010	$399,000
	2	$151,385	$181,730	$211,990	$242,250	$272,510	$302,770	$333,115	$363,375	$393,635	$423,980	$454,155	$484,500
	3	$178,100	$213,800	$249,400	$285,000	$320,600	$356,200	$391,900	$427,500	$463,100	$498,800	$534,300	$570,000
	4	$204,815	$245,870	$286,810	$327,750	$368,690	$409,630	$450,685	$491,625	$532,565	$573,620	$614,445	$655,500
4.500%	1	$122,850	$147,420	$171,990	$196,560	$221,130	$245,700	$270,340	$294,910	$319,480	$344,050	$368,620	$393,190
	2	$149,175	$179,010	$208,845	$238,680	$268,515	$298,350	$328,270	$358,105	$387,940	$417,775	$447,610	$477,445
	3	$175,500	$210,600	$245,700	$280,800	$315,900	$351,000	$386,200	$421,300	$456,400	$491,500	$526,600	$561,700
	4	$201,825	$242,190	$282,555	$322,920	$363,285	$403,650	$444,130	$484,495	$524,860	$565,225	$605,590	$645,955
4.625%	1	$121,100	$145,250	$169,540	$193,760	$217,980	$242,200	$266,350	$290,640	$314,790	$339,080	$363,230	$387,450
	2	$147,050	$176,375	$205,870	$235,280	$264,690	$294,100	$323,425	$352,920	$382,245	$411,740	$441,065	$470,475
	3	$173,000	$207,500	$242,200	$276,800	$311,400	$346,000	$380,500	$415,200	$449,700	$484,400	$518,900	$553,500
	4	$198,950	$238,625	$278,530	$318,320	$358,110	$397,900	$437,575	$477,480	$517,155	$557,060	$596,735	$636,525
4.750%	1	$119,350	$143,220	$167,090	$190,960	$214,830	$238,700	$262,500	$286,370	$310,310	$334,180	$358,050	$381,920
	2	$144,925	$173,910	$202,895	$231,880	$260,865	$289,850	$318,750	$347,735	$376,805	$405,790	$434,775	$463,760
	3	$170,500	$204,600	$238,700	$272,800	$306,900	$341,000	$375,000	$409,100	$443,300	$477,400	$511,500	$545,600
	4	$196,075	$235,290	$274,505	$313,720	$352,935	$392,150	$431,250	$470,465	$509,795	$549,010	$588,225	$627,440
4.875%	1	$117,600	$141,190	$164,710	$188,230	$211,750	$235,270	$258,790	$282,310	$305,900	$329,350	$352,940	$376,460
	2	$142,800	$171,445	$200,005	$228,565	$257,125	$285,685	$314,245	$342,805	$371,450	$399,925	$428,570	$457,130
	3	$168,000	$201,700	$235,300	$268,900	$302,500	$336,100	$369,700	$403,300	$437,000	$470,500	$504,200	$537,800
	4	$193,200	$231,955	$270,595	$309,235	$347,875	$386,515	$425,155	$463,795	$502,550	$541,075	$579,830	$618,470
5.000%	1	$115,990	$139,160	$162,330	$185,570	$208,740	$231,980	$255,150	$278,320	$301,490	$324,730	$347,900	$371,070
	2	$140,845	$168,980	$197,115	$225,335	$253,470	$281,690	$309,825	$337,960	$366,095	$394,315	$422,450	$450,585
	3	$165,700	$198,800	$231,900	$265,100	$298,200	$331,400	$364,500	$397,600	$430,700	$463,900	$497,000	$530,100
	4	$190,555	$228,620	$266,685	$304,865	$342,930	$381,110	$419,175	$457,240	$495,305	$533,485	$571,550	$609,615
5.125%	1	$114,380	$137,200	$160,090	$182,980	$205,800	$228,690	$251,580	$274,400	$297,290	$320,180	$343,070	$365,820
	2	$138,890	$166,600	$194,395	$222,190	$249,900	$277,695	$305,490	$333,200	$360,995	$388,790	$416,585	$444,210
	3	$163,400	$196,000	$228,700	$261,400	$294,000	$326,700	$359,400	$392,000	$424,700	$457,400	$490,100	$522,600
	4	$187,910	$225,400	$263,005	$300,610	$338,100	$375,705	$413,310	$450,800	$488,405	$526,010	$563,615	$600,990
5.250%	1	$112,700	$135,240	$157,850	$180,390	$202,930	$225,470	$248,010	$270,620	$293,160	$315,700	$338,170	$360,710
	2	$136,850	$164,220	$191,675	$219,045	$246,415	$273,785	$301,155	$328,610	$355,980	$383,350	$410,635	$438,005
	3	$161,000	$193,200	$225,500	$257,700	$289,900	$322,100	$354,300	$386,600	$418,800	$451,000	$483,100	$515,300
	4	$185,150	$222,180	$259,325	$296,355	$333,385	$370,415	$407,445	$444,590	$481,620	$518,650	$555,565	$592,595

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COUNTY OF MAUI

Effective: **May 1, 2015**

2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

MULTI-FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$37,550	$45,060	$52,570	$60,080	$67,590	$75,100	$82,610	$90,120	$97,630	$105,140	$112,650	$120,160
5.375%	1	$111,230	$133,420	$155,680	$177,870	$200,060	$222,320	$244,580	$266,840	$289,030	$311,290	$333,550	$355,740
	2	$135,065	$162,010	$189,040	$215,985	$242,930	$269,960	$296,990	$324,020	$350,965	$377,995	$405,025	$431,970
	3	$158,900	$190,600	$222,400	$254,100	$285,800	$317,600	$349,400	$381,200	$412,900	$444,700	$476,500	$508,200
	4	$182,735	$219,190	$255,760	$292,215	$328,670	$365,240	$401,810	$438,380	$474,835	$511,405	$547,975	$584,430
5.500%	1	$109,620	$131,530	$153,510	$175,490	$197,400	$219,310	$241,220	$263,130	$285,110	$307,020	$328,930	$350,840
	2	$133,110	$159,715	$186,405	$213,095	$239,700	$266,305	$292,910	$319,515	$346,205	$372,810	$399,415	$426,020
	3	$156,600	$187,900	$219,300	$250,700	$282,000	$313,300	$344,600	$375,900	$407,300	$438,600	$469,900	$501,200
	4	$180,090	$216,085	$252,195	$288,305	$324,300	$360,295	$396,290	$432,285	$468,395	$504,390	$540,385	$576,380
5.625%	1	$108,150	$129,780	$151,410	$173,040	$194,670	$216,300	$237,860	$259,560	$281,190	$302,750	$324,450	$346,080
	2	$131,325	$157,590	$183,855	$210,120	$236,385	$262,650	$288,830	$315,180	$341,445	$367,625	$393,975	$420,240
	3	$154,500	$185,400	$216,300	$247,200	$278,100	$309,000	$339,800	$370,800	$401,700	$432,500	$463,500	$494,400
	4	$177,675	$213,210	$248,745	$284,280	$319,815	$355,350	$390,770	$426,420	$461,955	$497,375	$533,025	$568,560
5.750%	1	$106,680	$128,030	$149,380	$170,660	$192,010	$213,360	$234,710	$256,060	$277,410	$298,690	$320,040	$341,390
	2	$129,540	$155,465	$181,390	$207,230	$233,155	$259,080	$285,005	$310,930	$336,855	$362,695	$388,620	$414,545
	3	$152,400	$182,900	$213,400	$243,800	$274,300	$304,800	$335,300	$365,800	$396,300	$426,700	$457,200	$487,700
	4	$175,260	$210,335	$245,410	$280,370	$315,445	$350,520	$385,595	$420,670	$455,745	$490,705	$525,780	$560,855
5.875%	1	$105,210	$126,350	$147,350	$168,420	$189,420	$210,490	$231,560	$252,560	$273,630	$294,630	$315,700	$336,770
	2	$127,755	$153,425	$178,925	$204,510	$230,010	$255,595	$281,180	$306,680	$332,265	$357,765	$383,350	$408,935
	3	$150,300	$180,500	$210,500	$240,600	$270,600	$300,700	$330,800	$360,800	$390,900	$420,900	$451,000	$481,100
	4	$172,845	$207,575	$242,075	$276,690	$311,190	$345,805	$380,420	$414,920	$449,535	$484,035	$518,650	$553,265
6.000%	1	$103,810	$124,600	$145,320	$166,110	$186,900	$207,620	$228,410	$249,200	$269,990	$290,780	$311,500	$332,290
	2	$126,055	$151,300	$176,460	$201,705	$226,950	$252,110	$277,355	$302,600	$327,845	$353,090	$378,250	$403,495
	3	$148,300	$178,000	$207,600	$237,300	$267,000	$296,600	$326,300	$356,000	$385,700	$415,400	$445,000	$474,700
	4	$170,545	$204,700	$238,740	$272,895	$307,050	$341,090	$375,245	$409,400	$443,555	$477,710	$511,750	$545,905
6.125%	1	$102,410	$122,990	$143,430	$163,940	$184,380	$204,960	$225,400	$245,910	$266,350	$286,930	$307,370	$327,880
	2	$124,355	$149,345	$174,165	$199,070	$223,890	$248,880	$273,700	$298,605	$323,425	$348,415	$373,235	$398,140
	3	$146,300	$175,700	$204,900	$234,200	$263,400	$292,800	$322,000	$351,300	$380,500	$409,900	$439,100	$468,400
	4	$168,245	$202,055	$235,635	$269,330	$302,910	$336,720	$370,300	$403,995	$437,575	$471,385	$504,965	$538,660
6.250%	1	$101,150	$121,310	$141,540	$161,770	$182,000	$202,230	$222,460	$242,690	$262,920	$283,150	$303,380	$323,540
	2	$122,825	$147,305	$171,870	$196,435	$221,000	$245,565	$270,130	$294,695	$319,260	$343,825	$368,390	$392,870
	3	$144,500	$173,300	$202,200	$231,100	$260,000	$288,900	$317,800	$346,700	$375,600	$404,500	$433,400	$462,200
	4	$166,175	$199,295	$232,530	$265,765	$299,000	$332,235	$365,470	$398,705	$431,940	$465,175	$498,410	$531,530
6.375%	1	$99,820	$119,770	$139,650	$159,670	$179,620	$199,570	$219,590	$239,470	$259,420	$279,440	$299,390	$319,340
	2	$121,210	$145,435	$169,575	$193,885	$218,110	$242,335	$266,645	$290,785	$315,010	$339,320	$363,545	$387,770
	3	$142,600	$171,100	$199,500	$228,100	$256,600	$285,100	$313,700	$342,100	$370,600	$399,200	$427,700	$456,200
	4	$163,990	$196,765	$229,425	$262,315	$295,090	$327,865	$360,755	$393,415	$426,190	$459,080	$491,855	$524,630
6.500%	1	$98,490	$118,160	$137,900	$157,570	$177,310	$196,980	$216,650	$236,390	$256,130	$275,730	$295,470	$315,210
	2	$119,595	$143,480	$167,450	$191,335	$215,305	$239,190	$263,075	$287,045	$311,015	$334,815	$358,785	$382,755
	3	$140,700	$168,800	$197,000	$225,100	$253,300	$281,400	$309,500	$337,700	$365,900	$393,900	$422,100	$450,300
	4	$161,805	$194,120	$226,550	$258,865	$291,295	$323,610	$355,925	$388,355	$420,785	$452,985	$485,415	$517,845
6.625%	1	$97,230	$116,690	$136,150	$155,540	$175,000	$194,390	$213,920	$233,380	$252,770	$272,230	$291,690	$311,080
	2	$118,065	$141,695	$165,325	$188,870	$212,500	$236,045	$259,760	$283,390	$306,935	$330,565	$354,195	$377,740
	3	$138,900	$166,700	$194,500	$222,200	$250,000	$277,700	$305,600	$333,400	$361,100	$388,900	$416,700	$444,400
	4	$159,735	$191,705	$223,675	$255,530	$287,500	$319,355	$351,440	$383,410	$415,265	$447,235	$479,205	$511,060

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: May 1, 2015

2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

MULTI-FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$37,550	$45,060	$52,570	$60,080	$67,590	$75,100	$82,610	$90,120	$97,630	$105,140	$112,650	$120,160
6.750%	1	$96,040	$115,150	$134,400	$153,580	$172,760	$191,940	$211,190	$230,300	$249,550	$268,730	$287,980	$307,160
	2	$116,620	$139,825	$163,200	$186,490	$209,780	$233,070	$256,445	$279,650	$303,025	$326,315	$349,690	$372,980
	3	$137,200	$164,500	$192,000	$219,400	$246,800	$274,200	$301,700	$329,000	$356,500	$383,900	$411,400	$438,800
	4	$157,780	$189,175	$220,800	$252,310	$283,820	$315,330	$346,955	$378,350	$409,975	$441,485	$473,110	$504,620
6.875%	1	$94,780	$113,750	$132,650	$151,620	$170,590	$189,490	$208,460	$227,430	$246,400	$265,370	$284,340	$303,240
	2	$115,090	$138,125	$161,075	$184,110	$207,145	$230,095	$253,130	$276,165	$299,200	$322,235	$345,270	$368,220
	3	$135,400	$162,500	$189,500	$216,600	$243,700	$270,700	$297,800	$324,900	$352,000	$379,100	$406,200	$433,200
	4	$155,710	$186,875	$217,925	$249,090	$280,255	$311,305	$342,470	$373,635	$404,800	$435,965	$467,130	$498,180
7.000%	1	$93,590	$112,280	$130,970	$149,660	$168,420	$187,180	$205,870	$224,630	$243,320	$262,010	$280,700	$299,460
	2	$113,645	$136,340	$159,035	$181,730	$204,510	$227,290	$249,985	$272,765	$295,460	$318,155	$340,850	$363,630
	3	$133,700	$160,400	$187,100	$213,800	$240,600	$267,400	$294,100	$320,900	$347,600	$374,300	$401,000	$427,800
	4	$153,755	$184,460	$215,165	$245,870	$276,690	$307,510	$338,215	$369,035	$399,740	$430,445	$461,150	$491,970
7.125%	1	$92,400	$110,880	$129,360	$147,840	$166,320	$184,800	$203,280	$221,760	$240,240	$258,720	$277,200	$295,750
	2	$112,200	$134,640	$157,080	$179,520	$201,960	$224,400	$246,840	$269,280	$291,720	$314,160	$336,600	$359,125
	3	$132,000	$158,400	$184,800	$211,200	$237,600	$264,000	$290,400	$316,800	$343,200	$369,600	$396,000	$422,500
	4	$151,800	$182,160	$212,520	$242,880	$273,240	$303,600	$333,960	$364,320	$394,680	$425,040	$455,400	$485,875
7.250%	1	$91,280	$109,480	$127,750	$146,020	$164,220	$182,490	$200,760	$218,960	$237,230	$255,500	$273,770	$292,040
	2	$110,840	$132,940	$155,125	$177,310	$199,410	$221,595	$243,780	$265,880	$288,065	$310,250	$332,435	$354,620
	3	$130,400	$156,400	$182,500	$208,600	$234,600	$260,700	$286,800	$312,800	$338,900	$365,000	$391,100	$417,200
	4	$149,960	$179,860	$209,875	$239,890	$269,790	$299,805	$329,820	$359,720	$389,735	$419,750	$449,765	$479,780
7.375%	1	$90,160	$108,150	$126,210	$144,200	$162,260	$180,250	$198,310	$216,370	$234,360	$252,350	$270,410	$288,400
	2	$109,480	$131,325	$153,255	$175,100	$197,030	$218,875	$240,805	$262,735	$284,580	$306,425	$328,355	$350,200
	3	$128,800	$154,500	$180,300	$206,000	$231,800	$257,500	$283,300	$309,100	$334,800	$360,500	$386,300	$412,000
	4	$148,120	$177,675	$207,345	$236,900	$266,570	$296,125	$325,795	$355,465	$385,020	$414,575	$444,245	$473,800
7.500%	1	$89,040	$106,820	$124,670	$142,450	$160,300	$178,010	$195,860	$213,710	$231,490	$249,270	$267,120	$284,900
	2	$108,120	$129,710	$151,385	$172,975	$194,650	$216,155	$237,830	$259,505	$281,095	$302,685	$324,360	$345,950
	3	$127,200	$152,600	$178,100	$203,500	$229,000	$254,300	$279,800	$305,300	$330,700	$356,100	$381,600	$407,000
	4	$146,280	$175,490	$204,815	$234,025	$263,350	$292,445	$321,770	$351,095	$380,305	$409,515	$438,840	$468,050
7.625%	1	$87,920	$105,560	$123,200	$140,770	$158,340	$175,910	$193,480	$211,120	$228,690	$246,260	$263,830	$281,470
	2	$106,760	$128,180	$149,600	$170,935	$192,270	$213,605	$234,940	$256,360	$277,695	$299,030	$320,365	$341,785
	3	$125,600	$150,800	$176,000	$201,100	$226,200	$251,300	$276,400	$301,600	$326,700	$351,800	$376,900	$402,100
	4	$144,440	$173,420	$202,400	$231,265	$260,130	$288,995	$317,860	$346,840	$375,705	$404,570	$433,435	$462,415
7.750%	1	$86,870	$104,300	$121,660	$139,020	$156,450	$173,810	$191,170	$208,530	$225,890	$243,320	$260,680	$278,110
	2	$105,485	$126,650	$147,730	$168,810	$189,975	$211,055	$232,135	$253,215	$274,295	$295,460	$316,540	$337,705
	3	$124,100	$149,000	$173,800	$198,600	$223,500	$248,300	$273,100	$297,900	$322,700	$347,600	$372,400	$397,300
	4	$142,715	$171,350	$199,870	$228,390	$257,025	$285,545	$314,065	$342,585	$371,105	$399,740	$428,260	$456,895
7.875%	1	$85,890	$103,040	$120,190	$137,410	$154,560	$171,710	$188,860	$206,080	$223,230	$240,380	$257,600	$274,750
	2	$104,295	$125,120	$145,945	$166,855	$187,680	$208,505	$229,330	$250,240	$271,065	$291,890	$312,800	$333,625
	3	$122,700	$147,200	$171,700	$196,300	$220,800	$245,300	$269,800	$294,400	$318,900	$343,400	$368,000	$392,500
	4	$141,105	$169,280	$197,455	$225,745	$253,920	$282,095	$310,270	$338,560	$366,735	$394,910	$423,200	$451,375
8.000%	1	$84,840	$101,780	$118,790	$135,800	$152,740	$169,680	$186,690	$203,630	$220,570	$237,580	$254,520	$271,460
	2	$103,020	$123,590	$144,245	$164,900	$185,470	$206,040	$226,695	$247,265	$267,835	$288,490	$309,060	$329,630
	3	$121,200	$145,400	$169,700	$194,000	$218,200	$242,400	$266,700	$290,900	$315,100	$339,400	$363,600	$387,800
	4	$139,380	$167,210	$195,155	$223,100	$250,930	$278,760	$306,705	$334,535	$362,365	$390,310	$418,140	$445,970

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2015
AFFORDABLE SALES PRICE GUIDELINES

MAUI (EXCEPT HANA)

MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$37,550	$45,060	$52,570	$60,080	$67,590	$75,100	$82,610	$90,120	$97,630	$105,140	$112,650	$120,160
8.125%	1	$83,860	$100,590	$117,390	$134,120	$150,920	$167,720	$184,450	$201,250	$217,980	$234,710	$251,580	$268,310
	2	$101,830	$122,145	$142,545	$162,860	$183,260	$203,660	$223,975	$244,375	$264,690	$285,005	$305,490	$325,805
	3	$119,800	$143,700	$167,700	$191,600	$215,600	$239,600	$263,500	$287,500	$311,400	$335,300	$359,400	$383,300
	4	$137,770	$165,255	$192,855	$220,340	$247,940	$275,540	$303,025	$330,625	$358,110	$385,595	$413,310	$440,795
8.250%	1	$82,880	$99,400	$115,990	$132,650	$149,170	$165,760	$182,350	$198,870	$215,460	$232,050	$248,570	$265,160
	2	$100,640	$120,700	$140,845	$161,075	$181,135	$201,280	$221,425	$241,485	$261,630	$281,775	$301,835	$321,980
	3	$118,400	$142,000	$165,700	$189,500	$213,100	$236,800	$260,500	$284,100	$307,800	$331,500	$355,100	$378,800
	4	$136,160	$163,300	$190,555	$217,925	$245,065	$272,320	$299,575	$326,715	$353,970	$381,225	$408,365	$435,620
8.375%	1	$81,900	$98,280	$114,660	$131,040	$147,420	$163,800	$180,180	$196,560	$212,940	$229,320	$245,700	$262,080
	2	$99,450	$119,340	$139,230	$159,120	$179,010	$198,900	$218,790	$238,680	$258,570	$278,460	$298,350	$318,240
	3	$117,000	$140,400	$163,800	$187,200	$210,600	$234,000	$257,400	$280,800	$304,200	$327,600	$351,000	$374,400
	4	$134,550	$161,460	$188,370	$215,280	$242,190	$269,100	$296,010	$322,920	$349,830	$376,740	$403,650	$430,560
8.500%	1	$80,990	$97,160	$113,330	$129,500	$145,740	$161,910	$178,080	$194,320	$210,490	$226,660	$242,900	$259,070
	2	$98,345	$117,980	$137,615	$157,250	$176,970	$196,605	$216,240	$235,960	$255,595	$275,230	$294,950	$314,585
	3	$115,700	$138,800	$161,900	$185,000	$208,200	$231,300	$254,400	$277,600	$300,700	$323,800	$347,000	$370,100
	4	$133,055	$159,620	$186,185	$212,750	$239,430	$265,995	$292,560	$319,240	$345,805	$372,370	$399,050	$425,615
8.625%	1	$80,010	$96,110	$112,070	$128,100	$144,060	$160,090	$176,120	$192,080	$208,110	$224,070	$240,100	$256,130
	2	$97,155	$116,705	$136,085	$155,550	$174,930	$194,395	$213,860	$233,240	$252,705	$272,085	$291,550	$311,015
	3	$114,300	$137,300	$160,100	$183,000	$205,800	$228,700	$251,600	$274,400	$297,300	$320,100	$343,000	$365,900
	4	$131,445	$157,895	$184,115	$210,450	$236,670	$263,005	$289,340	$315,560	$341,895	$368,115	$394,450	$420,785
8.750%	1	$79,100	$94,920	$110,810	$126,630	$142,450	$158,270	$174,090	$189,980	$205,730	$221,550	$237,370	$253,190
	2	$96,050	$115,260	$134,555	$153,765	$172,975	$192,185	$211,395	$230,690	$249,815	$269,025	$288,235	$307,445
	3	$113,000	$135,600	$158,300	$180,900	$203,500	$226,100	$248,700	$271,400	$293,900	$316,500	$339,100	$361,700
	4	$129,950	$155,940	$182,045	$208,035	$234,025	$260,015	$286,005	$312,110	$337,985	$363,975	$389,965	$415,955

Maximum affordable sales price is based on the following factors:

$75,100 Median family income as established by the U.S. Department of Housing and Urban Development (HUD).
30 Number of years for a fixed-rate mortgage loan with no discount points
30% Percentage of gross monthly income for housing expenses (principle and interest payment only)
5% Percentage of the purchase price for downpayment.

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COUNTY OF MAUI

Effective: **May 1, 2015**

2015
INCOME LIMITS & AFFORDABLE RENT GUIDELINES

MAUI (EXCEPT HANA)

INCOME LIMITS FOR RENTAL UNITS (BY FAMILY SIZE & PERCENTAGE OF MEDIAN FAMILY INCOME)

% of Median	1 PERSON 0.7	2 PERSON 0.8	3 PERSON 0.9	4 PERSON 1.0	5 PERSON 1.08	6 PERSON 1.16	7 PERSON 1.24	8 PERSON 1.32
10%	$5,260	$6,010	$6,760	$7,510	$8,110	$8,710	$9,310	$9,910
20%	$10,510	$12,020	$13,520	$15,020	$16,220	$17,420	$18,620	$19,830
30%	$15,770	$18,020	$20,280	$22,530	$24,330	$26,130	$27,940	$29,740
40%	$21,030	$24,030	$27,040	$30,040	$32,440	$34,850	$37,250	$39,650
50%	$26,290	$30,040	$33,800	$37,550	$40,550	$43,560	$46,560	$49,570
60%	$31,540	$36,050	$40,550	$45,060	$48,660	$52,270	$55,870	$59,480
70%	$36,800	$42,060	$47,310	$52,570	$56,780	$60,980	$65,190	$69,390
80%	$42,060	$48,060	$54,070	$60,080	$64,890	$69,690	$74,500	$79,310
90%	$47,310	$54,070	$60,830	$67,590	$73,000	$78,400	$83,810	$89,220
100%	$52,570	$60,080	$67,590	$75,100	$81,110	$87,120	$93,120	$99,130
110%	$57,830	$66,090	$74,350	$82,610	$89,220	$95,830	$102,440	$109,050
120%	$63,080	$72,100	$81,110	$90,120	$97,330	$104,540	$111,750	$118,960
130%	$68,340	$78,100	$87,870	$97,630	$105,440	$113,250	$121,060	$128,870
140%	$73,600	$84,110	$94,630	$105,140	$113,550	$121,960	$130,370	$138,780

AFFORDABLE RENT GUIDELINES (BY UNIT SIZE & PERCENTAGE OF MEDIAN FAMILY INCOME)

% of Median	UNIT SIZE (NO. OF BEDROOMS) 0	1	2	3	4	5
10%	$132	$141	$169	$195	$218	$240
20%	$263	$282	$338	$391	$436	$481
30%	$394	$422	$507	$586	$653	$721
40%	$526	$563	$676	$781	$871	$961
50%	$657	$704	$845	$976	$1,089	$1,202
60%	$789	$845	$1,014	$1,172	$1,307	$1,442
70%	$920	$986	$1,183	$1,367	$1,525	$1,682
80%	$1,052	$1,127	$1,352	$1,562	$1,742	$1,923
90%	$1,183	$1,267	$1,521	$1,757	$1,960	$2,163
100%	$1,314	$1,408	$1,690	$1,953	$2,178	$2,403
110%	$1,446	$1,549	$1,859	$2,148	$2,396	$2,644
120%	$1,577	$1,690	$2,028	$2,343	$2,614	$2,884
130%	$1,709	$1,831	$2,197	$2,538	$2,831	$3,124
140%	$1,840	$1,971	$2,366	$2,734	$3,049	$3,364

Note: Affordable rents are based on 30% of gross monthly income. Affordable rents include utilities.

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COUNTY OF MAUI

Effective: **May 1, 2015**

2015
AFFORDABLE SALES PRICE GUIDELINES
HANA
METHODOLOGY
For Calculating Median Family Income

Factors used in calculation:

HUD's 2015 median family income for the County of Maui	$75,100
American Community Survey 5-Year Estimate 2008-2012 median family income for Hana (from the Hawaii State Data Center)	$57,667
Est. 2015 Hana median family income (Rounded to the nearest $10)	**$57,670**

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2015
AFFORDABLE SALES PRICE GUIDELINES

HANA

SINGLE FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$28,835	$34,602	$40,369	$46,136	$51,903	$57,670	$63,437	$69,204	$74,971	$80,738	$86,505	$92,272
4.000%	1	$111,230	$133,490	$155,750	$178,010	$200,270	$222,530	$244,790	$267,050	$289,310	$311,500	$333,760	$356,020
	2	$135,065	$162,095	$189,125	$216,155	$243,185	$270,215	$297,245	$324,275	$351,305	$378,250	$405,280	$432,310
	3	$158,900	$190,700	$222,500	$254,300	$286,100	$317,900	$349,700	$381,500	$413,300	$445,000	$476,800	$508,600
	4	$182,735	$219,305	$255,875	$292,445	$329,015	$365,585	$402,155	$438,725	$475,295	$511,750	$548,320	$584,890
4.125%	1	$109,620	$131,530	$153,440	$175,350	$197,260	$219,170	$241,150	$263,060	$284,970	$306,880	$328,790	$350,700
	2	$133,110	$159,715	$186,320	$212,925	$239,530	$266,135	$292,825	$319,430	$346,035	$372,640	$399,245	$425,850
	3	$156,600	$187,900	$219,200	$250,500	$281,800	$313,100	$344,500	$375,800	$407,100	$438,400	$469,700	$501,000
	4	$180,090	$216,085	$252,080	$288,075	$324,070	$360,065	$396,175	$432,170	$468,165	$504,160	$540,155	$576,150
4.250%	1	$107,940	$129,570	$151,130	$172,760	$194,320	$215,950	$237,510	$259,140	$280,700	$302,330	$323,890	$345,520
	2	$131,070	$157,335	$183,515	$209,780	$235,960	$262,225	$288,405	$314,670	$340,850	$367,115	$393,295	$419,560
	3	$154,200	$185,100	$215,900	$246,800	$277,600	$308,500	$339,300	$370,200	$401,000	$431,900	$462,700	$493,600
	4	$177,330	$212,865	$248,285	$283,820	$319,240	$354,775	$390,195	$425,730	$461,150	$496,685	$532,105	$567,640
4.375%	1	$106,400	$127,680	$148,960	$170,240	$191,520	$212,800	$234,080	$255,360	$276,570	$297,850	$319,130	$340,410
	2	$129,200	$155,040	$180,880	$206,720	$232,560	$258,400	$284,240	$310,080	$335,835	$361,675	$387,515	$413,355
	3	$152,000	$182,400	$212,800	$243,200	$273,600	$304,000	$334,400	$364,800	$395,100	$425,500	$455,900	$486,300
	4	$174,800	$209,760	$244,720	$279,680	$314,640	$349,600	$384,560	$419,520	$454,365	$489,325	$524,285	$559,245
4.500%	1	$104,860	$125,790	$146,790	$167,720	$188,720	$209,650	$230,650	$251,580	$272,580	$293,510	$314,510	$335,440
	2	$127,330	$152,745	$178,245	$203,660	$229,160	$254,575	$280,075	$305,490	$330,990	$356,405	$381,905	$407,320
	3	$149,800	$179,700	$209,700	$239,600	$269,600	$299,500	$329,500	$359,400	$389,400	$419,300	$449,300	$479,200
	4	$172,270	$206,655	$241,155	$275,540	$310,040	$344,425	$378,925	$413,310	$447,810	$482,195	$516,695	$551,080
4.625%	1	$103,320	$123,970	$144,620	$165,270	$185,990	$206,640	$227,290	$247,940	$268,590	$289,310	$309,960	$330,610
	2	$125,460	$150,535	$175,610	$200,685	$225,845	$250,920	$275,995	$301,070	$326,145	$351,305	$376,380	$401,455
	3	$147,600	$177,100	$206,600	$236,100	$265,700	$295,200	$324,700	$354,200	$383,700	$413,300	$442,800	$472,300
	4	$169,740	$203,665	$237,590	$271,515	$305,555	$339,480	$373,405	$407,330	$441,255	$475,295	$509,220	$543,145
4.750%	1	$101,850	$122,220	$142,590	$162,890	$183,260	$203,630	$224,000	$244,370	$264,740	$285,110	$305,480	$325,850
	2	$123,675	$148,410	$173,145	$197,795	$222,530	$247,265	$272,000	$296,735	$321,470	$346,205	$370,940	$395,675
	3	$145,500	$174,600	$203,700	$232,700	$261,800	$290,900	$320,000	$349,100	$378,200	$407,300	$436,400	$465,500
	4	$167,325	$200,790	$234,255	$267,605	$301,070	$334,535	$368,000	$401,465	$434,930	$468,395	$501,860	$535,325
4.875%	1	$100,380	$120,470	$140,490	$160,580	$180,670	$200,760	$220,850	$240,870	$260,960	$281,050	$301,140	$321,160
	2	$121,890	$146,285	$170,595	$194,990	$219,385	$243,780	$268,175	$292,485	$316,880	$341,275	$365,670	$389,980
	3	$143,400	$172,100	$200,700	$229,400	$258,100	$286,800	$315,500	$344,100	$372,800	$401,500	$430,200	$458,800
	4	$164,910	$197,915	$230,805	$263,810	$296,815	$329,820	$362,825	$395,715	$428,720	$461,725	$494,730	$527,620
5.000%	1	$98,980	$118,720	$138,530	$158,340	$178,080	$197,890	$217,700	$237,440	$257,250	$277,060	$296,870	$316,610
	2	$120,190	$144,160	$168,215	$192,270	$216,240	$240,295	$264,350	$288,320	$312,375	$336,430	$360,485	$384,455
	3	$141,400	$169,600	$197,900	$226,200	$254,400	$282,700	$311,000	$339,200	$367,500	$395,800	$424,100	$452,300
	4	$162,610	$195,040	$227,585	$260,130	$292,560	$325,105	$357,650	$390,080	$422,625	$455,170	$487,715	$520,145
5.125%	1	$97,580	$117,040	$136,570	$156,100	$175,630	$195,090	$214,620	$234,150	$253,610	$273,140	$292,670	$312,200
	2	$118,490	$142,120	$165,835	$189,550	$213,265	$236,895	$260,610	$284,325	$307,955	$331,670	$355,385	$379,100
	3	$139,400	$167,200	$195,100	$223,000	$250,900	$278,700	$306,600	$334,500	$362,300	$390,200	$418,100	$446,000
	4	$160,310	$192,280	$224,365	$256,450	$288,535	$320,505	$352,590	$384,675	$416,645	$448,730	$480,815	$512,900
5.250%	1	$96,180	$115,430	$134,680	$153,930	$173,110	$192,360	$211,610	$230,860	$250,110	$269,360	$288,540	$307,790
	2	$116,790	$140,165	$163,540	$186,915	$210,205	$233,580	$256,955	$280,330	$303,705	$327,080	$350,370	$373,745
	3	$137,400	$164,900	$192,400	$219,900	$247,300	$274,800	$302,300	$329,800	$357,300	$384,800	$412,200	$439,700
	4	$158,010	$189,635	$221,260	$252,885	$284,395	$316,020	$347,645	$379,270	$410,895	$442,520	$474,030	$505,655

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: May 1, 2015

2015
AFFORDABLE SALES PRICE GUIDELINES
HANA
SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$28,835	$34,602	$40,369	$46,136	$51,903	$57,670	$63,437	$69,204	$74,971	$80,738	$86,505	$92,272
5.375%	1	$94,850	$113,820	$132,790	$151,760	$170,730	$189,700	$208,670	$227,640	$246,610	$265,580	$284,550	$303,520
	2	$115,175	$138,210	$161,245	$184,280	$207,315	$230,350	$253,385	$276,420	$299,455	$322,490	$345,525	$368,560
	3	$135,500	$162,600	$189,700	$216,800	$243,900	$271,000	$298,100	$325,200	$352,300	$379,400	$406,500	$433,600
	4	$155,825	$186,990	$218,155	$249,320	$280,485	$311,650	$342,815	$373,980	$405,145	$436,310	$467,475	$498,640
5.500%	1	$93,520	$112,280	$130,970	$149,660	$168,420	$187,110	$205,800	$224,490	$243,250	$261,940	$280,630	$299,390
	2	$113,560	$136,340	$159,035	$181,730	$204,510	$227,205	$249,900	$272,595	$295,375	$318,070	$340,765	$363,545
	3	$133,600	$160,400	$187,100	$213,800	$240,600	$267,300	$294,000	$320,700	$347,500	$374,200	$400,900	$427,700
	4	$153,640	$184,460	$215,165	$245,870	$276,690	$307,395	$338,100	$368,805	$399,625	$430,330	$461,035	$491,855
5.625%	1	$92,260	$110,740	$129,150	$147,630	$166,110	$184,520	$203,000	$221,480	$239,890	$258,370	$276,850	$295,260
	2	$112,030	$134,470	$156,825	$179,265	$201,705	$224,060	$246,500	$268,940	$291,295	$313,735	$336,175	$358,530
	3	$131,800	$158,200	$184,500	$210,900	$237,300	$263,600	$290,000	$316,400	$342,700	$369,100	$395,500	$421,800
	4	$151,570	$181,930	$212,175	$242,535	$272,895	$303,140	$333,500	$363,860	$394,105	$424,465	$454,825	$485,070
5.750%	1	$91,000	$109,200	$127,400	$145,600	$163,870	$182,070	$200,270	$218,470	$236,670	$254,870	$273,070	$291,270
	2	$110,500	$132,600	$154,700	$176,800	$198,985	$221,085	$243,185	$265,285	$287,385	$309,485	$331,585	$353,685
	3	$130,000	$156,000	$182,000	$208,000	$234,100	$260,100	$286,100	$312,100	$338,100	$364,100	$390,100	$416,100
	4	$149,500	$179,400	$209,300	$239,200	$269,215	$299,115	$329,015	$358,915	$388,815	$418,715	$448,615	$478,515
5.875%	1	$89,810	$107,730	$125,720	$143,640	$161,630	$179,620	$197,540	$215,530	$233,450	$251,440	$269,360	$287,350
	2	$109,055	$130,815	$152,660	$174,420	$196,265	$218,110	$239,870	$261,715	$283,475	$305,320	$327,080	$348,925
	3	$128,300	$153,900	$179,600	$205,200	$230,900	$256,600	$282,200	$307,900	$333,500	$359,200	$384,800	$410,500
	4	$147,545	$176,985	$206,540	$235,980	$265,535	$295,090	$324,530	$354,085	$383,525	$413,080	$442,520	$472,075
6.000%	1	$88,620	$106,330	$124,040	$141,750	$159,460	$177,170	$194,880	$212,660	$230,370	$248,080	$265,790	$283,500
	2	$107,610	$129,115	$150,620	$172,125	$193,630	$215,135	$236,640	$258,230	$279,735	$301,240	$322,745	$344,250
	3	$126,600	$151,900	$177,200	$202,500	$227,800	$253,100	$278,400	$303,800	$329,100	$354,400	$379,700	$405,000
	4	$145,590	$174,685	$203,780	$232,875	$261,970	$291,065	$320,160	$349,370	$378,465	$407,560	$436,655	$465,750
6.125%	1	$87,430	$104,930	$122,360	$139,860	$157,360	$174,860	$192,290	$209,790	$227,290	$244,790	$262,290	$279,720
	2	$106,165	$127,415	$148,580	$169,830	$191,080	$212,330	$233,495	$254,745	$275,995	$297,245	$318,495	$339,660
	3	$124,900	$149,900	$174,800	$199,800	$224,800	$249,800	$274,700	$299,700	$324,700	$349,700	$374,700	$399,600
	4	$143,635	$172,385	$201,020	$229,770	$258,520	$287,270	$315,905	$344,655	$373,405	$402,155	$430,905	$459,540
6.250%	1	$86,240	$103,530	$120,750	$138,040	$155,260	$172,550	$189,770	$207,060	$224,280	$241,570	$258,790	$276,080
	2	$104,720	$125,715	$146,625	$167,620	$188,530	$209,525	$230,435	$251,430	$272,340	$293,335	$314,245	$335,240
	3	$123,200	$147,900	$172,500	$197,200	$221,800	$246,500	$271,100	$295,800	$320,400	$345,100	$369,700	$394,400
	4	$141,680	$170,085	$198,375	$226,780	$255,070	$283,475	$311,765	$340,170	$368,460	$396,865	$425,155	$453,560
6.375%	1	$85,120	$102,200	$119,210	$136,220	$153,230	$170,310	$187,320	$204,330	$221,340	$238,420	$255,430	$272,440
	2	$103,360	$124,100	$144,755	$165,410	$186,065	$206,805	$227,460	$248,115	$268,770	$289,510	$310,165	$330,820
	3	$121,600	$146,000	$170,300	$194,600	$218,900	$243,300	$267,600	$291,900	$316,200	$340,600	$364,900	$389,200
	4	$139,840	$167,900	$195,845	$223,790	$251,735	$279,795	$307,740	$335,685	$363,630	$391,690	$419,635	$447,580
6.500%	1	$84,070	$100,870	$117,670	$134,470	$151,270	$168,070	$184,870	$201,670	$218,470	$235,270	$252,140	$268,940
	2	$102,085	$122,485	$142,885	$163,285	$183,685	$204,085	$224,485	$244,885	$265,285	$285,685	$306,170	$326,570
	3	$120,100	$144,100	$168,100	$192,100	$216,100	$240,100	$264,100	$288,100	$312,100	$336,100	$360,200	$384,200
	4	$138,115	$165,715	$193,315	$220,915	$248,515	$276,115	$303,715	$331,315	$358,915	$386,515	$414,230	$441,830
6.625%	1	$82,950	$99,540	$116,130	$132,720	$149,310	$165,900	$182,490	$199,080	$215,670	$232,260	$248,850	$265,440
	2	$100,725	$120,870	$141,015	$161,160	$181,305	$201,450	$221,595	$241,740	$261,885	$282,030	$302,175	$322,320
	3	$118,500	$142,200	$165,900	$189,600	$213,300	$237,000	$260,700	$284,400	$308,100	$331,800	$355,500	$379,200
	4	$136,275	$163,530	$190,785	$218,040	$245,295	$272,550	$299,805	$327,060	$354,315	$381,570	$408,825	$436,080

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DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

HANA

SINGLE FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$28,835	$34,602	$40,369	$46,136	$51,903	$57,670	$63,437	$69,204	$74,971	$80,738	$86,505	$92,272
6.750%	1	$81,900	$98,280	$114,660	$131,040	$147,420	$163,800	$180,180	$196,560	$212,940	$229,320	$245,700	$262,080
	2	$99,450	$119,340	$139,230	$159,120	$179,010	$198,900	$218,790	$238,680	$258,570	$278,460	$298,350	$318,240
	3	$117,000	$140,400	$163,800	$187,200	$210,600	$234,000	$257,400	$280,800	$304,200	$327,600	$351,000	$374,400
	4	$134,550	$161,460	$188,370	$215,280	$242,190	$269,100	$296,010	$322,920	$349,830	$376,740	$403,650	$430,560
6.875%	1	$80,850	$97,020	$113,190	$129,360	$145,530	$161,700	$177,870	$194,040	$210,210	$226,380	$242,550	$258,720
	2	$98,175	$117,810	$137,445	$157,080	$176,715	$196,350	$215,985	$235,620	$255,255	$274,890	$294,525	$314,160
	3	$115,500	$138,600	$161,700	$184,800	$207,900	$231,000	$254,100	$277,200	$300,300	$323,400	$346,500	$369,600
	4	$132,825	$159,390	$185,955	$212,520	$239,085	$265,650	$292,215	$318,780	$345,345	$371,910	$398,475	$425,040
7.000%	1	$79,870	$95,830	$111,790	$127,750	$143,710	$159,670	$175,630	$191,590	$207,550	$223,580	$239,540	$255,500
	2	$96,985	$116,365	$135,745	$155,125	$174,505	$193,885	$213,265	$232,645	$252,025	$271,490	$290,870	$310,250
	3	$114,100	$136,900	$159,700	$182,500	$205,300	$228,100	$250,900	$273,700	$296,500	$319,400	$342,200	$365,000
	4	$131,215	$157,435	$183,655	$209,875	$236,095	$262,315	$288,535	$314,755	$340,975	$367,310	$393,530	$419,750
7.125%	1	$78,820	$94,640	$110,390	$126,140	$141,890	$157,710	$173,460	$189,210	$204,960	$220,780	$236,530	$252,280
	2	$95,710	$114,920	$134,045	$153,170	$172,295	$191,505	$210,630	$229,755	$248,880	$268,090	$287,215	$306,340
	3	$112,600	$135,200	$157,700	$180,200	$202,700	$225,300	$247,800	$270,300	$292,800	$315,400	$337,900	$360,400
	4	$129,490	$155,480	$181,355	$207,230	$233,105	$259,095	$284,970	$310,845	$336,720	$362,710	$388,585	$414,460
7.250%	1	$77,840	$93,450	$108,990	$124,600	$140,140	$155,750	$171,290	$186,900	$202,440	$218,050	$233,590	$249,200
	2	$94,520	$113,475	$132,345	$151,300	$170,170	$189,125	$207,995	$226,950	$245,820	$264,775	$283,645	$302,600
	3	$111,200	$133,500	$155,700	$178,000	$200,200	$222,500	$244,700	$267,000	$289,200	$311,500	$333,700	$356,000
	4	$127,880	$153,525	$179,055	$204,700	$230,230	$255,875	$281,405	$307,050	$332,580	$358,225	$383,755	$409,400
7.375%	1	$76,930	$92,260	$107,660	$123,060	$138,460	$153,790	$169,190	$184,590	$199,990	$215,320	$230,720	$246,120
	2	$93,415	$112,030	$130,730	$149,430	$168,130	$186,745	$205,445	$224,145	$242,845	$261,460	$280,160	$298,860
	3	$109,900	$131,800	$153,800	$175,800	$197,800	$219,700	$241,700	$263,700	$285,700	$307,600	$329,600	$351,600
	4	$126,385	$151,570	$176,870	$202,170	$227,470	$252,655	$277,955	$303,255	$328,555	$353,740	$379,040	$404,340
7.500%	1	$75,950	$91,140	$106,330	$121,520	$136,710	$151,900	$167,160	$182,350	$197,540	$212,730	$227,920	$243,110
	2	$92,225	$110,670	$129,115	$147,560	$166,005	$184,450	$202,980	$221,425	$239,870	$258,315	$276,760	$295,205
	3	$108,500	$130,200	$151,900	$173,600	$195,300	$217,000	$238,800	$260,500	$282,200	$303,900	$325,600	$347,300
	4	$124,775	$149,730	$174,685	$199,640	$224,595	$249,550	$274,620	$299,575	$324,530	$349,485	$374,440	$399,395
7.625%	1	$75,040	$90,090	$105,070	$120,050	$135,100	$150,080	$165,130	$180,110	$195,090	$210,140	$225,120	$240,170
	2	$91,120	$109,395	$127,585	$145,775	$164,050	$182,240	$200,515	$218,705	$236,895	$255,170	$273,360	$291,635
	3	$107,200	$128,700	$150,100	$171,500	$193,000	$214,400	$235,900	$257,300	$278,700	$300,200	$321,600	$343,100
	4	$123,280	$148,005	$172,615	$197,225	$221,950	$246,560	$271,285	$295,895	$320,505	$345,230	$369,840	$394,565
7.750%	1	$74,130	$88,970	$103,810	$118,650	$133,490	$148,260	$163,100	$177,940	$192,780	$207,620	$222,460	$237,230
	2	$90,015	$108,035	$126,055	$144,075	$162,095	$180,030	$198,050	$216,070	$234,090	$252,110	$270,130	$288,065
	3	$105,900	$127,100	$148,300	$169,500	$190,700	$211,800	$233,000	$254,200	$275,400	$296,600	$317,800	$338,900
	4	$121,785	$146,165	$170,545	$194,925	$219,305	$243,570	$267,950	$292,330	$316,710	$341,090	$365,470	$389,735
7.875%	1	$73,290	$87,920	$102,550	$117,180	$131,880	$146,510	$161,140	$175,840	$190,470	$205,100	$219,800	$234,430
	2	$88,995	$106,760	$124,525	$142,290	$160,140	$177,905	$195,670	$213,520	$231,285	$249,050	$266,900	$284,665
	3	$104,700	$125,600	$146,500	$167,400	$188,400	$209,300	$230,200	$251,200	$272,100	$293,000	$314,000	$334,900
	4	$120,405	$144,440	$168,475	$192,510	$216,660	$240,695	$264,730	$288,880	$312,915	$336,950	$361,100	$385,135
8.000%	1	$72,380	$86,870	$101,360	$115,850	$130,270	$144,760	$159,250	$173,740	$188,230	$202,720	$217,140	$231,630
	2	$87,890	$105,485	$123,080	$140,675	$158,185	$175,780	$193,375	$210,970	$228,565	$246,160	$263,670	$281,265
	3	$103,400	$124,100	$144,800	$165,500	$186,100	$206,800	$227,500	$248,200	$268,900	$289,600	$310,200	$330,900
	4	$118,910	$142,715	$166,520	$190,325	$214,015	$237,820	$261,625	$285,430	$309,235	$333,040	$356,730	$380,535

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COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

HANA

SINGLE FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$28,835	$34,602	$40,369	$46,136	$51,903	$57,670	$63,437	$69,204	$74,971	$80,738	$86,505	$92,272
8.125%	1	$71,540	$85,820	$100,170	$114,450	$128,800	$143,080	$157,360	$171,710	$185,990	$200,340	$214,620	$228,900
	2	$86,870	$104,210	$121,635	$138,975	$156,400	$173,740	$191,080	$208,505	$225,845	$243,270	$260,610	$277,950
	3	$102,200	$122,600	$143,100	$163,500	$184,000	$204,400	$224,800	$245,300	$265,700	$286,200	$306,600	$327,000
	4	$117,530	$140,990	$164,565	$188,025	$211,600	$235,060	$258,520	$282,095	$305,555	$329,130	$352,590	$376,050
8.250%	1	$70,700	$84,840	$98,980	$113,120	$127,260	$141,400	$155,540	$169,680	$183,820	$197,960	$212,100	$226,240
	2	$85,850	$103,020	$120,190	$137,360	$154,530	$171,700	$188,870	$206,040	$223,210	$240,380	$257,550	$274,720
	3	$101,000	$121,200	$141,400	$161,600	$181,800	$202,000	$222,200	$242,400	$262,600	$282,800	$303,000	$323,200
	4	$116,150	$139,380	$162,610	$185,840	$209,070	$232,300	$255,530	$278,760	$301,990	$325,220	$348,450	$371,680
8.375%	1	$69,860	$83,860	$97,860	$111,790	$125,790	$139,790	$153,720	$167,720	$181,720	$195,650	$209,650	$223,650
	2	$84,830	$101,830	$118,830	$135,745	$152,745	$169,745	$186,660	$203,660	$220,660	$237,575	$254,575	$271,575
	3	$99,800	$119,800	$139,800	$159,700	$179,700	$199,700	$219,600	$239,600	$259,600	$279,500	$299,500	$319,500
	4	$114,770	$137,770	$160,770	$183,655	$206,655	$229,655	$252,540	$275,540	$298,540	$321,425	$344,425	$367,425
8.500%	1	$69,090	$82,880	$96,740	$110,530	$124,320	$138,180	$151,970	$165,760	$179,620	$193,410	$207,270	$221,060
	2	$83,895	$100,640	$117,470	$134,215	$150,960	$167,790	$184,535	$201,280	$218,110	$234,855	$251,685	$268,430
	3	$98,700	$118,400	$138,200	$157,900	$177,600	$197,400	$217,100	$236,800	$256,600	$276,300	$296,100	$315,800
	4	$113,505	$136,160	$158,930	$181,585	$204,240	$227,010	$249,665	$272,320	$295,090	$317,745	$340,515	$363,170
8.625%	1	$68,320	$81,970	$95,620	$109,270	$122,920	$136,570	$150,220	$163,870	$177,590	$191,240	$204,890	$218,540
	2	$82,960	$99,535	$116,110	$132,685	$149,260	$165,835	$182,410	$198,985	$215,645	$232,220	$248,795	$265,370
	3	$97,600	$117,100	$136,600	$156,100	$175,600	$195,100	$214,600	$234,100	$253,700	$273,200	$292,700	$312,200
	4	$112,240	$134,665	$157,090	$179,515	$201,940	$224,365	$246,790	$269,215	$291,755	$314,180	$336,605	$359,030
8.750%	1	$67,550	$80,990	$94,500	$108,010	$121,520	$135,030	$148,540	$162,050	$175,560	$189,070	$202,580	$216,090
	2	$82,025	$98,345	$114,750	$131,155	$147,560	$163,965	$180,370	$196,775	$213,180	$229,585	$245,990	$262,395
	3	$96,500	$115,700	$135,000	$154,300	$173,600	$192,900	$212,200	$231,500	$250,800	$270,100	$289,400	$308,700
	4	$110,975	$133,055	$155,250	$177,445	$199,640	$221,835	$244,030	$266,225	$288,420	$310,615	$332,810	$355,005

Maximum affordable sales price is based on the following factors:

$57,670 Median family income as established by the Department of Housing and Human Concerns (DHHC)
30 Number of years for a fixed-rate mortgage loan with no discount points
30% Percentage of gross monthly income for housing expenses (principle and interest payment only)
5% Percentage of the purchase price for downpayment.

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES
HANA
MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$28,835	$34,602	$40,369	$46,136	$51,903	$57,670	$63,437	$69,204	$74,971	$80,738	$86,505	$92,272
4.000%	1	$100,100	$120,120	$140,210	$160,230	$180,250	$200,270	$220,290	$240,380	$260,400	$280,350	$300,370	$320,390
	2	$121,550	$145,860	$170,255	$194,565	$218,875	$243,185	$267,495	$291,890	$316,200	$340,425	$364,735	$389,045
	3	$143,000	$171,600	$200,300	$228,900	$257,500	$286,100	$314,700	$343,400	$372,000	$400,500	$429,100	$457,700
	4	$164,450	$197,340	$230,345	$263,235	$296,125	$329,015	$361,905	$394,910	$427,800	$460,575	$493,465	$526,355
4.125%	1	$98,630	$118,370	$138,110	$157,850	$177,520	$197,260	$217,070	$236,740	$256,480	$276,220	$295,890	$315,630
	2	$119,765	$143,735	$167,705	$191,675	$215,560	$239,530	$263,585	$287,470	$311,440	$335,410	$359,295	$383,265
	3	$140,900	$169,100	$197,300	$225,500	$253,600	$281,800	$310,100	$338,200	$366,400	$394,600	$422,700	$450,900
	4	$162,035	$194,465	$226,895	$259,325	$291,640	$324,070	$356,615	$388,930	$421,360	$453,790	$486,105	$518,535
4.250%	1	$97,160	$116,620	$136,010	$155,470	$174,860	$194,390	$213,780	$233,240	$252,630	$272,090	$291,480	$310,940
	2	$117,980	$141,610	$165,155	$188,785	$212,330	$236,045	$259,590	$283,220	$306,765	$330,395	$353,940	$377,570
	3	$138,800	$166,600	$194,300	$222,100	$249,800	$277,700	$305,400	$333,200	$360,900	$388,700	$416,400	$444,200
	4	$159,620	$191,590	$223,445	$255,415	$287,270	$319,355	$351,210	$383,180	$415,035	$447,005	$478,860	$510,830
4.375%	1	$95,760	$114,940	$134,050	$153,230	$172,340	$191,520	$210,700	$229,810	$248,920	$268,100	$287,210	$306,390
	2	$116,280	$139,570	$162,775	$186,065	$209,270	$232,560	$255,850	$279,055	$302,260	$325,550	$348,755	$372,045
	3	$136,800	$164,200	$191,500	$218,900	$246,200	$273,600	$301,000	$328,300	$355,600	$383,000	$410,300	$437,700
	4	$157,320	$188,830	$220,225	$251,735	$283,130	$314,640	$346,150	$377,545	$408,940	$440,450	$471,845	$503,355
4.500%	1	$94,360	$113,190	$132,090	$150,920	$169,820	$188,720	$207,620	$226,450	$245,350	$264,180	$283,080	$301,910
	2	$114,580	$137,445	$160,395	$183,260	$206,210	$229,160	$252,110	$274,975	$297,925	$320,790	$343,740	$366,605
	3	$134,800	$161,700	$188,700	$215,600	$242,600	$269,600	$296,600	$323,500	$350,500	$377,400	$404,400	$431,300
	4	$155,020	$185,955	$217,005	$247,940	$278,990	$310,040	$341,090	$372,025	$403,075	$434,010	$465,060	$495,995
4.625%	1	$92,960	$111,580	$130,130	$148,750	$167,370	$185,990	$204,540	$223,160	$241,710	$260,400	$278,950	$297,570
	2	$112,880	$135,490	$158,015	$180,625	$203,235	$225,845	$248,370	$270,980	$293,505	$316,200	$338,725	$361,335
	3	$132,800	$159,400	$185,900	$212,500	$239,100	$265,700	$292,200	$318,800	$345,300	$372,000	$398,500	$425,100
	4	$152,720	$183,310	$213,785	$244,375	$274,965	$305,555	$336,030	$366,620	$397,095	$427,800	$458,275	$488,865
4.750%	1	$91,700	$109,970	$128,310	$146,580	$164,920	$183,260	$201,600	$219,940	$238,280	$256,620	$274,960	$293,300
	2	$111,350	$133,535	$155,805	$177,990	$200,260	$222,530	$244,800	$267,070	$289,340	$311,610	$333,880	$356,150
	3	$131,000	$157,100	$183,300	$209,400	$235,600	$261,800	$288,000	$314,200	$340,400	$366,600	$392,800	$419,000
	4	$150,650	$180,665	$210,795	$240,810	$270,940	$301,070	$331,200	$361,330	$391,460	$421,590	$451,720	$481,850
4.875%	1	$90,370	$108,430	$126,420	$144,550	$162,610	$180,670	$198,800	$216,790	$234,850	$252,980	$271,040	$289,030
	2	$109,735	$131,665	$153,510	$175,525	$197,455	$219,385	$241,400	$263,245	$285,175	$307,190	$329,120	$350,965
	3	$129,100	$154,900	$180,600	$206,500	$232,300	$258,100	$284,000	$309,700	$335,500	$361,400	$387,200	$412,900
	4	$148,465	$178,135	$207,690	$237,475	$267,145	$296,815	$326,600	$356,155	$385,825	$415,610	$445,280	$474,835
5.000%	1	$89,110	$106,820	$124,670	$142,520	$160,300	$178,080	$195,930	$213,710	$231,560	$249,340	$267,190	$284,970
	2	$108,205	$129,710	$151,385	$173,060	$194,650	$216,240	$237,915	$259,505	$281,180	$302,770	$324,445	$346,035
	3	$127,300	$152,600	$178,100	$203,600	$229,000	$254,400	$279,900	$305,300	$330,800	$356,200	$381,700	$407,100
	4	$146,395	$175,490	$204,815	$234,140	$263,350	$292,560	$321,885	$351,095	$380,420	$409,630	$438,955	$468,165
5.125%	1	$87,850	$105,350	$122,920	$140,490	$158,060	$175,560	$193,130	$210,770	$228,270	$245,840	$263,410	$280,980
	2	$106,675	$127,925	$149,260	$170,595	$191,930	$213,180	$234,515	$255,935	$277,185	$298,520	$319,855	$341,190
	3	$125,500	$150,500	$175,600	$200,700	$225,800	$250,800	$275,900	$301,100	$326,100	$351,200	$376,300	$401,400
	4	$144,325	$173,075	$201,940	$230,805	$259,670	$288,420	$317,285	$346,265	$375,015	$403,880	$432,745	$461,610
5.250%	1	$86,590	$103,880	$121,240	$138,530	$155,820	$173,110	$190,470	$207,760	$225,120	$242,410	$259,700	$276,990
	2	$105,145	$126,140	$147,220	$168,215	$189,210	$210,205	$231,285	$252,280	$273,360	$294,355	$315,350	$336,345
	3	$123,700	$148,400	$173,200	$197,900	$222,600	$247,300	$272,100	$296,800	$321,600	$346,300	$371,000	$395,700
	4	$142,255	$170,660	$199,180	$227,585	$255,990	$284,395	$312,915	$341,320	$369,840	$398,245	$426,650	$455,055

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2015
AFFORDABLE SALES PRICE GUIDELINES

HANA

MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$28,835	$34,602	$40,369	$46,136	$51,903	$57,670	$63,437	$69,204	$74,971	$80,738	$86,505	$92,272
5.375%	1	$85,400	$102,410	$119,490	$136,570	$153,650	$170,730	$187,810	$204,890	$221,970	$239,050	$256,130	$273,140
	2	$103,700	$124,355	$145,095	$165,835	$186,575	$207,315	$228,055	$248,795	$269,535	$290,275	$311,015	$331,670
	3	$122,000	$146,300	$170,700	$195,100	$219,500	$243,900	$268,300	$292,700	$317,100	$341,500	$365,900	$390,200
	4	$140,300	$168,245	$196,305	$224,365	$252,425	$280,485	$308,545	$336,605	$364,665	$392,725	$420,785	$448,730
5.500%	1	$84,140	$101,080	$117,880	$134,680	$151,550	$168,420	$185,220	$202,020	$218,960	$235,760	$252,560	$269,430
	2	$102,170	$122,740	$143,140	$163,540	$184,025	$204,510	$224,910	$245,310	$265,880	$286,280	$306,680	$327,165
	3	$120,200	$144,400	$168,400	$192,400	$216,500	$240,600	$264,600	$288,600	$312,800	$336,800	$360,800	$384,900
	4	$138,230	$166,060	$193,660	$221,260	$248,975	$276,690	$304,290	$331,890	$359,720	$387,320	$414,920	$442,635
5.625%	1	$83,020	$99,680	$116,270	$132,860	$149,520	$166,040	$182,700	$199,360	$215,880	$232,540	$249,200	$265,720
	2	$100,810	$121,040	$141,185	$161,330	$181,560	$201,620	$221,850	$242,080	$262,140	$282,370	$302,600	$322,660
	3	$118,600	$142,400	$166,100	$189,800	$213,600	$237,200	$261,000	$284,800	$308,400	$332,200	$356,000	$379,600
	4	$136,390	$163,760	$191,015	$218,270	$245,640	$272,780	$300,150	$327,520	$354,660	$382,030	$409,400	$436,540
5.750%	1	$81,900	$98,280	$114,660	$131,040	$147,490	$163,870	$180,250	$196,630	$213,010	$229,390	$245,770	$262,150
	2	$99,450	$119,340	$139,230	$159,120	$179,095	$198,985	$218,875	$238,765	$258,655	$278,545	$298,435	$318,325
	3	$117,000	$140,400	$163,800	$187,200	$210,700	$234,100	$257,500	$280,900	$304,300	$327,700	$351,100	$374,500
	4	$134,550	$161,460	$188,370	$215,280	$242,305	$269,215	$296,125	$323,035	$349,945	$376,855	$403,765	$430,675
5.875%	1	$80,850	$96,950	$113,120	$129,290	$145,460	$161,630	$177,800	$193,970	$210,140	$226,310	$242,410	$258,650
	2	$98,175	$117,725	$137,360	$156,995	$176,630	$196,265	$215,900	$235,535	$255,170	$274,805	$294,355	$314,075
	3	$115,500	$138,500	$161,600	$184,700	$207,800	$230,900	$254,000	$277,100	$300,200	$323,300	$346,300	$369,500
	4	$132,825	$159,275	$185,840	$212,405	$238,970	$265,535	$292,100	$318,665	$345,230	$371,795	$398,245	$424,925
6.000%	1	$79,730	$95,690	$111,650	$127,610	$143,500	$159,460	$175,420	$191,380	$207,340	$223,300	$239,190	$255,150
	2	$96,815	$116,195	$135,575	$154,955	$174,250	$193,630	$213,010	$232,390	$251,770	$271,150	$290,445	$309,825
	3	$113,900	$136,700	$159,500	$182,300	$205,000	$227,800	$250,600	$273,400	$296,200	$319,000	$341,700	$364,500
	4	$130,985	$157,205	$183,425	$209,645	$235,750	$261,970	$288,190	$314,410	$340,630	$366,850	$392,955	$419,175
6.125%	1	$78,680	$94,430	$110,110	$125,860	$141,610	$157,360	$173,040	$188,790	$204,540	$220,290	$236,040	$251,720
	2	$95,540	$114,665	$133,705	$152,830	$171,955	$191,080	$210,120	$229,245	$248,370	$267,495	$286,620	$305,660
	3	$112,400	$134,900	$157,300	$179,800	$202,300	$224,800	$247,200	$269,700	$292,200	$314,700	$337,200	$359,600
	4	$129,260	$155,135	$180,895	$206,770	$232,645	$258,520	$284,280	$310,155	$336,030	$361,905	$387,780	$413,540
6.250%	1	$77,630	$93,170	$108,710	$124,250	$139,720	$155,330	$170,800	$186,340	$201,880	$217,420	$232,890	$248,500
	2	$94,265	$113,135	$132,005	$150,875	$169,660	$188,615	$207,400	$226,270	$245,140	$264,010	$282,795	$301,750
	3	$110,900	$133,100	$155,300	$177,500	$199,600	$221,900	$244,000	$266,200	$288,400	$310,600	$332,700	$355,000
	4	$127,535	$153,065	$178,595	$204,125	$229,540	$255,185	$280,600	$306,130	$331,660	$357,190	$382,605	$408,250
6.375%	1	$76,580	$91,980	$107,310	$122,570	$137,900	$153,300	$168,560	$183,890	$199,220	$214,550	$229,880	$245,210
	2	$92,990	$111,690	$130,305	$148,835	$167,450	$186,150	$204,680	$223,295	$241,910	$260,525	$279,140	$297,755
	3	$109,400	$131,400	$153,300	$175,100	$197,000	$219,000	$240,800	$262,700	$284,600	$306,500	$328,400	$350,300
	4	$125,810	$151,110	$176,295	$201,365	$226,550	$251,850	$276,920	$302,105	$327,290	$352,475	$377,660	$402,845
6.500%	1	$75,670	$90,790	$105,910	$121,030	$136,150	$151,270	$166,390	$181,510	$196,630	$211,750	$226,940	$242,060
	2	$91,885	$110,245	$128,605	$146,965	$165,325	$183,685	$202,045	$220,405	$238,765	$257,125	$275,570	$293,930
	3	$108,100	$129,700	$151,300	$172,900	$194,500	$216,100	$237,700	$259,300	$280,900	$302,500	$324,200	$345,800
	4	$124,315	$149,155	$173,995	$198,835	$223,675	$248,515	$273,355	$298,195	$323,035	$347,875	$372,830	$397,670
6.625%	1	$74,690	$89,600	$104,510	$119,420	$134,400	$149,310	$164,220	$179,200	$194,110	$209,020	$224,000	$238,910
	2	$90,695	$108,800	$126,905	$145,010	$163,200	$181,305	$199,410	$217,600	$235,705	$253,810	$272,000	$290,105
	3	$106,700	$128,000	$149,300	$170,600	$192,000	$213,300	$234,600	$256,000	$277,300	$298,600	$320,000	$341,300
	4	$122,705	$147,200	$171,695	$196,190	$220,800	$245,295	$269,790	$294,400	$318,895	$343,390	$368,000	$392,495

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES
HANA
MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$28,835	$34,602	$40,369	$46,136	$51,903	$57,670	$63,437	$69,204	$74,971	$80,738	$86,505	$92,272
6.750%	1	$73,710	$88,480	$103,180	$117,950	$132,650	$147,420	$162,190	$176,890	$191,660	$206,360	$221,130	$235,900
	2	$89,505	$107,440	$125,290	$143,225	$161,075	$179,010	$196,945	$214,795	$232,730	$250,580	$268,515	$286,450
	3	$105,300	$126,400	$147,400	$168,500	$189,500	$210,600	$231,700	$252,700	$273,800	$294,800	$315,900	$337,000
	4	$121,095	$145,360	$169,510	$193,775	$217,925	$242,190	$266,455	$290,605	$314,870	$339,020	$363,285	$387,550
6.875%	1	$72,800	$87,290	$101,850	$116,410	$130,970	$145,530	$160,090	$174,650	$189,210	$203,770	$218,330	$232,820
	2	$88,400	$105,995	$123,675	$141,355	$159,035	$176,715	$194,395	$212,075	$229,755	$247,435	$265,115	$282,710
	3	$104,000	$124,700	$145,500	$166,300	$187,100	$207,900	$228,700	$249,500	$270,300	$291,100	$311,900	$332,600
	4	$119,600	$143,405	$167,325	$191,245	$215,165	$239,085	$263,005	$286,925	$310,845	$334,765	$358,685	$382,490
7.000%	1	$71,890	$86,240	$100,590	$115,010	$129,360	$143,710	$158,060	$172,410	$186,830	$201,250	$215,600	$229,950
	2	$87,295	$104,720	$122,145	$139,655	$157,080	$174,505	$191,930	$209,355	$226,865	$244,375	$261,800	$279,225
	3	$102,700	$123,200	$143,700	$164,300	$184,800	$205,300	$225,800	$246,300	$266,900	$287,500	$308,000	$328,500
	4	$118,105	$141,680	$165,255	$188,945	$212,520	$236,095	$259,670	$283,245	$306,935	$330,625	$354,200	$377,775
7.125%	1	$70,910	$85,190	$99,330	$113,540	$127,680	$141,960	$156,100	$170,310	$184,450	$198,730	$212,870	$227,080
	2	$86,105	$103,445	$120,615	$137,870	$155,040	$172,380	$189,550	$206,805	$223,975	$241,315	$258,485	$275,740
	3	$101,300	$121,700	$141,900	$162,200	$182,400	$202,800	$223,000	$243,300	$263,500	$283,900	$304,100	$324,400
	4	$116,495	$139,955	$163,185	$186,530	$209,760	$233,220	$256,450	$279,795	$303,025	$326,485	$349,715	$373,060
7.250%	1	$70,070	$84,140	$98,070	$112,140	$126,140	$140,210	$154,140	$168,210	$182,210	$196,280	$210,210	$224,280
	2	$85,085	$102,170	$119,085	$136,170	$153,170	$170,255	$187,170	$204,255	$221,255	$238,340	$255,255	$272,340
	3	$100,100	$120,200	$140,100	$160,200	$180,200	$200,300	$220,200	$240,300	$260,300	$280,400	$300,300	$320,400
	4	$115,115	$138,230	$161,115	$184,230	$207,230	$230,345	$253,230	$276,345	$299,345	$322,460	$345,345	$368,460
7.375%	1	$69,230	$83,020	$96,880	$110,740	$124,600	$138,390	$152,250	$166,110	$179,970	$193,760	$207,620	$221,480
	2	$84,065	$100,810	$117,640	$134,470	$151,300	$168,045	$184,875	$201,705	$218,535	$235,280	$252,110	$268,940
	3	$98,900	$118,600	$138,400	$158,200	$178,000	$197,700	$217,500	$237,300	$257,100	$276,800	$296,600	$316,400
	4	$113,735	$136,390	$159,160	$181,930	$204,700	$227,355	$250,125	$272,895	$295,665	$318,320	$341,090	$363,860
7.500%	1	$68,390	$82,040	$95,690	$109,340	$123,060	$136,710	$150,430	$164,150	$177,800	$191,450	$205,100	$218,820
	2	$83,045	$99,620	$116,195	$132,770	$149,430	$166,005	$182,665	$199,325	$215,900	$232,475	$249,050	$265,710
	3	$97,700	$117,200	$136,700	$156,200	$175,800	$195,300	$214,900	$234,500	$254,000	$273,500	$293,000	$312,600
	4	$112,355	$134,780	$157,205	$179,630	$202,170	$224,595	$247,135	$269,675	$292,100	$314,525	$336,950	$359,490
7.625%	1	$67,550	$81,060	$94,570	$108,080	$121,590	$135,100	$148,610	$162,120	$175,560	$189,140	$202,580	$216,160
	2	$82,025	$98,430	$114,835	$131,240	$147,645	$164,050	$180,455	$196,860	$213,180	$229,670	$245,990	$262,480
	3	$96,500	$115,800	$135,100	$154,400	$173,700	$193,000	$212,300	$231,600	$250,800	$270,200	$289,400	$308,800
	4	$110,975	$133,170	$155,365	$177,560	$199,755	$221,950	$244,145	$266,340	$288,420	$310,730	$332,810	$355,120
7.750%	1	$66,710	$80,080	$93,450	$106,820	$120,120	$133,420	$146,790	$160,160	$173,530	$186,830	$200,200	$213,500
	2	$81,005	$97,240	$113,475	$129,710	$145,860	$162,010	$178,245	$194,480	$210,715	$226,865	$243,100	$259,250
	3	$95,300	$114,400	$133,500	$152,600	$171,600	$190,600	$209,700	$228,800	$247,900	$266,900	$286,000	$305,000
	4	$109,595	$131,560	$153,525	$175,490	$197,340	$219,190	$241,155	$263,120	$285,085	$306,935	$328,900	$350,750
7.875%	1	$65,940	$79,100	$92,330	$105,490	$118,720	$131,880	$145,040	$158,270	$171,430	$184,590	$197,820	$210,980
	2	$80,070	$96,050	$112,115	$128,095	$144,160	$160,140	$176,120	$192,185	$208,165	$224,145	$240,210	$256,190
	3	$94,200	$113,000	$131,900	$150,700	$169,600	$188,400	$207,200	$226,100	$244,900	$263,700	$282,600	$301,400
	4	$108,330	$129,950	$151,685	$173,305	$195,040	$216,660	$238,280	$260,015	$281,635	$303,255	$324,990	$346,610
8.000%	1	$65,170	$78,190	$91,210	$104,300	$117,250	$130,270	$143,360	$156,380	$169,400	$182,420	$195,440	$208,460
	2	$79,135	$94,945	$110,755	$126,650	$142,375	$158,185	$174,080	$189,890	$205,700	$221,510	$237,320	$253,130
	3	$93,100	$111,700	$130,300	$149,000	$167,500	$186,100	$204,800	$223,400	$242,000	$260,600	$279,200	$297,800
	4	$107,065	$128,455	$149,845	$171,350	$192,625	$214,015	$235,520	$256,910	$278,300	$299,690	$321,080	$342,470

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES
HANA
MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$28,835	$34,602	$40,369	$46,136	$51,903	$57,670	$63,437	$69,204	$74,971	$80,738	$86,505	$92,272
8.125%	1	$64,400	$77,210	$90,160	$103,040	$115,920	$128,800	$141,610	$154,560	$167,370	$180,320	$193,130	$206,010
	2	$78,200	$93,755	$109,480	$125,120	$140,760	$156,400	$171,955	$187,680	$203,235	$218,960	$234,515	$250,155
	3	$92,000	$110,300	$128,800	$147,200	$165,600	$184,000	$202,300	$220,800	$239,100	$257,600	$275,900	$294,300
	4	$105,800	$126,845	$148,120	$169,280	$190,440	$211,600	$232,645	$253,920	$274,965	$296,240	$317,285	$338,445
8.250%	1	$63,630	$76,370	$89,110	$101,780	$114,520	$127,260	$140,000	$152,740	$165,410	$178,150	$190,890	$203,630
	2	$77,265	$92,735	$108,205	$123,590	$139,060	$154,530	$170,000	$185,470	$200,855	$216,325	$231,795	$247,265
	3	$90,900	$109,100	$127,300	$145,400	$163,600	$181,800	$200,000	$218,200	$236,300	$254,500	$272,700	$290,900
	4	$104,535	$125,465	$146,395	$167,210	$188,140	$209,070	$230,000	$250,930	$271,745	$292,675	$313,605	$334,535
8.375%	1	$62,860	$75,460	$88,060	$100,590	$113,190	$125,790	$138,320	$150,920	$163,520	$176,120	$188,720	$201,320
	2	$76,330	$91,630	$106,930	$122,145	$137,445	$152,745	$167,960	$183,260	$198,560	$213,860	$229,160	$244,460
	3	$89,800	$107,800	$125,800	$143,700	$161,700	$179,700	$197,600	$215,600	$233,600	$251,600	$269,600	$287,600
	4	$103,270	$123,970	$144,670	$165,255	$185,955	$206,655	$227,240	$247,940	$268,640	$289,340	$310,040	$330,740
8.500%	1	$62,160	$74,620	$87,080	$99,470	$111,860	$124,390	$136,780	$149,170	$161,630	$174,090	$186,550	$198,940
	2	$75,480	$90,610	$105,740	$120,785	$135,830	$151,045	$166,090	$181,135	$196,265	$211,395	$226,525	$241,570
	3	$88,800	$106,600	$124,400	$142,100	$159,800	$177,700	$195,400	$213,100	$230,900	$248,700	$266,500	$284,200
	4	$102,120	$122,590	$143,060	$163,415	$183,770	$204,355	$224,710	$245,065	$265,535	$286,005	$306,475	$326,830
8.625%	1	$61,460	$73,780	$86,030	$98,350	$110,600	$122,920	$135,170	$147,490	$159,810	$172,130	$184,380	$196,700
	2	$74,630	$89,590	$104,465	$119,425	$134,300	$149,260	$164,135	$179,095	$194,055	$209,015	$223,890	$238,850
	3	$87,800	$105,400	$122,900	$140,500	$158,000	$175,600	$193,100	$210,700	$228,300	$245,900	$263,400	$281,000
	4	$100,970	$121,210	$141,335	$161,575	$181,700	$201,940	$222,065	$242,305	$262,545	$282,785	$302,910	$323,150
8.750%	1	$60,830	$72,870	$85,050	$97,230	$109,340	$121,520	$133,700	$145,880	$157,990	$170,170	$182,350	$194,460
	2	$73,865	$88,485	$103,275	$118,065	$132,770	$147,560	$162,350	$177,140	$191,845	$206,635	$221,425	$236,130
	3	$86,900	$104,100	$121,500	$138,900	$156,200	$173,600	$191,000	$208,400	$225,700	$243,100	$260,500	$277,800
	4	$99,935	$119,715	$139,725	$159,735	$179,630	$199,640	$219,650	$239,660	$259,555	$279,565	$299,575	$319,470

Maximum affordable sales price is based on the following factors:

$57,670 Median family income as established by the Department of Housing and Human Concerns (DHHC)
30 Number of years for a fixed-rate mortgage loan with no discount points
30% Percentage of gross monthly income for housing expenses (principle and interest payment only)
5% Percentage of the purchase price for downpayment.

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **May 1, 2015**

2015
INCOME LIMITS & AFFORDABLE RENT GUIDELINES
HANA

INCOME LIMITS FOR RENTAL UNITS (BY FAMILY SIZE & PERCENTAGE OF MEDIAN FAMILY INCOME)

% of Median	1 PERSON 0.7	2 PERSON 0.8	3 PERSON 0.9	4 PERSON 1.0	5 PERSON 1.08	6 PERSON 1.16	7 PERSON 1.24	8 PERSON 1.32
10%	$4,040	$4,610	$5,190	$5,770	$6,230	$6,690	$7,150	$7,610
20%	$8,070	$9,230	$10,380	$11,530	$12,460	$13,380	$14,300	$15,220
30%	$12,110	$13,840	$15,570	$17,300	$18,690	$20,070	$21,450	$22,840
40%	$16,150	$18,450	$20,760	$23,070	$24,910	$26,760	$28,600	$30,450
50%	$20,180	$23,070	$25,950	$28,840	$31,140	$33,450	$35,760	$38,060
60%	$24,220	$27,680	$31,140	$34,600	$37,370	$40,140	$42,910	$45,670
70%	$28,260	$32,300	$36,330	$40,370	$43,600	$46,830	$50,060	$53,290
80%	$32,300	$36,910	$41,520	$46,140	$49,830	$53,520	$57,210	$60,900
90%	$36,330	$41,520	$46,710	$51,900	$56,060	$60,210	$64,360	$68,510
100%	$40,370	$46,140	$51,900	$57,670	$62,280	$66,900	$71,510	$76,120
110%	$44,410	$50,750	$57,090	$63,440	$68,510	$73,590	$78,660	$83,740
120%	$48,440	$55,360	$62,280	$69,200	$74,740	$80,280	$85,810	$91,350
130%	$52,480	$59,980	$67,470	$74,970	$80,970	$86,970	$92,960	$98,960
140%	$56,520	$64,590	$72,660	$80,740	$87,200	$93,660	$100,120	$106,570

AFFORDABLE RENT GUIDELINES (BY UNIT SIZE & PERCENTAGE OF MEDIAN FAMILY INCOME)

% of Median	UNIT SIZE (NO. OF BEDROOMS) 0	1	2	3	4	5
10%	$101	$108	$130	$150	$167	$185
20%	$202	$216	$260	$300	$335	$369
30%	$303	$324	$389	$450	$502	$554
40%	$404	$433	$519	$600	$669	$738
50%	$505	$541	$649	$750	$836	$923
60%	$606	$649	$779	$900	$1,004	$1,107
70%	$707	$757	$908	$1,050	$1,171	$1,292
80%	$808	$865	$1,038	$1,200	$1,338	$1,476
90%	$908	$973	$1,168	$1,350	$1,505	$1,661
100%	$1,009	$1,081	$1,298	$1,499	$1,673	$1,845
110%	$1,110	$1,190	$1,427	$1,649	$1,840	$2,030
120%	$1,211	$1,298	$1,557	$1,799	$2,007	$2,215
130%	$1,312	$1,406	$1,687	$1,949	$2,174	$2,399
140%	$1,413	$1,514	$1,817	$2,099	$2,342	$2,584

Note: Affordable rents are based on 30% of gross monthly income. Affordable rents include utilities.

Factors used in calculation:

HUD's 2015 median family income for the County of Maui	$75,100
American Community Survey 5-Year Estimate 2008-2012 median family income for Lana'i (from the Hawaii State Data Center)	$59,861
Est. 2015 Lanai`i median family income (Rounded to the nearest $10)	**$59,860**

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: May 1, 2015

2015
AFFORDABLE SALES PRICE GUIDELINES
LANA`I
SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$59,860	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
4.000%	1	$115,500	$138,600	$161,700	$184,800	$207,900	$231,000	$254,100	$277,130	$300,230	$323,330	$346,430	$369,530
	2	$140,250	$168,300	$196,350	$224,400	$252,450	$280,500	$308,550	$336,515	$364,565	$392,615	$420,665	$448,715
	3	$165,000	$198,000	$231,000	$264,000	$297,000	$330,000	$363,000	$395,900	$428,900	$461,900	$494,900	$527,900
	4	$189,750	$227,700	$265,650	$303,600	$341,550	$379,500	$417,450	$455,285	$493,235	$531,185	$569,135	$607,085
4.125%	1	$113,750	$136,500	$159,250	$182,000	$204,750	$227,500	$250,250	$273,000	$295,750	$318,500	$341,250	$364,070
	2	$138,125	$165,750	$193,375	$221,000	$248,625	$276,250	$303,875	$331,500	$359,125	$386,750	$414,375	$442,085
	3	$162,500	$195,000	$227,500	$260,000	$292,500	$325,000	$357,500	$390,000	$422,500	$455,000	$487,500	$520,100
	4	$186,875	$224,250	$261,625	$299,000	$336,375	$373,750	$411,125	$448,500	$485,875	$523,250	$560,625	$598,115
4.250%	1	$112,070	$134,470	$156,940	$179,340	$201,740	$224,140	$246,540	$269,010	$291,410	$313,810	$336,210	$358,610
	2	$136,085	$163,285	$190,570	$217,770	$244,970	$272,170	$299,370	$326,655	$353,855	$381,055	$408,255	$435,455
	3	$160,100	$192,100	$224,200	$256,200	$288,200	$320,200	$352,200	$384,300	$416,300	$448,300	$480,300	$512,300
	4	$184,115	$220,915	$257,830	$294,630	$331,430	$368,230	$405,030	$441,945	$478,745	$515,545	$552,345	$589,145
4.375%	1	$110,460	$132,510	$154,630	$176,680	$198,800	$220,850	$242,970	$265,020	$287,140	$309,190	$331,310	$353,360
	2	$134,130	$160,905	$187,765	$214,540	$241,400	$268,175	$295,035	$321,810	$348,670	$375,445	$402,305	$429,080
	3	$157,800	$189,300	$220,900	$252,400	$284,000	$315,500	$347,100	$378,600	$410,200	$441,700	$473,300	$504,800
	4	$181,470	$217,695	$254,035	$290,260	$326,600	$362,825	$399,165	$435,390	$471,730	$507,955	$544,295	$580,520
4.500%	1	$108,780	$130,550	$152,320	$174,090	$195,860	$217,630	$239,400	$261,170	$282,940	$304,710	$326,410	$348,180
	2	$132,090	$158,525	$184,960	$211,395	$237,830	$264,265	$290,700	$317,135	$343,570	$370,005	$396,355	$422,790
	3	$155,400	$186,500	$217,600	$248,700	$279,800	$310,900	$342,000	$373,100	$404,200	$435,300	$466,300	$497,400
	4	$178,710	$214,475	$250,240	$286,005	$321,770	$357,535	$393,300	$429,065	$464,830	$500,595	$536,245	$572,010
4.625%	1	$107,240	$128,660	$150,150	$171,570	$192,990	$214,480	$235,900	$257,390	$278,810	$300,230	$321,720	$343,140
	2	$130,220	$156,230	$182,325	$208,335	$234,345	$260,440	$286,450	$312,545	$338,555	$364,565	$390,660	$416,670
	3	$153,200	$183,800	$214,500	$245,100	$275,700	$306,400	$337,000	$367,700	$398,300	$428,900	$459,600	$490,200
	4	$176,180	$211,370	$246,675	$281,865	$317,055	$352,360	$387,550	$422,855	$458,045	$493,235	$528,540	$563,730
4.750%	1	$105,700	$126,840	$147,980	$169,120	$190,260	$211,400	$232,540	$253,680	$274,820	$295,960	$317,100	$338,240
	2	$128,350	$154,020	$179,690	$205,360	$231,030	$256,700	$282,370	$308,040	$333,710	$359,380	$385,050	$410,720
	3	$151,000	$181,200	$211,400	$241,600	$271,800	$302,000	$332,200	$362,400	$392,600	$422,800	$453,000	$483,200
	4	$173,650	$208,380	$243,110	$277,840	$312,570	$347,300	$382,030	$416,760	$451,490	$486,220	$520,950	$555,680
4.875%	1	$104,160	$125,020	$145,880	$166,670	$187,530	$208,390	$229,180	$250,040	$270,900	$291,690	$312,550	$333,410
	2	$126,480	$151,810	$177,140	$202,385	$227,715	$253,045	$278,290	$303,620	$328,950	$354,195	$379,525	$404,855
	3	$148,800	$178,600	$208,400	$238,100	$267,900	$297,700	$327,400	$357,200	$387,000	$416,700	$446,500	$476,300
	4	$171,120	$205,390	$239,660	$273,815	$308,085	$342,355	$376,510	$410,780	$445,050	$479,205	$513,475	$547,745
5.000%	1	$102,690	$123,270	$143,780	$164,360	$184,870	$205,380	$225,960	$246,470	$267,050	$287,560	$308,140	$328,650
	2	$124,695	$149,685	$174,590	$199,580	$224,485	$249,390	$274,380	$299,285	$324,275	$349,180	$374,170	$399,075
	3	$146,700	$176,100	$205,400	$234,800	$264,100	$293,400	$322,800	$352,100	$381,500	$410,800	$440,200	$469,500
	4	$168,705	$202,515	$236,210	$270,020	$303,715	$337,410	$371,220	$404,915	$438,725	$472,420	$506,230	$539,925
5.125%	1	$101,290	$121,520	$141,750	$161,980	$182,280	$202,510	$222,740	$243,040	$263,270	$283,500	$303,800	$324,030
	2	$122,995	$147,560	$172,125	$196,690	$221,340	$245,905	$270,470	$295,120	$319,685	$344,250	$368,900	$393,465
	3	$144,700	$173,600	$202,500	$231,400	$260,400	$289,300	$318,200	$347,200	$376,100	$405,000	$434,000	$462,900
	4	$166,405	$199,640	$232,875	$266,110	$299,460	$332,695	$365,930	$399,280	$432,515	$465,750	$499,100	$532,335
5.250%	1	$99,820	$119,840	$139,790	$159,740	$179,690	$199,710	$219,660	$239,610	$259,560	$279,580	$299,530	$319,480
	2	$121,210	$145,520	$169,745	$193,970	$218,195	$242,505	$266,730	$290,955	$315,180	$339,490	$363,715	$387,940
	3	$142,600	$171,200	$199,700	$228,200	$256,700	$285,300	$313,800	$342,300	$370,800	$399,400	$427,900	$456,400
	4	$163,990	$196,880	$229,655	$262,430	$295,205	$328,095	$360,870	$393,645	$426,420	$459,310	$492,085	$524,860

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **May 1, 2015**

2015
AFFORDABLE SALES PRICE GUIDELINES
LANA`I
SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$59,860	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
5.375%	1	$98,490	$118,160	$137,830	$157,500	$177,240	$196,910	$216,580	$236,320	$255,990	$275,660	$295,400	$315,070
	2	$119,595	$143,480	$167,365	$191,250	$215,220	$239,105	$262,990	$286,960	$310,845	$334,730	$358,700	$382,585
	3	$140,700	$168,800	$196,900	$225,000	$253,200	$281,300	$309,400	$337,600	$365,700	$393,800	$422,000	$450,100
	4	$161,805	$194,120	$226,435	$258,750	$291,180	$323,495	$355,810	$388,240	$420,555	$452,870	$485,300	$517,615
5.500%	1	$97,090	$116,550	$135,940	$155,400	$174,790	$194,180	$213,640	$233,030	$252,490	$271,880	$291,340	$310,730
	2	$117,895	$141,525	$165,070	$188,700	$212,245	$235,790	$259,420	$282,965	$306,595	$330,140	$353,770	$377,315
	3	$138,700	$166,500	$194,200	$222,000	$249,700	$277,400	$305,200	$332,900	$360,700	$388,400	$416,200	$443,900
	4	$159,505	$191,475	$223,330	$255,300	$287,155	$319,010	$350,980	$382,835	$414,805	$446,660	$478,630	$510,485
5.625%	1	$95,760	$114,940	$134,120	$153,230	$172,410	$191,520	$210,700	$229,880	$248,990	$268,170	$287,350	$306,460
	2	$116,280	$139,570	$162,860	$186,065	$209,355	$232,560	$255,850	$279,140	$302,345	$325,635	$348,925	$372,130
	3	$136,800	$164,200	$191,600	$218,900	$246,300	$273,600	$301,000	$328,400	$355,700	$383,100	$410,500	$437,800
	4	$157,320	$188,830	$220,340	$251,735	$283,245	$314,640	$346,150	$377,660	$409,055	$440,565	$472,075	$503,470
5.750%	1	$94,500	$113,400	$132,300	$151,130	$170,030	$188,930	$207,830	$226,730	$245,630	$264,530	$283,430	$302,330
	2	$114,750	$137,700	$160,650	$183,515	$206,465	$229,415	$252,365	$275,315	$298,265	$321,215	$344,165	$367,115
	3	$135,000	$162,000	$189,000	$215,900	$242,900	$269,900	$296,900	$323,900	$350,900	$377,900	$404,900	$431,900
	4	$155,250	$186,300	$217,350	$248,285	$279,335	$310,385	$341,435	$372,485	$403,535	$434,585	$465,635	$496,685
5.875%	1	$93,170	$111,860	$130,480	$149,100	$167,790	$186,410	$205,030	$223,720	$242,340	$260,960	$279,580	$298,270
	2	$113,135	$135,830	$158,440	$181,050	$203,745	$226,355	$248,965	$271,660	$294,270	$316,880	$339,490	$362,185
	3	$133,100	$159,800	$186,400	$213,000	$239,700	$266,300	$292,900	$319,600	$346,200	$372,800	$399,400	$426,100
	4	$153,065	$183,770	$214,360	$244,950	$275,655	$306,245	$336,835	$367,540	$398,130	$428,720	$459,310	$490,015
6.000%	1	$91,980	$110,320	$128,730	$147,140	$165,550	$183,890	$202,300	$220,710	$239,120	$257,460	$275,870	$294,280
	2	$111,690	$133,960	$156,315	$178,670	$201,025	$223,295	$245,650	$268,005	$290,360	$312,630	$334,985	$357,340
	3	$131,400	$157,600	$183,900	$210,200	$236,500	$262,700	$289,000	$315,300	$341,600	$367,800	$394,100	$420,400
	4	$151,110	$181,240	$211,485	$241,730	$271,975	$302,105	$332,350	$362,595	$392,840	$422,970	$453,215	$483,460
6.125%	1	$90,720	$108,920	$127,050	$145,180	$163,310	$181,510	$199,640	$217,770	$235,900	$254,100	$272,230	$290,360
	2	$110,160	$132,260	$154,275	$176,290	$198,305	$220,405	$242,420	$264,435	$286,450	$308,550	$330,565	$352,580
	3	$129,600	$155,600	$181,500	$207,400	$233,300	$259,300	$285,200	$311,100	$337,000	$363,000	$388,900	$414,800
	4	$149,040	$178,940	$208,725	$238,510	$268,295	$298,195	$327,980	$357,765	$387,550	$417,450	$447,235	$477,020
6.250%	1	$89,530	$107,450	$125,370	$143,290	$161,210	$179,060	$196,980	$214,900	$232,820	$250,740	$268,660	$286,510
	2	$108,715	$130,475	$152,235	$173,995	$195,755	$217,430	$239,190	$260,950	$282,710	$304,470	$326,230	$347,905
	3	$127,900	$153,500	$179,100	$204,700	$230,300	$255,800	$281,400	$307,000	$332,600	$358,200	$383,800	$409,300
	4	$147,085	$176,525	$205,965	$235,405	$264,845	$294,170	$323,610	$353,050	$382,490	$411,930	$441,370	$470,695
6.375%	1	$88,340	$106,050	$123,690	$141,400	$159,040	$176,750	$194,390	$212,100	$229,740	$247,450	$265,090	$282,800
	2	$107,270	$128,775	$150,195	$171,700	$193,120	$214,625	$236,045	$257,550	$278,970	$300,475	$321,895	$343,400
	3	$126,200	$151,500	$176,700	$202,000	$227,200	$252,500	$277,700	$303,000	$328,200	$353,500	$378,700	$404,000
	4	$145,130	$174,225	$203,205	$232,300	$261,280	$290,375	$319,355	$348,450	$377,430	$406,525	$435,505	$464,600
6.500%	1	$87,220	$104,650	$122,150	$139,580	$157,010	$174,440	$191,870	$209,370	$226,800	$244,230	$261,660	$279,160
	2	$105,910	$127,075	$148,325	$169,490	$190,655	$211,820	$232,985	$254,235	$275,400	$296,565	$317,730	$338,980
	3	$124,600	$149,500	$174,500	$199,400	$224,300	$249,200	$274,100	$299,100	$324,000	$348,900	$373,800	$398,800
	4	$143,290	$171,925	$200,675	$229,310	$257,945	$286,580	$315,215	$343,965	$372,600	$401,235	$429,870	$458,620
6.625%	1	$86,100	$103,320	$120,540	$137,760	$154,980	$172,200	$189,420	$206,640	$223,860	$241,080	$258,300	$275,520
	2	$104,550	$125,460	$146,370	$167,280	$188,190	$209,100	$230,010	$250,920	$271,830	$292,740	$313,650	$334,560
	3	$123,000	$147,600	$172,200	$196,800	$221,400	$246,000	$270,600	$295,200	$319,800	$344,400	$369,000	$393,600
	4	$141,450	$169,740	$198,030	$226,320	$254,610	$282,900	$311,190	$339,480	$367,770	$396,060	$424,350	$452,640

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COUNTY OF MAUI

Effective: **May 1, 2015**

2015
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LANA`I
SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$59,860	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
6.750%	1	$84,980	$101,990	$119,000	$136,010	$153,020	$170,030	$187,040	$203,980	$220,990	$238,000	$255,010	$272,020
	2	$103,190	$123,845	$144,500	$165,155	$185,810	$206,465	$227,120	$247,690	$268,345	$289,000	$309,655	$330,310
	3	$121,400	$145,700	$170,000	$194,300	$218,600	$242,900	$267,200	$291,400	$315,700	$340,000	$364,300	$388,600
	4	$139,610	$167,555	$195,500	$223,445	$251,390	$279,335	$307,280	$335,110	$363,055	$391,000	$418,945	$446,890
6.875%	1	$83,930	$100,730	$117,530	$134,260	$151,060	$167,860	$184,660	$201,460	$218,190	$234,990	$251,790	$268,590
	2	$101,915	$122,315	$142,715	$163,030	$183,430	$203,830	$224,230	$244,630	$264,945	$285,345	$305,745	$326,145
	3	$119,900	$143,900	$167,900	$191,800	$215,800	$239,800	$263,800	$287,800	$311,700	$335,700	$359,700	$383,700
	4	$137,885	$165,485	$193,085	$220,570	$248,170	$275,770	$303,370	$330,970	$358,455	$386,055	$413,655	$441,255
7.000%	1	$82,880	$99,470	$115,990	$132,580	$149,170	$165,760	$182,350	$198,870	$215,460	$232,050	$248,640	$265,160
	2	$100,640	$120,785	$140,845	$160,990	$181,135	$201,280	$221,425	$241,485	$261,630	$281,775	$301,920	$321,980
	3	$118,400	$142,100	$165,700	$189,400	$213,100	$236,800	$260,500	$284,100	$307,800	$331,500	$355,200	$378,800
	4	$136,160	$163,415	$190,555	$217,810	$245,065	$272,320	$299,575	$326,715	$353,970	$381,225	$408,480	$435,620
7.125%	1	$81,830	$98,210	$114,590	$130,970	$147,280	$163,660	$180,040	$196,420	$212,800	$229,110	$245,490	$261,870
	2	$99,365	$119,255	$139,145	$159,035	$178,840	$198,730	$218,620	$238,510	$258,400	$278,205	$298,095	$317,985
	3	$116,900	$140,300	$163,700	$187,100	$210,400	$233,800	$257,200	$280,600	$304,000	$327,300	$350,700	$374,100
	4	$134,435	$161,345	$188,255	$215,165	$241,960	$268,870	$295,780	$322,690	$349,600	$376,395	$403,305	$430,215
7.250%	1	$80,850	$97,020	$113,120	$129,290	$145,460	$161,630	$177,800	$193,970	$210,140	$226,310	$242,480	$258,650
	2	$98,175	$117,810	$137,360	$156,995	$176,630	$196,265	$215,900	$235,535	$255,170	$274,805	$294,440	$314,075
	3	$115,500	$138,600	$161,600	$184,700	$207,800	$230,900	$254,000	$277,100	$300,200	$323,300	$346,400	$369,500
	4	$132,825	$159,390	$185,840	$212,405	$238,970	$265,535	$292,100	$318,665	$345,230	$371,795	$398,360	$424,925
7.375%	1	$79,800	$95,760	$111,790	$127,750	$143,710	$159,670	$175,630	$191,590	$207,550	$223,510	$239,470	$255,430
	2	$96,900	$116,280	$135,745	$155,125	$174,505	$193,885	$213,265	$232,645	$252,025	$271,405	$290,785	$310,165
	3	$114,000	$136,800	$159,700	$182,500	$205,300	$228,100	$250,900	$273,700	$296,500	$319,300	$342,100	$364,900
	4	$131,100	$157,320	$183,655	$209,875	$236,095	$262,315	$288,535	$314,755	$340,975	$367,195	$393,415	$419,635
7.500%	1	$78,820	$94,640	$110,390	$126,140	$141,960	$157,710	$173,460	$189,210	$205,030	$220,780	$236,530	$252,350
	2	$95,710	$114,920	$134,045	$153,170	$172,380	$191,505	$210,630	$229,755	$248,965	$268,090	$287,215	$306,425
	3	$112,600	$135,200	$157,700	$180,200	$202,800	$225,300	$247,800	$270,300	$292,900	$315,400	$337,900	$360,500
	4	$129,490	$155,480	$181,355	$207,230	$233,220	$259,095	$284,970	$310,845	$336,835	$362,710	$388,585	$414,575
7.625%	1	$77,910	$93,450	$109,060	$124,600	$140,210	$155,820	$171,360	$186,970	$202,510	$218,120	$233,660	$249,270
	2	$94,605	$113,475	$132,430	$151,300	$170,255	$189,210	$208,080	$227,035	$245,905	$264,860	$283,730	$302,685
	3	$111,300	$133,500	$155,800	$178,000	$200,300	$222,600	$244,800	$267,100	$289,300	$311,600	$333,800	$356,100
	4	$127,995	$153,525	$179,170	$204,700	$230,345	$255,990	$281,520	$307,165	$332,695	$358,340	$383,870	$409,515
7.750%	1	$76,930	$92,330	$107,730	$123,130	$138,530	$153,930	$169,330	$184,730	$200,060	$215,460	$230,860	$246,260
	2	$93,415	$112,115	$130,815	$149,515	$168,215	$186,915	$205,615	$224,315	$242,930	$261,630	$280,330	$299,030
	3	$109,900	$131,900	$153,900	$175,900	$197,900	$219,900	$241,900	$263,900	$285,800	$307,800	$329,800	$351,800
	4	$126,385	$151,685	$176,985	$202,285	$227,585	$252,885	$278,185	$303,485	$328,670	$353,970	$379,270	$404,570
7.875%	1	$76,020	$91,280	$106,470	$121,660	$136,850	$152,110	$167,300	$182,490	$197,680	$212,940	$228,130	$243,320
	2	$92,310	$110,840	$129,285	$147,730	$166,175	$184,705	$203,150	$221,595	$240,040	$258,570	$277,015	$295,460
	3	$108,600	$130,400	$152,100	$173,800	$195,500	$217,300	$239,000	$260,700	$282,400	$304,200	$325,900	$347,600
	4	$124,890	$149,960	$174,915	$199,870	$224,825	$249,895	$274,850	$299,805	$324,760	$349,830	$374,785	$399,740
8.000%	1	$75,110	$90,160	$105,210	$120,190	$135,240	$150,290	$165,340	$180,320	$195,370	$210,420	$225,400	$240,450
	2	$91,205	$109,480	$127,755	$145,945	$164,220	$182,495	$200,770	$218,960	$237,235	$255,510	$273,700	$291,975
	3	$107,300	$128,800	$150,300	$171,700	$193,200	$214,700	$236,200	$257,600	$279,100	$300,600	$322,000	$343,500
	4	$123,395	$148,120	$172,845	$197,455	$222,180	$246,905	$271,630	$296,240	$320,965	$345,690	$370,300	$395,025

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DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **May 1, 2015**

2015
AFFORDABLE SALES PRICE GUIDELINES
LANA`I
SINGLE FAMILY

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$59,860	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
8.125%	1	$74,270	$89,110	$103,950	$118,790	$133,630	$148,540	$163,380	$178,220	$193,060	$207,900	$222,740	$237,650
	2	$90,185	$108,205	$126,225	$144,245	$162,265	$180,370	$198,390	$216,410	$234,430	$252,450	$270,470	$288,575
	3	$106,100	$127,300	$148,500	$169,700	$190,900	$212,200	$233,400	$254,600	$275,800	$297,000	$318,200	$339,500
	4	$122,015	$146,395	$170,775	$195,155	$219,535	$244,030	$268,410	$292,790	$317,170	$341,550	$365,930	$390,425
8.250%	1	$73,360	$88,060	$102,760	$117,390	$132,090	$146,790	$161,420	$176,120	$190,820	$205,520	$220,150	$234,850
	2	$89,080	$106,930	$124,780	$142,545	$160,395	$178,245	$196,010	$213,860	$231,710	$249,560	$267,325	$285,175
	3	$104,800	$125,800	$146,800	$167,700	$188,700	$209,700	$230,600	$251,600	$272,600	$293,600	$314,500	$335,500
	4	$120,520	$144,670	$168,820	$192,855	$217,005	$241,155	$265,190	$289,340	$313,490	$337,640	$361,675	$385,825
8.375%	1	$72,520	$87,080	$101,570	$116,060	$130,550	$145,110	$159,600	$174,090	$188,580	$203,140	$217,630	$232,120
	2	$88,060	$105,740	$123,335	$140,930	$158,525	$176,205	$193,800	$211,395	$228,990	$246,670	$264,265	$281,860
	3	$103,600	$124,400	$145,100	$165,800	$186,500	$207,300	$228,000	$248,700	$269,400	$290,200	$310,900	$331,600
	4	$119,140	$143,060	$166,865	$190,670	$214,475	$238,395	$262,200	$286,005	$309,810	$333,730	$357,535	$381,340
8.500%	1	$71,680	$86,030	$100,380	$114,730	$129,080	$143,430	$157,780	$172,060	$186,410	$200,760	$215,110	$229,460
	2	$87,040	$104,465	$121,890	$139,315	$156,740	$174,165	$191,590	$208,930	$226,355	$243,780	$261,205	$278,630
	3	$102,400	$122,900	$143,400	$163,900	$184,400	$204,900	$225,400	$245,800	$266,300	$286,800	$307,300	$327,800
	4	$117,760	$141,335	$164,910	$188,485	$212,060	$235,635	$259,210	$282,670	$306,245	$329,820	$353,395	$376,970
8.625%	1	$70,910	$85,050	$99,260	$113,400	$127,610	$141,750	$155,960	$170,100	$184,310	$198,450	$212,660	$226,800
	2	$86,105	$103,275	$120,530	$137,700	$154,955	$172,125	$189,380	$206,550	$223,805	$240,975	$258,230	$275,400
	3	$101,300	$121,500	$141,800	$162,000	$182,300	$202,500	$222,800	$243,000	$263,300	$283,500	$303,800	$324,000
	4	$116,495	$139,725	$163,070	$186,300	$209,645	$232,875	$256,220	$279,450	$302,795	$326,025	$349,370	$372,600
8.750%	1	$70,070	$84,070	$98,140	$112,140	$126,140	$140,140	$154,210	$168,210	$182,210	$196,210	$210,280	$224,280
	2	$85,085	$102,085	$119,170	$136,170	$153,170	$170,170	$187,255	$204,255	$221,255	$238,255	$255,340	$272,340
	3	$100,100	$120,100	$140,200	$160,200	$180,200	$200,200	$220,300	$240,300	$260,300	$280,300	$300,400	$320,400
	4	$115,115	$138,115	$161,230	$184,230	$207,230	$230,230	$253,345	$276,345	$299,345	$322,345	$345,460	$368,460

Maximum affordable sales price is based on the following factors:

$59,860 Median family income as established by the Department of Housing and Human Concerns (DHHC)
30 Number of years for a fixed-rate mortgage loan with no discount points
30% Percentage of gross monthly income for housing expenses (principle and interest payment only)
5% Percentage of the purchase price for downpayment.

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: May 1, 2015

2015
AFFORDABLE SALES PRICE GUIDELINES
LANA`I
MULTI-FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$59,860	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
4.000%	1	$103,950	$124,740	$145,530	$166,320	$187,110	$207,900	$228,690	$249,410	$270,200	$290,990	$311,780	$332,570
	2	$126,225	$151,470	$176,715	$201,960	$227,205	$252,450	$277,695	$302,855	$328,100	$353,345	$378,590	$403,835
	3	$148,500	$178,200	$207,900	$237,600	$267,300	$297,000	$326,700	$356,300	$386,000	$415,700	$445,400	$475,100
	4	$170,775	$204,930	$239,085	$273,240	$307,395	$341,550	$375,705	$409,745	$443,900	$478,055	$512,210	$546,365
4.125%	1	$102,410	$122,850	$143,360	$163,800	$184,310	$204,750	$225,260	$245,700	$266,210	$286,650	$307,160	$327,670
	2	$124,355	$149,175	$174,080	$198,900	$223,805	$248,625	$273,530	$298,350	$323,255	$348,075	$372,980	$397,885
	3	$146,300	$175,500	$204,800	$234,000	$263,300	$292,500	$321,800	$351,000	$380,300	$409,500	$438,800	$468,100
	4	$168,245	$201,825	$235,520	$269,100	$302,795	$336,375	$370,070	$403,650	$437,345	$470,925	$504,620	$538,315
4.250%	1	$100,870	$121,030	$141,260	$161,420	$181,580	$201,740	$221,900	$242,130	$262,290	$282,450	$302,610	$322,770
	2	$122,485	$146,965	$171,530	$196,010	$220,490	$244,970	$269,450	$294,015	$318,495	$342,975	$367,455	$391,935
	3	$144,100	$172,900	$201,800	$230,600	$259,400	$288,200	$317,000	$345,900	$374,700	$403,500	$432,300	$461,100
	4	$165,715	$198,835	$232,070	$265,190	$298,310	$331,430	$364,550	$397,785	$430,905	$464,025	$497,145	$530,265
4.375%	1	$99,400	$119,280	$139,160	$159,040	$178,920	$198,800	$218,680	$238,490	$258,440	$278,250	$298,200	$318,010
	2	$120,700	$144,840	$168,980	$193,120	$217,260	$241,400	$265,540	$289,595	$313,820	$337,875	$362,100	$386,155
	3	$142,000	$170,400	$198,800	$227,200	$255,600	$284,000	$312,400	$340,700	$369,200	$397,500	$426,000	$454,300
	4	$163,300	$195,960	$228,620	$261,280	$293,940	$326,600	$359,260	$391,805	$424,580	$457,125	$489,900	$522,445
4.500%	1	$97,930	$117,530	$137,060	$156,660	$176,260	$195,860	$215,460	$235,060	$254,660	$274,260	$293,790	$313,390
	2	$118,915	$142,715	$166,430	$190,230	$214,030	$237,830	$261,630	$285,430	$309,230	$333,030	$356,745	$380,545
	3	$139,900	$167,900	$195,800	$223,800	$251,800	$279,800	$307,800	$335,800	$363,800	$391,800	$419,700	$447,700
	4	$160,885	$193,085	$225,170	$257,370	$289,570	$321,770	$353,970	$386,170	$418,370	$450,570	$482,655	$514,855
4.625%	1	$99,633	$119,502	$139,515	$159,384	$179,252	$199,266	$219,134	$239,075	$259,016	$278,885	$298,826	$318,767
	2	$117,215	$140,590	$164,135	$187,510	$210,885	$234,430	$257,805	$281,265	$304,725	$328,100	$351,560	$375,020
	3	$137,900	$165,400	$193,100	$220,600	$248,100	$275,800	$303,300	$330,900	$358,500	$386,000	$413,600	$441,200
	4	$158,585	$190,210	$222,065	$253,690	$285,315	$317,170	$348,795	$380,535	$412,275	$443,900	$475,640	$507,380
4.750%	1	$95,130	$114,170	$133,210	$152,180	$171,220	$190,260	$209,300	$228,340	$247,310	$266,350	$285,390	$304,430
	2	$115,515	$138,635	$161,755	$184,790	$207,910	$231,030	$254,150	$277,270	$300,305	$323,425	$346,545	$369,665
	3	$135,900	$163,100	$190,300	$217,400	$244,600	$271,800	$299,000	$326,200	$353,300	$380,500	$407,700	$434,900
	4	$156,285	$187,565	$218,845	$250,010	$281,290	$312,570	$343,850	$375,130	$406,295	$437,575	$468,855	$500,135
4.875%	1	$93,730	$112,490	$131,320	$150,010	$168,770	$187,530	$206,290	$225,050	$243,810	$262,500	$281,330	$300,090
	2	$113,815	$136,595	$159,460	$182,155	$204,935	$227,715	$250,495	$273,275	$296,055	$318,750	$341,615	$364,395
	3	$133,900	$160,700	$187,600	$214,300	$241,100	$267,900	$294,700	$321,500	$348,300	$375,000	$401,900	$428,700
	4	$153,985	$184,805	$215,740	$246,445	$277,265	$308,085	$338,905	$369,725	$400,545	$431,250	$462,185	$493,005
5.000%	1	$92,400	$110,950	$129,430	$147,910	$166,390	$184,870	$203,350	$221,830	$240,380	$258,790	$277,340	$295,820
	2	$112,200	$134,725	$157,165	$179,605	$202,045	$224,485	$246,925	$269,365	$291,890	$314,245	$336,770	$359,210
	3	$132,000	$158,500	$184,900	$211,300	$237,700	$264,100	$290,500	$316,900	$343,400	$369,700	$396,200	$422,600
	4	$151,800	$182,275	$212,635	$242,995	$273,355	$303,715	$334,075	$364,435	$394,910	$425,155	$455,630	$485,990
5.125%	1	$91,140	$109,340	$127,610	$145,810	$164,080	$182,280	$200,480	$218,750	$236,950	$255,150	$273,420	$291,620
	2	$110,670	$132,770	$154,955	$177,055	$199,240	$221,340	$243,440	$265,625	$287,725	$309,825	$332,010	$354,110
	3	$130,200	$156,200	$182,300	$208,300	$234,400	$260,400	$286,400	$312,500	$338,500	$364,500	$390,600	$416,600
	4	$149,730	$179,630	$209,645	$239,545	$269,560	$299,460	$329,360	$359,375	$389,275	$419,175	$449,190	$479,090
5.250%	1	$89,810	$107,870	$125,790	$143,780	$161,700	$179,760	$197,680	$215,670	$233,590	$251,650	$269,570	$287,560
	2	$109,055	$130,985	$152,745	$174,590	$196,350	$218,280	$240,040	$261,885	$283,645	$305,575	$327,335	$349,180
	3	$128,300	$154,100	$179,700	$205,400	$231,000	$256,800	$282,400	$308,100	$333,700	$359,500	$385,100	$410,800

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HOUSING DIVISION
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COUNTY OF MAUI

2015
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LANA`I

MULTI-FAMILY

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		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$59,860	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
5.375%	1	$88,620	$106,330	$124,040	$141,750	$159,530	$177,240	$194,950	$212,660	$230,370	$248,080	$265,860	$283,570
	2	$107,610	$129,115	$150,620	$172,125	$193,715	$215,220	$236,725	$258,230	$279,735	$301,240	$322,830	$344,335
	3	$126,600	$151,900	$177,200	$202,500	$227,900	$253,200	$278,500	$303,800	$329,100	$354,400	$379,800	$405,100
	4	$145,590	$174,685	$203,780	$232,875	$262,085	$291,180	$320,275	$349,370	$378,465	$407,560	$436,770	$465,865
5.500%	1	$87,360	$104,930	$122,360	$139,860	$157,290	$174,790	$192,290	$209,720	$227,220	$244,720	$262,220	$279,650
	2	$106,080	$127,415	$148,580	$169,830	$190,995	$212,245	$233,495	$254,660	$275,910	$297,160	$318,410	$339,575
	3	$124,800	$149,900	$174,800	$199,800	$224,700	$249,700	$274,700	$299,600	$324,600	$349,600	$374,600	$399,500
	4	$143,520	$172,385	$201,020	$229,770	$258,405	$287,155	$315,905	$344,540	$373,290	$402,040	$430,790	$459,425
5.625%	1	$86,170	$103,460	$120,680	$137,900	$155,190	$172,340	$189,630	$206,920	$224,070	$241,360	$258,650	$275,800
	2	$104,635	$125,630	$146,540	$167,450	$188,445	$209,270	$230,265	$251,260	$272,085	$293,080	$314,075	$334,900
	3	$123,100	$147,800	$172,400	$197,000	$221,700	$246,200	$270,900	$295,600	$320,100	$344,800	$369,500	$394,000
	4	$141,565	$169,970	$198,260	$226,550	$254,955	$283,130	$311,535	$339,940	$368,115	$396,520	$424,925	$453,100
5.750%	1	$85,050	$102,060	$119,070	$136,010	$153,020	$170,030	$187,040	$204,050	$221,060	$238,070	$255,080	$272,090
	2	$103,275	$123,930	$144,585	$165,155	$185,810	$206,465	$227,120	$247,775	$268,430	$289,085	$309,740	$330,395
	3	$121,500	$145,800	$170,100	$194,300	$218,600	$242,900	$267,200	$291,500	$315,800	$340,100	$364,400	$388,700
	4	$139,725	$167,670	$195,615	$223,445	$251,390	$279,335	$307,280	$335,225	$363,170	$391,115	$419,060	$447,005
5.875%	1	$83,860	$100,660	$117,460	$134,190	$150,990	$167,790	$184,520	$201,320	$218,120	$234,850	$251,650	$268,450
	2	$101,830	$122,230	$142,630	$162,945	$183,345	$203,745	$224,060	$244,460	$264,860	$285,175	$305,575	$325,975
	3	$119,800	$143,800	$167,800	$191,700	$215,700	$239,700	$263,600	$287,600	$311,600	$335,500	$359,500	$383,500
	4	$137,770	$165,370	$192,970	$220,455	$248,055	$275,655	$303,140	$330,740	$358,340	$385,825	$413,425	$441,025
6.000%	1	$82,810	$99,260	$115,850	$132,440	$149,030	$165,480	$182,070	$198,660	$215,180	$231,700	$248,290	$264,880
	2	$100,555	$120,530	$140,675	$160,820	$180,965	$200,940	$221,085	$241,230	$261,290	$281,350	$301,495	$321,640
	3	$118,300	$141,800	$165,500	$189,200	$212,900	$236,400	$260,100	$283,800	$307,400	$331,000	$354,700	$378,400
	4	$136,045	$163,070	$190,325	$217,580	$244,835	$271,860	$299,115	$326,370	$353,510	$380,650	$407,905	$435,160
6.125%	1	$81,620	$98,000	$114,380	$130,690	$147,000	$163,380	$179,690	$196,000	$212,310	$228,690	$245,000	$261,310
	2	$99,110	$119,000	$138,890	$158,695	$178,500	$198,390	$218,195	$238,000	$257,805	$277,695	$297,500	$317,305
	3	$116,600	$140,000	$163,400	$186,700	$210,000	$233,400	$256,700	$280,000	$303,300	$326,700	$350,000	$373,300
	4	$134,090	$161,000	$187,910	$214,705	$241,500	$268,410	$295,205	$322,000	$348,795	$375,705	$402,500	$429,295
6.250%	1	$80,570	$96,740	$112,840	$128,940	$145,110	$161,140	$177,310	$193,410	$209,510	$225,680	$241,780	$257,880
	2	$97,835	$117,470	$137,020	$156,570	$176,205	$195,670	$215,305	$234,855	$254,405	$274,040	$293,590	$313,140
	3	$115,100	$138,200	$161,200	$184,200	$207,300	$230,200	$253,300	$276,300	$299,300	$322,400	$345,400	$368,400
	4	$132,365	$158,930	$185,380	$211,830	$238,395	$264,730	$291,295	$317,745	$344,195	$370,760	$397,210	$423,660
6.375%	1	$79,520	$95,480	$111,300	$127,260	$143,150	$159,110	$174,930	$190,890	$206,780	$222,740	$238,560	$254,520
	2	$96,560	$115,940	$135,150	$154,530	$173,825	$193,205	$212,415	$231,795	$251,090	$270,470	$289,680	$309,060
	3	$113,600	$136,400	$159,000	$181,800	$204,500	$227,300	$249,900	$272,700	$295,400	$318,200	$340,800	$363,600
	4	$130,640	$156,860	$182,850	$209,070	$235,175	$261,395	$287,385	$313,605	$339,710	$365,930	$391,920	$418,140
6.500%	1	$78,470	$94,220	$109,970	$125,650	$141,330	$157,010	$172,690	$188,440	$204,120	$219,800	$235,480	$251,230
	2	$95,285	$114,410	$133,535	$152,575	$171,615	$190,655	$209,695	$228,820	$247,860	$266,900	$285,940	$305,065
	3	$112,100	$134,600	$157,100	$179,500	$201,900	$224,300	$246,700	$269,200	$291,600	$314,000	$336,400	$358,900
	4	$128,915	$154,790	$180,665	$206,425	$232,185	$257,945	$283,705	$309,580	$335,340	$361,100	$386,860	$412,735
6.625%	1	$77,490	$92,960	$108,500	$123,970	$139,510	$154,980	$170,450	$185,990	$201,460	$217,000	$232,470	$247,940
	2	$94,095	$112,880	$131,750	$150,535	$169,405	$188,190	$206,975	$225,845	$244,630	$263,500	$282,285	$301,070
	3	$110,700	$132,800	$155,000	$177,100	$199,300	$221,400	$243,500	$265,700	$287,800	$310,000	$332,100	$354,200
	4	$127,305	$152,720	$178,250	$203,665	$229,195	$254,610	$280,025	$305,555	$330,970	$356,500	$381,915	$407,330

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

LANA`I

MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$59,860	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
6.750%	1	$76,510	$91,770	$107,100	$122,430	$137,690	$153,020	$168,350	$183,610	$198,870	$214,200	$229,530	$244,790
	2	$92,905	$111,435	$130,050	$148,665	$167,195	$185,810	$204,425	$222,955	$241,485	$260,100	$278,715	$297,245
	3	$109,300	$131,100	$153,000	$174,900	$196,700	$218,600	$240,500	$262,300	$284,100	$306,000	$327,900	$349,700
	4	$125,695	$150,765	$175,950	$201,135	$226,205	$251,390	$276,575	$301,645	$326,715	$351,900	$377,085	$402,155
6.875%	1	$75,530	$90,650	$105,770	$120,820	$135,940	$151,060	$166,180	$181,300	$196,350	$211,470	$226,590	$241,710
	2	$91,715	$110,075	$128,435	$146,710	$165,070	$183,430	$201,790	$220,150	$238,425	$256,785	$275,145	$293,505
	3	$107,900	$129,500	$151,100	$172,600	$194,200	$215,800	$237,400	$259,000	$280,500	$302,100	$323,700	$345,300
	4	$124,085	$148,925	$173,765	$198,490	$223,330	$248,170	$273,010	$297,850	$322,575	$347,415	$372,255	$397,095
7.000%	1	$74,620	$89,530	$104,370	$119,350	$134,260	$149,170	$164,150	$178,990	$193,900	$208,880	$223,790	$238,630
	2	$90,610	$108,715	$126,735	$144,925	$163,030	$181,135	$199,325	$217,345	$235,450	$253,640	$271,745	$289,765
	3	$106,600	$127,900	$149,100	$170,500	$191,800	$213,100	$234,500	$255,700	$277,000	$298,400	$319,700	$340,900
	4	$122,590	$147,085	$171,465	$196,075	$220,570	$245,065	$269,675	$294,055	$318,550	$343,160	$367,655	$392,035
7.125%	1	$73,640	$88,410	$103,110	$117,880	$132,580	$147,280	$162,050	$176,750	$191,520	$206,220	$220,920	$235,690
	2	$89,420	$107,355	$125,205	$143,140	$160,990	$178,840	$196,775	$214,625	$232,560	$250,410	$268,260	$286,195
	3	$105,200	$126,300	$147,300	$168,400	$189,400	$210,400	$231,500	$252,500	$273,600	$294,600	$315,600	$336,700
	4	$120,980	$145,245	$169,395	$193,660	$217,810	$241,960	$266,225	$290,375	$314,640	$338,790	$362,940	$387,205
7.250%	1	$72,800	$87,290	$101,780	$116,340	$130,900	$145,460	$160,020	$174,580	$189,140	$203,700	$218,260	$232,820
	2	$88,400	$105,995	$123,590	$141,270	$158,950	$176,630	$194,310	$211,990	$229,670	$247,350	$265,030	$282,710
	3	$104,000	$124,700	$145,400	$166,200	$187,000	$207,800	$228,600	$249,400	$270,200	$291,000	$311,800	$332,600
	4	$119,600	$143,405	$167,210	$191,130	$215,050	$238,970	$262,890	$286,810	$310,730	$334,650	$358,570	$382,490
7.375%	1	$71,820	$86,170	$100,590	$115,010	$129,360	$143,710	$158,060	$172,410	$186,830	$201,180	$215,530	$229,880
	2	$87,210	$104,635	$122,145	$139,655	$157,080	$174,505	$191,930	$209,355	$226,865	$244,290	$261,715	$279,140
	3	$102,600	$123,100	$143,700	$164,300	$184,800	$205,300	$225,800	$246,300	$266,900	$287,400	$307,900	$328,400
	4	$117,990	$141,565	$165,255	$188,945	$212,520	$236,095	$259,670	$283,245	$306,935	$330,510	$354,085	$377,660
7.500%	1	$70,910	$85,190	$99,330	$113,540	$127,750	$141,960	$156,100	$170,310	$184,520	$198,730	$212,870	$227,150
	2	$86,105	$103,445	$120,615	$137,870	$155,125	$172,380	$189,550	$206,805	$224,060	$241,315	$258,485	$275,825
	3	$101,300	$121,700	$141,900	$162,200	$182,500	$202,800	$223,000	$243,300	$263,600	$283,900	$304,100	$324,500
	4	$116,495	$139,955	$163,185	$186,530	$209,875	$233,220	$256,450	$279,795	$303,140	$326,485	$349,715	$373,175
7.625%	1	$70,140	$84,140	$98,140	$112,140	$126,210	$140,210	$154,210	$168,280	$182,280	$196,280	$210,280	$224,350
	2	$85,170	$102,170	$119,170	$136,170	$153,255	$170,255	$187,255	$204,340	$221,340	$238,340	$255,340	$272,425
	3	$100,200	$120,200	$140,200	$160,200	$180,300	$200,300	$220,300	$240,400	$260,400	$280,400	$300,400	$320,500
	4	$115,230	$138,230	$161,230	$184,230	$207,345	$230,345	$253,345	$276,460	$299,460	$322,460	$345,460	$368,575
7.750%	1	$69,230	$83,090	$96,950	$110,810	$124,670	$138,530	$152,390	$166,250	$180,040	$193,900	$207,760	$221,620
	2	$84,065	$100,895	$117,725	$134,555	$151,385	$168,215	$185,045	$201,875	$218,620	$235,450	$252,280	$269,110
	3	$98,900	$118,700	$138,500	$158,300	$178,100	$197,900	$217,700	$237,500	$257,200	$277,000	$296,800	$316,600
	4	$113,735	$136,505	$159,275	$182,045	$204,815	$227,585	$250,355	$273,125	$295,780	$318,550	$341,320	$364,090
7.875%	1	$68,390	$82,180	$95,830	$109,480	$123,200	$136,920	$150,570	$164,220	$177,940	$191,660	$205,310	$218,960
	2	$83,045	$99,790	$116,365	$132,940	$149,600	$166,260	$182,835	$199,410	$216,070	$232,730	$249,305	$265,880
	3	$97,700	$117,400	$136,900	$156,400	$176,000	$195,600	$215,100	$234,600	$254,200	$273,800	$293,300	$312,800
	4	$112,355	$135,010	$157,435	$179,860	$202,400	$224,940	$247,365	$269,790	$292,330	$314,870	$337,295	$359,720
8.000%	1	$67,620	$81,130	$94,710	$108,150	$121,730	$135,240	$148,820	$162,260	$175,840	$189,350	$202,860	$216,440
	2	$82,110	$98,515	$115,005	$131,325	$147,815	$164,220	$180,710	$197,030	$213,520	$229,925	$246,330	$262,820
	3	$96,600	$115,900	$135,300	$154,500	$173,900	$193,200	$212,600	$231,800	$251,200	$270,500	$289,800	$309,200
	4	$111,090	$133,285	$155,595	$177,675	$199,985	$222,180	$244,490	$266,570	$288,880	$311,075	$333,270	$355,580

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES
LANA`I
MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$59,860	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
8.125%	1	$66,850	$80,220	$93,590	$106,890	$120,260	$133,700	$147,070	$160,370	$173,740	$187,110	$200,480	$213,920
	2	$81,175	$97,410	$113,645	$129,795	$146,030	$162,350	$178,585	$194,735	$210,970	$227,205	$243,440	$259,760
	3	$95,500	$114,600	$133,700	$152,700	$171,800	$191,000	$210,100	$229,100	$248,200	$267,300	$286,400	$305,600
	4	$109,825	$131,790	$153,755	$175,605	$197,570	$219,650	$241,615	$263,465	$285,430	$307,395	$329,360	$351,440
8.250%	1	$66,010	$79,240	$92,470	$105,630	$118,860	$132,090	$145,250	$158,480	$171,710	$184,940	$198,170	$211,400
	2	$80,155	$96,220	$112,285	$128,265	$144,330	$160,395	$176,375	$192,440	$208,505	$224,570	$240,635	$256,700
	3	$94,300	$113,200	$132,100	$150,900	$169,800	$188,700	$207,500	$226,400	$245,300	$264,200	$283,100	$302,000
	4	$108,445	$130,180	$151,915	$173,535	$195,270	$217,005	$238,625	$260,360	$282,095	$303,830	$325,565	$347,300
8.375%	1	$65,240	$78,400	$91,420	$104,440	$117,530	$130,620	$143,640	$156,660	$169,750	$182,840	$195,860	$208,880
	2	$79,220	$95,200	$111,010	$126,820	$142,715	$158,610	$174,420	$190,230	$206,125	$222,020	$237,830	$253,640
	3	$93,200	$112,000	$130,600	$149,200	$167,900	$186,600	$205,200	$223,800	$242,500	$261,200	$279,800	$298,400
	4	$107,180	$128,800	$150,190	$171,580	$193,085	$214,590	$235,980	$257,370	$278,875	$300,380	$321,770	$343,160
8.500%	1	$64,540	$77,420	$90,370	$103,250	$116,200	$129,080	$142,030	$154,840	$167,790	$180,670	$193,620	$206,500
	2	$78,370	$94,010	$109,735	$125,375	$141,100	$156,740	$172,465	$188,020	$203,745	$219,385	$235,110	$250,750
	3	$92,200	$110,600	$129,100	$147,500	$166,000	$184,400	$202,900	$221,200	$239,700	$258,100	$276,600	$295,000
	4	$106,030	$127,190	$148,465	$169,625	$190,900	$212,060	$233,335	$254,380	$275,655	$296,815	$318,090	$339,250
8.625%	1	$63,840	$76,580	$89,320	$102,060	$114,870	$127,610	$140,350	$153,090	$165,900	$178,640	$191,380	$204,120
	2	$77,520	$92,990	$108,460	$123,930	$139,485	$154,955	$170,425	$185,895	$201,450	$216,920	$232,390	$247,860
	3	$91,200	$109,400	$127,600	$145,800	$164,100	$182,300	$200,500	$218,700	$237,000	$255,200	$273,400	$291,600
	4	$104,880	$125,810	$146,740	$167,670	$188,715	$209,645	$230,575	$251,505	$272,550	$293,480	$314,410	$335,340
8.750%	1	$63,070	$75,670	$88,340	$100,940	$113,540	$126,140	$138,810	$151,410	$164,010	$176,610	$189,280	$201,880
	2	$76,585	$91,885	$107,270	$122,570	$137,870	$153,170	$168,555	$183,855	$199,155	$214,455	$229,840	$245,140
	3	$90,100	$108,100	$126,200	$144,200	$162,200	$180,200	$198,300	$216,300	$234,300	$252,300	$270,400	$288,400
	4	$103,615	$124,315	$145,130	$165,830	$186,530	$207,230	$228,045	$248,745	$269,445	$290,145	$310,960	$331,660

Maximum affordable sales price is based on the following factors:

$59,860 Median family income as established by the Department of Housing and Human Concerns (DHHC)
30 Number of years for a fixed-rate mortgage loan with no discount points
30% Percentage of gross monthly income for housing expenses (principle and interest payment only)
5% Percentage of the purchase price for downpayment.

Prepared by:
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DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **May 1, 2015**

2015
INCOME LIMITS & AFFORDABLE RENT GUIDELINES
LANA`I

INCOME LIMITS FOR RENTAL UNITS (BY FAMILY SIZE & PERCENTAGE OF MEDIAN FAMILY INCOME)

% of Median	1 PERSON 0.7	2 PERSON 0.8	3 PERSON 0.9	4 PERSON 1.0	5 PERSON 1.08	6 PERSON 1.16	7 PERSON 1.24	8 PERSON 1.32
10%	$4,190	$4,790	$5,390	$5,990	$6,460	$6,940	$7,420	$7,900
20%	$8,380	$9,580	$10,770	$11,970	$12,930	$13,890	$14,850	$15,800
30%	$12,570	$14,370	$16,160	$17,960	$19,390	$20,830	$22,270	$23,700
40%	$16,760	$19,160	$21,550	$23,940	$25,860	$27,780	$29,690	$31,610
50%	$20,950	$23,940	$26,940	$29,930	$32,320	$34,720	$37,110	$39,510
60%	$25,140	$28,730	$32,320	$35,920	$38,790	$41,660	$44,540	$47,410
70%	$29,330	$33,520	$37,710	$41,900	$45,250	$48,610	$51,960	$55,310
80%	$33,520	$38,310	$43,100	$47,890	$51,720	$55,550	$59,380	$63,210
90%	$37,710	$43,100	$48,490	$53,870	$58,180	$62,490	$66,800	$71,110
100%	$41,900	$47,890	$53,870	$59,860	$64,650	$69,440	$74,230	$79,020
110%	$46,090	$52,680	$59,260	$65,850	$71,110	$76,380	$81,650	$86,920
120%	$50,280	$57,470	$64,650	$71,830	$77,580	$83,330	$89,070	$94,820
130%	$54,470	$62,250	$70,040	$77,820	$84,040	$90,270	$96,490	$102,720
140%	$58,660	$67,040	$75,420	$83,800	$90,510	$97,210	$103,920	$110,620

AFFORDABLE RENT GUIDELINES (BY UNIT SIZE & PERCENTAGE OF MEDIAN FAMILY INCOME)

% of Median	UNIT SIZE (NO. OF BEDROOMS) 0	1	2	3	4	5
10%	$105	$112	$135	$156	$174	$192
20%	$210	$225	$269	$311	$347	$383
30%	$314	$337	$404	$467	$521	$575
40%	$419	$449	$539	$623	$695	$766
50%	$524	$561	$674	$778	$868	$958
60%	$629	$673	$808	$934	$1,042	$1,149
70%	$733	$786	$943	$1,089	$1,215	$1,341
80%	$838	$898	$1,078	$1,245	$1,389	$1,532
90%	$943	$1,010	$1,212	$1,401	$1,562	$1,724
100%	$1,048	$1,122	$1,347	$1,556	$1,736	$1,916
110%	$1,152	$1,235	$1,482	$1,712	$1,910	$2,107
120%	$1,257	$1,347	$1,616	$1,868	$2,083	$2,299
130%	$1,362	$1,459	$1,751	$2,023	$2,257	$2,490
140%	$1,467	$1,571	$1,886	$2,179	$2,430	$2,682

Note: Affordable rents are based on 30% of gross monthly income. Affordable rents include utilities

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COUNTY OF MAUI

Effective: **May 1, 2015**

2015
AFFORDABLE SALES PRICE GUIDELINES

MOLOKA`I
METHODOLOGY

For Calculating Median Family Income

Factors used in calculation:

American Community Survey 5-Year Estimate 2008-2012 population for Molokai	6,809	100%
American Community Survey 5-Year Estimate 2008-2012 population for West Molokai	2,525	37%
American Community Survey 5-Year Estimate 2008-2012 population for East Molokai	4,284	63%
American Community Survey 5-Year Estimate 2008-2012 median family income for West Molokai	$41,714	
American Community Survey 5-Year Estimate 2008-2012 median family income for East Molokai	$52,546	
HUD's 2015 median family income for the County of Maui	$75,100	

Estimated 2012 median family income for Molokai:

$41,714 x 37% + $52,546 x 63% = $48,538

$48,540 Est. 2015 Molokai median family income
(Rounded to nearest $10)

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2015
AFFORDABLE SALES PRICE GUIDELINES

MOLOKA`I

SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$24,270	$29,124	$33,978	$38,832	$43,686	$48,540	$53,394	$58,248	$63,102	$67,956	$72,810	$77,664
4.000%	1	$93,660	$112,350	$131,110	$149,800	$168,560	$187,320	$206,010	$224,770	$243,460	$262,220	$280,910	$299,670
	2	$113,730	$136,425	$159,205	$181,900	$204,680	$227,460	$250,155	$272,935	$295,630	$318,410	$341,105	$363,885
	3	$133,800	$160,500	$187,300	$214,000	$240,800	$267,600	$294,300	$321,100	$347,800	$374,600	$401,300	$428,100
	4	$153,870	$184,575	$215,395	$246,100	$276,920	$307,740	$338,445	$369,265	$399,970	$430,790	$461,495	$492,315
4.125%	1	$92,260	$110,670	$129,150	$147,630	$166,040	$184,520	$202,930	$221,410	$239,820	$258,300	$276,710	$295,190
	2	$112,030	$134,385	$156,825	$179,265	$201,620	$224,060	$246,415	$268,855	$291,210	$313,650	$336,005	$358,445
	3	$131,800	$158,100	$184,500	$210,900	$237,200	$263,600	$289,900	$316,300	$342,600	$369,000	$395,300	$421,700
	4	$151,570	$181,815	$212,175	$242,535	$272,780	$303,140	$333,385	$363,745	$393,990	$424,350	$454,595	$484,955
4.250%	1	$90,860	$109,060	$127,260	$145,390	$163,590	$181,790	$199,920	$218,120	$236,320	$254,450	$272,650	$290,850
	2	$110,330	$132,430	$154,530	$176,545	$198,645	$220,745	$242,760	$264,860	$286,960	$308,975	$331,075	$353,175
	3	$129,800	$155,800	$181,800	$207,700	$233,700	$259,700	$285,600	$311,600	$337,600	$363,500	$389,500	$415,500
	4	$149,270	$179,170	$209,070	$238,855	$268,755	$298,655	$328,440	$358,340	$388,240	$418,025	$447,925	$477,825
4.375%	1	$89,530	$107,450	$125,370	$143,290	$161,210	$179,060	$196,980	$214,900	$232,820	$250,740	$268,660	$286,510
	2	$108,715	$130,475	$152,235	$173,995	$195,755	$217,430	$239,190	$260,950	$282,710	$304,470	$326,230	$347,905
	3	$127,900	$153,500	$179,100	$204,700	$230,300	$255,800	$281,400	$307,000	$332,600	$358,200	$383,800	$409,300
	4	$147,085	$176,525	$205,965	$235,405	$264,845	$294,170	$323,610	$353,050	$382,490	$411,930	$441,370	$470,695
4.500%	1	$88,270	$105,910	$123,550	$141,190	$158,830	$176,470	$194,110	$211,750	$229,390	$247,030	$264,740	$282,380
	2	$107,185	$128,605	$150,025	$171,445	$192,865	$214,285	$235,705	$257,125	$278,545	$299,965	$321,470	$342,890
	3	$126,100	$151,300	$176,500	$201,700	$226,900	$252,100	$277,300	$302,500	$327,700	$352,900	$378,200	$403,400
	4	$145,015	$173,995	$202,975	$231,955	$260,935	$289,915	$318,895	$347,875	$376,855	$405,835	$434,930	$463,910
4.625%	1	$86,940	$104,370	$121,730	$139,160	$156,520	$173,880	$191,310	$208,670	$226,100	$243,460	$260,890	$278,250
	2	$105,570	$126,735	$147,815	$168,980	$190,060	$211,140	$232,305	$253,385	$274,550	$295,630	$316,795	$337,875
	3	$124,200	$149,100	$173,900	$198,800	$223,600	$248,400	$273,300	$298,100	$323,000	$347,800	$372,700	$397,500
	4	$142,830	$171,465	$199,985	$228,620	$257,140	$285,660	$314,295	$342,815	$371,450	$399,970	$428,605	$457,125
4.750%	1	$85,680	$102,830	$119,980	$137,130	$154,280	$171,430	$188,580	$205,660	$222,810	$239,960	$257,110	$274,260
	2	$104,040	$124,865	$145,690	$166,515	$187,340	$208,165	$228,990	$249,730	$270,555	$291,380	$312,205	$333,030
	3	$122,400	$146,900	$171,400	$195,900	$220,400	$244,900	$269,400	$293,800	$318,300	$342,800	$367,300	$391,800
	4	$140,760	$168,935	$197,110	$225,285	$253,460	$281,635	$309,810	$337,870	$366,045	$394,220	$422,395	$450,570
4.875%	1	$84,490	$101,360	$118,300	$135,170	$152,040	$168,980	$185,850	$202,720	$219,660	$236,530	$253,470	$270,340
	2	$102,595	$123,080	$143,650	$164,135	$184,620	$205,190	$225,675	$246,160	$266,730	$287,215	$307,785	$328,270
	3	$120,700	$144,800	$169,000	$193,100	$217,200	$241,400	$265,500	$289,600	$313,800	$337,900	$362,100	$386,200
	4	$138,805	$166,520	$194,350	$222,065	$249,780	$277,610	$305,325	$333,040	$360,870	$388,585	$416,415	$444,130
5.000%	1	$83,300	$99,960	$116,620	$133,280	$149,940	$166,600	$183,190	$199,850	$216,510	$233,170	$249,830	$266,490
	2	$101,150	$121,380	$141,610	$161,840	$182,070	$202,300	$222,445	$242,675	$262,905	$283,135	$303,365	$323,595
	3	$119,000	$142,800	$166,600	$190,400	$214,200	$238,000	$261,700	$285,500	$309,300	$333,100	$356,900	$380,700
	4	$136,850	$164,220	$191,590	$218,960	$246,330	$273,700	$300,955	$328,325	$355,695	$383,065	$410,435	$437,805
5.125%	1	$82,110	$98,560	$114,940	$131,390	$147,770	$164,220	$180,670	$197,050	$213,500	$229,880	$246,330	$262,780
	2	$99,705	$119,680	$139,570	$159,545	$179,435	$199,410	$219,385	$239,275	$259,250	$279,140	$299,115	$319,090
	3	$117,300	$140,800	$164,200	$187,700	$211,100	$234,600	$258,100	$281,500	$305,000	$328,400	$351,900	$375,400
	4	$134,895	$161,920	$188,830	$215,855	$242,765	$269,790	$296,815	$323,725	$350,750	$377,660	$404,685	$431,710
5.250%	1	$80,990	$97,160	$113,330	$129,570	$145,740	$161,910	$178,150	$194,320	$210,490	$226,730	$242,900	$259,070
	2	$98,345	$117,980	$137,615	$157,335	$176,970	$196,605	$216,325	$235,960	$255,595	$275,315	$294,950	$314,585
	3	$115,700	$138,800	$161,900	$185,100	$208,200	$231,300	$254,500	$277,600	$300,700	$323,900	$347,000	$370,100
	4	$133,055	$159,620	$186,185	$212,865	$239,430	$265,995	$292,675	$319,240	$345,805	$372,485	$399,050	$425,615

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **May 1, 2015**

2015
AFFORDABLE SALES PRICE GUIDELINES
MOLOKA`I
SINGLE FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$24,270	$29,124	$33,978	$38,832	$43,686	$48,540	$53,394	$58,248	$63,102	$67,956	$72,810	$77,664
5.375%	1	$79,870	$95,830	$111,790	$127,750	$143,710	$159,670	$175,630	$191,590	$207,550	$223,580	$239,540	$255,500
	2	$96,985	$116,365	$135,745	$155,125	$174,505	$193,885	$213,265	$232,645	$252,025	$271,490	$290,870	$310,250
	3	$114,100	$136,900	$159,700	$182,500	$205,300	$228,100	$250,900	$273,700	$296,500	$319,400	$342,200	$365,000
	4	$131,215	$157,435	$183,655	$209,875	$236,095	$262,315	$288,535	$314,755	$340,975	$367,310	$393,530	$419,750
5.500%	1	$78,750	$94,500	$110,250	$126,000	$141,750	$157,500	$173,250	$189,000	$204,750	$220,500	$236,250	$252,000
	2	$95,625	$114,750	$133,875	$153,000	$172,125	$191,250	$210,375	$229,500	$248,625	$267,750	$286,875	$306,000
	3	$112,500	$135,000	$157,500	$180,000	$202,500	$225,000	$247,500	$270,000	$292,500	$315,000	$337,500	$360,000
	4	$129,375	$155,250	$181,125	$207,000	$232,875	$258,750	$284,625	$310,500	$336,375	$362,250	$388,125	$414,000
5.625%	1	$77,630	$93,170	$108,710	$124,250	$139,790	$155,330	$170,870	$186,410	$201,950	$217,490	$232,960	$248,500
	2	$94,265	$113,135	$132,005	$150,875	$169,745	$188,615	$207,485	$226,355	$245,225	$264,095	$282,880	$301,750
	3	$110,900	$133,100	$155,300	$177,500	$199,700	$221,900	$244,100	$266,300	$288,500	$310,700	$332,800	$355,000
	4	$127,535	$153,065	$178,595	$204,125	$229,655	$255,185	$280,715	$306,245	$331,775	$357,305	$382,720	$408,250
5.750%	1	$76,580	$91,910	$107,240	$122,570	$137,900	$153,230	$168,560	$183,890	$199,220	$214,480	$229,810	$245,140
	2	$92,990	$111,605	$130,220	$148,835	$167,450	$186,065	$204,680	$223,295	$241,910	$260,440	$279,055	$297,670
	3	$109,400	$131,300	$153,200	$175,100	$197,000	$218,900	$240,800	$262,700	$284,600	$306,400	$328,300	$350,200
	4	$125,810	$150,995	$176,180	$201,365	$226,550	$251,735	$276,920	$302,105	$327,290	$352,360	$377,545	$402,730
5.875%	1	$75,600	$90,720	$105,840	$120,960	$136,010	$151,130	$166,250	$181,370	$196,490	$211,610	$226,730	$241,850
	2	$91,800	$110,160	$128,520	$146,880	$165,155	$183,515	$201,875	$220,235	$238,595	$256,955	$275,315	$293,675
	3	$108,000	$129,600	$151,200	$172,800	$194,300	$215,900	$237,500	$259,100	$280,700	$302,300	$323,900	$345,500
	4	$124,200	$149,040	$173,880	$198,720	$223,445	$248,285	$273,125	$297,965	$322,805	$347,645	$372,485	$397,325
6.000%	1	$74,550	$89,460	$104,370	$119,280	$134,190	$149,170	$164,080	$178,990	$193,900	$208,810	$223,720	$238,630
	2	$90,525	$108,630	$126,735	$144,840	$162,945	$181,135	$199,240	$217,345	$235,450	$253,555	$271,660	$289,765
	3	$106,500	$127,800	$149,100	$170,400	$191,700	$213,100	$234,400	$255,700	$277,000	$298,300	$319,600	$340,900
	4	$122,475	$146,970	$171,465	$195,960	$220,455	$245,065	$269,560	$294,055	$318,550	$343,045	$367,540	$392,035
6.125%	1	$73,570	$88,270	$103,040	$117,740	$132,440	$147,140	$161,910	$176,610	$191,310	$206,010	$220,710	$235,480
	2	$89,335	$107,185	$125,120	$142,970	$160,820	$178,670	$196,605	$214,455	$232,305	$250,155	$268,005	$285,940
	3	$105,100	$126,100	$147,200	$168,200	$189,200	$210,200	$231,300	$252,300	$273,300	$294,300	$315,300	$336,400
	4	$120,865	$145,015	$169,280	$193,430	$217,580	$241,730	$265,995	$290,145	$314,295	$338,445	$362,595	$386,860
6.250%	1	$72,590	$87,150	$101,640	$116,200	$130,690	$145,250	$159,740	$174,300	$188,790	$203,280	$217,840	$232,330
	2	$88,145	$105,825	$123,420	$141,100	$158,695	$176,375	$193,970	$211,650	$229,245	$246,840	$264,520	$282,115
	3	$103,700	$124,500	$145,200	$166,000	$186,700	$207,500	$228,200	$249,000	$269,700	$290,400	$311,200	$331,900
	4	$119,255	$143,175	$166,980	$190,900	$214,705	$238,625	$262,430	$286,350	$310,155	$333,960	$357,880	$381,685
6.375%	1	$71,680	$85,960	$100,310	$114,660	$129,010	$143,290	$157,640	$171,990	$186,340	$200,620	$214,970	$229,320
	2	$87,040	$104,380	$121,805	$139,230	$156,655	$173,995	$191,420	$208,845	$226,270	$243,610	$261,035	$278,460
	3	$102,400	$122,800	$143,300	$163,800	$184,300	$204,700	$225,200	$245,700	$266,200	$286,600	$307,100	$327,600
	4	$117,760	$141,220	$164,795	$188,370	$211,945	$235,405	$258,980	$282,555	$306,130	$329,590	$353,165	$376,740
6.500%	1	$70,700	$84,910	$99,050	$113,190	$127,330	$141,470	$155,610	$169,750	$183,890	$198,030	$212,170	$226,310
	2	$85,850	$103,105	$120,275	$137,445	$154,615	$171,785	$188,955	$206,125	$223,295	$240,465	$257,635	$274,805
	3	$101,000	$121,300	$141,500	$161,700	$181,900	$202,100	$222,300	$242,500	$262,700	$282,900	$303,100	$323,300
	4	$116,150	$139,495	$162,725	$185,955	$209,185	$232,415	$255,645	$278,875	$302,105	$325,335	$348,565	$371,795
6.625%	1	$69,790	$83,790	$97,720	$111,720	$125,650	$139,650	$153,580	$167,580	$181,510	$195,510	$209,440	$223,440
	2	$84,745	$101,745	$118,660	$135,660	$152,575	$169,575	$186,490	$203,490	$220,405	$237,405	$254,320	$271,320
	3	$99,700	$119,700	$139,600	$159,600	$179,500	$199,500	$219,400	$239,400	$259,300	$279,300	$299,200	$319,200
	4	$114,655	$137,655	$160,540	$183,540	$206,425	$229,425	$252,310	$275,310	$298,195	$321,195	$344,080	$367,080

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2015
AFFORDABLE SALES PRICE GUIDELINES

MOLOKA`I

SINGLE FAMILY

Effective: May 1, 2015

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$24,270	$29,124	$33,978	$38,832	$43,686	$48,540	$53,394	$58,248	$63,102	$67,956	$72,810	$77,664
6.750%	1	$68,950	$82,740	$96,530	$110,320	$124,040	$137,830	$151,620	$165,410	$179,200	$192,990	$206,780	$220,570
	2	$83,725	$100,470	$117,215	$133,960	$150,620	$167,365	$184,110	$200,855	$217,600	$234,345	$251,090	$267,835
	3	$98,500	$118,200	$137,900	$157,600	$177,200	$196,900	$216,600	$236,300	$256,000	$275,700	$295,400	$315,100
	4	$113,275	$135,930	$158,585	$181,240	$203,780	$226,435	$249,090	$271,745	$294,400	$317,055	$339,710	$362,365
6.875%	1	$68,040	$81,690	$95,270	$108,920	$122,500	$136,080	$149,730	$163,310	$176,960	$190,540	$204,190	$217,770
	2	$82,620	$99,195	$115,685	$132,260	$148,750	$165,240	$181,815	$198,305	$214,880	$231,370	$247,945	$264,435
	3	$97,200	$116,700	$136,100	$155,600	$175,000	$194,400	$213,900	$233,300	$252,800	$272,200	$291,700	$311,100
	4	$111,780	$134,205	$156,515	$178,940	$201,250	$223,560	$245,985	$268,295	$290,720	$313,030	$335,455	$357,765
7.000%	1	$67,200	$80,640	$94,080	$107,520	$120,960	$134,400	$147,840	$161,280	$174,720	$188,160	$201,600	$215,040
	2	$81,600	$97,920	$114,240	$130,560	$146,880	$163,200	$179,520	$195,840	$212,160	$228,480	$244,800	$261,120
	3	$96,000	$115,200	$134,400	$153,600	$172,800	$192,000	$211,200	$230,400	$249,600	$268,800	$288,000	$307,200
	4	$110,400	$132,480	$154,560	$176,640	$198,720	$220,800	$242,880	$264,960	$287,040	$309,120	$331,200	$353,280
7.125%	1	$66,360	$79,660	$92,890	$106,190	$119,420	$132,720	$146,020	$159,250	$172,550	$185,780	$199,080	$212,380
	2	$80,580	$96,730	$112,795	$128,945	$145,010	$161,160	$177,310	$193,375	$209,525	$225,590	$241,740	$257,890
	3	$94,800	$113,800	$132,700	$151,700	$170,600	$189,600	$208,600	$227,500	$246,500	$265,400	$284,400	$303,400
	4	$109,020	$130,870	$152,605	$174,455	$196,190	$218,040	$239,890	$261,625	$283,475	$305,210	$327,060	$348,910
7.250%	1	$65,520	$78,610	$91,770	$104,860	$117,950	$131,040	$144,200	$157,290	$170,380	$183,470	$196,630	$209,720
	2	$79,560	$95,455	$111,435	$127,330	$143,225	$159,120	$175,100	$190,995	$206,890	$222,785	$238,765	$254,660
	3	$93,600	$112,300	$131,100	$149,800	$168,500	$187,200	$206,000	$224,700	$243,400	$262,100	$280,900	$299,600
	4	$107,640	$129,145	$150,765	$172,270	$193,775	$215,280	$236,900	$258,405	$279,910	$301,415	$323,035	$344,540
7.375%	1	$64,750	$77,700	$90,650	$103,600	$116,550	$129,430	$142,380	$155,330	$168,280	$181,230	$194,180	$207,130
	2	$78,625	$94,350	$110,075	$125,800	$141,525	$157,165	$172,890	$188,615	$204,340	$220,065	$235,790	$251,515
	3	$92,500	$111,000	$129,500	$148,000	$166,500	$184,900	$203,400	$221,900	$240,400	$258,900	$277,400	$295,900
	4	$106,375	$127,650	$148,925	$170,200	$191,475	$212,635	$233,910	$255,185	$276,460	$297,735	$319,010	$340,285
7.500%	1	$63,910	$76,720	$89,530	$102,270	$115,080	$127,890	$140,700	$153,440	$166,250	$179,060	$191,800	$204,610
	2	$77,605	$93,160	$108,715	$124,185	$139,740	$155,295	$170,850	$186,320	$201,875	$217,430	$232,900	$248,455
	3	$91,300	$109,600	$127,900	$146,100	$164,400	$182,700	$201,000	$219,200	$237,500	$255,800	$274,000	$292,300
	4	$104,995	$126,040	$147,085	$168,015	$189,060	$210,105	$231,150	$252,080	$273,125	$294,170	$315,100	$336,145
7.625%	1	$63,140	$75,810	$88,410	$101,080	$113,680	$126,350	$138,950	$151,620	$164,220	$176,890	$189,490	$202,160
	2	$76,670	$92,055	$107,355	$122,740	$138,040	$153,425	$168,725	$184,110	$199,410	$214,795	$230,095	$245,480
	3	$90,200	$108,300	$126,300	$144,400	$162,400	$180,500	$198,500	$216,600	$234,600	$252,700	$270,700	$288,800
	4	$103,730	$124,545	$145,245	$166,060	$186,760	$207,575	$228,275	$249,090	$269,790	$290,605	$311,305	$332,120
7.750%	1	$62,440	$74,900	$87,360	$99,820	$112,350	$124,810	$137,270	$149,800	$162,260	$174,720	$187,250	$199,710
	2	$75,820	$90,950	$106,080	$121,210	$136,425	$151,555	$166,685	$181,900	$197,030	$212,160	$227,375	$242,505
	3	$89,200	$107,000	$124,800	$142,600	$160,500	$178,300	$196,100	$214,000	$231,800	$249,600	$267,500	$285,300
	4	$102,580	$123,050	$143,520	$163,990	$184,575	$205,045	$225,515	$246,100	$266,570	$287,040	$307,625	$328,095
7.875%	1	$61,670	$73,990	$86,310	$98,630	$111,020	$123,340	$135,660	$147,980	$160,300	$172,620	$185,010	$197,330
	2	$74,885	$89,845	$104,805	$119,765	$134,810	$149,770	$164,730	$179,690	$194,650	$209,610	$224,655	$239,615
	3	$88,100	$105,700	$123,300	$140,900	$158,600	$176,200	$193,800	$211,400	$229,000	$246,600	$264,300	$281,900
	4	$101,315	$121,555	$141,795	$162,035	$182,390	$202,630	$222,870	$243,110	$263,350	$283,590	$303,945	$324,185
8.000%	1	$60,900	$73,150	$85,330	$97,510	$109,690	$121,870	$134,050	$146,230	$158,410	$170,590	$182,770	$194,950
	2	$73,950	$88,825	$103,615	$118,405	$133,195	$147,985	$162,775	$177,565	$192,355	$207,145	$221,935	$236,725
	3	$87,000	$104,500	$121,900	$139,300	$156,700	$174,100	$191,500	$208,900	$226,300	$243,700	$261,100	$278,500
	4	$100,050	$120,175	$140,185	$160,195	$180,205	$200,215	$220,225	$240,235	$260,245	$280,255	$300,265	$320,275

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

MOLOKA`I

SINGLE FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	**Low Income**			**Below Moderate**		**Moderate**		**Above Moderate**		**Gap Income**	
		50% & Below	**(51% to 80%)**			**(81% to 100%)**		**(101% to 120%)**		**(121% to 140%)**		**(141% to 160%)**	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$24,270	$29,124	$33,978	$38,832	$43,686	$48,540	$53,394	$58,248	$63,102	$67,956	$72,810	$77,664
8.125%	1	$60,200	$72,240	$84,280	$96,320	$108,360	$120,400	$132,440	$144,480	$156,520	$168,630	$180,670	$192,710
	2	$73,100	$87,720	$102,340	$116,960	$131,580	$146,200	$160,820	$175,440	$190,060	$204,765	$219,385	$234,005
	3	$86,000	$103,200	$120,400	$137,600	$154,800	$172,000	$189,200	$206,400	$223,600	$240,900	$258,100	$275,300
	4	$98,900	$118,680	$138,460	$158,240	$178,020	$197,800	$217,580	$237,360	$257,140	$277,035	$296,815	$316,595
8.250%	1	$59,500	$71,400	$83,300	$95,200	$107,100	$119,000	$130,900	$142,800	$154,700	$166,600	$178,500	$190,400
	2	$72,250	$86,700	$101,150	$115,600	$130,050	$144,500	$158,950	$173,400	$187,850	$202,300	$216,750	$231,200
	3	$85,000	$102,000	$119,000	$136,000	$153,000	$170,000	$187,000	$204,000	$221,000	$238,000	$255,000	$272,000
	4	$97,750	$117,300	$136,850	$156,400	$175,950	$195,500	$215,050	$234,600	$254,150	$273,700	$293,250	$312,800
8.375%	1	$58,800	$70,560	$82,320	$94,080	$105,910	$117,670	$129,430	$141,190	$152,950	$164,710	$176,470	$188,230
	2	$71,400	$85,680	$99,960	$114,240	$128,605	$142,885	$157,165	$171,445	$185,725	$200,005	$214,285	$228,565
	3	$84,000	$100,800	$117,600	$134,400	$151,300	$168,100	$184,900	$201,700	$218,500	$235,300	$252,100	$268,900
	4	$96,600	$115,920	$135,240	$154,560	$173,995	$193,315	$212,635	$231,955	$251,275	$270,595	$289,915	$309,235
8.500%	1	$58,170	$69,790	$81,410	$93,030	$104,650	$116,270	$127,890	$139,580	$151,200	$162,820	$174,440	$186,060
	2	$70,635	$84,745	$98,855	$112,965	$127,075	$141,185	$155,295	$169,490	$183,600	$197,710	$211,820	$225,930
	3	$83,100	$99,700	$116,300	$132,900	$149,500	$166,100	$182,700	$199,400	$216,000	$232,600	$249,200	$265,800
	4	$95,565	$114,655	$133,745	$152,835	$171,925	$191,015	$210,105	$229,310	$248,400	$267,490	$286,580	$305,670
8.625%	1	$57,470	$68,950	$80,500	$91,980	$103,460	$114,940	$126,490	$137,970	$149,450	$160,930	$172,410	$183,960
	2	$69,785	$83,725	$97,750	$111,690	$125,630	$139,570	$153,595	$167,535	$181,475	$195,415	$209,355	$223,380
	3	$82,100	$98,500	$115,000	$131,400	$147,800	$164,200	$180,700	$197,100	$213,500	$229,900	$246,300	$262,800
	4	$94,415	$113,275	$132,250	$151,110	$169,970	$188,830	$207,805	$226,665	$245,525	$264,385	$283,245	$302,220
8.750%	1	$56,840	$68,180	$79,590	$90,930	$102,270	$113,680	$125,020	$136,360	$147,770	$159,110	$170,520	$181,860
	2	$69,020	$82,790	$96,645	$110,415	$124,185	$138,040	$151,810	$165,580	$179,435	$193,205	$207,060	$220,830
	3	$81,200	$97,400	$113,700	$129,900	$146,100	$162,400	$178,600	$194,800	$211,100	$227,300	$243,600	$259,800
	4	$93,380	$112,010	$130,755	$149,385	$168,015	$186,760	$205,390	$224,020	$242,765	$261,395	$280,140	$298,770

Maximum affordable sales price is based on the following factors:

$48,540 Median family income as established by the Department of Housing and Human Concerns (DHHC)
30 Number of years for a fixed-rate mortgage loan with no discount points
30% Percentage of gross monthly income for housing expenses (principle and interest payment only)
5% Percentage of the purchase price for downpayment.

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

MOLOKA`I

MULTI-FAMILY

Effective: May 1, 2015

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$24,270	$29,124	$33,978	$38,832	$43,686	$48,540	$53,394	$58,248	$63,102	$67,956	$72,810	$77,664
4.000%	1	$84,280	$101,150	$118,020	$134,820	$151,690	$168,560	$185,430	$202,300	$219,100	$235,970	$252,840	$269,710
	2	$102,340	$122,825	$143,310	$163,710	$184,195	$204,680	$225,165	$245,650	$266,050	$286,535	$307,020	$327,505
	3	$120,400	$144,500	$168,600	$192,600	$216,700	$240,800	$264,900	$289,000	$313,000	$337,100	$361,200	$385,300
	4	$138,460	$166,175	$193,890	$221,490	$249,205	$276,920	$304,635	$332,350	$359,950	$387,665	$415,380	$443,095
4.125%	1	$83,020	$99,610	$116,270	$132,860	$149,450	$166,040	$182,630	$199,290	$215,810	$232,470	$249,060	$265,650
	2	$100,810	$120,955	$141,185	$161,330	$181,475	$201,620	$221,765	$241,995	$262,055	$282,285	$302,430	$322,575
	3	$118,600	$142,300	$166,100	$189,800	$213,500	$237,200	$260,900	$284,700	$308,300	$332,100	$355,800	$379,500
	4	$136,390	$163,645	$191,015	$218,270	$245,525	$272,780	$300,035	$327,405	$354,545	$381,915	$409,170	$436,425
4.250%	1	$81,760	$98,140	$114,520	$130,830	$147,210	$163,590	$179,900	$196,280	$212,660	$229,040	$245,420	$261,800
	2	$99,280	$119,170	$139,060	$158,865	$178,755	$198,645	$218,450	$238,340	$258,230	$278,120	$298,010	$317,900
	3	$116,800	$140,200	$163,600	$186,900	$210,300	$233,700	$257,000	$280,400	$303,800	$327,200	$350,600	$374,000
	4	$134,320	$161,230	$188,140	$214,935	$241,845	$268,755	$295,550	$322,460	$349,370	$376,280	$403,190	$430,100
4.375%	1	$80,570	$96,740	$112,840	$128,940	$145,110	$161,140	$177,310	$193,410	$209,510	$225,680	$241,780	$257,880
	2	$97,835	$117,470	$137,020	$156,570	$176,205	$195,670	$215,305	$234,855	$254,405	$274,040	$293,590	$313,140
	3	$115,100	$138,200	$161,200	$184,200	$207,300	$230,200	$253,300	$276,300	$299,300	$322,400	$345,400	$368,400
	4	$132,365	$158,930	$185,380	$211,830	$238,395	$264,730	$291,295	$317,745	$344,195	$370,760	$397,210	$423,660
4.500%	1	$79,450	$95,340	$111,230	$127,050	$142,940	$158,830	$174,720	$190,610	$206,430	$222,320	$238,280	$254,170
	2	$96,475	$115,770	$135,065	$154,275	$173,570	$192,865	$212,160	$231,455	$250,665	$269,960	$289,340	$308,635
	3	$113,500	$136,200	$158,900	$181,500	$204,200	$226,900	$249,600	$272,300	$294,900	$317,600	$340,400	$363,100
	4	$130,525	$156,630	$182,735	$208,725	$234,830	$260,935	$287,040	$313,145	$339,135	$365,240	$391,460	$417,565
4.625%	1	$78,260	$93,940	$109,550	$125,230	$140,840	$156,520	$172,200	$187,810	$203,490	$219,100	$234,780	$250,460
	2	$95,030	$114,070	$133,025	$152,065	$171,020	$190,060	$209,100	$228,055	$247,095	$266,050	$285,090	$304,130
	3	$111,800	$134,200	$156,500	$178,900	$201,200	$223,600	$246,000	$268,300	$290,700	$313,000	$335,400	$357,800
	4	$128,570	$154,330	$179,975	$205,735	$231,380	$257,140	$282,900	$308,545	$334,305	$359,950	$385,710	$411,470
4.750%	1	$77,140	$92,540	$108,010	$123,410	$138,880	$154,280	$169,750	$185,080	$200,550	$215,950	$231,420	$246,820
	2	$93,670	$112,370	$131,155	$149,855	$168,640	$187,340	$206,125	$224,740	$243,525	$262,225	$281,010	$299,710
	3	$110,200	$132,200	$154,300	$176,300	$198,400	$220,400	$242,500	$264,400	$286,500	$308,500	$330,600	$352,600
	4	$126,730	$152,030	$177,445	$202,745	$228,160	$253,460	$278,875	$304,060	$329,475	$354,775	$380,190	$405,490
4.875%	1	$76,020	$91,210	$106,470	$121,660	$136,850	$152,110	$167,300	$182,420	$197,680	$212,870	$228,130	$243,320
	2	$92,310	$110,755	$129,285	$147,730	$166,175	$184,705	$203,150	$221,510	$240,040	$258,485	$277,015	$295,460
	3	$108,600	$130,300	$152,100	$173,800	$195,500	$217,300	$239,000	$260,600	$282,400	$304,100	$325,900	$347,600
	4	$124,890	$149,845	$174,915	$199,870	$224,825	$249,895	$274,850	$299,690	$324,760	$349,715	$374,785	$399,740
5.000%	1	$77,380	$92,841	$108,303	$123,837	$139,298	$154,760	$170,149	$185,683	$201,144	$216,606	$232,067	$247,529
	2	$91,035	$109,225	$127,415	$145,690	$163,880	$182,070	$200,175	$218,450	$236,640	$254,830	$273,020	$291,210
	3	$107,100	$128,500	$149,900	$171,400	$192,800	$214,200	$235,500	$257,000	$278,400	$299,800	$321,200	$342,600
	4	$123,165	$147,775	$172,385	$197,110	$221,720	$246,330	$270,825	$295,550	$320,160	$344,770	$369,380	$393,990
5.125%	1	$73,920	$88,690	$103,460	$118,230	$133,000	$147,770	$162,610	$177,380	$192,150	$206,920	$221,690	$236,530
	2	$89,760	$107,695	$125,630	$143,565	$161,500	$179,435	$197,455	$215,390	$233,325	$251,260	$269,195	$287,215
	3	$105,600	$126,700	$147,800	$168,900	$190,000	$211,100	$232,300	$253,400	$274,500	$295,600	$316,700	$337,900
	4	$121,440	$145,705	$169,970	$194,235	$218,500	$242,765	$267,145	$291,410	$315,675	$339,940	$364,205	$388,585
5.250%	1	$72,870	$87,430	$101,990	$116,620	$131,180	$145,740	$160,370	$174,860	$189,420	$204,050	$218,610	$233,170
	2	$88,485	$106,165	$123,845	$141,610	$159,290	$176,970	$194,735	$212,330	$230,010	$247,775	$265,455	$283,135
	3	$104,100	$124,900	$145,700	$166,600	$187,400	$208,200	$229,100	$249,800	$270,600	$291,500	$312,300	$333,100
	4	$119,715	$143,635	$167,555	$191,590	$215,510	$239,430	$263,465	$287,270	$311,190	$335,225	$359,145	$383,065

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COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES
MOLOKA`I
MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$24,270	$29,124	$33,978	$38,832	$43,686	$48,540	$53,394	$58,248	$63,102	$67,956	$72,810	$77,664
5.375%	1	$71,890	$86,240	$100,590	$115,010	$129,360	$143,710	$158,060	$172,410	$186,830	$201,250	$215,600	$229,950
	2	$87,295	$104,720	$122,145	$139,655	$157,080	$174,505	$191,930	$209,355	$226,865	$244,375	$261,800	$279,225
	3	$102,700	$123,200	$143,700	$164,300	$184,800	$205,300	$225,800	$246,300	$266,900	$287,500	$308,000	$328,500
	4	$118,105	$141,680	$165,255	$188,945	$212,520	$236,095	$259,670	$283,245	$306,935	$330,625	$354,200	$377,775
5.500%	1	$73,189	$87,784	$102,451	$117,045	$131,712	$146,306	$160,973	$175,568	$190,234	$204,829	$219,496	$234,090
	2	$86,105	$103,275	$120,530	$137,700	$154,955	$172,125	$189,380	$206,550	$223,805	$240,975	$258,230	$275,400
	3	$101,300	$121,500	$141,800	$162,000	$182,300	$202,500	$222,800	$243,000	$263,300	$283,500	$303,800	$324,000
	4	$116,495	$139,725	$163,070	$186,300	$209,645	$232,875	$256,220	$279,450	$302,795	$326,025	$349,370	$372,600
5.625%	1	$69,860	$83,860	$97,860	$111,860	$125,790	$139,790	$153,790	$167,790	$181,790	$195,720	$209,650	$223,650
	2	$84,830	$101,830	$118,830	$135,830	$152,745	$169,745	$186,745	$203,745	$220,745	$237,660	$254,575	$271,575
	3	$99,800	$119,800	$139,800	$159,800	$179,700	$199,700	$219,700	$239,700	$259,700	$279,600	$299,500	$319,500
	4	$114,770	$137,770	$160,770	$183,770	$206,655	$229,655	$252,655	$275,655	$298,655	$321,540	$344,425	$367,425
5.750%	1	$68,950	$82,740	$96,530	$110,320	$124,110	$137,900	$151,690	$165,480	$179,270	$193,060	$206,850	$220,640
	2	$83,725	$100,470	$117,215	$133,960	$150,705	$167,450	$184,195	$200,940	$217,685	$234,430	$251,175	$267,920
	3	$98,500	$118,200	$137,900	$157,600	$177,300	$197,000	$216,700	$236,400	$256,100	$275,800	$295,500	$315,200
	4	$113,275	$135,930	$158,585	$181,240	$203,895	$226,550	$249,205	$271,860	$294,515	$317,170	$339,825	$362,480
5.875%	1	$68,040	$81,620	$95,270	$108,850	$122,430	$136,010	$149,660	$163,240	$176,820	$190,470	$204,050	$217,700
	2	$82,620	$99,110	$115,685	$132,175	$148,665	$165,155	$181,730	$198,220	$214,710	$231,285	$247,775	$264,350
	3	$97,200	$116,600	$136,100	$155,500	$174,900	$194,300	$213,800	$233,200	$252,600	$272,100	$291,500	$311,000
	4	$111,780	$134,090	$156,515	$178,825	$201,135	$223,445	$245,870	$268,180	$290,490	$312,915	$335,225	$357,650
6.000%	1	$67,130	$80,500	$93,940	$107,380	$120,750	$134,260	$147,700	$161,070	$174,510	$187,950	$201,320	$214,760
	2	$81,515	$97,750	$114,070	$130,390	$146,625	$163,030	$179,350	$195,585	$211,905	$228,225	$244,460	$260,780
	3	$95,900	$115,000	$134,200	$153,400	$172,500	$191,800	$211,000	$230,100	$249,300	$268,500	$287,600	$306,800
	4	$110,285	$132,250	$154,330	$176,410	$198,375	$220,570	$242,650	$264,615	$286,695	$308,775	$330,740	$352,820
6.125%	1	$66,220	$79,450	$92,750	$105,980	$119,210	$132,440	$145,740	$158,970	$172,200	$185,430	$198,660	$211,960
	2	$80,410	$96,475	$112,625	$128,690	$144,755	$160,820	$176,970	$193,035	$209,100	$225,165	$241,230	$257,380
	3	$94,600	$113,500	$132,500	$151,400	$170,300	$189,200	$208,200	$227,100	$246,000	$264,900	$283,800	$302,800
	4	$108,790	$130,525	$152,375	$174,110	$195,845	$217,580	$239,430	$261,165	$282,900	$304,635	$326,370	$348,220
6.250%	1	$65,310	$78,470	$91,490	$104,580	$117,600	$130,760	$143,780	$156,870	$169,890	$182,980	$196,070	$209,090
	2	$79,305	$95,285	$111,095	$126,990	$142,800	$158,780	$174,590	$190,485	$206,295	$222,190	$238,085	$253,895
	3	$93,300	$112,100	$130,700	$149,400	$168,000	$186,800	$205,400	$224,100	$242,700	$261,400	$280,100	$298,700
	4	$107,295	$128,915	$150,305	$171,810	$193,200	$214,820	$236,210	$257,715	$279,105	$300,610	$322,115	$343,505
6.375%	1	$64,540	$77,350	$90,300	$103,180	$116,130	$128,940	$141,890	$154,770	$167,720	$180,530	$193,480	$206,360
	2	$78,370	$93,925	$109,650	$125,290	$141,015	$156,570	$172,295	$187,935	$203,660	$219,215	$234,940	$250,580
	3	$92,200	$110,500	$129,000	$147,400	$165,900	$184,200	$202,700	$221,100	$239,600	$257,900	$276,400	$294,800
	4	$106,030	$127,075	$148,350	$169,510	$190,785	$211,830	$233,105	$254,265	$275,540	$296,585	$317,860	$339,020
6.500%	1	$63,630	$76,440	$89,180	$101,850	$114,590	$127,330	$140,070	$152,810	$165,480	$178,220	$190,960	$203,700
	2	$77,265	$92,820	$108,290	$123,675	$139,145	$154,615	$170,085	$185,555	$200,940	$216,410	$231,880	$247,350
	3	$90,900	$109,200	$127,400	$145,500	$163,700	$181,900	$200,100	$218,300	$236,400	$254,600	$272,800	$291,000
	4	$104,535	$125,580	$146,510	$167,325	$188,255	$209,185	$230,115	$251,045	$271,860	$292,790	$313,720	$334,650
6.625%	1	$62,790	$75,390	$87,920	$100,520	$113,120	$125,720	$138,250	$150,850	$163,380	$175,980	$188,510	$201,110
	2	$76,245	$91,545	$106,760	$122,060	$137,360	$152,660	$167,875	$183,175	$198,390	$213,690	$228,905	$244,205
	3	$89,700	$107,700	$125,600	$143,600	$161,600	$179,600	$197,500	$215,500	$233,400	$251,400	$269,300	$287,300
	4	$103,155	$123,855	$144,440	$165,140	$185,840	$206,540	$227,125	$247,825	$268,410	$289,110	$309,695	$330,395

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

2015
AFFORDABLE SALES PRICE GUIDELINES

MOLOKA`I

MULTI-FAMILY

Effective: **May 1, 2015**

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$24,270	$29,124	$33,978	$38,832	$43,686	$48,540	$53,394	$58,248	$63,102	$67,956	$72,810	$77,664
6.750%	1	$62,090	$74,480	$86,870	$99,260	$111,650	$124,040	$136,430	$148,890	$161,280	$173,670	$186,130	$198,520
	2	$75,395	$90,440	$105,485	$120,530	$135,575	$150,620	$165,665	$180,795	$195,840	$210,885	$226,015	$241,060
	3	$88,700	$106,400	$124,100	$141,800	$159,500	$177,200	$194,900	$212,700	$230,400	$248,100	$265,900	$283,600
	4	$102,005	$122,360	$142,715	$163,070	$183,425	$203,780	$224,135	$244,605	$264,960	$285,315	$305,785	$326,140
6.875%	1	$61,250	$73,500	$85,750	$98,000	$110,250	$122,500	$134,750	$147,000	$159,250	$171,500	$183,750	$196,000
	2	$74,375	$89,250	$104,125	$119,000	$133,875	$148,750	$163,625	$178,500	$193,375	$208,250	$223,125	$238,000
	3	$87,500	$105,000	$122,500	$140,000	$157,500	$175,000	$192,500	$210,000	$227,500	$245,000	$262,500	$280,000
	4	$100,625	$120,750	$140,875	$161,000	$181,125	$201,250	$221,375	$241,500	$261,625	$281,750	$301,875	$322,000
7.000%	1	$60,480	$72,590	$84,700	$96,740	$108,850	$120,960	$133,070	$145,180	$157,220	$169,330	$181,440	$193,550
	2	$73,440	$88,145	$102,850	$117,470	$132,175	$146,880	$161,585	$176,290	$190,910	$205,615	$220,320	$235,025
	3	$86,400	$103,700	$121,000	$138,200	$155,500	$172,800	$190,100	$207,400	$224,600	$241,900	$259,200	$276,500
	4	$99,360	$119,255	$139,150	$158,930	$178,825	$198,720	$218,615	$238,510	$258,290	$278,185	$298,080	$317,975
7.125%	1	$59,710	$71,680	$83,580	$95,550	$107,450	$119,420	$131,390	$143,360	$155,330	$167,230	$179,200	$191,170
	2	$72,505	$87,040	$101,490	$116,025	$130,475	$145,010	$159,545	$174,080	$188,615	$203,065	$217,600	$232,135
	3	$85,300	$102,400	$119,400	$136,500	$153,500	$170,600	$187,700	$204,800	$221,900	$238,900	$256,000	$273,100
	4	$98,095	$117,760	$137,310	$156,975	$176,525	$196,190	$215,855	$235,520	$255,185	$274,735	$294,400	$314,065
7.250%	1	$58,940	$70,770	$82,600	$94,360	$106,190	$117,950	$129,780	$141,540	$153,370	$165,130	$176,960	$188,720
	2	$71,570	$85,935	$100,300	$114,580	$128,945	$143,225	$157,590	$171,870	$186,235	$200,515	$214,880	$229,160
	3	$84,200	$101,100	$118,000	$134,800	$151,700	$168,500	$185,400	$202,200	$219,100	$235,900	$252,800	$269,600
	4	$96,830	$116,265	$135,700	$155,020	$174,455	$193,775	$213,210	$232,530	$251,965	$271,285	$290,720	$310,040
7.375%	1	$58,310	$69,930	$81,620	$93,240	$104,930	$116,480	$128,170	$139,790	$151,480	$163,100	$174,790	$186,410
	2	$70,805	$84,915	$99,110	$113,220	$127,415	$141,440	$155,635	$169,745	$183,940	$198,050	$212,245	$226,355
	3	$83,300	$99,900	$116,600	$133,200	$149,900	$166,400	$183,100	$199,700	$216,400	$233,000	$249,700	$266,300
	4	$95,795	$114,885	$134,090	$153,180	$172,385	$191,360	$210,565	$229,655	$248,860	$267,950	$287,155	$306,245
7.500%	1	$57,540	$69,020	$80,570	$92,050	$103,600	$115,080	$126,630	$138,110	$149,660	$161,140	$172,620	$184,170
	2	$69,870	$83,810	$97,835	$111,775	$125,800	$139,740	$153,765	$167,705	$181,730	$195,670	$209,610	$223,635
	3	$82,200	$98,600	$115,100	$131,500	$148,000	$164,400	$180,900	$197,300	$213,800	$230,200	$246,600	$263,100
	4	$94,530	$113,390	$132,365	$151,225	$170,200	$189,060	$208,035	$226,895	$245,870	$264,730	$283,590	$302,565
7.625%	1	$56,840	$68,250	$79,590	$91,000	$102,340	$113,750	$125,090	$136,430	$147,770	$159,180	$170,520	$181,930
	2	$69,020	$82,875	$96,645	$110,500	$124,270	$138,125	$151,895	$165,665	$179,435	$193,290	$207,060	$220,915
	3	$81,200	$97,500	$113,700	$130,000	$146,200	$162,500	$178,700	$194,900	$211,100	$227,400	$243,600	$259,900
	4	$93,380	$112,125	$130,755	$149,500	$168,130	$186,875	$205,505	$224,135	$242,765	$261,510	$280,140	$298,885
7.750%	1	$56,210	$67,410	$78,610	$89,810	$101,150	$112,350	$123,550	$134,820	$146,020	$157,220	$168,560	$179,760
	2	$68,255	$81,855	$95,455	$109,055	$122,825	$136,425	$150,025	$163,710	$177,310	$190,910	$204,680	$218,280
	3	$80,300	$96,300	$112,300	$128,300	$144,500	$160,500	$176,500	$192,600	$208,600	$224,600	$240,800	$256,800
	4	$92,345	$110,745	$129,145	$147,545	$166,175	$184,575	$202,975	$221,490	$239,890	$258,290	$276,920	$295,320
7.875%	1	$55,510	$66,570	$77,700	$88,760	$99,890	$111,020	$122,080	$133,210	$144,270	$155,330	$166,530	$177,590
	2	$67,405	$80,835	$94,350	$107,780	$121,295	$134,810	$148,240	$161,755	$175,185	$188,615	$202,215	$215,645
	3	$79,300	$95,100	$111,000	$126,800	$142,700	$158,600	$174,400	$190,300	$206,100	$221,900	$237,900	$253,700
	4	$91,195	$109,365	$127,650	$145,820	$164,105	$182,390	$200,560	$218,845	$237,015	$255,185	$273,585	$291,755
8.000%	1	$54,810	$65,870	$76,790	$87,780	$98,700	$109,690	$120,680	$131,600	$142,590	$153,510	$164,500	$175,490
	2	$66,555	$79,985	$93,245	$106,590	$119,850	$133,195	$146,540	$159,800	$173,145	$186,405	$199,750	$213,095
	3	$78,300	$94,100	$109,700	$125,400	$141,000	$156,700	$172,400	$188,000	$203,700	$219,300	$235,000	$250,700
	4	$90,045	$108,215	$126,155	$144,210	$162,150	$180,205	$198,260	$216,200	$234,255	$252,195	$270,250	$288,305

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **May 1, 2015**

2015
AFFORDABLE SALES PRICE GUIDELINES
MOLOKA`I
MULTI-FAMILY

		Percent of Median Income											
		Very Low	Low Income			Below Moderate		Moderate		Above Moderate		Gap Income	
		50% & Below	(51% to 80%)			(81% to 100%)		(101% to 120%)		(121% to 140%)		(141% to 160%)	
Prevailing Int. Rate	No. of Bedroom	50%	60%	70%	80%	90%	100%	110%	120%	130%	140%	150%	160%
		$29,930	$35,916	$41,902	$47,888	$53,874	$48,540	$65,846	$71,832	$77,818	$83,804	$89,790	$95,776
8.125%	1	$54,180	$65,030	$75,880	$86,660	$97,510	$108,360	$119,210	$130,060	$140,840	$151,760	$162,610	$173,460
	2	$65,790	$78,965	$92,140	$105,230	$118,405	$131,580	$144,755	$157,930	$171,020	$184,280	$197,455	$210,630
	3	$77,400	$92,900	$108,400	$123,800	$139,300	$154,800	$170,300	$185,800	$201,200	$216,800	$232,300	$247,800
	4	$89,010	$106,835	$124,660	$142,370	$160,195	$178,020	$195,845	$213,670	$231,380	$249,320	$267,145	$284,970
8.250%	1	$53,550	$64,260	$74,970	$85,680	$96,390	$107,100	$117,810	$128,520	$139,230	$149,940	$160,650	$171,360
	2	$65,025	$78,030	$91,035	$104,040	$117,045	$130,050	$143,055	$156,060	$169,065	$182,070	$195,075	$208,080
	3	$76,500	$91,800	$107,100	$122,400	$137,700	$153,000	$168,300	$183,600	$198,900	$214,200	$229,500	$244,800
	4	$87,975	$105,570	$123,165	$140,760	$158,355	$175,950	$193,545	$211,140	$228,735	$246,330	$263,925	$281,520
8.375%	1	$52,920	$63,490	$74,060	$84,700	$95,340	$105,910	$116,480	$127,050	$137,690	$148,260	$158,830	$169,400
	2	$64,260	$77,095	$89,930	$102,850	$115,770	$128,605	$141,440	$154,275	$167,195	$180,030	$192,865	$205,700
	3	$75,600	$90,700	$105,800	$121,000	$136,200	$151,300	$166,400	$181,500	$196,700	$211,800	$226,900	$242,000
	4	$86,940	$104,305	$121,670	$139,150	$156,630	$173,995	$191,360	$208,725	$226,205	$243,570	$260,935	$278,300
8.500%	1	$52,360	$62,790	$73,290	$83,720	$94,220	$104,650	$115,080	$125,650	$136,080	$146,510	$157,010	$167,440
	2	$63,580	$76,245	$88,995	$101,660	$114,410	$127,075	$139,740	$152,575	$165,240	$177,905	$190,655	$203,320
	3	$74,800	$89,700	$104,700	$119,600	$134,600	$149,500	$164,400	$179,500	$194,400	$209,300	$224,300	$239,200
	4	$86,020	$103,155	$120,405	$137,540	$154,790	$171,925	$189,060	$206,425	$223,560	$240,695	$257,945	$275,080
8.625%	1	$51,730	$62,090	$72,450	$82,810	$93,100	$103,460	$113,820	$124,180	$134,540	$144,830	$155,190	$165,550
	2	$62,815	$75,395	$87,975	$100,555	$113,050	$125,630	$138,210	$150,790	$163,370	$175,865	$188,445	$201,025
	3	$73,900	$88,700	$103,500	$118,300	$133,000	$147,800	$162,600	$177,400	$192,200	$206,900	$221,700	$236,500
	4	$84,985	$102,005	$119,025	$136,045	$152,950	$169,970	$186,990	$204,010	$221,030	$237,935	$254,955	$271,975
8.750%	1	$51,170	$61,390	$71,610	$81,830	$92,050	$102,340	$112,490	$122,710	$133,000	$143,220	$153,440	$163,660
	2	$62,135	$74,545	$86,955	$99,365	$111,775	$124,270	$136,595	$149,005	$161,500	$173,910	$186,320	$198,730
	3	$73,100	$87,700	$102,300	$116,900	$131,500	$146,200	$160,700	$175,300	$190,000	$204,600	$219,200	$233,800
	4	$84,065	$100,855	$117,645	$134,435	$151,225	$168,130	$184,805	$201,595	$218,500	$235,290	$252,080	$268,870

Maximum affordable sales price is based on the following factors:

$48,540 Median family income as established by the Department of Housing and Human Concerns (DHHC)
30 Number of years for a fixed-rate mortgage loan with no discount points
30% Percentage of gross monthly income for housing expenses (principle and interest payment only)
5% Percentage of the purchase price for downpayment.

Prepared by:
HOUSING DIVISION
DEPARTMENT OF HOUSING AND HUMAN CONCERNS (DHHC)
COUNTY OF MAUI

Effective: **May 1, 2015**

2015
INCOME LIMITS & AFFORDABLE RENT GUIDELINES
MOLOKA`I

INCOME LIMITS FOR RENTAL UNITS (BY FAMILY SIZE & PERCENTAGE OF MEDIAN FAMILY INCOME)

% of Median	1 PERSON 0.7	2 PERSON 0.8	3 PERSON 0.9	4 PERSON 1.0	5 PERSON 1.08	6 PERSON 1.16	7 PERSON 1.24	8 PERSON 1.32
10%	$3,400	$3,880	$4,370	$4,850	$5,240	$5,630	$6,020	$6,410
20%	$6,800	$7,770	$8,740	$9,710	$10,480	$11,260	$12,040	$12,810
30%	$10,190	$11,650	$13,110	$14,560	$15,730	$16,890	$18,060	$19,220
40%	$13,590	$15,530	$17,470	$19,420	$20,970	$22,520	$24,080	$25,630
50%	$16,990	$19,420	$21,840	$24,270	$26,210	$28,150	$30,090	$32,040
60%	$20,390	$23,300	$26,210	$29,120	$31,450	$33,780	$36,110	$38,440
70%	$23,780	$27,180	$30,580	$33,980	$36,700	$39,410	$42,130	$44,850
80%	$27,180	$31,070	$34,950	$38,830	$41,940	$45,050	$48,150	$51,260
90%	$30,580	$34,950	$39,320	$43,690	$47,180	$50,680	$54,170	$57,670
100%	$33,980	$38,830	$43,690	$48,540	$52,420	$56,310	$60,190	$64,070
110%	$37,380	$42,720	$48,050	$53,390	$57,670	$61,940	$66,210	$70,480
120%	$40,770	$46,600	$52,420	$58,250	$62,910	$67,570	$72,230	$76,890
130%	$44,170	$50,480	$56,790	$63,100	$68,150	$73,200	$78,250	$83,290
140%	$47,570	$54,360	$61,160	$67,960	$73,390	$78,830	$84,270	$89,700

AFFORDABLE RENT GUIDELINES (BY UNIT SIZE & PERCENTAGE OF MEDIAN FAMILY INCOME)

% of Median	UNIT SIZE (NO. OF BEDROOMS) 0	1	2	3	4	5
10%	$85	$91	$109	$126	$141	$155
20%	$170	$182	$219	$252	$282	$311
30%	$255	$273	$328	$379	$422	$466
40%	$340	$364	$437	$505	$563	$621
50%	$425	$455	$546	$631	$704	$777
60%	$510	$546	$655	$757	$845	$932
70%	$595	$637	$765	$884	$985	$1,087
80%	$680	$728	$874	$1,010	$1,126	$1,243
90%	$765	$819	$983	$1,136	$1,267	$1,398
100%	$850	$910	$1,092	$1,262	$1,408	$1,553
110%	$935	$1,001	$1,201	$1,388	$1,549	$1,709
120%	$1,019	$1,092	$1,311	$1,515	$1,689	$1,864
130%	$1,104	$1,183	$1,420	$1,641	$1,830	$2,019
140%	$1,189	$1,274	$1,529	$1,767	$1,971	$2,175

Note: Affordable rents are based on 30% of gross monthly income. Affordable rents include utilities

APPENDIX ~~M~~P.

Preliminary Traffic Impact Analysis Report

Olowalu Town

Preliminary Traffic Impact Analysis Report

Prepared for:

Olowalu Town, LLC

2073 Wells Street – Suite 101

Wailuku, HI 96793

Prepared by:

Roger D. Dyar, P.E., P.A.

Consulting Transportation Engineer

Greenville, SC 29609

September 16, 2011

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Introduction, Purpose and Methodology

The Olowalu Town Master Plan is proposing to re-establish the once thriving village of Olowalu, located on the west side of the island of Maui. The subject property encompasses the lower coastal reaches of Olowalu ahupua'a; between the base of the south-west facing slopes of West Maui Mountains and the shoreline of Olowalu, as shown in Figure 1. Olowalu Town will be a small-scale and mixed-use community designed to be a pedestrian-friendly community which will allow residents to live within walking distance of corner stores, schools, parks, employment opportunities, community centers, beaches, and social and civic resources, ultimately reducing reliance on automobiles. The Master Plan is guided by values and principles of sustainability by balancing the needs of Maui's growing population; yet maintaining and respecting our cultural, historical and natural resources.

The new town will be designed to be self-sustaining in that commercial uses will in general be expected to operate to a very large degree based on the anticipated activities of the residents. At the same time, it is expected that the majority of the base of labor needed in the town can come from residents of the town.

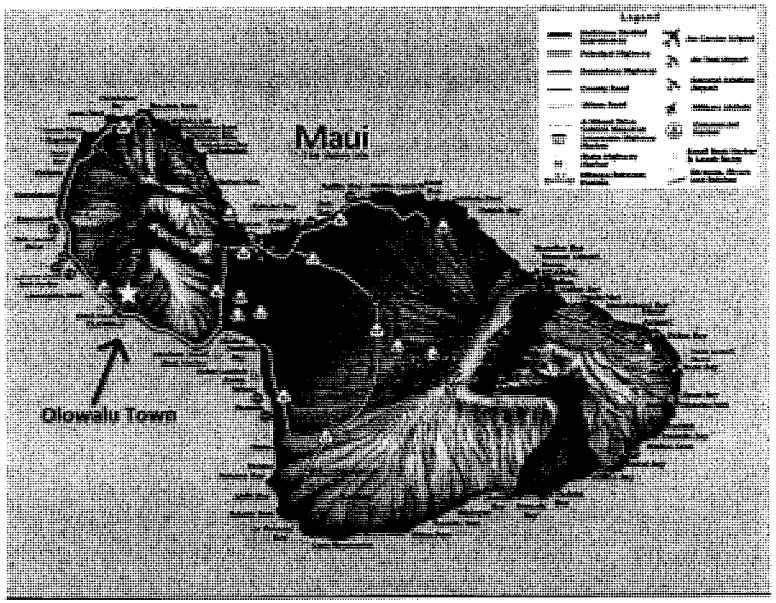
This Preliminary Traffic Impact Analysis Report (TIAR) has been prepared to support the Draft Environmental Impact Statement (EIS). A Final TIAR will be prepared to support the Final EIS. The purpose of this preliminary TIAR is to provide a general assessment of the expected traffic impacts of the proposed project and a general framework for the anticipated traffic and transportation system mitigations that may be needed at full buildout of the project. This preliminary TIAR will review the expected traffic impacts based on existing daily traffic volumes and future traffic volumes which are predicted to occur due to the Olowalu Town project. This preliminary TIAR will concentrate on predicted daily traffic volumes and on more general traffic needs. It will utilize the same general process by providing an assessment of existing conditions, prediction of trip generation, distribution and assignment for the new town, and analysis of future-year traffic volumes and traffic flow conditions. This report utilizes data from several other TIARs which have been done for other projects on the west side of Maui over the last five years. It also uses information from previous master transportation studies of the island conducted by HDOT in 1997 and 2002, as well as studies done by Maui County.

As noted above, a Final TIAR will be prepared to address and incorporate comments received during review of the Draft EIS. The Final TIAR will address peak hour traffic flows and utilize the methods that are normally employed in standard traffic assessments. That TIAR will also analyze in detail the predicted traffic operations at the access points to Honoapi'ilani Highway. It will assess the need for any mitigation and analyze the need for traffic control measures and devices that may be required for proper functioning of the street system. This preliminary report will not cover all items that may be studied and analyzed in the future detailed TIAR and it is not intended to substitute for that more comprehensive analysis.

The methods of study employed in this report rely upon daily traffic volumes that exist or will be created by the activities of the proposed Olowalu Town. Analysis of capacity and traffic flow utilizes approaches that were developed by the Florida Department of Transportation, based on

the Highway Capacity Manual. These methods take into account the peaking that occurs in morning and afternoon hours but they also consider the overall traffic flow on a facility over a 24-hour period. The level of analysis in this preliminary TIAR does not include detailed analysis of all traffic movements at individual intersections. This report is intended to illustrate that the increase in vehicular traffic along the Honoapi'ilani Highway attributed to Olowalu Town will be successfully mitigated by way of implementing the proposed transportation plan and the related improvements, including the relocation and widening of the segment of Hononpi'ilani Highway which traverses the subject property. This transportation plan is discussed in the following sections.

Figure 1 Location of Olowalu Town



As indicated in Figure 1, the proposed Olowalu Town is located about half-way between the town of Lahaina and Ma'alea along Honoapi'ilani Highway.

Description of Olowalu Town

At final build-out, Olowalu Town will consists of approximately 1,500 residential dwelling units to be built concurrent with appropriate infrastructure in phases spread out over a period of approximately 10 years. There will be a wide variety of single-family and multi-family dwelling types, including houses, apartments, live-work units, cottages, rural homes and farmsteads, to be offered at a wide-range of income levels, including both rental and fee-ownership. A substantial portion of the homes are planned for much-needed affordable housing and senior living.

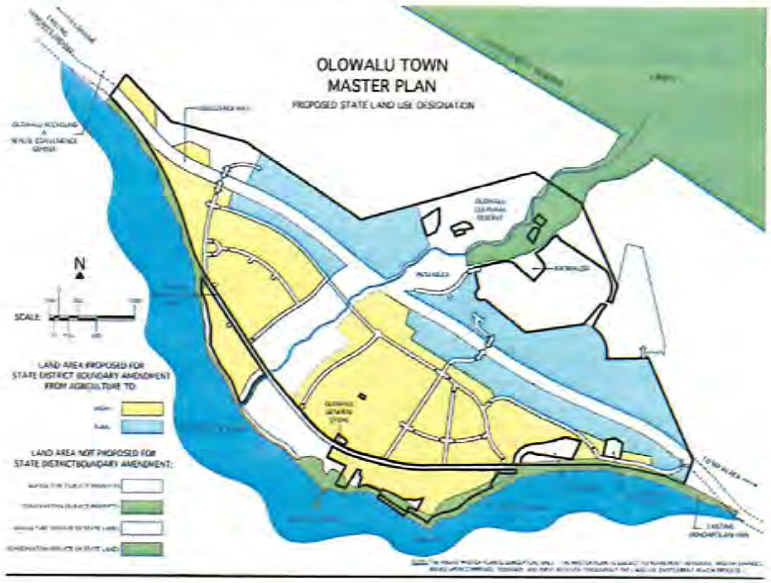
The design of Olowalu Town incorporates smart growth and sustainable land use principles of New Urbanism. As a result, Olowalu Town's spatial layout of land uses, varying density, connective transportation, parks/greenways, civic/social facilities, housing, employment and other land uses are balanced to create a mixed-use community. Neighborhood town centers provide economic sustainability with a range of business and employment opportunities. Olowalu Town is also designed to meet the certification requirements of *Leadership in Energy and Environmental Design for Neighborhood Development* (LEED ND). As such, the Master Plan will be built using strategies aimed at improving performance in regards to energy savings, water efficiency, reducing CO2 emissions, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

Olowalu Town's proposed infrastructure improvements will be constructed concurrently with the project and will incorporate innovative, efficient, and sustainable technology to minimize adverse impacts upon the natural environment. Olowalu Town's Transportation system includes the relocation of the existing high speed/high volume Honoapi'ilani highway away from coastal resources to a new mauka alignment, which will be designed to accommodate mass transit or light rail, if needed in future. The existing highway corridor with monkey-pod trees will be preserved and converted to low speed/low volume coastal roadway. The project includes an internal roadway network, as well as, an assortment of interconnected greenways and bikeways links community and supports overall well-being and health of residents; reducing dependency on automobiles.

Additionally, other infrastructure system improvements will require an expansion of both the existing potable and non-potable water system, the likely addition of a second ground water well to supplement the existing well; and an extensive drainage system to capture storm-water runoff. The project will also include the construction of an onsite decentralized wastewater treatment facility, which will include R-1 water storage tank, a constructed vertical flow wetland, and a soil aquifer treatment system. The wastewater treatment facility will produce clean recycled water for irrigation, and thereby eliminate the need for injection wells.

The Olowalu Town consists of four general land use categories as defined by the state of Hawaii Land Use Commission, as shown in Figure 2.

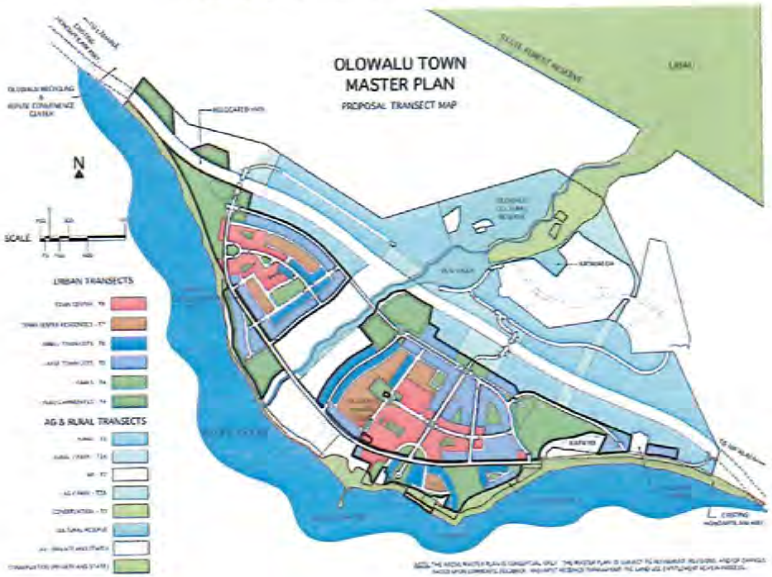
Figure 2 Land Use Categories for Olowalu Town



As shown in the above figure, there are conservation districts, shown in green, along the shore of the Pacific Ocean and in the areas upland to the mauka side of the proposed relocated Route 30. The green areas with the dots delineate the conservation areas which are not part of the subject properties. The site for the Olowalu Town includes both rural designations as shown in the blue color and urban areas as shown in the lighter beige color. Agricultural designations which are not proposed for reclassification are shown in white. Agricultural land areas which are not part of the subject properties are shown in the same colors but with dots.

Figure 3 shows the proposed land uses within the Olowalu Town.

Figure 3 Proposed Land Uses in Olowalu Town

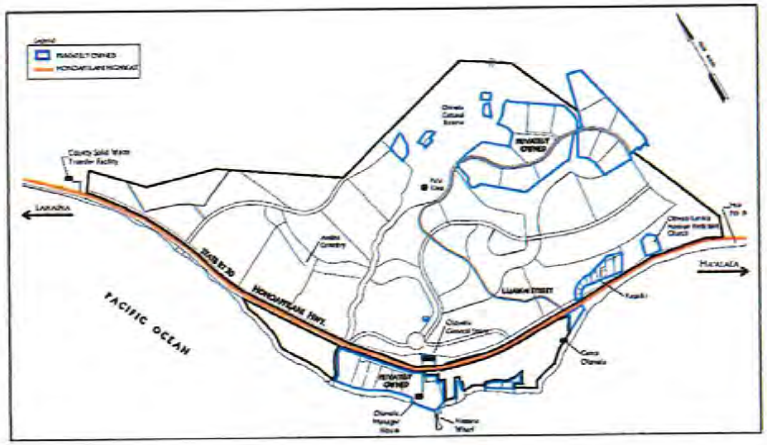


As shown in Figure 3 there are generally two neighborhood town centers on either side of Olowalu Stream, with smaller tracts of rural on the mauka side of Honoapi'ilani Highway. All the tracts on the mauka side of Honoapi'ilani Highway are either rural or agricultural lots ranging from ½ to 2 acres. The urban areas, shown in yellow, will have commercial developments along with a variety of residential units including apartments, townhouses and single-family house. Areas in white and green along the Pacific Ocean will contain recreational facilities and include beach access. The street patterns in the urban footprint areas will be modified grids following the principles of new urbanism.

Review of Existing Road and Traffic Conditions

The site of the proposed Olowalu Town is situated on both sides of Honoapi'ilani Highway on the west side of the island of Maui. Honoapi'ilani Highway is the major surface transportation route for the west side of Maui and it provides a connection from the town of Lahaina to Ma'alea. The highway is on the HDOT road system as Route 30. It is classified as a major arterial roadway and it has several different design cross-sections as it winds its way along the Pacific Ocean coastline and inland to Lahaina and Ma'alea. Within the boundaries of Olowalu Town, the roadway is primarily a two-lane highway with turn lanes in place at intersections and access points. The site for the proposed project is traversed by approximately 2.6 miles of the existing Honoapi'ilani Highway. Photographs of the roadway are included in the appendices. The following Figure 4 depicts existing conditions with area landmarks shown.

Figure 4 Existing Conditions with Area Landmarks



Trip Generation Methodology

Trip generation for Olowalu Town was estimated using the methods of the Institute of Transportation Engineers (ITE) that are generally endorsed by HDOT and Maui County. The ITE methodology uses tables that relate units of land use to predicted trips into and out a site or development for peak hours of travel and for an entire day. Trips were predicted using the latest version of the ITE Trip Generation Edition 8, as well as a software package developed by the Florida Department of Transportation (FDOT). This software provides a spreadsheet for calculation of predicted trips based on ITE average national rates, with provisions for pass-by trips and internal capture trips.

Figure 5 shows the predicted total trips for the Olowalu Town using the software from FDOT. As indicated in Figure 5, it is estimated that the Olowalu Town would generate approximately 32,800 trips per day at full buildout. This would include all trips within the town and to and from the Town via Honoapi'ilani Highway. Further analysis of internal and external trips will be made in a subsequent section. The detailed printout from the FDOT software for trip generation is provided in the appendices.

Figure 5 Summary of Trip Generation for Olowalu Town

Site Information		Adjacent Highway PassBy Information	
Name of Development	Olowalu	North/ South Roadway	Honoapi'ilani Highway
Name of Applicant	F&W	North/ South 24-Hour Volume	22,840
Name of Analyst	Dyar	East/ West Roadway	NA
Date	02/08/2011	East/ West 24-Hour Volume	NA
Development Phase	Full Buildout	Analysis Year	2020

ITE Code	Land Use	# Units	Unit	Unit Conversion	Trip Rate Per Unit	Total Trips	Directional Distribution		Trip Generation	
							In	Out	In	Out
730	Government Office Building	15,000	sq. feet	1,000	11.933	179	0.5	0.5	90	90
110	General Light Industrial	26,000	sq. feet	1,000	6.962	181	0.5	0.5	90	90
590	Library	5,000	sq. feet	1,000	54.0	270	0.5	0.5	135	135
417	Regional Park	77	acres	1	4.571	352	0.5	0.5	176	176
310	Boutique Hotels	58	rooms	1	8.172	474	0.5	0.5	237	237
732	United States Post Office	5,000	sq. feet	1,000	108.2	541	0.5	0.5	270	270
710	General Office Building	60,000	sq. feet	1,000	11.017	661	0.5	0.5	330	330
230	Residential Condo Or Townhouse	174	dwelling units	1	5.908	1028	0.5	0.5	514	514
220	Apartments	260	dwelling units	1	6.719	1747	0.5	0.5	874	874
944	Gasoline/ Service Station	20	fueling positions	1	168.55	3371	0.5	0.5	1686	1686
220	Apartments	593	dwelling units	1	6.72	3985	0.5	0.5	1992	1992
210	Single-Family Detached Housing	523	dwelling units	1	9.109	4764	0.5	0.5	2382	2382
820	Commercial Retail	114,000	sq. feet	1,000	64.868	7395	0.5	0.5	3698	3698
820	Commercial Retail	125,000	sq. feet	1,000	62.808	7851	0.5	0.5	3926	3926
Totals						32,800	0.5	0.5	16,400	16,400

Trip Distribution

Trips were distributed based on the existing pattern of traffic on Honoapi'ilani Highway and trip data available from the most recent update of the Maui Long Range Transportation Plan (MLRTP). The MLRTP update was prepared for HDOT by a consulting firm utilizing the TransCad model. This model predicts trip generation using equations for production and attraction of trips for the traffic analysis zones (TAZs) established for the island. The gravity model distributes trips to and from the TAZs using a complicated algorithm. The study established some 400 TAZs for the island, as indicated in materials in the appendices. The model then assigns trips to the existing (and proposed) network of streets using equations that take into account the capacity of the street network and anticipated speeds on the network. One of the results of this effort is the development of a trip table that indicates the number of trips to and from each TAZ on the island. The trip distribution process will require additional work when the detailed TIAR is prepared, since trip distribution for peak hours may differ from the values for the overall daily traffic generated. This may occur especially at early morning hours when there are a greater percentage of journey-to-work trips being made and fewer trips made for shopping or recreational uses.

Available traffic counts on Honoapi'ilani Highway indicate the direction of traffic flow by hour of the day nearby the project site. This information was used as background information in determining the distribution of trips; however it is of course more useful when looking at hourly trip generation and traffic distribution.

Trip Assignment

Trips were assigned to the three proposed access points to the Olowalu Town, based on the general preliminary site development plan. Trips from the residential and commercial components of Olowalu Town were assigned mostly to the two primary access points along the relocated Honoapi'ilani Highway. These two access points are expected to be designed as non-signalized intersections with the use of median U-turns in an arrangement generally known as the "Michigan U-turn." The design has been called the "O-turn" to refer to Olowalu Town. The "Michigan U-turn" frequently utilizes traffic signals, however it is expected that the "O-turns" will operate with U-turns required for all left turns out of the site (after a right turn), for left turns into the site and for straight-through movements from one side of Honoapi'ilani Highway to the other. It is envisioned that no traffic signals will be required for through traffic along the new Honoapi'ilani Highway and that traffic control for vehicles entering or leaving Olowalu Town will be via stop signs or yield signs. The third access point planned is a right-in/right-out access point on the southern end of the site, which will have limited use compared to the other two major access points. Trip assignments were made to each of the three proposed access points based on the number of residential units and the square footage of commercial and other space planned for Olowalu Town, including the proposed recreational areas. The amount of trips generated by the mauka side of Honoapi'ilani Highway will be very small in comparison to the total trips generated by the entire site and will have a relatively small impact on traffic flow. In addition, there is a connector road planned to link the mauka and makai sides that will

allow for traffic flow without the need to utilize either of the "O-turns." This connector should minimize the trips that would be made through the "O-turns."

Background Traffic Growth

Several studies were made available which analyzed traffic growth trends on Honoapi'ilani Highway and in the west Maui area. Data from these studies are included in the appendices.

Based on a review of available data, it was decided that an annual traffic volume growth rate of approximately 1% would be appropriate for Honoapi'ilani Highway, resulting in a total growth of 8% between 2011 and full buildout of the Olowalu Town in 2020. This 8% growth rate was applied to the existing traffic volumes on Honoapi'ilani Highway to derive future year traffic volumes without the Olowalu Town project in place. Detailed analysis of peak hour traffic growth rates will result in the application of hourly factors when the final TIAR is completed.

The current average annual daily traffic on Honoapi'ilani Highway was estimated with a 24-hour machine traffic count made in October 2010. Other studies have indicated there are approximately 5% trucks in the traffic stream on Honoapi'ilani Highway. Using the assumption of 5% trucks, the count made in October 2010 indicates a daily traffic volume of 22,840. This count was made slightly north of the solid waste transfer station which is just beyond the northern boundary of the proposed Olowalu Town site. Assuming the growth rate of 8%, the background traffic volume growth on Honoapi'ilani Highway would be 1798 vehicles resulting in an average daily traffic volume of 24,667 (or approximately 24,700) in the future year of 2020 without the project in place.

Traffic Analysis in Year 2020 without Olowalu Town Project

An analysis was made of the traffic flow on Honoapi'ilani Highway in the year 2020 without the project in place. This analysis assumed the background traffic volume growth would continue, resulting in a total increase of 8% in the daily traffic volumes on Honoapi'ilani Highway. The analysis assumed that that all peak hour and directional factors and truck factors remained the same. The results of the use of the Highplan software are given in Figure 6. As noted in Figure 6, the volume to capacity ratio would increase to 0.73 and the level of service when considering speed would be at an E. The volume to capacity ratio of 0.73 indicates there would be the ability to add more traffic to the roadway on a daily basis, although peak hour traffic speeds would continue to decrease.

Additional information on the Highplan software and its outputs is available in the appendices. See Figure 7 for existing 24-hour traffic volumes on Honoapi'ilani Highway and Figure 8 for the predicted traffic volumes in the year 2020 without the project in place.

Figure 6 Output from Highplan Software for Honoapi'ilani Highway for Year 2020 without Project in Place

HIGHPLAN 2009 Conceptual Planning Analysis									
Project Information									
Analyst	RDD	Highway Name	Honoapi'ilani Highway	Study Period	K100				
Date Prep.	4/22/2011	From	Old Landfill	Program	HIGHPLAN 2009				
Agency	For F&W	To	Mile 14	Version	7/17/2010				
Area Type	Rural Undeveloped	Peak Direction	Northbound						
File Name	C:\Users\rogerdyar\AppData\Local\Temp\preview.xml								
User Notes	Future Year 2020 without Project in Place								
Highway Data									
Roadway Variables				Traffic Variables					
Area Type	Rural Undeveloped	Segment Length	2.6 miles	AADT	24,470	PHF	0.85		
# Thru Lanes	2	Median	Yes	K factor	0.078	% Heavy Vehicles	5		
Terrain	Level	Left Turn Impact	No	D factor	0.58	Base Capacity	1700		
Posted Speed	55	Pass Lane Spacing	N/A	Peak Dir. Hourly Vol.	1107	Local Adj. Factor	1		
Free Flow Speed	50	% No Passing Zones	100	Off Peak Dir. Hourly Vol.	802	Adjusted Capacity	1659		
LOS Results									
v/c Ratio	0.73	Density	NA	PTSF	91.83	ATS	42.0	% FFS	70.04
FFS Delay	66.73	LOS Thresh. Delay	35.53	Service Measure	PTSF	LOS	E		
Service Volumes									
Note: The maximum normally acceptable directional service volume for LOS E in Florida for this facility type and area type is 1500 veh/h/ln.									
		LOS	A	B	C	D	E		
		Lanes	Hourly Volume In Peak Direction						
		2	490	140	280	590	1500		
		Lanes	Hourly Volume In Both Directions						
		4	850	250	490	1020	2590		
		Lanes	Annual Average Daily Traffic						
		4	9,500	3300	6300	13100	33300		

Traffic Generation for Olowalu Town

Traffic generation was predicted for Olowalu Town using the methods of the ITE that were discussed earlier. To account for the principles of New Urbanism, an adjustment was made to trip generation rates. Based on research of other New Urbanism style developments in a number of states, it is apparent that there is a reduction in total travel in communities with this type of design and layout. These communities are designed to encourage walking and cycling and they are often attractive to people whose lifestyles include less traditional travel for various needs, including for employment, recreation and shopping. In these communities there are frequently recreational opportunities that reduce the need for off-site travel; and there are many cases of live-work uses of residences. A review of this phenomenon in several other locations led to an estimate that these communities have a typical reduction in total trip generation ranging between 15% and 45%. There are local governments such as Frederick, Maryland, which typically allow for a reduction in trip generation rates, in recognition that this phenomenon does occur, as noted in the appendices. Using this methodology, the land use mix for Olowalu Town indicates that the trip generation should be reduced to about 85% of the ITE values. Therefore the ITE trip generation rates for all the residential land uses were decreased by applying a factor of 85% to the published ITE rates. It should be remembered the ITE publishes ranges but also publishes average rates. So, the rates for trip generation used in this report are at essentially at 85% of the national averages.

It was also assumed that many of the trips generated would be made to and from the residences and commercial and recreational establishments in the town by residents of Olowalu Town. This phenomenon is generally referred to as "internal capture." Based on the anticipated plan for the proposed project, it was determined that significant proportions of total travel could and would be made within the town itself, without any requirement to travel on Honoapi'ilani Highway to Lahaina, Ma'alea or elsewhere on the island. The plan for the town is for a substantial amount of the business activity to be supported by town residents and for many if not the majority of the potential employment opportunities to be taken by town residents. Facilities such as the proposed library, the post office, many of the retail establishments and many of the recreational opportunities would be used primarily by town residents. As a result, many of the trips generated will have both origin and destination in the town. Due to the design of the town and its street network, many of the trips within the town will likely be made via walking or cycling and not require use of the automobile. This element will be addressed in detail in the final TIAR.

For this preliminary TIAR, it was assumed that the "internal capture" of trips generated would align with and be affected by the various land uses. Some land uses would have higher proportions of trips made within the town with others having more trips made outside the town via Honoapi'ilani Highway to west Maui or other locations. The following Table 1 shows the anticipated "internal capture" of trips generated by the proposed land uses in Olowalu Town.

Table 1 Internal Capture of Trips in Olowalu Town

ITE Land Use Code	Land Use Description	Percentage of Trips Internal to Olowalu Town	Percentage of Trips External to Olowalu Town
730	Government Office Building	85%	15%
110	General Light Industrial	30%	70%
590	Library	90%	10%
520	Elementary School	90%	10%
415/417	Regional Park with Beach	50%	50%
310	Hotel	10%	90%
732	United States Post Office	95%	5%
230	Condominium/Townhouse	45%	55%
944	Gasoline/Service Station	95%	5%
220	Apartments	45%	55%
210	Single-Family Detached Housing	45%	55%
820	Commercial Retail	75%	25%
710	General Office	30%	70%

As seen in Table 1, some land uses, such as the library and the gasoline station would have almost all their trips made by residents of the Olowalu Town. Others, such as the general light industrial and general office land uses, would depend more heavily on residents and commercial ventures in other parts of the island and would have much lower "internal capture" percentages.

In addition to the "internal capture", there was also a major consideration of the effect of existing traffic on Honoapi'ilani Highway for the trips that are external to the Olowalu Town. Due to the isolated nature of the site, with long travel distance to other populated areas on the island, it is less likely that island residents on other parts of the island would make special trips to Olowalu Town for employment, shopping opportunities, or other services that could be found closer to their respective home region. However, it is also recognized that a significant number of trips that will be made to and from Olowalu Town that are not generated within Olowalu Town will be from travelers already on Honoapi'ilani Highway. Generally, this phenomenon is referred to as "pass-by trips or diverted trips." In other words, many trips made to Olowalu Town will be made by drivers who are already on Honoapi'ilani Highway and will divert into Olowalu Town for their business, employment, recreation of for other purposes. An analysis of trip length frequency curves from the Maul LRTP was made to assist in estimating the amount of "pass-by" trips that would have destinations or origins in Olowalu Town that would already be on Honoapi'ilani Highway.

The following Table 2 shows the estimated proportions of trips that would essentially be pass-by trips on Honoapi'ilani Highway to and from Olowalu Town.

Table 2 Pass-by and Diverted Trips on Honoapi'ilani Highway

ITE Land Use Code	Land Use Description	Percentage of Trips to/from Olowalu Town Already On Honoapi'ilani Hwy	Percentage of Trips to/from Olowalu Town Not Already On Honoapi'ilani Hwy
730	Government Office Building	50%	50%
110	General Light Industrial	20%	80%
590	Library	20%	80%
520	Elementary School	80%	20%
415/417	Regional Park with Beach	20%	80%
310	Boutique Hotel	20%	80%
732	United States Post Office	80%	20%
230	Condominium/Townhouse	20%	80%
944	Gasoline/Service Station	90%	10%
220	Apartments	20%	80%
210	Single-Family Detached Housing	20%	80%
820	Commercial Retail	80%	20%
710	General Office	20%	80%

As indicated in Table 2, some land uses have high rates of pass-by trips on Honoapi'ilani Highway. For example, it is estimated that 90% of all trips to the gasoline station in Olowalu Town that are not from within Olowalu Town would be trips that are already on Honoapi'ilani Highway. In other words, only 10% of the trips that come from external to Olowalu Town would be by traffic that is not already on Honoapi'ilani Highway. A similar situation is shown for the post office. It is not likely that very many trips to the post office that are not from Olowalu Town would be made by the casual traveler on Honoapi'ilani Highway. In other words, it is unlikely that many special trips will be made via Honoapi'ilani Highway to get to Olowalu Town to use the post office. This is of course due to there being sufficient other post office locations already on the island of Maui. At Olowalu Town, some land uses, like the hotels, would generate more new trips (80%) that are not already on Honoapi'ilani Highway than are already on Honoapi'ilani Highway (20%). This would reflect the fact that hotel guests may well come

from other portions of the island and would not be as likely to be traveling on Honoapi'ilani Highway already. The percentages used in Tables 1 and 2 were used to allocate new trips and pass-by trips to the access points on Honoapi'ilani Highway for the Olowalu Town.

Trip Distribution

Trips were distributed using information from the Maui LRTP and a review of the trip length frequency curves from the latest update of the island's LRTP. By analyzing this data and by being aware of the location of various traffic generators on the island, distribution values for each land use were developed. The trip distribution pattern for external trips shows trips that would leave Olowalu Town to travel to or from the north (Lahaina and beyond) or the central and south portions of Maui. The following Table 3 shows the distribution of trips generated for each land use in the Olowalu Town.

Table 3 Trip Distribution for New External Trips Generated in Olowalu Town

ITE Land Use Code	Land Use Description	Percentage on Honoapi'ilani Hwy To/from Lahaina	Percentage on Honoapi'ilani Hwy To/from Ma'alea
730	Government Office Building	46%	54%
110	General Light Industrial	58%	42%
590	Library	54%	46%
520	Elementary School	54%	46%
415/417	Regional Park with Beach	46%	54%
310	Hotel	72%	28%
732	United States Post Office	54%	46%
230	Condominium/Townhouse	60%	40%
944	Gasoline/Service Station	50%	50%
220	Apartments	60%	40%
210	Single-Family Detached Housing	60%	40%
820	Commercial Retail	60%	40%
710	General Office	60%	40%

A similar process was used for pass-by or diverted trips to and from Olowalu Town that would be added to traffic on Honoapi'ilani Highway. The following Table 4 shows the distribution of pass-by trips for the various land uses in Olowalu Town.

Table 4 Trip Distribution for Passby Trips Generated to and from Olowalu Town

ITE Land Use Code	Land Use Description	Percentage on Honoapi'ilani Hwy To/from Lahaina	Percentage on Honoapi'ilani Hwy To/from Ma'alea
730	Government Office Building	46%	54%
110	General Light Industrial	58%	42%
590	Library	54%	46%
520	Elementary School	54%	46%
415/417	Regional Park with Beach	46%	54%
310	Hotel	72%	28%
732	United States Post Office	54%	46%
230	Condominium/Townhouse	60%	40%
944	Gasoline/Service Station	50%	50%
220	Apartments	60%	40%
210	Single-Family Detached Housing	60%	40%
820	Commercial Retail	60%	40%
710	General Office	60%	40%

Traffic Assignment

The Wintass software program was used to assign trips to the street network with trips allocated based on the distribution data described earlier and the allocation of trips to the three proposed access points. Generally, trips were allocated by land use to the most logical access point, depending upon the direction of travel away from Olowalu Town. These trips are only for travel external to Olowalu Town. Overall, a small percentage of trips were assigned to the proposed right-in/right-out access point that will be located on the southern end of the project. The remaining trips were allocated to the two major access points that will operated as

the "O-turns." The following Table 5 shows the general allocation of trips to the three access points.

Table 5 Allocation of External Trips to Proposed Olowalu Town Access Points

Access Point	Percentage of External Trips Entering Olowalu Town	Percentage of External Trips Exiting Olowalu Town	Comments
O-turn 1	35%	35%	Values vary slightly for individual land uses
O-turn 2	54%	58%	Values vary slightly for individual land uses
RIRO	11%	7%	Assumes fewer entries than exits due to location and design of access point

Detailed percentage values for each land use for each access point and direction of travel are provided in the appendices. This analysis does not include estimation of travel from the mauka side to and from the makai side of the Olowalu Town. The amount of land development on the mauka side of Honoapi'ilani Highway compared to the makai side is very low, so that a very small percentage of trips will be made from one side to the other. This item will be reviewed in detail in the final TIAR which will be prepared at a later date. This analysis also does not address the internal trips made from the mauka side to the makai side of Honoapi'ilani Highway via a connector that does not require access to Honoapi'ilani Highway. This item will also be reviewed in the final TIAR to be prepared at a later date.

Development of Future Traffic Data

Traffic volumes were predicted for the future development of the entire Olowalu Town using the Wintass software mentioned earlier. This software takes existing traffic volumes and adds background growth and trips that are assigned to the street network at each node and for each turning movement. This preliminary TIAR focuses only on the total daily traffic volumes for the proposed Olowalu Town. Trip generation for the Olowalu Town included new external trips that would use Honoapi'ilani Highway either for entry to or exit from Olowalu Town. It also included the allocation of pass-by trips that would have already been on Honoapi'ilani Highway. The following schematic Figure 6 shows the street network with the Olowalu Town in place, not including a proposed internal connector from the mauka side to the makai side of Honoapi'ilani Highway.

As discussed earlier, a background growth factor of 8% was used to account for growth in traffic on Honoapi'ilani Highway without the Olowalu Town being in place. This factor was applied to all traffic movements on Honoapi'ilani Highway that would exist without Olowalu Town. Trips were allocated as indicated in Tables 1 – 5. Detailed printouts from the Wintass software are included in the appendices.

Figure 7 provides a schematic diagram showing the existing average daily traffic volumes on Honoapi'ilani Highway for the study network. Figure 8 shows the predicted traffic volumes on Honoapi'ilani Highway in the year 2020 without the project in place. Figure 9 shows the new trips added to the street network with Olowalu Town in place at its full buildout in the year 2020, with the relocated and widened Honoapi'ilani Highway in place. Figure 10 shows the total traffic volumes on the street network at full buildout of the Olowalu Town in the year 2020 with the background growth of 15%. Again, Figure 10 includes the relocation of Honoapi'ilani Highway mauka of the existing highway along with its widening to four lanes.

Figure 7 Existing Traffic Volumes on Honoapi'ilani Highway

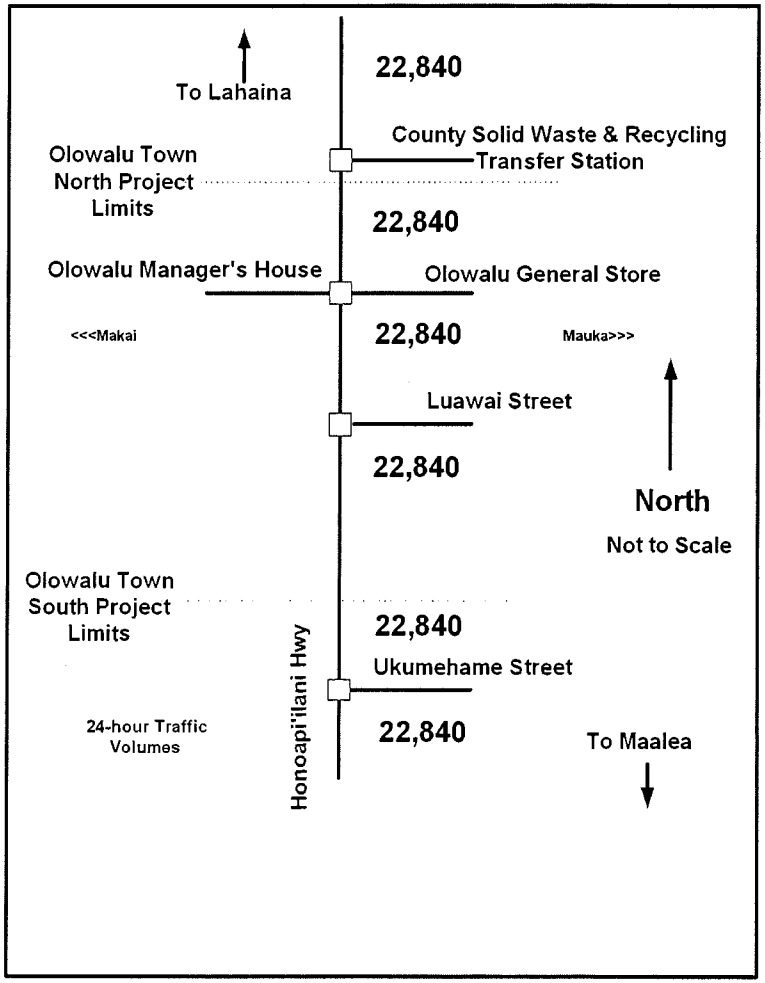


Figure 8 Future Year 2020 Traffic Volumes without Project on Honoapi'ilani Highway

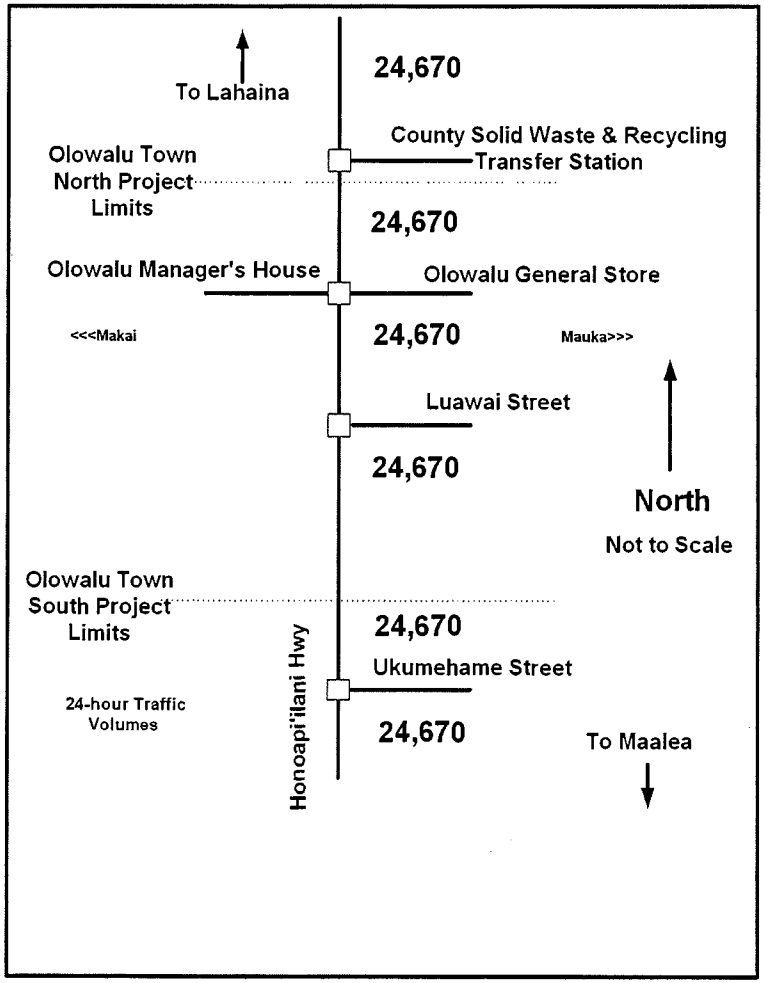


Figure 9 Traffic Added from Olowalu Town Project

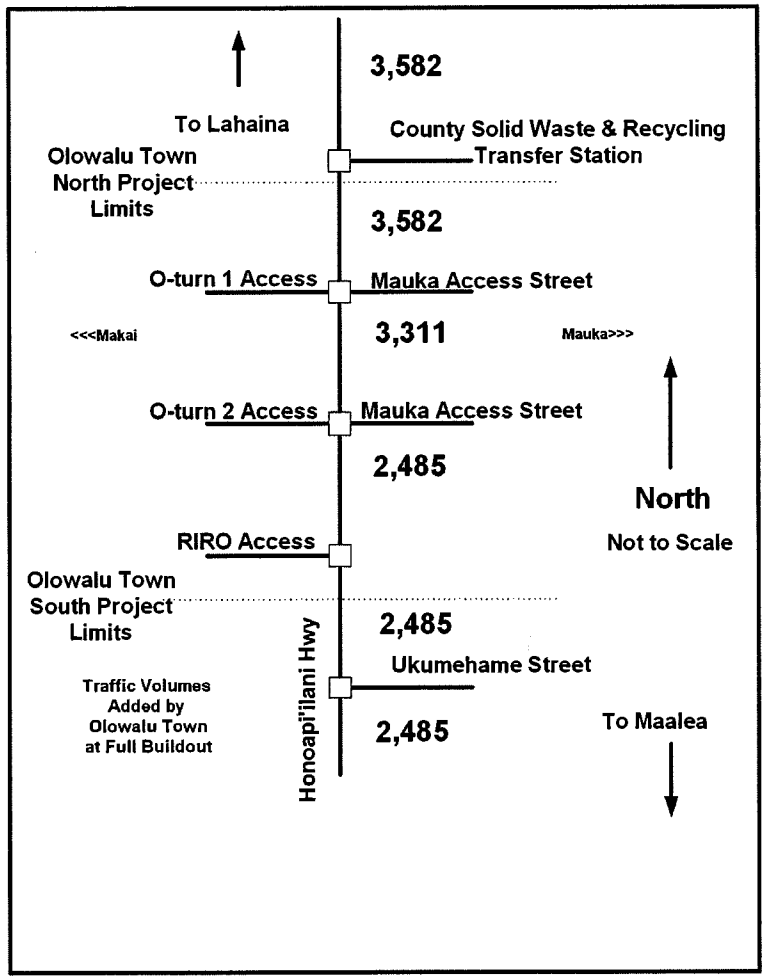
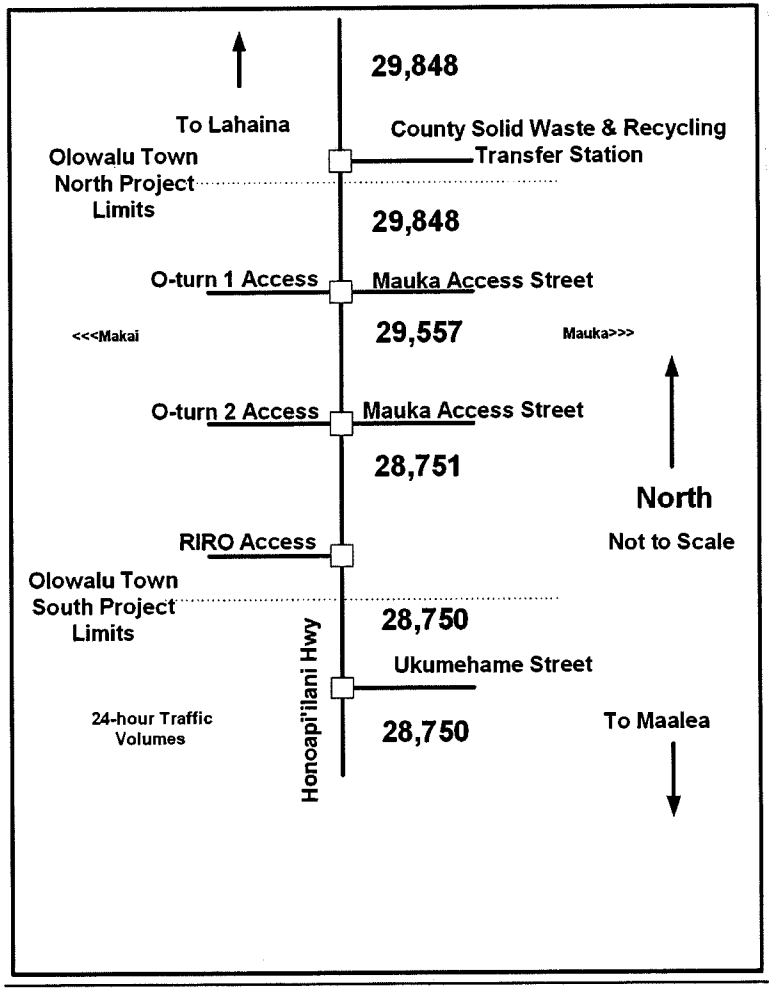


Figure 10 Olowalu Town Study Network Traffic with Full Buildout of Project in Place

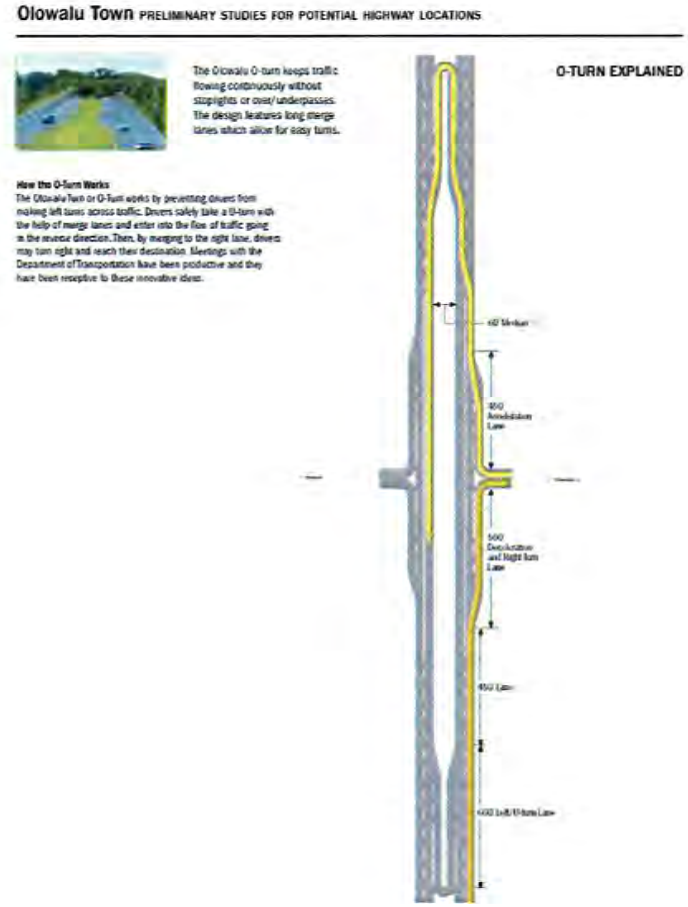


Future Roadway Network

The following Figure 11 shows the conceptual design of the O-turns for the relocated Honoapi'ilani Highway (Route 30). As shown in the Figure 11, the roadway will be widened to four lanes with two through lanes plus necessary acceleration and deceleration lanes in each direction. Access to Olowalu Town will be via three new intersections. Two of the intersections will operate with the modified "Michigan U-turn," named the "O-Turn." The remaining access point will be a right-in/right-out connection with limited traffic predicted.

As shown in Figure 11, the "O-Turn" would have a deceleration lane and a stacking lane for right turns into each new access point. For right turns from the "O-Turn," a driver simply makes a right turn and uses an acceleration lane to reach highway speed. For left turns out of Olowalu Town to go to Lahaina, a driver makes a right turn and then moves to the left lane and enters a left turn deceleration and stacking area and then makes a U-turn to go north. For left turns into Olowalu Town from the Ma'alea direction, the reverse maneuver is made, with a left turn followed by a U-turn, then with travel to the south followed by a right turn into Olowalu Town. Detailed analysis will be made with the final TIAR to assess detailed traffic operations for the peak hours. Based on preliminary reviews it appears the future traffic volumes predicted for the various movements at the "O-Turns" on a daily basis are well within the expected capacity of the design for an acceptable level of service.

Figure 11 Anticipated Roadway Connections for O-Turns on Relocated Honoapi'ilani Highway



Analysis of Impacts of Olowalu Town Project

As seen in Figure 10, the predicted average daily traffic volumes on Honoapi'ilani Highway with the Olowalu Town in place at its full buildout will vary from 28,750 to about 29,850. With the proposed Olowalu Town project, there will be a relocation of Honoapi'ilani Highway and widening to provide for two through lanes in each direction for the extent of the project. South of the project, the roadway would return to its current status with one through lane in each direction plus turn lanes at intersections. A review was made of the general overall impacts of Olowalu Town by analyzing the predicted ADTs versus the daily capacity of the roadway. To achieve this preliminary analysis, the methods of the Florida Department of Transportation (FDOT) were used. The FDOT methodology is based on the Highway Capacity Manual (HCM) which is published by the Federal Highway Administration (FHWA) as well as extensive research in the state of Florida on capacity of highway facilities. The software modules available from FDOT include Highplan, which provides estimated daily capacities for highway facilities such as Honoapi'ilani Highway. While Honoapi'ilani Highway in its current state does have direct access, the number of access points is limited and their approach volumes are quite low. All major intersections have turn lanes in place. Generally, Honoapi'ilani Highway operates more like a controlled access highway rather than an arterial street. Therefore it appears to be appropriate to use the Highplan software to estimate capacity of Honoapi'ilani Highway. Additional information on the Highplan software is provided in the appendices.

Figure 12 shows the output from the Highplan software for the existing configuration of Honoapi'ilani Highway while Figure 13 provides the output from the Highplan software for Honoapi'ilani Highway with the relocation and widening in place. As indicated in Figure 13, the estimated daily maximum capacity for Honoapi'ilani Highway is approximately 56,600. For the portion of Honoapi'ilani Highway south of Olowalu Town with its current status of two through lanes and turn lanes, the estimated maximum daily capacity is shown to be 33,300. The following Table 6 shows the predicted daily capacities and ADTs without and with the Olowalu Town project in place at its potential full buildout in the year 2020. As seen in Table 6, the widened and relocated Honoapi'ilani Highway will have more than adequate capacity to handle the existing traffic plus the background growth of 8% plus the new traffic added from the Olowalu Town. At the junction of the widened and relocated section to the existing section, the level of service will reduce to E but the calculations indicate the total capacity will not be exceeded at full buildout of the Olowalu Town. As seen in the appendices and Figures 12 - 14 the predicted overall average speed for the portion of Honoapi'ilani Highway south of Olowalu Town is approximately 29 mph, while the predicted speed in the relocated and widened segment of the highway is approximately 50 mph. The speeds in the proposed relocated and widened segment assume a design free-flow speed of 50 mph with a posted speed limit of 45 mph. Actual speeds will be affected by the speeds of the merging and diverging areas and will be modeled in detail in the final TIAR. See the appendices for detailed program outputs.

Figure 12 Output from Highplan Software for Honoapi'ilani Highway with Existing Roadway Configuration

HIGHPLAN 2009 Conceptual Planning Analysis

Project Information

Analyst	RDD	Highway Name	Honoapi'ilani Highway	Study Period	K100				
Date Prep.	4/22/2011	From	Old Landfill	Program	HIGHPLAN 2009				
Agency	For F&W	To	Mile 14	Version	7/17/2010				
Area Type	Rural Undeveloped	Peak Direction	Northbound						
File Name	C:\Users\rogerdyar\AppData\Local\Temp\preview.xml								
User Notes	Preliminary TIAR								

Highway Data

Roadway Variables				Traffic Variables					
Area Type	Rural Undeveloped	Segment Length	5 miles	AADT	22,840	PHF	0.85		
# Thru Lanes	2	Median	Yes	K factor	0.088	% Heavy Vehicles	5		
Terrain	Level	Left Turn Impact	No	D factor	0.58	Base Capacity	1700		
Posted Speed	45	Pass Lane Spacing	N/A	Peak Dir. Hourly Vol.	1258	Local Adj. Factor	1		
Free Flow Speed	50	% No Passing Zones	100	Off Peak Dir. Hourly Vol.	911	Adjusted Capacity	1659		

LOS Results

v/c Ratio	0.77	Density	N/A	PTSF	90.5	ATS	43.1	% FFS	71.8
FFS Delay	55.4	LOS Thresh. Delay	27.2	Service Measure	PTSF	LOS	E		

Service Volumes

Note: The maximum normally acceptable directional service volume for LOS E in Florida for this facility type and area type is 1500 veh/h/ln.

		LOS	A	B	C	D	E		
		Lanes	Hourly Volume In Peak Direction						
		1	*	140	280	590	1500		
		Lanes	Hourly Volume In Both Directions						
		2	*	250	490	1020	2590		
		Lanes	Annual Average Daily Traffic						
		2	*	3300	6300	13100	33300		

Figure 13 Output from Highplan Software with Relocated and Widened Honoapi'ilani Highway in Place at Full Buildout of Olowalu Town

HIGHPLAN 2009 Conceptual Planning Analysis

Project Information

Analyst	RDD	Highway Name	Honoapi'ilani Highway	Study Period	K100				
Date Prep.	4/22/2011	From	Old Landfill	Program	HIGHPLAN 2009				
Agency	For F&W	To	Mile 14	Version	7/17/2010				
Area Type	Rural Undeveloped	Peak Direction	Northbound						
File Name	C:\Users\rogerdyar\AppData\Local\Temp\preview.xml								
User Notes	Preliminary TIAR								

Highway Data

Roadway Variables				Traffic Variables					
Area Type	Rural Undeveloped	Segment Length	5 miles	AADT	29,850	PHF	0.85		
# Thru Lanes	4	Median	Yes	K factor	0.090	% Heavy Vehicles	5		
Terrain	Level	Left Turn Impact	No	D factor	0.58	Base Capacity	2000		
Posted Speed	45	Pass Lane Spacing	N/A	Peak Dir. Hourly Vol.	1558	Local Adj. Factor	1		
Free Flow Speed	50	% No Passing Zones	N/A	Off Peak Dir. Hourly Vol.	1128	Adjusted Capacity	1659		

LOS Results

v/c Ratio	0.47	Density	18.8	PTSF	N/A	ATS	50.0	% FFS	100
FFS Delay	0	LOS Thresh. Delay	60.0	Service Measure	Density	LOS	C		

Service Volumes

Note: The maximum normally acceptable directional service volume for LOS E in Florida for this facility type and area type is 1500 veh/h/ln.

		LOS	A	B	C	D	E		
		Lanes	Hourly Volume In Peak Direction						
		2	490	1,160	1,820	2,390	2,950		
		Lanes	Hourly Volume In Both Directions						
		4	850	2,010	3,140	4,130	5,090		
		Lanes	Annual Average Daily Traffic						
		4	9,500	22,400	34,900	45,900	56,600		

Figure 14 Output from Highplan Software for Portion of Honoapi'ilani Highway South of the Project Site at Full Buildout of Olowalu Town

HIGHPLAN 2009 Conceptual Planning Analysis

Project Information

Analyst	RDD	Highway Name	Honoapi'ilani Highway	Study Period	K100				
Date Prep.	4/22/2011	From	Mile 14	Program	HIGHPLAN 2009				
Agency	For F&W	To	Mile 13	Version	7/17/2010				
Area Type	Rural Undeveloped	Peak Direction	Northbound						
File Name	C:\Users\rogerdyar\AppData\Local\Temp\preview.xml								
User Notes	Two Lane Portion South of Site								

Highway Data

Roadway Variables				Traffic Variables					
Area Type	Rural Undeveloped	Segment Length	1 miles	AADT	28,750	PHF	0.85		
# Thru Lanes	4	Median	Yes	K factor	0.090	% Heavy Vehicles	5		
Terrain	Level	Left Turn Impact	No	D factor	0.58	Base Capacity	1700		
Posted Speed	45	Pass Lane Spacing	N/A	Peak Dir. Hourly Vol.	1301	Local Adj. Factor	1		
Free Flow Speed	50	% No Passing Zones	N/A	Off Peak Dir. Hourly Vol.	942	Adjusted Capacity	1659		

LOS Results

v/c Ratio	0.86	Density	NA	PTSF	94.30	ATS	29.3	% FFS	58.7
FFS Delay	50.7	LOS Thresh. Delay	50.7	Service Measure	Density	LOS	E		

Service Volumes

Note: The maximum normally acceptable directional service volume for LOS E in Florida for this facility type and area type is 1500 veh/h/ln.

		LOS	A	B	C	D	E		
		Lanes	Hourly Volume In Peak Direction						
		2	*	140	280	590	1500		
		Lanes	Hourly Volume In Both Directions						
		4	*	250	490	1020	2590		
		Lanes	Annual Average Daily Traffic						
		4	*	3300	6300	13100	33300		

Table 6 Capacity, ADTs and Levels of Service for Honoapi'ilani Highway

In Full Buildout Year of 2020

Segment of Honoapi'ilani Highway	Daily Maximum Capacity(1)	Predicted ADT	Volume to Capacity Ratio	Predicted LOS	Comments
North of Transfer Station	56,600	29,850	0.53	C	Assumes widening to two through lanes in each direction
Transfer Station to O-turn 1	56,600	29,870	0.53	C	
O-turn 1 to O-turn 2	56,600	29,580	0.52	C	
O-turn 2 To RIRO	56,600	28,800	0.51	C	
RIRO to Existing Roadway	56,600	28,750	0.51	C	
Existing Roadway South of Olowalu Town Project	33,300	28,750	0.86	E	Under capacity on daily basis

(1) From Highplan calculations.

Conclusions

Based on a review of the preliminary development plan for Olowalu Town and a review of the traffic data for daily 24-hour traffic volumes and daily 24-hour trip generation, the following conclusions are made:

1. The Olowalu Town will generate about 32,800 total trips per day with about 26,700 of these trips being internal to the town.

2. The Olowalu Town will generate about 6,100 new trips per day external to the town with this traffic using Honoapi'ilani Highway to travel to or from other island destinations.

3. The new trips added to HPH will be distributed with a ratio of approximately 60% towards Lahaina and 40% towards Ma'alea. On the Lahaina side, it is expected that the new Olowalu Town will add about 3,600 vehicles per day to Honoapi'ilani Highway. On the Ma'alea side, it is expected the new Olowalu Town will add about 2,500 vehicles per day to Honoapi'ilani Highway.

4. The proposed relocation and widening of Honoapi'ilani Highway will provide significant additional capacity to Honoapi'ilani Highway. Within the widened portion of the highway, the predicted volume to capacity ratio is no more than 0.47, resulting in a predicted LOS of C or better.

5. Within the portion of Honoapi'ilani Highway that is not proposed for widening at this time, the predicted future volume to capacity ratio is higher at 0.86 with an expected LOS of E. However, this analysis indicates that the segment of roadway south of the proposed Olowalu Town would still operate at less than capacity. Also, it is predicted that overall speeds in this segment of the highway will still be approximately 29.3 mph, even with the full buildout of the Olowalu Town. The additional time to drive the entire route from the Lahaina end towards the Ma'alea end with the widening in place is predicted to be just slightly more than with the existing roadway. This is due to the increased speeds in the portion of the highway which will be widened to four lanes, as well as the shorter distance of that portion of the roadway combined with the slightly reduced speeds in the existing portion of the highway that will not be widened. For the total roadway from the County Solid Waste and Recycling Transfer Center to a point one mile south of the site the total travel time is predicted to increase by only about 5 seconds.

Recommendations

Based on a review of the data analyzed in this report and the above conclusions, the following recommendations are made:

1. Approval of the preliminary plan and roadway access plan should be approved since the analysis indicates that the roadway capacity will be sufficient to accommodate the traffic added by Olowalu Town.

2. The analysis of the daily capacity and traffic flow indicates that the proposed roadway and access system will be sufficient.

3. The Final TIAR will include detailed analysis of peak hour conditions for Olowalu Town. Detailed analysis in the Final TIAR of the morning and afternoon peak hours will reveal

how well the system will operate at those hours. It is expected the results will indicate the proposed system with O-turns will work well.

4. Additional options for access and traffic control should also be examined in the Final TIAR to include the possibility of traffic signals. Mitigations that would include the required number of through lanes and auxiliary lanes, signal coordination, signal phasing and design for safety will be included in the Final TIAR.

List of Appendices

1. Additional Site Plan and Trip Generation Information
2. Trip Distribution Information
3. Trip Assignment and Urban Transportation Demand Model Information
4. Traditional Neighborhood Design and Internal Capture Information
5. O-turn and Michigan U-turn Information
6. Florida D.O.T. Highway Capacity Tables

TIPS Site Summary Worksheet

Site Information

Name of Development	Olowalu
Name of Applicant	F&W
Name of Analyst	Dyar
Date	02/08/2011
Development Phase	Full Buildout
Analysis Year	2030

Adjacent Highways Passby Information

North/ South Roadway

North/ South Daily Hour Volume

East/ West Roadway

East/ West Daily Hour Volume

ITE Code	Land Type	# Units	Independent Variable	Total Single Use Trips	Trip Generation		IC Trips Based on IC Rate		Balanced IC Trips w/Reason Check		Total IC Trips	Real IC %	Trips on External Roadway		Total Trips	Result Pass By	Street Dir	MOD
					In	Out	In	Out	In	Out			In	Out				
730	Government Office Building	15000	sq. feet gross floor area	179	90	89	0	0	0	0	0	0	90	89	179	-	N/S	*
110	General Light Industrial	26000	sq. feet gross floor area	181	90	91	0	0	0	0	0	0	90	91	181	-	N/S	*
590	Library	5000	sq. feet gross floor area	270	135	135	0	0	0	0	0	0	135	135	270	-	N/S	*
417	Regional Park	77	acres	352	176	176	0	0	0	0	0	0	176	176	352	-	N/S	*
310	Hotel	58	rooms	474	237	237	0	0	0	0	0	0	237	237	474	-	N/S	*
732	United States Post Office	5000	sq. feet gross floor area	541	270	271	128	200	128	200	328	61	142	71	213	0	N/S	
710	General Office Building	60000	sq. feet gross floor area	661	330	331	155	239	155	239	394	60	175	92	267	-	N/S	
230	Residential Condominium/Townhouse	174	dwelling units	1028	514	514	489	492	489	492	981	95	25	22	47	-	N/S	*
220	Apartments	260	dwelling units	1747	874	873	756	816	756	816	1572	90	118	57	175	-	N/S	*
944	Gasoline/Service Station	20	vehicle fueling positions	3371	1686	1685	1493	1496	1493	1496	2989	89	193	189	382	0	N/S	*
220	Apartments	593	dwelling units	3985	1992	1993	0	0	0	0	0	0	1992	1993	3985	-	N/S	*
210	Single-Family Detached Housing	523	dwelling units	4764	2382	2382	1019	838	1019	838	1857	39	1363	1544	2907	-	N/S	*
820	Shopping Center	114000	sq. feet gross leasable area	7395	3698	3697	2458	2499	2458	2499	4957	67	1240	1198	2438	0	N/S	
820	Shopping Center	125000	sq. feet gross leasable area	7851	3926	3925	2542	2460	2542	2460	5002	64	1384	1465	2849	0	N/S	
	Total Volume			32799			9040	9040	9040	9040	18080	55%	7360	7359	14719			

(indicates the land use was modified from the original rates.)*

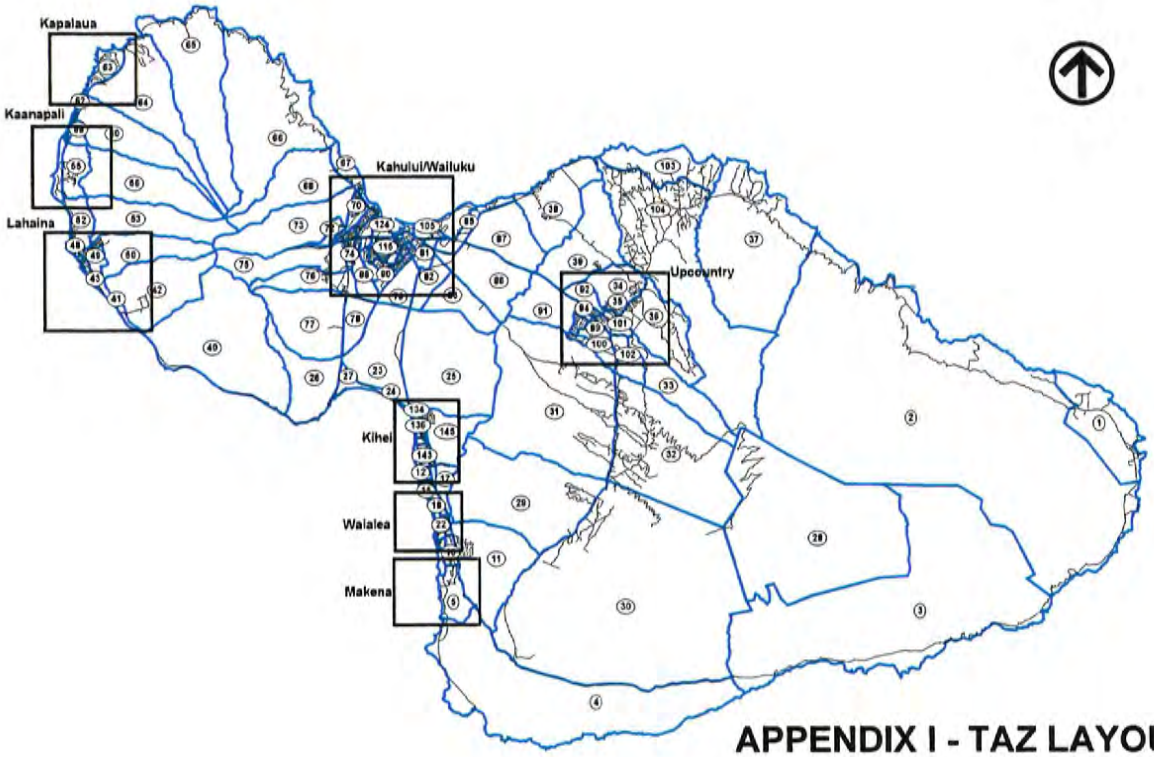
Trip Distribution Calculations Olowalu Town

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC
1	ITE Land Use Code	Land Use Type	# Units	Independent Variable	Internal Capture Rate Est.	Unit Conversion	Trip Rate Per Unit Per Hr	Total Single Use Trips Peak	Directional Distribution		Trip Generation		Town Only		External of Town		External Penalty Estimate	External New Only Added		External Penalty Only		Internal Total	External Total	External New	External Penalty	External New		External Penalty	
2					(From)		RTI)		In	Out	In	Out	In	Out	In	Out	Tot %	In	Out	In	Out					In	Out	In	Out
3											C/T*G*I	C/T*G*O	K*E	L*E	E-M	L-N		(E-Q)*D	(E-Q)*F	O-R	O-R								
4	730	Government Office Building	13,000	sq. feet gross floor area	65%	1000	11.0	179	50%	50%	89	89	26	26	13	13	50%	7	7	7	7	152	37	19	13	7	7	7	7
5	110	General Light Industrial	34,000	sq. feet gross floor area	30%	1000	7.0	181	50%	50%	91	91	27	27	42	42	30%	51	51	13	13	54	137	101	25	51	51	13	13
6	590	Library	5,000	sq. feet gross floor area	90%	1000	54.0	270	50%	50%	135	135	122	122	14	14	90%	11	11	3	3	243	27	27	5	11	11	3	3
7	412	Regional Park	77	acres	20%	1	4.6	352	50%	50%	176	176	35	35	141	141	20%	113	113	28	28	70	282	225	56	113	113	28	28
8	210	Hotel	54	rooms	20%	1	8.2	474	50%	50%	237	237	47	47	190	190	20%	153	153	38	38	95	379	302	76	153	153	38	38
9	732	United States Post Office	5,000	sq. feet gross floor area	95%	1000	108.3	543	50%	50%	271	271	257	257	14	14	80%	3	3	11	11	514	37	5	27	3	3	11	11
10	230	Residential Condominium/Townhouse	174	dwelling units	40%	1	5.8	674	50%	50%	337	337	149	149	188	188	30%	231	231	58	58	404	674	419	105	231	231	57	57
11	220	Apartments	180	dwelling units	40%	1	6.7	1,485	50%	50%	742	742	297	297	445	445	30%	356	356	89	89	594	891	713	178	356	356	89	89
12	944	Gasoline/Service Station	30	vehicle fueling positions	90%	1	168.6	3,371	50%	50%	1,686	1,686	1,517	1,517	169	169	90%	17	17	152	152	3,034	337	34	304	17	17	152	152
13	220	Apartments	396	dwelling units	40%	1	6.7	2,682	50%	50%	1,341	1,341	672	672	669	669	30%	759	759	190	190	1,245	1,897	1,518	379	759	759	190	190
14	210	Single-Family Detached Housing	252	dwelling units	40%	1	9.1	2,027	50%	50%	1,013	1,013	405	405	608	608	30%	486	486	122	122	811	1,216	973	243	486	486	122	122
15	210	Single-Family Detached Housing	243	dwelling units	40%	1	9.1	2,023	50%	50%	1,016	1,016	404	404	608	608	30%	483	483	121	121	808	1,213	970	243	485	485	121	121
16	820	Shopping Center (Retail)	188,000	sq. feet gross leasable area	50%	1000	50.1	9,419	50%	50%	4,709	4,709	2,355	2,355	2,355	2,355	80%	471	471	1,884	1,884	4,709	4,709	847	3,768	471	471	1,884	1,884
17	820	Shopping Center (Retail)	187,000	sq. feet gross leasable area	50%	1000	50.1	9,367	50%	50%	4,683	4,683	2,340	2,340	2,340	2,340	80%	468	468	1,872	1,872	4,683	4,683	936	3,745	468	468	1,872	1,872
18								33,737			16,858	16,858	8,664	8,664	8,195	8,195		3,608	3,608	4,586	4,586	17,980	16,337	7,175	9,162	3,547	3,547	4,581	4,581
19																													
20																						33,717			16,337	7,175	9,162		
21																													
22																													
23	Column	Description and Meaning								Trips		Permute			% Trips	Amt.	% Increase												
24	A	ITE land use code								Total for site	33,717		M16		100%														
25	B	Land use description				Distribution				Internal to site	17,380		M16 + M18		52%														
26	C	Units (provided by F&W)				Mauka	40%			External	16,337		K33 - K35		48%											33,717			
27	D	Variable for calculations				Lahaina	60%			External new	7,175		K14 + K16		21%											32,672			
28	E	Internal capture rate for each use (estimated)								External penalty	9,162				27%														
29	F	Unit conversion factor																											
30	G	ITE Trip Rate per unit (national average)								Existing ADT	22,900																		
31	H	Trips generated by each land use								Add new ADT	7,175		K25					Capacity	Space	%	Trs at 1%								
32	I	Percentage of trips into the land use				Internal Capture %		52%	K35/K24	Lahaina Side	37,805		K24 + (K29*K25)		4,308		18%	31,700	4,495	20%	16								
33	J	Percentage of trips out of the land use				12.73561 New Lahaina Side %		13%		Mauka Side	25,770		K34 + (K29*K30)		2,870		13%	31,200	5,830	26%	22								
34	C	Trips generated mon each land use (C * G * H)				14.31915 Possibly Lahaina Side %		18%		Total ADT					7,175		31%												
35	L	Trips generated out of each land use (C * G * I)				8.439043 New Mauka Side %		8%																					
36	M	Trips in/from the town itself (E * F) inbound				10.87377 Possibly Mauka Side %		11%																					
37	N	Trips to/from the town itself (L * E) outbound						100%																					

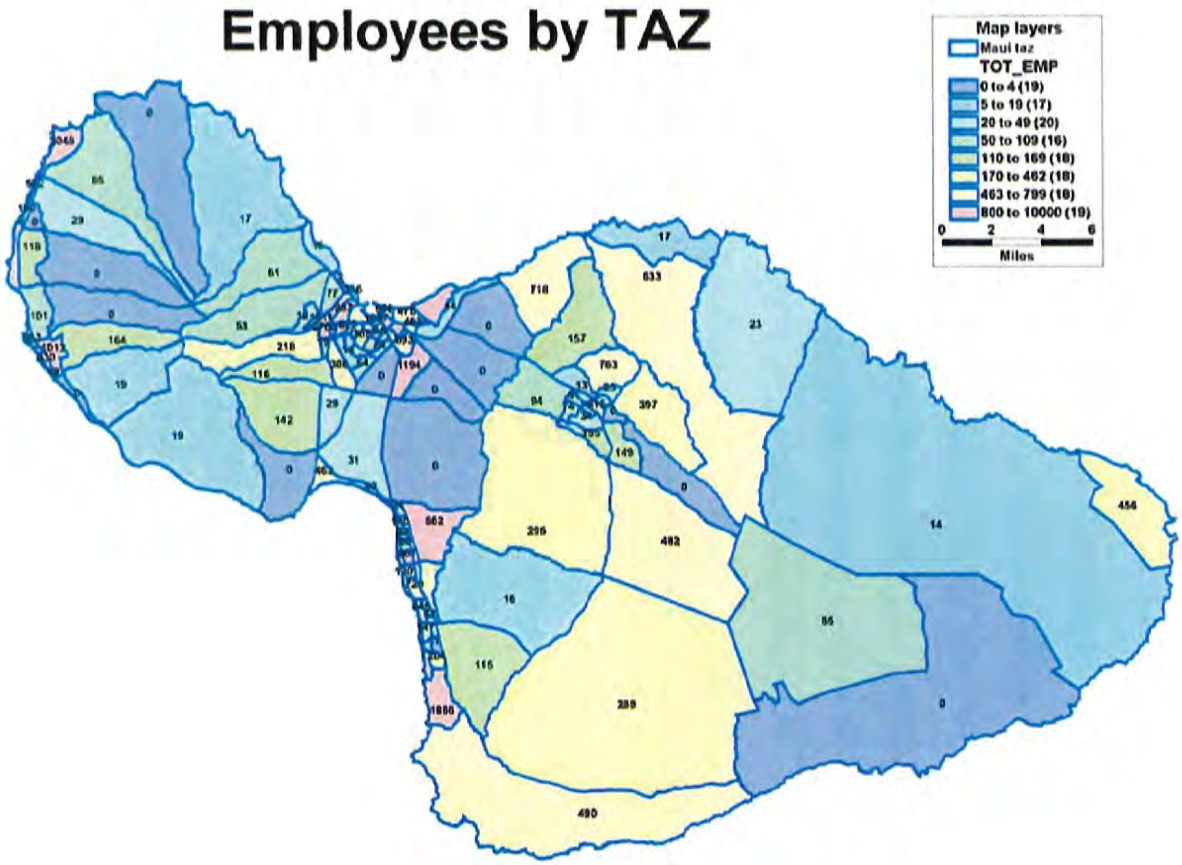
Island Trip Distribution From Urban Model

	A	B	C	D	E	F	G
2	Section	Lahaina	Kaanapali	Honokowai Napili	Kahana	Kapalua	Total
3	West Maui	17%	28%	3%	5%	7%	60%
4	Kahului	4%	6%	0%	0%	1%	11%
5	Wailuku	5%	8%	1%	0%	1%	15%
6	Kihei	3%	4%	0%	0%	1%	8%
7	Up Country	2%	3%	0%	0%	1%	6%
8	Other	0%	0%	0%	0%	0%	0%
9	Total	31%	49%	4%	5%	11%	100%

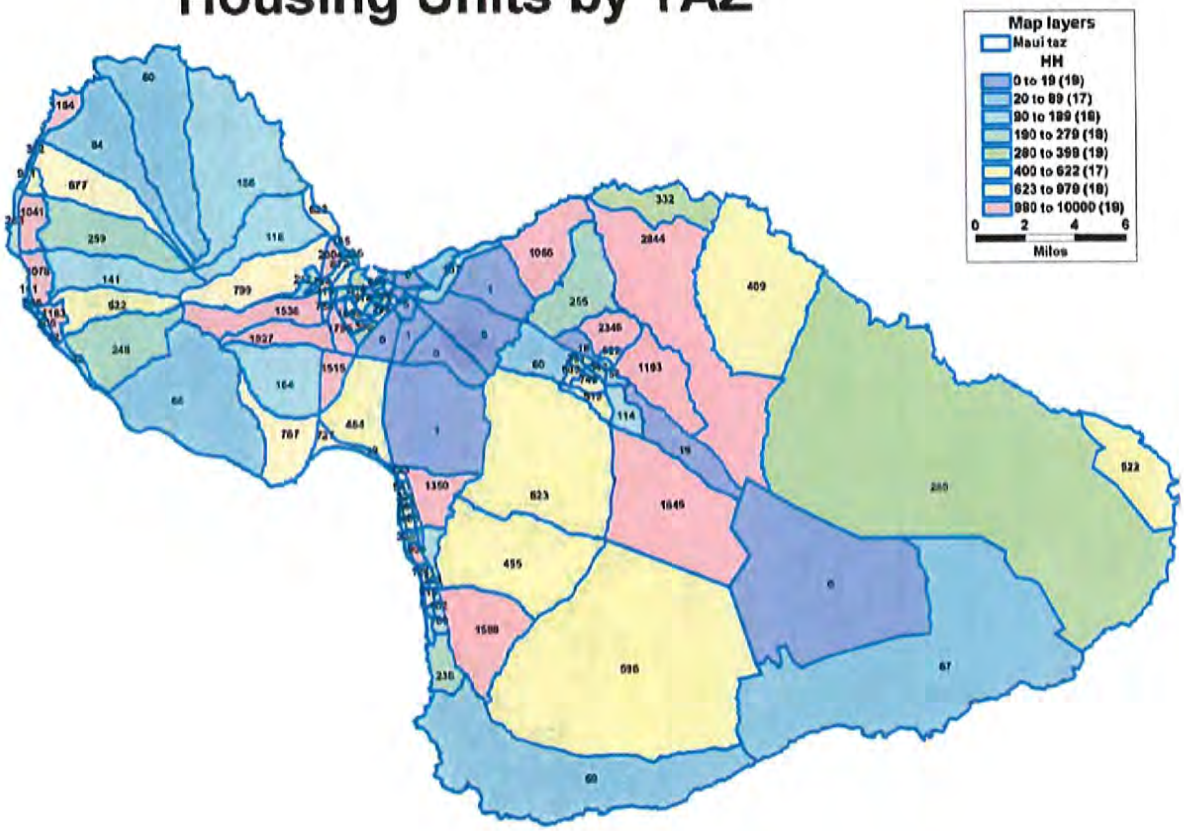
3



APPENDIX I - TAZ LAYOUT



Housing Units by TAZ



Trips in 1990 and 2020 By Community Name and By Purpose

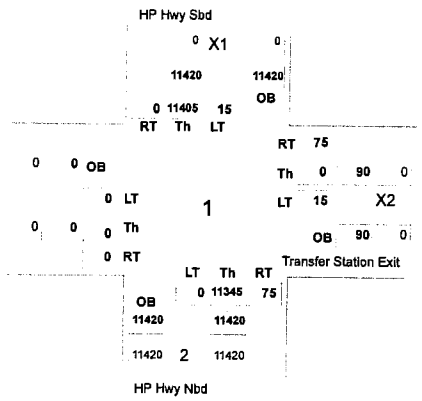
	A	B	C	D	E	F	G	H	I	J	K	L
1												
2												
3				1990						2020		
4			Home Based Work	Home Based Other	Non-Home Based	Visitors	Total	Home Based Work	Home Based Other	Non-Home Based	Visitors	Total
5	Community Name	aka 1997 LRTP										
6	West Maui	Lahaina										
7	Kihei-Makena	Kihei-Makena										
8	Wailuku-Kahului	Wailuku-Kahului										
9	Makawao-Pukalani-Kula	Makawao-Pukalani-Kula										
10	Paia-Haiku	Paia-Haiku										
11	Hana	Hana										
12	Total Daily Trips		43,260	89,660	65,590	35,140	233,650	69,050	143,130	114,250	59,850	386,280
13	A.M. Peak Hour		8,980	4,490	1,450	2,600	17,520	14,340	7,170	2,520	4,430	28,460
14	P.M. Peak Hour		9,070	5,050	2,210	4,220	20,550	14,470	8,050	3,840	7,190	33,550
15												
16	Percentage of Total Trips by Purpose Daily		18.5%	38.4%	28.1%	15.0%		17.9%	37.1%	29.6%	15.5%	
17	Percentage of Total Trips by Purpose AM		51.3%	25.6%	8.3%	14.8%		50.4%	25.2%	8.9%	15.6%	
18	Percentage of Total Trips by Purpose PM		44.1%	24.6%	10.8%	20.5%		43.1%	24.0%	11.4%	21.4%	
19												
20												
21			1990 LRTP Daily Trips		2020 LRTP Daily Trips							
22		From	To/from	To/from	To/from	To/from						
23		Site by Purpose	Lahaina	All others	Lahaina	All others						
24		HBW	12,899	30,361	19,476	49,624						
25		HBO	16,431	73,229	20,230	122,900						
26		NHB	10,475	55,115	20,969	93,281						
27		Visitor	21,547	13,503	32,943	26,907						
28		Total	61,352	172,298	93,568	292,712						
29			26.3%	73.7%	26.3%	73.7%						
30	Daily 1990 % by Purpose							2020 % by Purpose				
31	18.5%	HBW	29.8%	70.2%	28.1%	71.9%		17.9%				
32	38.4%	HBO	18.3%	81.7%	14.1%	85.9%		37.1%				
33	28.1%	NHB	16.0%	84.0%	18.4%	81.6%		29.6%				
34	15.0%	Visitor	61.3%	38.7%	55.0%	45.0%		15.5%				
35		Total	26.3%	73.7%	24.2%	75.8%						
36												
37												
38												
39												
40												
41												
42		Example of 5000	To Lahaina (left out)	All others (right out)								
43		5000	275	650								
44		5000	352	1567								
45		5000	224	1179								
46		5000	461	291								
47		Total	1313	3687								

Intersection Turning Movements

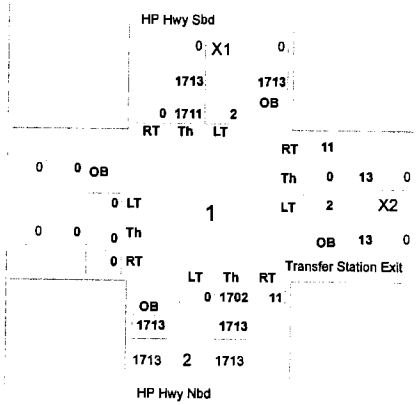
Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

Intersection Name: HP Hwy at Transfer Station
Intersection ID: 1

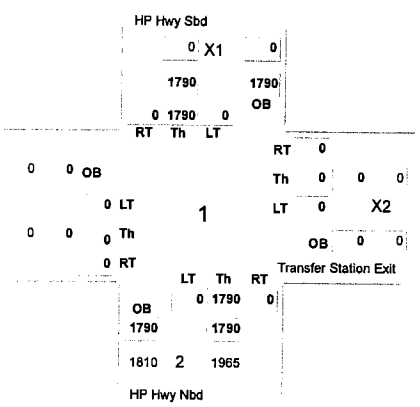
Existing



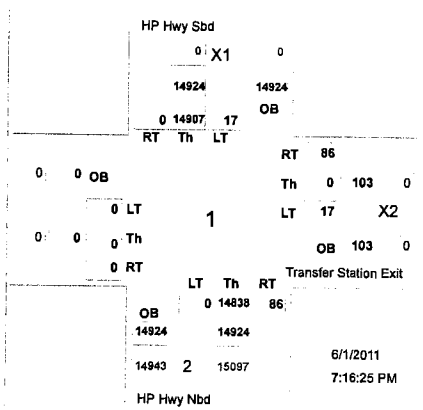
Growth



Site



Future

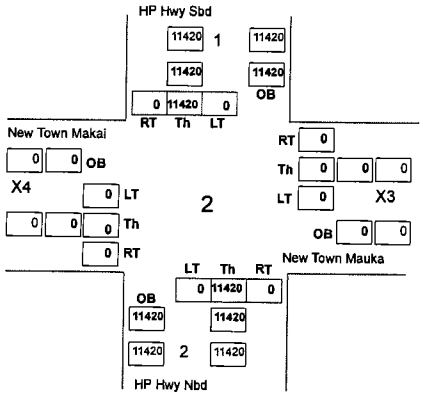


Intersection Turning Movements

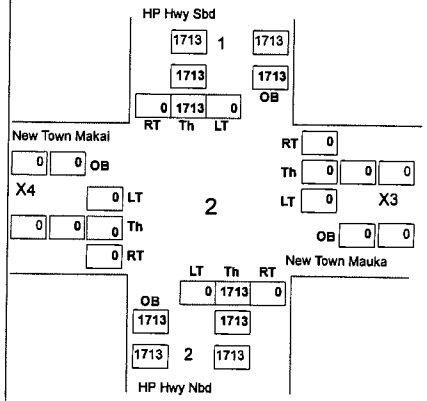
Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

Intersection Name: HP Hwy at New Town Access 1
Intersection ID: 2

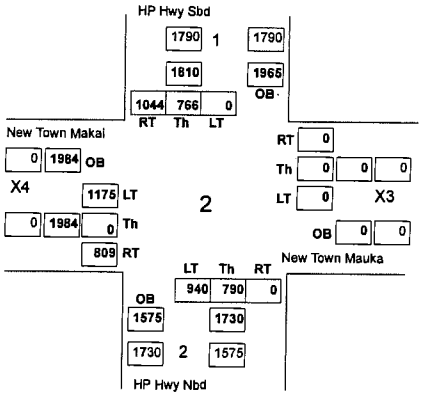
Existing



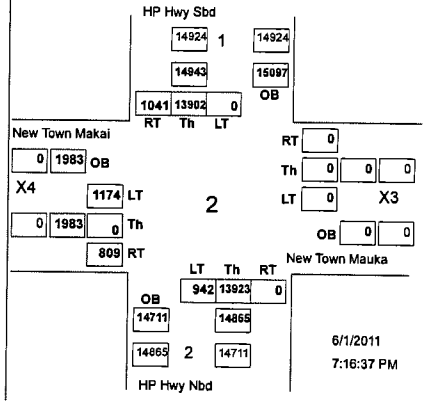
Growth



Site



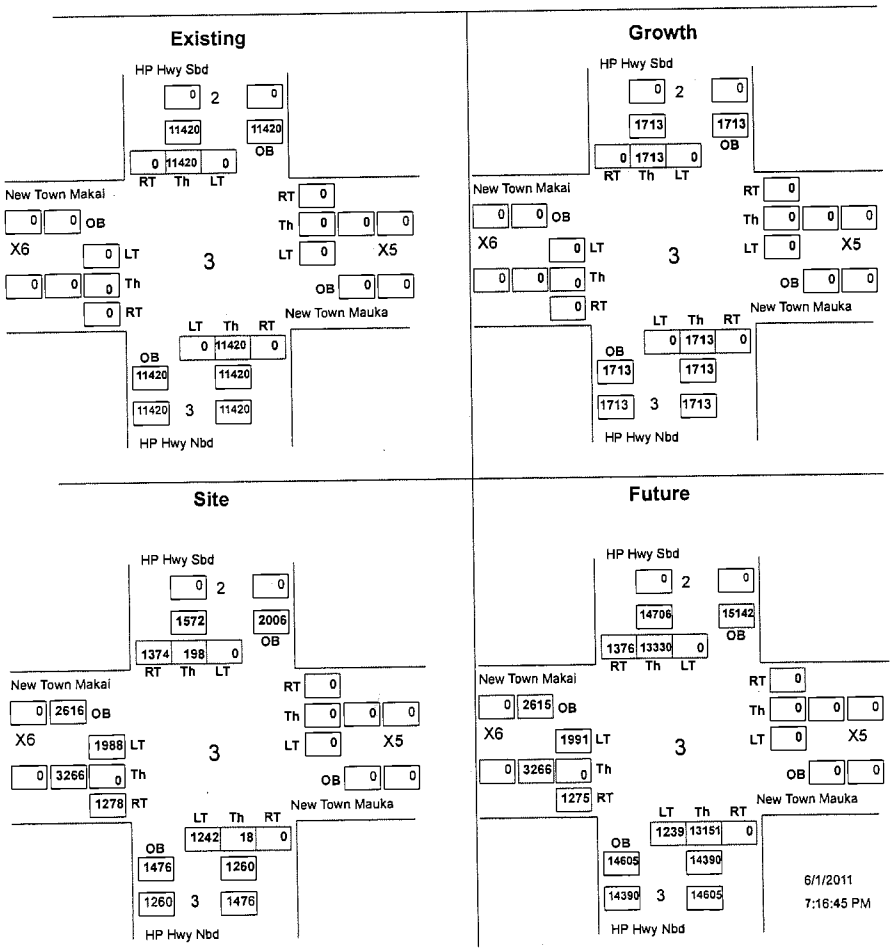
Future



Intersection Turning Movements

Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

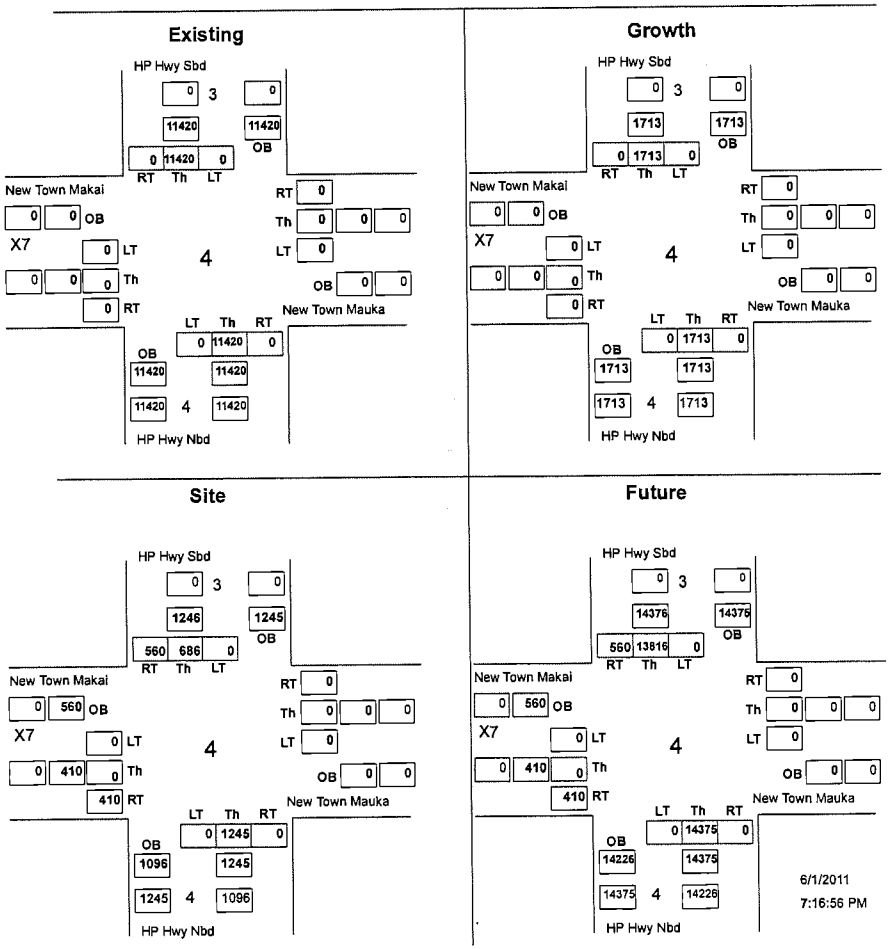
Intersection Name: HP Hwy at New Town Access 2
Intersection ID: 3



Intersection Turning Movements

Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

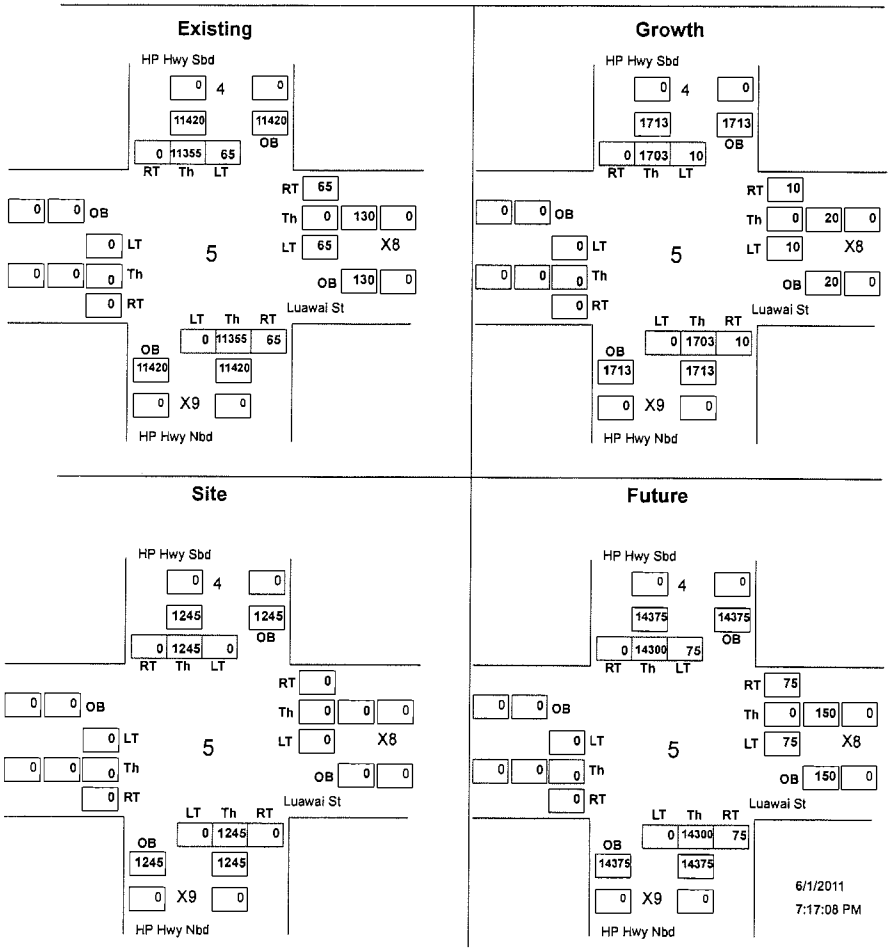
Intersection Name: HP Hwy at New Town Access RIRO
Intersection ID: 4



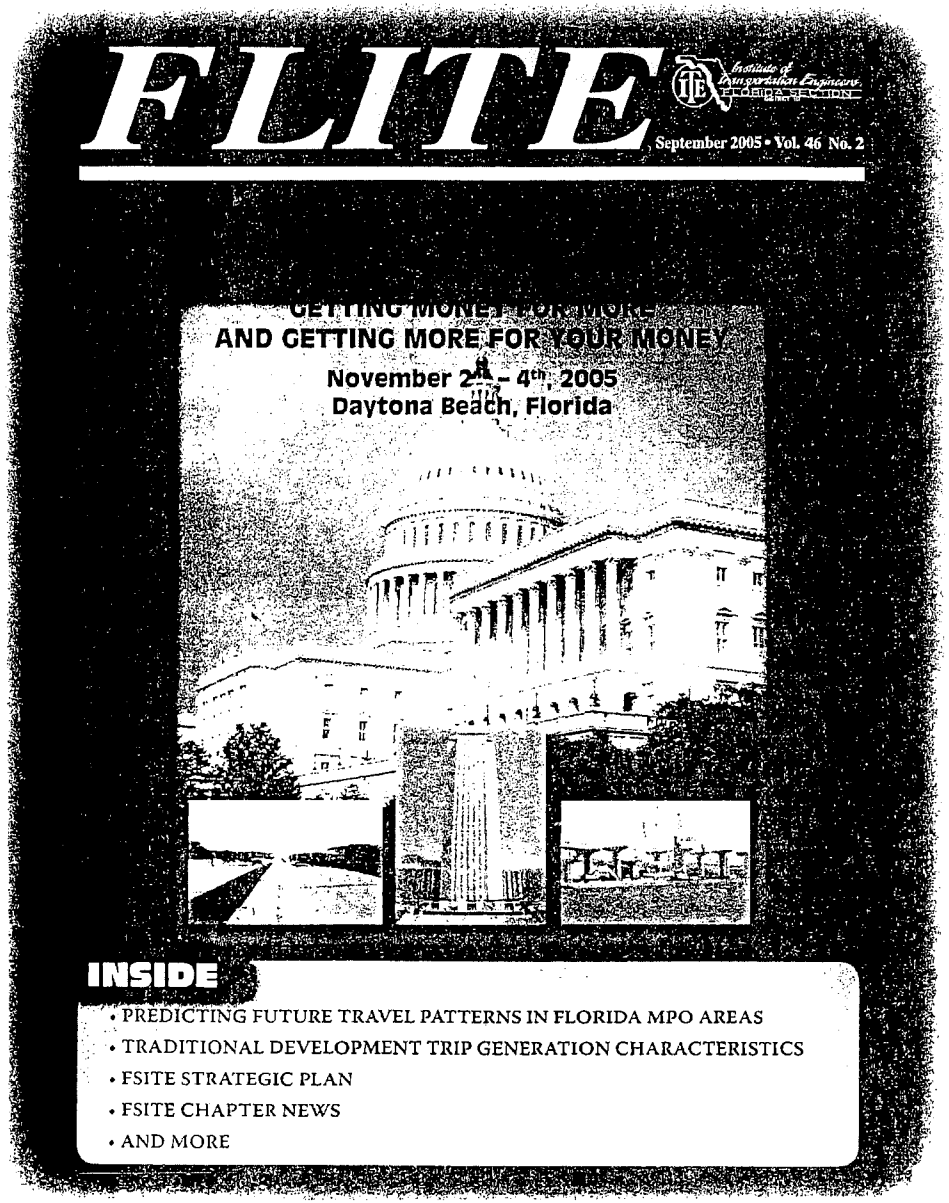
Intersection Turning Movements

Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

Intersection Name: HP Hwy at Luawai
Intersection ID: 5



4



Traditional Development Trip Generation Characteristics

I. Introduction

Planned communities today are widely employing a New Urbanism approach in design. These concepts are hailed as one of the remedies to the rapid utilization of resources due to suburban sprawl. Traditional neighborhood developments incorporate a varied mixture of land uses usually within walking distance of one another. The proximity of these easily accessible facilities is intended to promote pedestrian, bicycle, and shorter internal auto trips. A large percentage of internal trips should be the result and lessen the impact of the community on the surrounding roadway network. Internal trips are defined as those that have both trip ends within the development project. Although they often utilize one or more segments of a public roadway, there is no net increase in traffic volume on the external roadway system outside the boundary of the project.

These benefits of internal capture and the level of trip reduction associated with traditional land use development, however, are supported by a minimal amount of documented research. Estimations for traffic characteristics such as trip generation and internal capture are sometimes challenged due to this lack of information. This report presents available information from the research conducted for traditional neighborhood developments and provides sources for greater inquiry.

II. Study Review

A. Celebration Monitoring & Modeling Study

Published in September 2003, the Celebration Monitoring & Modeling Study provides a quantified insight into an established traditional community. The report was mandated by the Third Amended and Restated Development Order of the Celebration Development of Regional Impact (DRI). The report contributes information on many aspects of the community. Relevant information includes the development program, traffic counts, trip generation, and internal capture percentages.

Celebration is located in Osceola County, Florida. Interstate 4 (I-4) and US 192 form the community's north and west borders, respectively. Other communities in the area include Lake Buena Vista at approximately 7 miles, and Kissimmee at approximately 10 miles away.

B. Traditional Neighborhood Development Trip Generation Study

Traditional Neighborhood Development Trip Generation Study was prepared by Dr. Asad J. Khattak, Dr. John R. Stone, William E. Letchworth, Ben K. Rasmussen and Bastian J. Schroeder in February 2005. The report was completed for the North Carolina Department of Transportation by the Department of City and Regional Planning of the University of North Carolina in Chapel Hill and the Department of Civil, Construction, and Environmental Engineering at North Carolina State. The report uses local traffic impact analysis methods to estimate trip generation rates. These estimated trip generation rates were compared with actual traffic counts produced by the existing developments.

The Traditional Neighborhood Development surveyed for this study is Southern Village, which is located within the city limits of the City of Chapel Hill. The other suburban development surveyed is located within the Northern Carrboro area. The developments are approximately 7 miles apart. The nearest commercial district is Franklin Street of Chapel Hill and the University of North Carolina and both developments are located equal distances away.

C. Haile Plantation Traffic Study

The Haile Plantation Traffic Study was prepared in November 15, 1996 by Buckholz Traffic. The study was completed to monitor the effect of changes to the Haile Plantation Master Plan and to document the actual project traffic characteristics. Both machine and manual intersection turning movement counts were conducted for the study. The manual counts were conducted at the intersection of SW 46th Boulevard and SW 75th Street, and SW 91st Street and Archer Road. The machine counts were taken at SW 46th Boulevard and SW 91st Street. These locations were determined sufficient to record all traffic movements from the traditional project elements.

Haile Plantation Village is located in Alachua County, FL. The development is approximately 7 miles from the commercial district of the City of Gainesville.

Continued on page 17

D. Internalizing Travel by Mixing Land Uses: A Study of Master-Planned Communities in South Florida

Internalizing Travel by Mixing Land Uses: A Study of Master-Planned Communities in South Florida, a study completed by Reid Ewing, Eric Dumbaugh, and Mike Brown, was presented at the 80th Transportation Research Board Conference in Washington D.C. The travel data originated form the Southeast Florida Travel 2000 Survey conducted by the Florida Department of Transportation. The land use data originated from metropolitan planning organizations and the Florida Department of Transportation. The information for Palm Beach and Broward counties was updated in 1999; the information for Dade County in 1996. Land use measures employed in the study were size, density, entropy, balance and accessibility.

Twenty different neighborhood developments from Palm Beach, Broward and Dade counties are included in this study. These communities were built over the last 40 years, and were both family and retirement oriented. The land uses included in each development included "housing, shopping, services, and recreational facilities."

E. Other Traditional Neighborhood Development Resources

Using the New Urban News' list of traditional neighborhood communities as a starting point, a list of additional nearly or recently completed developments was compiled. Local jurisdictions and development companies were contacted in reference to traffic studies for each of these projects but no usable information was available. These communities could provide opportunities for study in the future.

- Seaside, Walton County, FL. 350 Single Family (SF), 60 ksf commercial, charter school, chapel
- Kentlands, Gaithersburg, MD. 520 SF, 1539 Multi Family (MF), 1,000 ksf commercial & office, elementary school, convenience store/gas station/car wash
- Birkdale Village, Huntersville, NC. 230 SF, 360 MF, 234,921 sf Specialty Retail, 52,202 sf Office
- Daniel Island, Charleston, SC. 10,000 seat Tennis Stadium, 16 tennis courts, 5,100 seat Soccer Stadium, Private High School, K-8 Public, Preschool/Daycare
- I'ON, Mt. Pleasant, SC. 762 SF, 30,000 sf Commercial
- Harbor Town, Memphis, TN. 550 SF, 345 MF, 43 ksf commercial
- Middleton Hills, Middleton, WI. 327 SF, 87 MF, 150 ksf commercial

III. Traffic Generation & Internal Capture

A. Celebration, Osceola County, FL

The land use composition at the time of the Monitoring & Modeling (M&M) study is listed below. In keeping with the traditional community philosophy, the development program is quite diverse. Since Celebration development is still under way, this mixture of uses will change with time.

- Single Family 2,232 DU
- Retail 65,687 square feet
- Multi-Family 1,868 DU
- Hospital 100 beds
- Hotel 90 rooms
- Medical Office 204,940 square feet
- Office 922,857 square feet
- Golf Course 18 holes

Data was collected for the Celebration M&M during 72-hour machine cordon line counts. These counts revealed a significant difference from the internal trip values predicted by the ITE Trip Generation Handbook 6th Edition. This difference was evident in both the peak hour and daily trips and created significant internal capture percentages.

- Total Peak Hour Project Trips (actual counts): 3,458
- Total Peak Hour Project Trips (ITE, 6th Edition): 5,044
- Total Daily Project Trips (actual counts): 40,912
- Total Daily Project Trips (ITE, 6th Edition): 56,544
- Calculated Peak Hour Internal Capture: 31.8%
- Calculated Daily Internal Capture: 27.7%

B. Southern Village, Chapel Hill, NC

The study of Southern Village compares the development to a similar conventional neighborhood. Both development programs are depicted below and the multi-use housing is included for Southern Village.

Southern Village:

- Single Family 611 DU
- Church 27,000 square feet
- Multi-family 309 DU
- Retail 30,000 square feet
- School 90,000 square feet
- Office 95,000 square feet
- Day Care Center 6,000 square feet

Northern Carrboro:

- Single Family 891 DU

Continued on page 18

Traditional Development Trip Generation Characteristics, *continued from page 17*

Traffic counts for Southern Village single-family households recorded a value of 1,336 for the PM peak-hour and a value of 12,609 for the daily period. Using ITE trip generation methods, estimated trip generation values were calculated at 1,363 for the PM peak and 12,250 for the daily. The percent difference between actual and estimated is negligible. Thus, the findings confirm that the ITE trip generation methods were very reasonable for Southern Village.

The authors concluded that the residents of Southern Village did not make significantly fewer trips than residents of the conventional neighborhood. However, the trips by residents of Southern Village were shorter in time and distances, used different modes, and were less frequently external. For instance, each household in Southern Village was responsible for 7.7 auto trips per day. A single-family household in the conventional neighborhood created approximately 10 auto trips per day. The study also found that Southern Village residents traveled 28 fewer miles per day. In Southern Village, 78.4% of all trips were made by automobile. This compares favorably with an average of 89.9% for the Northern Carrboro suburbs, a 92.4% regional average, and a national average of 87%. The internal capture percentage for Southern Village was calculated to be 20.2 %. Southern Village residents also produced 25.8% fewer external trips and 30.3% fewer regional trips.

The intent of this study was to produce a comparison of traffic studies for traditional neighborhood development and conventional communities. The report suggests that no matter the type of residential use, tradition neighborhood developments produce different traffic behaviors than the conventional community and that those behaviors include fewer external and long distance trips.

C. Haile Village Plantation Center, Alachua County, FL

The development program for Haile Plantation is listed below. The community was not complete when the study was conducted, however, a variety of land uses were represented to a large extent.

- Single Family 1,070 DU
- Multi Family 2,460 DU
- Retail 175,000 square feet
- Office 175,000 square feet
- Church 18,000 square feet
- Church/School 12,000 square feet & 600 Students
- School Elementary/Middle 1,650 Students

The traffic study conducted in 1996 concluded that Haile Village Plantation Center is exhibiting an internal capture rate of 24% of the daily trips, and 28% during the PM peak hour. The ITE trip generation manual estimated that a traditional neighborhood project like Haile Plantation would have an internal capture rate of approximately 32% of daily trips and 36% of PM peak hour trips. Based upon the comparison of these two sets of internal capture percentages, it was determined that due to the existing mixture and density of development , the percentages of 24% for the daily and 28% of the PM peak hour were an appropriate expectation for the project at its current state of completion.

D. Southern Florida – Palm Beach, Broward, and Dade Counties

The 20 Traditional Neighborhood Developments for this study were chosen based upon the mix of land uses. Each development was required to have housing, shopping, services, and recreational facilities. All were constructed after 1965. The size of the developments, in population and acreage, ranged significantly. Each of the developments was analyzed according to its gross acreage, population, and employment.

Community	Gross Acreage	Population	Employment
Aventura	692	8,303	5,965
California Club	1,234	13,649	1,869
Century Village	934	12,781	534
Century Village North	716	10,246	331
The Crossings	662	6,036	965
The Hammocks	863	13,801	1,338
Jonathan's Landing	1,205	4,211	3,127
Kendale Lakes	985	12,207	2,588
Kings Point	845	12,523	771
Miami Lakes	2,541	12,918	17,862
Mission Bay	3,851	10,598	7,869
Pembroke Meadows	1,687	5,638	1,032
PGA National	2,421	9,178	2,324
Sabel Chase	325	4,984	1,120
Silver Lakes	3,210	11,329	1,593
The Township	715	4,267	556
Village of Palm Beach Lakes	1,475	8,215	1,818
Wellington	10,727	34,267	5,220
Weston	15,517	44,199	9,206
Winston Park	1,464	8,017	440

The focus of this paper was to evaluate and report internal capture rates from a multitude of traditional neighborhood developments. The land use measures considered in calculations were size, density, entropy, balance, and accessibility. The scale of the development was directly related to capture levels and regional accessibility was inversely related to internal capture rates.

The internal capture percentages for the twenty "traditional" neighborhood developments varied greatly. However, the authors highlighted the trend of the largest traditional neighborhood developments also employing the largest

internal capture percentages.

- Wellington, Palm Beach County 57 %
- Weston, Broward County 52 %
- Century Village Broward, Broward County 43 %
- The Township, Broward County 41 %
- Century Village North, Palm Beach County 40 %
- Village of Palm Beach Lakes, Palm Beach County 34 %
- Winston Park, Broward County 30 %
- The Hammocks, Dade County 28 %
- Silver Lakes, Broward County 27 %
- Miami Lakes, Dade County 25 %
- Mission Bay, Palm Beach County 18 %
- PGA National, Palm Beach County 17 %
- Aventura, Dade County 17 %
- Jonathan's Landing, Palm Beach County 13 %
- Sabel Chase, Dade County 13 %
- Kendale Lakes, Dade County 12 %
- Kings Point, Palm Beach County 10 %
- Pembroke Meadows, Broward County 9 %
- The Crossings, Dade County 6 %
- California Club, Dade County 0 %

The mean internal capture percentage was 25% and the median was 22%. The authors concluded that the traditional neighborhood developments most successful in obtaining increased internal capture were large in size and distant from similar regional trip attractions.

IV. Summary

Most of the studies reviewed in this report indicated support for more research into the effect of traditional neighborhood developments. The studies confirm that while traditional neighborhood developments lower trip distances and encourage other modes, the actual number of total trips produced does not decrease but the net number that reach the external roadway network are reduced by up to over 50% with an average of between 25% and 30%. Each of the studies supports the trend of increasing internal capture with increasing size and diversity of land uses. Many questions still remain regarding the effects on trip length and geographic effect on trip production, but the majority of researchers agree that the ITE trip generation estimates and the results produced using the methodologies are reasonably accurate for these communities.

In conclusion, the data available for use in the development of this paper supports the use of internal capture estimates produced using the ITE Trip Generation Handbook methodologies and that results ranging between 25% and 50% should not be questioned if the land use composition is favorable in size and diversity to supporting the estimated capture rate. Therefore, placing a cap on the level of internal capture that can be assumed for purposes of development planning, a common approach in some jurisdictions due to limited documented data, is not a practice that can be supported by this research.

Researcher: Claire Rubin, Summer Intern

Ms. Rubin is enrolled in the Civil Engineering program at Vanderbilt University

Supervising Transportation Planner: Brent A. Lacy, AICP, Glatting Jackson

Mr. Lacy is a Principal Transportation Planner and is located in the Orlando Office.

Case Study – From ITE Website

ITE Journal - Surface Transportation Security Lessons Learned from 9/11

The terrorist attacks of Sept. 11, 2001 exacted a terrible toll on the United States and fundamentally changed the way of life in America. Surface transportation has changed and continues to change in response to the attack. Agencies that own and operate surface transportation systems must understand the relevant lessons from the 9/11 experience and respond accordingly so that we as a nation are well prepared should we be attacked again. The U.S. Federal Highway Administration (FHWA) commissioned the John A. Volpe National Transportation Systems Center (Cambridge, MA, USA) and Science Applications International Corporation (SAIC) to prepare detailed case studies of surface transportation in the New York City (NYC) and Washington, DC metro areas on the day of and in the days and weeks following the attacks. Published material was reviewed, participants were interviewed and internal agency working documents were analyzed. Extensive chronologies of actions were prepared for each study and impacts of the actions were identified whenever possible. The final two case studies total more than 150 pages. A panel of participants in the actual events have reviewed and approved the studies. The following material summarizes the lessons learned, exploring what did and did not work. This article synthesizes the findings from both studies and presents lessons that can be made available to the transportation profession as a whole. http://www.ite.org/membersonly/itejournal/ite-journal/pdf/2002/JB02IA38.pdf

A. Following approval of a final site plan and subdivision plat, the first seventy five percent (75%) of all certificates of occupancy for dwelling units shall be issued prior to the establishment of any non-residential use.

B. No certificate of use and occupancy may be issued for the remaining dwelling units until a certificate of use and occupancy has been issued for one-hundred percent (100%) of the non-residential floor area.

Table 407-2 Trip Reductions for Mixed Use Development

Percent Residential Equivalent Units	Percent Non-residential Equivalent Units	Percent Trips Reduced
85-100%	0-14%	Not Applicable
75-84%	15-25%	10%
65-74%	25-35%	20%
35-65%	35-74%	30%
25-34%	65-74%	20%
15-24%	75-84%	10%
0-14%	85-100%	Not Applicable

Rules of Interpretation for Table 407-2:

For purposes of computing the percentage established above, one dwelling unit or 800 square feet of non-residential space shall equal one (1) equivalent unit. The equivalent units shall be located within the boundaries of the proposed development.

(3) For purposes of this section, the overall trip generation for an eligible use (see subsection (4), below) in the DR, DB, or DBO district shall be reduced by thirty percent (30%).

(4) For purposes of this subsection, an "eligible use" includes any residential, retail, institutional or industrial use except Auto-Oriented Uses as defined in Article 10 of this Code.

(f) Stormwater management

Stormwater credits are defined in the Maryland Department of Environment, 2000 Maryland Stormwater Design Manual, which is hereby incorporated by reference. Credits are calculated for using non-structural practices including Natural Area Conservation, Disconnection of Rooftop Runoff, Disconnection of Non Rooftop Runoff, Sheet Flow to Buffers, Open Channel Use, and Environmentally Sensitive Development. The percentage refers to the reduction in Water Quality Volume (WQv) from a development.

Improved Estimation Of Internal Trip Capture For Mixed-Use Developments

THIS ARTICLE DESCRIBES THE KEY TASKS AND FINDINGS OF NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM PROJECT 8-51, WHICH DEVELOPED IMPROVEMENTS TO THE EXISTING ITE METHODOLOGY FOR ESTIMATING INTERNAL CAPTURE. VALIDATION OF THE PROPOSED METHOD WAS BASED ON COMPARISON OF ESTIMATED EXTERNAL VEHICLE TRIP GENERATION WITH OBSERVED CORDON COUNTS.

BY BRIAN S. BOCHNER, P.E., PTOE, PTP, KEVIN G. HOOPER, P.E., AND BENJAMIN R. SPERRY, E.I.

INTRODUCTION

One of the key components of traffic impact analyses (TIA) for proposed land developments is the estimation of the number of trips that are expected to be generated by the site. For developments composed of a single land use, trip generation can be estimated using the Institute of Transportation Engineers' (ITE's) *Trip Generation*, 8th Edition or similar reference, based on certain characteristics of the proposed site.[1] For multi-use land developments, the process of estimating trip generation is slightly more complex due to the internalization of some trips between on-site land uses. ITE defines a "multi-use development" as a single real-estate project that consists of two or more ITE land-use classifications between which trips can be made without using the off-site road system.[2] Internal trip capture is used as a measure of the extent to which trips made at multi-use developments are internalized with both origin and destination within the development. Accurate estimation of internal trip capture for mixed-use developments benefits all parties involved with the development review process. In recent years, a new form of multi-use development, the mixed-use development (MXD), has emerged as a popular development style in both suburban greenfield and urban infill areas. MXD sites are developed in conformance with a single master plan, including fully integrated on-site land uses and deliberate layout and design of buildings and streets.

RESEARCH PROBLEM

Despite the importance of accurately estimating internal trip capture for MXDs, very little research exists on the subject. Prior to 2005, the most robust research effort examining internal trip capture was two studies from the early 1990s funded by the Florida (USA) Department of Transportation (FDOT). These studies identified internal capture using intercept surveys of residents, employees, and visitors at six developments in south Florida. The FDOT studies would ultimately form the basis of the ITE-recommended procedure for estimating internal trip capture at multi-use developments, which is described in Chapter 7 of the ITE *Trip Generation Handbook*.[3] For more details of the FDOT studies, the reader is referred to summaries located in Appendix C of the *Trip Generation Handbook*.[4]

While the ITE-recommended internal trip capture estimation procedure is the most frequently used method in practice, there are several limitations to the method. For example, the method includes data for only three land uses: residential, office, and retail. Although the data allow for estimation of internal capture during the p.m. peak hour, it does not allow data for the a.m. peak hour, so the current method does not support completion of traffic impact analyses for both street peak hours. Finally, there are no provisions in the method to account for certain features of the MXD that may have a profound impact on trip internalization, including the proximity of on-site land uses or the emphasis on pedestrian-oriented design.

Recognizing these limitations, the National Cooperative Highway Research Program (NCHRP) initiated Project 8-51 in 2005 to improve the methodology used to estimate internal trip capture within mixed-use developments.[5] Among the project outputs were the following:

- A data collection framework and methodology to estimate internal trip capture at an existing MXD site; and
- A defensible improved methodology for estimating internal trip capture to determine appropriate reductions below single-use trip generation estimates.

The improved estimation method was developed using existing survey data from prior studies plus surveys of three additional MXDs conducted in the NCHRP project. The estimation method is based on the existing ITE procedure but expands it to cover both a.m. and p.m. peak periods, six primary land uses most frequently found at MXDs, and proximity of interacting land uses.

This article describes the key tasks and findings of NCHRP Project 8-51. For more details on the study methodology and analysis findings, readers are encouraged to read the project report, which is available from the Transportation Research Board.[6]

DATA COLLECTION METHODOLOGY

The first key task of the NCHRP 8-51 project was development of a methodology and procedural instructions for the data collection process as well as for selection of MXD sites that would be used for data collection. Preliminary steps of the data collection process included the following:

- Selection of representative MXDs that could be sufficiently isolated to collect data to determine both total external trip generation by mode and to determine internal trip making by interviewing the trip makers to determine trip origins, destinations, modes of travel, and related information; and
- Acquisition of owner/manager permissions to conduct the surveys and to obtain data describing each MXD and its land uses, including numbers of occupied development units.

Data were collected at the subject MXD sites during typical weekdays (Tuesday–Thursday) during the morning peak period (6:30 to 10:00 a.m.) and the weekday afternoon peak period (4:00 to 7:00 p.m.). Data obtained at each site included the following:

- Origin-destination intercept interviews of persons exiting land uses within the MXD; where not all doors could be covered due to limitations of resources, representative establishments were selected;
- Door counts of the number of people entering and exiting each MXD establishment at which interviews were conducted;
- Cordon line counts, including numbers of persons and vehicles by mode and direction; and
- Where specifics of a development required, additional interviews or counts to cover the characteristics of that development (for example, interviews of transit patrons accessing a rail station via an on-site access point).

Counts were used to factor interview data to represent the full population of travelers at the MXD site. Observed cordon counts were checked to ensure that total factored interview data compared logically with counts.

Table 1. Characteristics of NCHRP 8-51 study MXD sites.

Characteristic[1]	Mockingbird Station	Atlantic Station	Legacy Town Center
Location	Dallas, Texas	Atlanta, Georgia	Plano, Texas
MXD Style	Urban Infill Transit-Oriented Development	Urban Infill	Suburban
Site Size (Acres)	7	120	75
Maximum Walk Distance (Feet)	700	1,600[2]	2,000
Residential (DU)	191	798	1,360
Retail (GLA)	156,100	434,500	196,300
Office (GSF)	114,600	550,600	310,800
Restaurant (GLA)	28,900	64,600	69,300
Hotel (Rooms)	*No On-Site Hotel*	101	404
Cinema (GLA/Screens)	31,500/8	87,000/16	27,100/5
Parking Spaces	1,528	7,300	6,070
Transit Service	Adjacent DART Light Rail Station	Heavy Rail via Shuttle; City Bus	Limited Suburban Bus/Hotel Shuttle

Source: Cited Reference 5
[1]DU = dwelling units; GLA = gross leasable floor area; GSF = gross square feet of floor area.
[2]Reflects walking distance across main town center district.

STUDY SITES

Three MXDs in the United States were selected for study in the NCHRP 8-51 project: Mockingbird Station in Dallas, Texas; Atlantic Station in Atlanta, Georgia; and Legacy Town Center in Plano, Texas. Each site contained at least five of the six land uses most frequently found in major MXDs: office, retail, restaurant, residential, cinema, and hotel. All were developed from a single master plan with fully integrated component land uses. Table 1 reports selected characteristics of the three MXD sites surveyed in NCHRP 8-51, including the quantities of each of the six land uses being examined for internal trip capture relationships.

Office properties at the study sites were generally mid-rise office towers, although some offices were vertically integrated above ground-level retail space or restaurants. Retail, restaurant, and cinema land uses were generally grouped in a "town center" configuration. Retail properties ranged from specialty stores to convenience/service shops. The retail component of the study sites included a large department store and grocery store at Atlantic Station and a large furniture store at Legacy Town Center. On-site restaurants ranged from high-turnover fast food to exclusive. Residential units at the study sites consisted of free-standing multi-family apartment buildings or owner-occupied townhomes. As with the offices, vertical integration between on-site residences and ground-level retail or restaurant was present at the study sites.

In general, the walkability of the study sites was excellent; maximum walking distances across the study sites were no more than one-half mile, although a majority of the walking activity occurred at much shorter distances. Parking (on-street and garage/surface lots) at the study sites was generally available to visitors but also included reserved parking spaces for on-site residents and employees. Observed vehicle occupancy rates were higher during

Table 2. Proposed revision to ITE *Trip Generation Handbook* Table 7.1—unconstrained internal trip capture rates for trip origins within a mixed-use development.

Land-Use Pairs		Weekday Peak Hours a.m.	Weekday Peak Hours p.m.
From OFFICE	To Office		
	To Retail	28%	*20%*
	To Restaurant	63%	*4%*
	To Cinema/Entertainment		0%
	To Residential	1%	*2%*
	To Hotel	0%	0%
From RETAIL	To Office	29%	2%
	To Retail		
	To Restaurant	13%	29%
	To Cinema/Entertainment		4%
	To Residential	14%	*26%*
	To Hotel	0%	5%
From RESTAURANT	To Office	31%	3%
	To Retail	14%	41%
	To Restaurant		
	To Cinema/Entertainment		8%
	To Residential	4%	*18%*
	To Hotel	3%	7%
From CINEMA/ENTERTAINMENT	To Office		2%
	To Retail		21%
	To Restaurant		31%
	To Cinema/Entertainment		
	To Residential		*8%*
	To Hotel		2%
From RESIDENTIAL	To Office	2%	4%
	To Retail	1%	*42%*
	To Restaurant	20%	*21%*
	To Cinema/Entertainment		0%
	To Residential		
	To Hotel	0%	3%
From HOTEL	To Office	75%	0%
	To Retail	14%	16%
	To Restaurant	9%	68%
	To Cinema/Entertainment		0%
	To Residential	0%	*2%*
	To Hotel		

Note: Blank cells indicate intra-land-use trips or locations not open in a.m. peak hours.
Italicized values indicate internal capture rates eligible for proximity adjustment.
Source: Cited Reference 5

the p.m., ranging between 1.07 and 1.12 in the a.m. and between 1.09 and 1.40 in the p.m. peak hour. Transit service at the study sites was as follows:

- Mockingbird Station: light-rail station adjacent to site; transit mode share approximately 15 percent of external trips;
- Atlantic Station: frequent circulator shuttle connecting site and nearby heavy rail station; transit mode share approximately 5 percent; and
- Legacy Town Center: infrequent suburban bus route adjacent to site plus private hotel shuttle to nearby business park; negligible transit mode share (less than 1 percent).

INTERNAL TRIP CAPTURE ANALYSIS

Using the factored interview data, researchers developed origin-destination (O-D) matrices that reported travel between each of the six land uses being examined as well as trips external to the site. Researchers excluded trips between the same land uses because ITE trip generation estimates already reflect trips within the same land use on the same site. From the O-D matrices, researchers computed internal trip capture percentages for origin and destination ends at land uses in the MXD. Researchers reviewed the internal trip capture rates for the three NCHRP study sites (and three FDOT sites where applicable) for logic related to nearby competing opportunities, proximity, connectivity, and specifics of the establishments to ensure the results were consistent with expectations. Researchers identified both consistencies and differences between the internal capture percentages for the same land-use pairs and directions. These consistencies and differences result from differences in proximity of the interacting land uses as well as the balance of development units. Other factors may also affect these percentages.

For each land-use pair and peak period, researchers identified up to six unique internal trip capture percentages, one for each of the three NCHRP sites plus up to three from the FDOT sites (where applicable). The highest percentages for each land-use pair examined represent the highest directional interaction shown by the survey data. The researchers considered these percentages to be unconstrained (or at least the least-constrained found): That is, they result from the most favorable balance of land-use development units as well as relatively close proximity. Tables 2 and 3 report the unconstrained internal trip capture percentages for trip origins and destinations within an MXD identified in this research. The data in Tables 2 and 3 are reported in a similar format as Tables 7.1 and 7.2 in the *Trip Generation Handbook*.[7]

IMPROVED ESTIMATION METHODOLOGY

The second key task of the NCHRP 8-51 project was to develop an improved methodology for estimating internal trip capture for proposed MXD sites. Figure 1 shows a flowchart of the improved methodology, which is closely patterned after and builds upon the ITE-recommended methodology found in the *Trip Generation Handbook*.[8] The ITE-recommended method applies internal trip capture percentages to estimated vehicle trips generated by each on-site land use (for which data are available) and distributes these trips among the other land uses at the site. In order to reflect the balance between quantities of each land use, directional trips between each land-use pair are constrained so the internal capture estimate includes only those trips for which there are enough of both origin and destination land uses to support trips. External travel is then computed by subtracting the estimated internal trips between on-site land uses from the single-site trip generation estimates. The NCHRP 8-51 project improves upon the ITE methodology by adding the following elements:

- Internal trip capture rates for the weekday a.m. peak hour;
- Internal trip capture rates for restaurant, cinema, and hotel land uses; and
- Adjustments to certain unconstrained internal trip capture rates (italicized values in Tables 2 and 3) to account for the effects of proximity (convenient walking distance) between interacting land uses to represent both compactness and design.

In addition to these improvements, researchers developed a convenient spreadsheet-based estimator tool to apply the methodology in practice. As shown in Figure 1, the improved method uses the following inputs:

- User-estimated a.m. and p.m. inbound and outbound vehicle trip generation for the six land uses as single-use, free-standing sites;
- Mode split for MXD trips to/from each land use—percent by auto, transit, and nonmotorized travel modes (walk/bicycle);
- Average vehicle occupancy to/from each land use; and
- Average walking distance (feet) between land-use pairs.

From these inputs, the following outputs are produced:

- A.m. and p.m. peak hour internal person trips by land use in origin-destination form;
- A.m. and p.m. peak hour percent internal capture (person trips); and
- A.m. and p.m. peak hour inbound,

Table 3. Proposed Revision to ITE *Trip Generation Handbook* Table 7.2—unconstrained internal trip capture rates for trip destinations within a mixed-use development.

Land-Use Pairs		Weekday Peak Hours a.m.	Weekday Peak Hours p.m.
To OFFICE	From Office		
	From Retail	32%	8%
	From Restaurant	23%	2%
	From Cinema/Entertainment		1%
	From Residential	0%	4%
	From Hotel	0%	0%
To RETAIL	From Office	4%	*31%*
	From Retail		
	From Restaurant	50%	29%
	From Cinema/Entertainment		26%
	From Residential	2%	*46%*
	From Hotel	0%	17%
To RESTAURANT	From Office	14%	*30%*
	From Retail	8%	50%
	From Restaurant		
	From Cinema/Entertainment		32%
	From Residential	5%	*16%*
	From Hotel	4%	71%
To CINEMA/ENTERTAINMENT	From Office		6%
	From Retail		4%
	From Restaurant		3%
	From Cinema/Entertainment		
	From Residential		4%
	From Hotel		1%
To RESIDENTIAL	From Office	3%	57%
	From Retail	17%	10%
	From Restaurant	20%	14%
	From Cinema/Entertainment		0%
	From Residential		
	From Hotel	0%	12%
To HOTEL	From Office	3%	0%
	From Retail	4%	2%
	From Restaurant	6%	5%
	From Cinema/Entertainment		0%
	From Residential	0%	0%
	From Hotel		

Note: Blank cells indicate intra-land-use trips or locations not open in a.m. peak hours.
Italicized values indicate internal capture rates eligible for proximity adjustment.
Source: Cited Reference 5

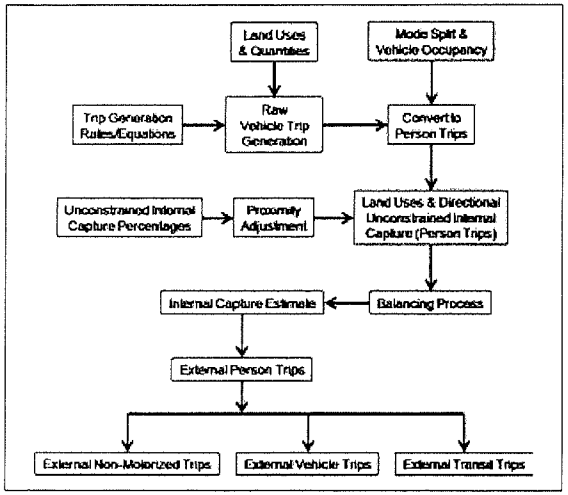


Figure 1. Generalized NCHRP 8-51 internal capture estimation method.

outbound, and total external person trips (trips to and from the development being analyzed) by mode (vehicles, transit, or nonmotorized).

VALIDATION

The validity of the improved method was tested by comparing the estimated trip generation from the method with observed cordon count data from MXDs. Cordon count data from the three NCHRP sites, the three FDOT sites, and one additional MXD site were used in the validation. For the seven MXD sites included in the validation, the proposed method was found to reduce estimation error by about half as compared to the existing ITE method and by three-fourths compared to raw ITE-based trip generation estimates.

RECOMMENDED MODIFICATIONS TO EXISTING ITE PROCEDURES

The recommended estimation method developed by NCHRP Project 8-51 does build on the current ITE internal trip capture procedures contained in the second edition of the *Trip Generation Handbook*. Incorporation of the NCHRP project's recommendations could be accomplished by doing the following:

- Expand Tables 7.1 and 7.2 of the *Trip Generation Handbook* to include all six land uses examined in the NCHRP project;
- Add a proximity adjustment to the unconstrained internal capture rates before estimating directional internal trips by land use and the balancing process; and
- Modify the data collection procedures to include those recommended in this project.

It should be noted that the findings of NCHRP Project 8-51 are being published for informational purposes; this research has yet not been advanced through ITE's process for development of recommended practices and therefore should not yet be considered an ITE-recommended methodology. This research will be considered for inclusion in an update to the ITE *Trip Generation Handbook*.

SUGGESTED FUTURE RESEARCH

The NCHRP 8-51 project made progress to improve estimation of internal capture for MXDs. However, the database is still sparse, and much that is thought to be logical about MXD travel characteristics is still unproven and largely untested. The results presented in this paper are based on surveys of six mixed-use developments, and validation was limited to seven such developments. Caution should be exercised in application of this methodology. For example, it cannot be concluded that the methodology will be appropriate for mixed-use developments that differ substantially from those surveyed.

Two of the research efforts recommended by the research team are as follows:

- Collect more data at MXDs; the researchers think data are needed from at least six more sites that have five to six land uses; and
- Independent of the additional data collection, test the applicability of the proposed methodology using data from MXDs of different sizes, character, and land-use components; use validation tests similar to those used in NCHRP 8-51. To do so, the only data needed are a complete directional cordon count for morning and afternoon peak hours plus development data and a good site plan from which to estimate proximities.

Practitioners, researchers, and other interested parties are encouraged to collect and contribute additional data using the data collection procedures described in research report. Those data could be used to further enhance the accuracy of the proposed methodology and/or expand the number of land-use classifications covered by the methodology. New data should be forwarded to the Institute of Transportation Engineers. ■

References

1. *Trip Generation*, 8th Edition, Institute of Transportation Engineers, Washington, DC, December 2008.
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3. Ibid.
4. Ibid.
5. Bochner, Brian, Kevin Hooper, and Benjamin Sperry, *Improved Estimation Method for Estimating Internal Capture for Mixed-Use Developments*, draft final report, NCHRP Project 8-51, Texas Transportation Institute, November 2009.
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8. Ibid.

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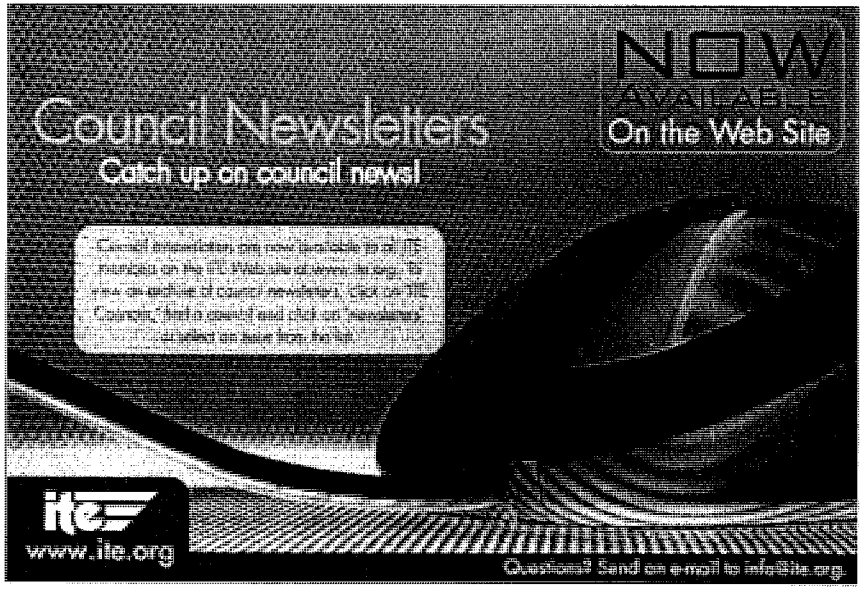

Table 411-7 TND Trip Reductions for Traffic Studies

% Residential Equivalent Units	% Commercial Equivalent Units	% Trips Reduced
76-85%	15-24%	7.5%
66-75%	25-34%	15%
56-65%	35-44%	22.5%
46-55%	45-54%	30%
36-45%	55-64%	22.5%
26-35%	65-74%	15%
16-25%	75-84%	7.5%

For purposes of computing the percentage established above, one dwelling unit or 800 square feet of non-residential space equals one (1) equivalent unit.

Sec. 412 – 416 [RESERVED]

Pages 169 – 170 Reserved

Background and Overview of
Validation of Potential Smart Growth Trip Generation Methodologies

for the California Smart Growth Trip Generation Rate (SGTGR)
Methodology and Validation Subcommittees
(prepared by Rick Lee – July 28, 2010)

Overview

As we have seen, most traffic studies conducted in California base their estimates of development impacts on the Institute of Transportation Engineers' *Trip Generation* manual, or on the San Diego Association of Governments' (SANDAG) similarly constructed *Traffic Generators*. The ITE *Trip Generation Handbook* (a companion volume to *Trip Generation*), describes procedures for adjusting the manual's vehicle trip generation rates to account for the effects of mixed use development, based on limited data. While neither the ITE manual nor the handbook present validation data of their reported rates and equations, they do describe procedures for collecting traffic generation data at developed sites in order to validate, refine or replace the published rates.

The methods that are being studied (or possibly developed) by the SGTGR effort differ substantially from conventional ITE trip-generation methods. In order to provide practitioners with substantiation of the validity of the methods and their estimates, the study team plans to compare results of each potential method against empirical traffic data gathered at developed smart growth sites within California. Site identification is underway, and data collection will hopefully begin under separate contract by early 2011 (if the recession subsides sufficiently to allow data collection).

The study team is also using traffic count data already available from the EPA and SANDAG studies for 10 of the California sites that was used to evaluate these agencies' versions of the MXD method. These sites include one in Northern California (in Sacramento), three in Orange County, and six in San Diego County. A limitation of this existing set of data is that it includes vehicle trips only; also it does not report peak hours in some cases.

The SGTGR evaluation process (whether using pre-existing or new data) will be to compare the empirical data collected at each site to estimates produced by the various "candidate" methodologies for that site. Key steps the UCD project team anticipates conducting in this approach are as follows:

1. Calculate each site's ITE gross trip generation based on: a) the reported ITE average trip rates, and b) the reported ITE trip generation equations. (i.e., summing the trips from the individual land use categories). Also apply the ITE Handbook's multi-use internal capture rates equation for mixed-use sites.
2. Identify each candidate method's needed input variables on a consistent basis for each validation site.
3. For all candidate methods, compute the estimate of external vehicle trip generation, and compare to both the gross and multi-use ITE trip generation estimates to the cordon traffic counts for the site.
4. The study team and Methodology Subcommittee may consider possible refinements to the candidate methodologies to improve the validation against the empirical traffic count data, or may decide to develop a new methodology if no existing methodologies are sufficiently accurate.

This approach represents a substantial advance over the approach taken in the existing ITE trip generation guidelines. The methodologies tested in this study will be validated via comparison of method estimates against the best available empirical field data gathered from a range of case study sites. When the validation process is completed, it will help select or devise a new analysis technique for traffic engineers that can more accurately and defensibly quantify impacts and size infrastructure for smart growth development projects.

The remainder of this document summarizes the "validation" approach taken by three key prior tool development projects: the EPA MXD spreadsheet, the SANDAG MXD spreadsheet, and the finalized NCHRP 8-51 report *Enhancing Internal Trip Capture Estimation for Mixed-Use Developments.*

I. EPA MXD Spreadsheet Validation Approach (based on the draft *Research-Based National Method of Estimating Trip Reduction Attributable to Multi-Use Development Research Report,* US EPA, n.d.)

The EPA MXD spreadsheet model was applied to 16 multi-use developments (MXDs) in various parts of the US for which counts of external vehicle trips were available AND which were not one of the 239 mixed-use sites used to develop the underlying equations. Seven of these sites are in Florida: six of these Florida sites are described in Appendix C of the ITE Trip Generation *Handbook*, and the seventh is the new neo-traditional town of Celebration, Florida. Six of the remaining sites are located in northern and southern California, and the remaining three are in Texas and Georgia; cordon counts at these last three sites were originally conducted for the NCHRP 8-51 study (see below).

Overall, the EPA validation sites are comprised of mixed-use developments and areas ranging in size from approximately 5 acres to over 1,000 acres. The sites represent a wide range of densities, land use mixes, and development scales. Populations of the validation MXDs range from zero (Crocker Center in Boca Raton, FL, containing commercial and office uses only) to nearly 17,000 (the entire town of Moraga, CA). Employment levels range from near zero (in The Villages in Irvine, CA) to more than 6,000 (Jamboree Center in Irvine, CA). Some sites are well served by transit, including one built around a rail station. Others are located in suburban areas and are poorly served by transit. The diversity of the comparison sites suggests that a tool that matches all would help establish its validity for analyzing a wide variety of projects.

Data were collected for all model variables for each of the 16 sites. The variables "Employment within one-mile" and "Employment within 30 minutes by transit" were estimated from regional travel models, and verified from aerial photos. Some of the site data was confirmed from development websites. Trip purpose percentages were estimated based data presented in NCHRP Report 365 for the combination of land uses contained within each MXD.

These validation tests produced two types of performance measures: root mean squared error (RMSE) and pseudo R-squared. RMSE is a measure of the percentage by which the trip generation estimates produced by the method deviate from the actual trip generation counted at each of the study sites. The lower the RMSE deviation, the more accurate is the prediction method. R-squared is a measure of how well the prediction method accounts for the degree of variation in trip generation from one site to another, An R-squared of 0.5 indicates the method explains 50 percent of the variation among cases and a value of 1.0 would imply a perfect ability to capture the variation in trips from one site to another.

Among the validation sites, use of the EPA Mixed-Use Method produced a significantly better root mean squared error (RMSE) and pseudo-R squared than traditional methods when comparing estimated to observed external vehicle trips. Estimates from the ITE *Trip Generation* manual had an RMSE of 40 percent and pseudo-R squared of 0.58, and modified estimates using ITE's current trip internalization techniques had an RMSE of 32 percent and pseudo-R squared of 0.73. Estimates produced by the Mixed-Use Method had an RMSE of only 26 percent and pseudo-R squared of 0.82. This means that the Mixed-Use Method explains roughly 82 percent of the variation in trip generation among the 16 sites, with the remaining 18 percent attributable to variables not included in the method.

II. VALIDATION of the EPA MXD METHOD for SAN DIEGO SITES (Based on *Trip Generation for Smart Growth, Final Report*, SANDAG, 2010)

To evaluate the EPA MXD method (referred to as the Mixed-Use Method in this section) for use in the San Diego region, a series of tests were performed comparing the method's estimations with actual traffic count data from a number of sites within the region. This included comparisons at both large designated Smart Growth Opportunity Areas (SGOAs, defined below) and six smaller mixed-use and TOD sites.

Smart Growth Opportunity Areas. The SANDAG Smart Growth Concept Map identifies a list of SGOAs classified into one of seven place types (Metropolitan Center, Urban Center, Town Center, Community Center, Rural Village, Mixed-Use Transit Corridor, and Special Use Center). SANDAG identified a list of 57 existing SGOAs to be studied in this analysis. These 57 SGOAs were chosen by virtue of having residential and employment densities on the ground that currently meet the prescribed thresholds

Analysis of SGOAs. For most of the SGOAs, obtaining traffic counts entering and exiting the areas was not feasible due to the size of the SGOAs and the inability to filter out through trips. An alternative method to cordon counts was therefore identified.

Fehr & Peers (consultant to SANDAG) used available data from the *SANDAG Regional Household Travel Behavior Survey* (conducted mainly in 2006) to collect observed trip reduction percentages, which could be compared to the Mixed-Use Method's predicted trip reduction percentages. SANDAG staff provided Fehr & Peers with a data set of "flags" identifying which trips from the survey began and/or ended in one of the SGOAs. The trip data also included travel modes and travel party sizes. From this information, the total number of origins, destinations, and internalized trips (trips that begin and end in the same SGOA) by auto, walk, bicycle, and transit modes was computed for each SGOA. This was translated into observed values of probability of a trip being internal, or external Walk/Bike, or Transit, the three key outputs of the Mixed-Use Method.

The analysis was performed for each of the twenty SGOAs that had at least 100 trips recorded in the survey. A cutoff of 100 trip records was chosen because in general, a sample size of at least 30 to 40 for each probability being estimated (i.e., the probability of a trip being either 1) internal; 2) external Walk/Bike; or 3) external Transit) is necessary for meaningful sample probabilities that are close to their true values.

Vehicle trip reduction at the SGOAs studied averaged 24 percent relative to raw trip calculations using SANDAG trip rates, ranging from as high as 47 percent in downtown San Diego to 32 percent in North Park/City Heights, and as low as 5 percent in Mira Mesa. Overall, the Mixed-Use Method proved to be a conservative predictor of trip reduction, underestimating trip reduction by about 10 percent on average, but the estimated and observed trip reductions are highly correlated.

Smaller Mixed-Use/TOD Sites. Six additional smaller mixed-use/TOD sites were identified for comparing the Mixed-Use Method estimates to actual counts of vehicles entering and exiting each site. The sites were selected from a list of developments representing typical smart development mixes and density in the region. The sites are all cohesive developments rather than historic neighborhood, because so as to be more representative of new development. Sites were also selected to be as consistent as possible with ITE data collection recommendations, e.g. the ability to identify and count all vehicular access/egress points.

The six sites selected and counted were as follows:

1. Station Village at Rio Vista Trolley Station, bounded by Camino Del Este, Rio San Diego Drive, Qualcomm Way, and the trolley tracks (residential and retail; trolley station and local bus)
2. La Mesa Village Plaza, bounded by La Mesa Boulevard, Acacia Avenue, Orange Avenue, and the train tracks (residential, retail, and office; trolley station)
3. The Uptown Center in the Hillcrest neighborhood, bound by University Avenue, Cleveland Avenue, Richmond Street, Washington Street, and SR-163 (residential & retail; high frequency local bus)
4. The Village at Morena Linda Vista Trolley Station, bound by Morena Boulevard, Linda Vista Road, Napa Street, and the train tracks (residential and retail; trolley station)
5. Hazard Center, bound by SR-163, Friars Road, Frazee Road, and Hazard Center Drive (retail and office; trolley station)
6. Heritage Town Center at Otay Ranch in Chula Vista, bound by Santa Rita Street, Palomar Street, Santa Andrea Street, and the southern end of the parking lot, not including the houses on Fieldbrook Street (residential, retail, and medical office).

A set of maps were created illustrating the sites' locations and driveways where traffic counts were made. Continuous 24-hour traffic counts were conducted at the six small mixed-use/TOD sites on typical midweek weekdays: Tuesday, Wednesday, or Thursday. Counts were conducted in October of 2008 for Otay Ranch, and in May and early June of 2009 (prior to the end of the K-12 school year) for all other sites.

Analysis: Small Mixed-Use/TOD Sites With Counts. For the small mixed-use/TOD sites, preliminary estimates of site trip generation were calculated from *San Diego Traffic Generators* trip rates and site land uses. These estimates of raw trips use suburban trip generation rates for single use sites and do not consider the effects of mixed-use development or transit access. The Mixed-Use Method was applied to each site and the trip reduction percentages were applied to the raw trips to obtain Mixed-Use Method net trips. SANDAG staff provided site land uses and values for most of the Mixed-Use Method input variables.

The results of the small sites analysis suggest that the Mixed-Use Method is an excellent predictor of external vehicle trips generated by smart growth development, tending to be slightly conservative, but without overestimating smart growth trips to the same degree as conventional trip generation methods. At all six sites, the Mixed-Use Method results in an estimation of external vehicle trips that is below the levels of estimated trip

generation using raw trips alone and at or above the level of trips that was determined through actual counts. On average, the *San Diego Traffic Generators* trip generation rates for suburban development overestimate traffic from the six sites by 29 percent, while the Mixed-Use Method reduces the average overestimate to 9 percent.

In the study of the six small SANDAG sites some of the input variables were determined by estimation methods, as follows:

- Due to confidentiality restrictions associated with California Employment Development Department data, employment levels for some sites were not always reflective of current land uses in the SANDAG databases; in those cases, they were determined from the building areas and jobs per 1,000 square foot conversion ratios.
- VRPA Technologies performed an independent set of land use data checks, collecting data from traffic studies wherever possible, and estimated building occupancy. Those estimates were taken into account in the calculation of raw trips.
- Vehicle ownership per capita was calculated from 2000 Census data using the census block group(s) that most closely matched the sites' locations. SANDAG staff estimated employment within 30 minutes by transit using their regional travel demand model.

III. VALIDATION of the NCHRP 8-51 Estimation Procedure (Based on pending NCHRP 8-51 Final Report Appendix F)

The NCHRP 8-51 estimation procedure was applied to seven different developments for which at least land use information, peak hour cordon counts, and proximity information were available. Four of these developments provided data for this study; the other three did not. The validation test was to see how well the estimation procedure could begin with ITE trip generation data and reproduce the external vehicular cordon volumes. Five of the developments had directional cordon traffic volumes available for both peaks. These developments included:

- Mockingbird Station (Dallas, TX)
- Legacy Town Center (Plano, TX)
- Atlantic Station (Atlanta, GA)
- Crocker Center (independent site, Boca Raton, Florida), and
- Mizner Center (independent site, Boca Raton, Florida).

Two developments had only non-directional PM peak period counts available. They were:

- Boca del Mar (FL) and
- Southern Village (independent site, Chapel Hill, North Carolina).

The validation test compared four different estimation methods to determine which method produced the results closest to the cordon counts:

- the estimator described in the NCHRP 8-51 report,
- the estimator, but without a proximity adjustment,
- the existing ITE multi-use estimation method, and
- unadjusted ITE trip generation.

Development data and approximations of surveyed mode split and vehicle occupancies were input to the estimation procedure.

Figures F-1 through F-4 (that follow) show the comparisons of vehicle trips for both AM and PM peak periods and both inbound and outbound directions.

In Figure F-1, it is evident that for the AM peak hour inbound vehicle trips, the NCHRP estimation methods—both with and without the proximity adjustment—produce the best results for three of the five developments; the current ITE multi-use method is closest for one site and slightly better than the NCHRP method for another site. Atlantic Station is more closely estimated by both unadjusted trip generation and the current ITE multi-use method. The current ITE multi-use method is better than raw trip generation, but the method developed in this project is even closer to the counts.

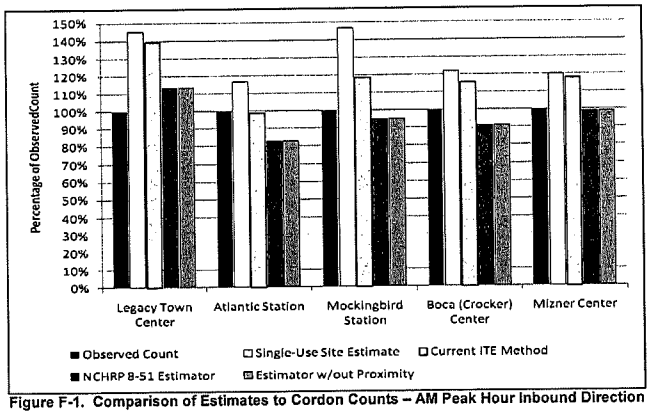

Figure F-1. Comparison of Estimates to Cordon Counts – AM Peak Hour Inbound Direction

Figure F-2 shows similar results for AM peak hour outbound vehicle trips with the recommended estimator (both with and without the proximity adjustment) producing the best results for four of the five developments. This time Mizner Center is better estimated by raw trip generation and the current ITE method. As with the previous comparison, the ITE multi-use method is an improvement on raw trip generation.

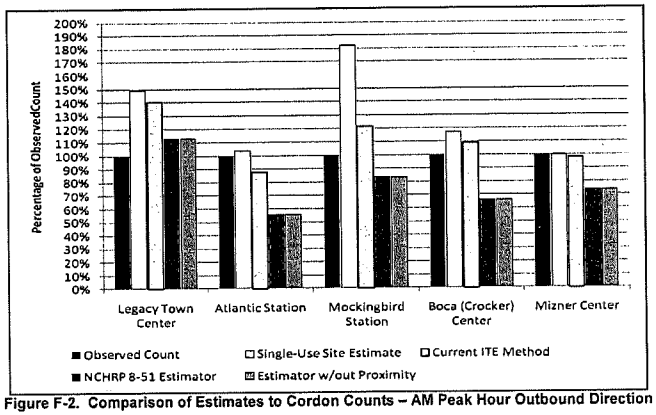

Figure F-2. Comparison of Estimates to Cordon Counts – AM Peak Hour Outbound Direction

The PM inbound comparison in Figure F-3 shows that the NCHRP method with the proximity adjustment produces the closest estimates for two sites, with the methods with and without proximity about equal for the two sites, and the raw ITE trip generation closest for one site. Again, Mizner Center was better estimated by another method (this time raw trip generation), but the other four are best estimated by the recommended method.

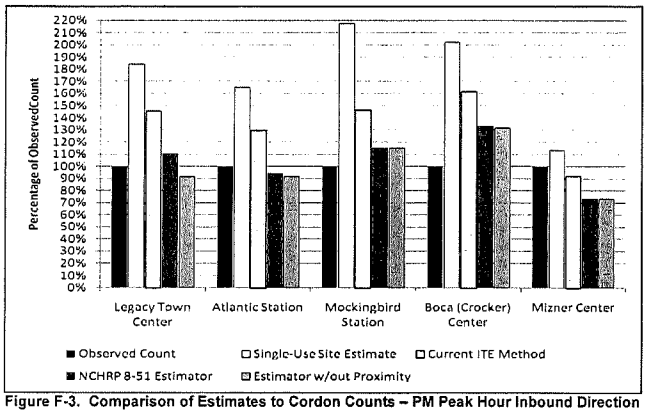

Figure F-3. Comparison of Estimates to Cordon Counts – PM Peak Hour Inbound Direction

Figure F-4 shows the comparison for PM peak hour inbound trips. As for the other time periods and directions, one or the other of the NCHRP 8-51 methods produces the closest estimates in four of the five cases. The methods with and without proximity adjustments are each best for one MXD while both yield approximately the same results for two MXDs. In this case, Boca Center is better estimated using the existing ITE method.

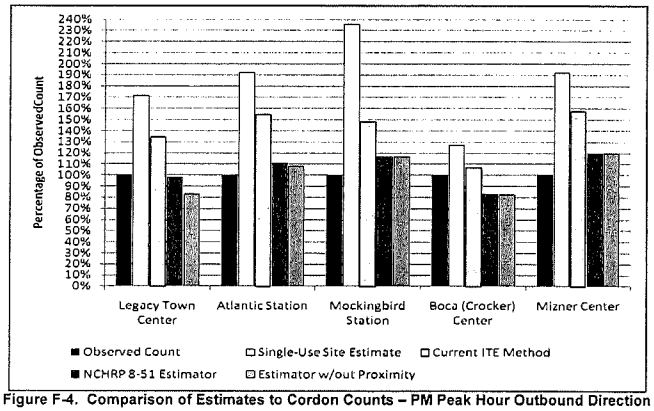

Figure F-4. Comparison of Estimates to Cordon Counts – PM Peak Hour Outbound Direction

In total, the recommended method—with or without the proximity adjustment—produces more reliable estimates for four of the five developments.

The results for the other two developments—Boca del Mar and Southern Village—show two different patterns. For Boca del Mar, both the existing ITE and recommended methods produce significantly low estimates, but are closer than the recommended method without proximity adjustments or the ITE method. The raw estimate is above the actual external count, but it and the ITE method are the closest of the estimates (about 4 percent closer than the recommended method with proximity adjustment). For Southern Village, the results are very different. The recommended method (both with and without proximity adjustments) produce estimates very close to the counts.

Table F-3 (note this is the original table number in the NCHRP 8-51 report) may quantify the degree of accuracy or error more clearly, recognizing that the statistics presented represent the sum of combined results. The average error shown is the simple sum of the percent deviations from the counts as derived in Table F-2. On average, as a group the estimates all exceed the counts (for example, the recommended method with proximity adjustment is an average of 4 percent). This is very misleading and not relevant for single developments, because overestimates and underestimates tend to cancel each other out. What may be of value in those percentages is that they could result in the sum total trip generation of several developments in an area. However, that is not what is being validated here.

More applicable is the absolute average error, which is the sum of the magnitudes of the errors averaged over the five developments. This shows more clearly what deviations—above or below actual—were found. Clearly, by examining the figures and Table F-3, it is easy to determine that the raw trip generation greatly overestimates external vehicle trip generation for the validation sites. The existing ITE method is a major improvement from raw trip generation. The recommended NCHRP 8-51 method brings the estimates significantly closer to actual. (Note that the difference between the actual and absolute value of the errors shows that there are both overestimates and underestimates occurring.)

Table F-3. Comparison of Error Statistics

Error Type	Raw ITE Trip Generation	Existing ITE Multi-use Method	Recommended NCHRP 8-51 Method		Explanation
			With Proximity Adjustment	No Proximity Adjustment	
Average error	+55%	+26%	-4%	–7%	Average error for sum of all sites
Absolute average error	55	28	17	17	Average magnitude of error per site
Standard deviation	68	34	20	19	Expect two-thirds of site estimates within this error range

The standard deviation shown in Table F-3 better represents the estimated probable magnitude of error that might occur using these estimation methods. Again, the relative magnitudes of error among the methods place them consistently in the same order.

It is clear that the NCHRP 8-51 recommended method provides more accurate estimates. Since the existing ITE multi-use adjustment method was developed from data from three of the six developments that were also used in this NCHRP project, the recommended method can only be viewed as being a further improvement.

The standard deviations for the recommended NCHRP 8-51 method, both with and without proximity adjustment, are about 20 percent of the actual external inbound and outbound volumes. This is less than the variations in the raw ITE nondirectional trip generation rates for the component land uses. For example, for the land uses listed in Table F-1, the standard deviations for their AM and PM peak hour trip generation rates are all in excess of 50 percent of the mean.

Not clear, however, is whether or not the proximity adjustment adds any current value. The validation results show no significant statistical benefit from the proximity adjustment. It has sufficient data only for the PM peak period (and less of that than would be desired). There is no AM proximity adjustment recommended at this time. On the other hand, the only examples for which the results were better without the proximity adjustment was when both variations of the new method were overestimating. In all cases the proximity adjustment either has no significant effect or renders the estimate more conservative (higher).

Conclusions Regarding Validation of the NCHRP 8-51 Method

The validation supports two principal findings:

1. The recommended method does produce noticeably more accurate results than either raw ITE trip generation estimates from the ITE *Trip Generation* report or the existing method described in the *Trip Generation Handbook*. This is true with or without the proximity adjustment.

2. The proximity adjustment, available at this time for the PM peak period, tends to make slightly more conservative estimates but overall does not, at this time, improve accuracy over a group of estimates. It can produce significant effects for larger developments.

5

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TECHBRIEF

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Synthesis of the Median U-Turn Intersection Treatment

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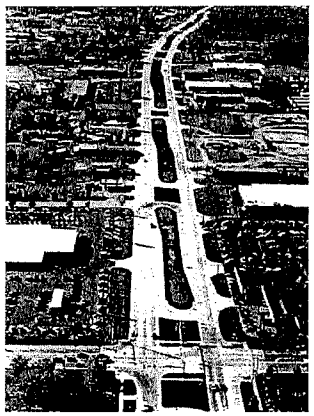
PDF Version (919 KB)

PDF files can be viewed with the Acrobat® Reader®

Objective

In the United States, congestion at intersections throughout urban and suburban areas continues to worsen. Crashes reported at intersections have continued to increase. One potential treatment to combat congestion and safety problems at intersections is the Median U-Turn Intersection Treatment (MUTIT), which has been used extensively in Michigan for many years and has been implemented successfully in Florida, Maryland, New Jersey, and Louisiana in recent years (Figure 1).

Figure 1. Example of MUTIT on Michigan corridors
(Source: AAA, Michigan).



The treatment involves the elimination of direct left turns at signal-controlled intersections from major and/or minor approaches. Drivers desiring to turn left from the major road onto an intersecting cross street must first travel through the at-grade, signal-controlled intersection and then execute a U turn at the median opening downstream of the intersection. These drivers then can turn right at the crossstreet. For drivers on the sidestreet desiring to turn left onto the major road, they must first turn right at the signal-controlled intersection and then execute a U turn at the downstream median opening and proceed back through the signalized intersection. The MUTIT can be implemented with and without signal control at the median openings on the major road.

This synthesis summarizes the advantages and disadvantages of the MUTIT compared to conventional, at-grade signal-controlled

intersections with left turns permitted from all approaches. The synthesis presents design guidelines including the location and design of the median crossovers on the major roads. Many of the guidelines presented in the synthesis are from the Michigan Department of Transportation (MDOT), and address directional and bidirectional crossovers and widened areas called "loons" that facilitate the U-turn maneuver by larger vehicles and at roads with narrow medians. The synthesis also discusses application criteria for the MUTIT, and presents information on the capacity and crash experience at these intersections relative to traditional intersections. Special considerations related to signal phasing at the median openings and signal phasing at the at-grade intersection also are discussed. Empirical evidence supports the practice that the reduction in signal phases at intersections can have higher vehicle-processing capacity and better level-of-service. In terms of safety, past research has shown that the reported numbers of crashes at MUTITs are 20 to 50 percent lower than comparable conventional intersections. The major safety benefit is a reduction in the probability of head-on and angle crashes that typically have high percentages of injury severity. Although the MUTIT typically is considered a corridor-wide treatment, the concept has been used successfully at isolated intersections to improve traffic flow and enhance safety.

Introduction

The MUTIT eliminates left turns at intersections and allows the maneuver to be made via median crossovers beyond the intersection. Drivers desiring to turn left at the subject intersection from the major road first must travel through the intersection, execute a U turn at the median crossover, and then make a right turn at the crossroad. Drivers on the minor road desiring to make a left at the subject intersection first make a right turn at the intersection onto the major road, and then make a U turn at the median crossover, and subsequently go straight through the intersection. Figure 1 shows an illustrative photograph of the MUTIT implementation in Michigan, and figure 2 shows the schematic for a typical MUTIT. The MUTIT is typically a corridor treatment. However, the concept is used at isolated intersections to alleviate specific traffic operational and safety problems. Levinson et al. (1) recommended that the application of MUTIT along the corridor should not be mixed with other indirect left-turn treatments or conventional left-turn treatments, thereby meeting driver expectancy. Figure 3 shows the MUTIT movements corresponding to left turns at conventional at-grade intersections.

The MUTIT has been used widely in the State of Michigan. Several highways in Michigan, particularly in the Detroit Metropolitan area, were constructed with wide medians on wide rights-of-way. Many of these medians are 18.3 to 30.5 meters (m) (60 to 100 feet (ft)) wide and were built decades ago in semirural areas to separate opposing directions of traffic and to provide an adequate median width for landscaping and beautification. The wide rights-of-way were originally established for "super highways," as they were called in the 1920s. By the early 1960s, many of these highways had capacity problems, generally because of interlocking left turns at the conventional intersections. To address this capacity problem, MUTITs replaced conventional intersections on various corridors. Today, there are more than 684 kilometers (km) (425 miles (mi)) of "boulevards" with over 700 directional crossovers on the Michigan State highway system. Partial implementations or designs with similar concepts have appeared in Florida, Maryland, New Mexico, and New Orleans. Hummer and Reid (2) and Levinson et al. (1) compared the MUTITs to conventional intersections. Hummer and Reid recommended that agencies consider the median U-turn alternative for junctions on high design arterials where relatively high through volumes conflict with moderate or low left-turn volumes, regardless of the cross-street through volumes.

Some of the advantages cited include:

- Reduced delay and better progression for through traffic on the major arterial.
- Increased capacity at the main intersection.
- Fewer stops for through traffic, especially where there are STOP-controlled directional crossovers.
- Reduced risk to crossing pedestrians.
- Fewer and more separated conflict points.
- Two-phase signal control allows shorter cycle lengths, thereby permitting more flexibility in traffic signal progression.

Figure 2. Typical schematics of MUTIT.

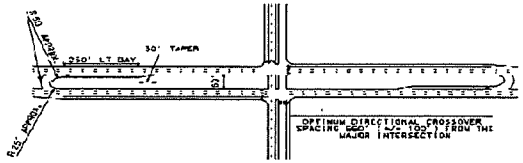
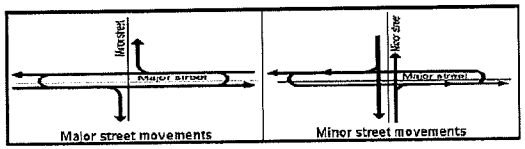


Figure 3. Vehicular movements at a MUTIT
(Source: Signalized Intersections Information Guide, FHWA-HRT-04-091, pg. 243).



Some disadvantages include:

- Possible driver confusion and disregard of left-turn prohibition at the main intersection.
- Possible increased delay, travel distances, and stops for left-turning traffic.
- Larger rights-of-way required for the arterial, although this potentially could be mitigated by the provision of loons (discussed later in this document) on roads with narrow medians.
- Higher operation and maintenance costs attributable to additional traffic signal control equipment if the directional crossovers are signalized.
- Longer minimum green times for cross-street phases or two-cycle pedestrian crossing.

MUTIT Design Guidelines

The 2004 AASHTO Green Book (3) recommends a distance of 122 to 183 m (400 to 600 ft) for the minimum spacing between the median crossover and the MUTIT intersection. The Michigan Department of Transportation (MDOT) recommends a distance of 201 m (660 ft) (+/- 30.5 m (100 ft)) for the median crossover from the MUTIT intersection. The distances recommended by the MDOT were established to accommodate drivers desiring to turn left from the crossroad. The longer distance facilitates the completion of the U-turn maneuver at the median crossover and subsequent right turn maneuver at the intersection of the major road and cross street for a 72 km/hour (h) (45 mi/h) posted speed limit on the major road. The selection of the spacing from the median crossover to the intersection is also a tradeoff between preventing spillback from the main intersection and the adverse impacts of additional travel for the left-turning vehicles. The Access Management Manual recommends an access spacing of 201 m (660 ft) on minor arterials and 402.3 m (1320 ft) on principal arterials between consecutive directional median openings on divided highways. Figures 4a, 4b, and 4c below show typical U-turn maneuvers. Table 1 gives the minimum median widths required for U turns from the major road as suggested by the MDOT.

Figure 4a. Left lane to inner lane maneuver.

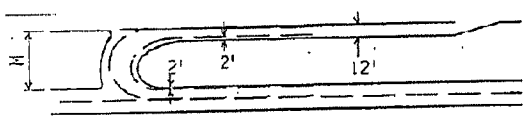


Figure 4b. Left lane to second lane maneuver.

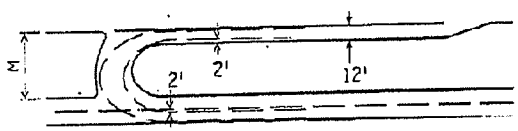


Figure 4c. Left lane to third lane maneuver.

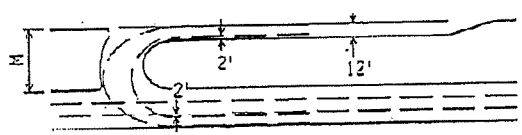


Table 1. Minimum median widths M for U-turn maneuvers suggested by MDOT.

Type of Maneuver	P	SU	BUS	WB-50	WB-60
	Length of Design Vehicle, m (ft)				
	5.8 (19)	9.1 (30)	12.2 (40)	16.8 (55)	21.3 (70)
Left Lane to Inner Lane	13.4 (44)	23.2 (76)	24.4 (80)	25 (82)	25 (82)
Left Lane to 2nd Lane	9.8 (32)	19.5 (64)	20.7 (68)	21.3 (70)	21.3 (70)
Left Lane to 3rd Lane	6.7 (22)	16.5 (54)	17.7 (58)	18.3 (60)	18.3 (60)

Where:
P = passenger car
SU = Single-unit truck
WB-50 = Semitruc medium size
WB-60 = Semitruck large size

Location and Design of Median Crossovers

Figure 5 shows the two types of median crossovers, the "bidirectional" and the "directional." A bidirectional crossover is simply an opening in the median for vehicles to make U turns from either direction. Cars may enter from either direction. Bidirectional crossovers are sometimes installed without any deceleration or storage lanes. Most bidirectional median crossovers without deceleration/storage lanes can only store one or two vehicles. With high turning volumes, an interlocking effect is sometimes created. The vehicles queued to enter the crossover cannot do so until the vehicles in the crossover move out of the opening and merge into the travel lanes. A directional crossover is a one-way crossover with a deceleration/storage lane. This type of median crossover allows vehicles traveling in one direction of the boulevard to enter. As a result, motorists at a properly designed directional crossover should never experience the interlocking effect found at medians with a bidirectional crossover.

Taylor et al. (4) studied the effects of replacing existing bidirectional crossovers with directional crossovers on eight roadway sections in Michigan between 1991 and 1997. The study investigated crash frequency on roadway segments for two datasets. The study did not adjust for regression to the mean using control sites. One dataset included all the intersection crashes in the study segment, and the other dataset excluded intersection crashes from the study segment. The important findings of this study were:

- In total crash frequencies, 4 percent to 60 percent reductions were observed for the eight sections examined. The average reduction in total crash frequencies was 31 percent.
- In injury crash frequencies, 3 percent to 71 percent reductions were observed for the eight sections examined. The average reduction in injury crash frequencies was 32 percent.
- The crash types that experienced the largest decreases in crash frequency were rear-end and angle crashes. This effect was attributed to the lack of storage space and restricted visibility associated with bidirectional crossovers. There was an average 37 percent reduction in rear-end crashes when the bidirectional median crossovers were converted to directional median crossovers.
- Replacing bidirectional median crossovers at four-legged intersections and three-legged intersections produced reductions in total crash frequencies of 58 percent and 34 percent, respectively.

Figure 5. Directional and bidirectional crossovers.

Bidirectional Crossover Directional Crossovers

Scheuer and Kunde (5) studied the effects of replacing existing bidirectional crossovers with directional crossovers on two segments of Grand River Avenue in Wayne County, MI, totaling 6.78 km (4.21 mi). The study segment was an eight-lane boulevard in a commercialized area with many driveways and minor crossroads. Three years of "before" crash data and approximately 2 years of "after" crash data were used in the analysis. The project achieved a total crash reduction of 24 percent. When the intersections where the crossovers were in-line with a crossroad are omitted, the crash reduction was 29 percent. Head-on and angle crashes showed the greatest reduction. The sideswipe crashes did increase, but the decrease in the heads-on and angle crashes far outweighed the increase of sideswipe crashes.

Castronovo et al. (6) studied the safety performance of divided highways with directional median crossovers versus bidirectional median crossovers. The key findings were:

- Divided highways with exclusive directional median crossovers have approximately the same crash rates as divided highways with exclusive bidirectional median crossovers for those sections without traffic signals.
- As the traffic signal density increases, divided highways with exclusive directional crossovers had 50 percent lower crash rates than crashes rates for divided highways with exclusive bidirectional median crossovers.

Figure 6a. Cured section of directional crossover
(Source: MDOT Geometric Design Guide 670).
CREST OF MOUND, FOR DRAINAGE AND AETHETICS, SHOULD SHOULD NOT EXCEED 1' ABOVE TOP OF CURB. IF NOT PAVED, VEGETATION MUST NOT OBSTRUCT DRIVER SIGHT DISTANCE (TYP.)

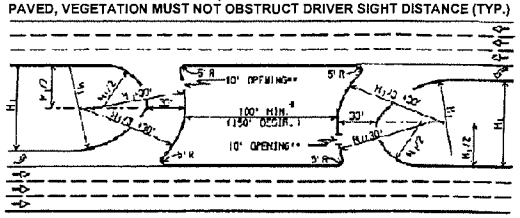
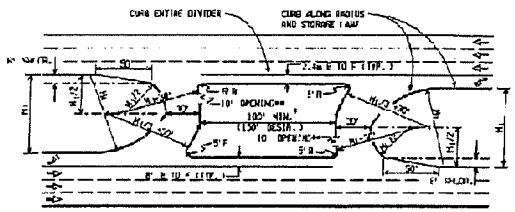


Figure 6b. Uncured section of directional median crossovers (Source: MDOT Geometric Design Guide 670).



Based on the studies cited, directional median crossovers likely provide better traffic operations and safety performance than bidirectional median crossovers. Figures 6a and 6b illustrate MDOT guidelines for designing directional median crossovers.

Location and Design of Loons

The design vehicle and the number of opposing lanes directly govern the required median width at the MUTIT median crossover junction. If the available median width is not sufficient, then agencies add additional pavement outside the travel lane to allow the design vehicle to complete the U-turn maneuver and merge back into the traffic stream. The additional pavements are typically referred to as "loons." Sisiopiku and Aylsworth-Bonzelet (7) defined loons as expanded paved aprons opposite a median crossover. Figure 7 shows a schematic diagram of a loon design, and figure 8 is a photo of an actual loon implementation in Wilmington, NC. The design width for loons will be the difference between the recommended median width in table 1 and the available median width.

Sisiopiku and Aylsworth-Bonzelet (7) evaluated the design and operation of loons and developed guidelines for loon design and placement. The important findings of the study were:

- Consistent placement of advance warning signs preceding the indirect median crossover and associated loon assisted driver expectancy when using MUTITs.
- Proper design of U turns for the appropriate design vehicle was essential to ensure safe traffic operation at the loons.
- At signalized median crossovers, the clearance intervals should account for the extra travel time required for drivers to travel through the loon.
- Suboptimal gap acceptance for U-turn maneuvers and driver confusion were two issues for loons either tapered into downstream right-turn lanes or for situations where right-turn lanes were located within approximately 45.7 m (150 ft) downstream of the loon. However, the placement of a loon and consecutive right-turn lane was recommended for major roads with MUTITs and high U-turning volumes at the median crossover
- Minimal differences were found between the travel times for commercial and passenger vehicles at MUTIT sites with signalized median crossovers. At unsignalized median crossovers, commercial vehicles were forced to wait for larger gaps in the conflicting traffic stream to complete their U-turn maneuvers.
- Several crashes involved commercial vehicles parked or backing within the median crossovers. Inadequate storage in the left lane preceding the median crossover due to the parked commercial vehicles caused spillback into through lanes. Commercial vehicles parked in the loon presented challenges for larger commercial vehicles executing U turns.

- A majority of the crashes at the loons were fixed-object crashes or sideswipe crashes. The objects most commonly hit were delineator posts, signposts (in the median and along the mainline), and spot locations of guardrail. A majority of the sideswipe crashes involved vehicles merging into traffic from the loon, or mainline traffic attempting to use the right turn lane.
- The study recommended a minimum 1.82-m (6-ft) auxiliary shoulder, with a 0.91-m (3-ft) paved area to provide the additional width necessary to ensure that the required pavement width will not be destroyed by U-turning vehicles that require the entire width of the loon. The study also recommended placement of short curves at both ends of the tapered section of the loon to assist the driver through the loon and U-turn maneuver.

Overall, loons are good design practice for facilities with narrow medians. With the use of loons, agencies can realize safety and operational benefits of a divided roadway (boulevard) with MUTITs, without incurring the significant cost of acquiring enough land along the entire corridor to provide sufficient median width.

Alternative Intersection Design

Michigan corridors with MUTIT typically have medians widths ranging from 18.3 to 30.5 m (60 to 100 ft). A wide median on the major road at the intersection of the major road and the cross street increases the pedestrian crossing distance along the sidestreet. Larger clearance intervals are required for the sidestreet signal phase with an increased possibility of vehicles and pedestrians getting "stranded" in the median space. Therefore, narrower medians with sufficient pedestrian refuge areas may be more efficient for the pedestrians and sidestreet traffic at the intersection of the major road and cross street. Figure 9 shows a possible reduction in median width at the intersection for a roadway with a median width of 18.3 m (60 ft) and a posted speed limit of 80.5 mi/h (50 mi/h). The reduction in median width was achieved by using reverse curves of sufficiently large radii on normal crowned sections of the roadway.

Capacity of Nonsignalized U-Turn Lanes

The Highway Capacity Manual 2000 (HCM) treats U turns as left turns for estimating saturation flow rate. However, the operational effects of U turns and left turns are different. U-turning vehicles have slower turning speeds than left-turning vehicles. Al-Masaeid (8) studied the capacity of U turns at unsignalized intersections as a function of the conflicting traffic flow on two opposing through lanes for median-divided roadways in Jordan . Figure 10 shows the field data collection results. He developed regression equations to predict the U-turn capacity based on the conflicting flows on two opposing through lanes.

$C = 799 - 0.31 * q_c$

$C = 1{,}545 - 790 * \text{exponential}\ (q_c/3{,}600)$

$C = 799 - 0.62 * q_{cp}$

Where:

C = capacity of U-turn movement in passenger car equivalent units per hour (PCU/hr).

q_c = conflicting traffic flow on two lanes (PCU/hr).

q_{cp} = conflicting traffic flow per lane (PCU/hr).

Yang et al. (9) studied the gap acceptance of U-turn maneuvers at median opening for 10 sites in Tampa, FL, and concluded that the critical gap ranged from 5.6 seconds to 7.4 seconds. Carter et al. (10) collected data at 14 signalized intersections with U turns in North Carolina. Based on a large database, they recommend a saturation flow adjustment factor of 0.82 for U-turn lanes at signalized intersections without conflicting right-turn overlap phase on the side street. Tsao and Ando (11) and Liu et al. (12) suggested saturation flow rate reduction factors of 0.8 and 0.76 for U-turn lanes at signalized intersections, respectively.

Provision of a Signal Phase to Serve U turns

The HCM suggests implementing a protected left-turn phase when the cross product of the hourly left-turning volumes and the corresponding hourly opposing through volumes exceeds the threshold value based on the number of opposing through lanes. Cross product thresholds of 50,000, 90,000, and 110,000 are applicable for one, two, and three lanes of opposing through traffic, respectively. The Traffic Control Devices (TCD) Handbook suggests the following criteria for where and when a left-turn phase should be provided:

1. Volume

a. Number for left turns multiplied by the opposing conflicting volumes in the peak hour exceeds 100,000 on a four-lane street or exceeds 50,000 on a two-lane street.
b. Left-turn peak-hour volume of more than 90 vehicles per hour, or 50 vehicles per hour on streets with through traffic at speeds over 72 km/h (45 mi/h).
c. At pretimed signal-controlled intersections, more than two vehicles per cycle per approach at the end of green during peak

hour.

2. Delay

Left-turn delay of more than 2.0 vehicle hours in the peak hour on a critical approach, provided there are at least two left turns per cycle during peak hour and the average delay per left-turning vehicle exceeds 35 seconds.

3. Crashes—number of left-turn crashes

a. One approach—4 crashes in 1 year or 6 crashes in 2 years.
b. Both approaches—6 crashes in 1 year or 10 crashes in 2 years.

The criteria above apply when determining whether a separate left-turn phase is needed at a signal-controlled intersection. The criteria can be applied equally, or in a more conservative way, applied to determine when signal control is needed at median crossovers to accommodate U turns. Signalized median crossovers can provide higher U-turn capacities compared to unsignalized median crossovers when the green time for the signalized median U-turn phase is adequate to satisfy the traffic demand. In addition, it is relatively easy to coordinate the signal at a median crossover with the signal at the main intersection without adding much extra delay to the high-volume mainline traffic.

Figure 7. Schematic of a loon implementation for a Michigan MUTIT.

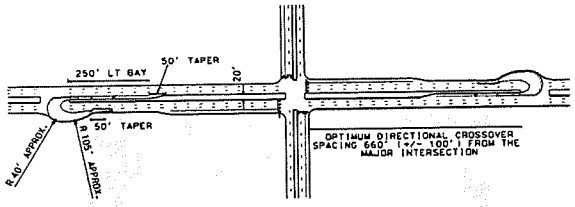
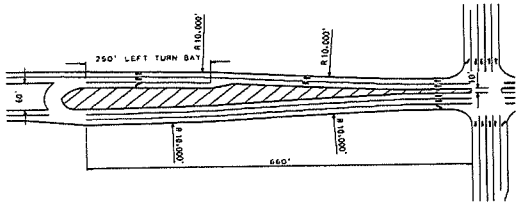


Figure 8. Example of loon implementation for a Michigan MUTIT.

Figure 9. Example of a transition from a wide median section to a narrow median section on MUTIT corridors.



Signal Phasing

The signal control at the intersection of the major road and minor crossroad operates with two signal phases because all left turns are prohibited at this junction. Figures 11a and 11b show the typical signal phasing diagram for the 2-phase signal. In some cases, the green signal indication at the median crossover junction for phase 2 can be delayed slightly relative to the green signal indication for the through/right-turning vehicles on the crossroad. This facilitates uninterrupted movement for the left-turning vehicles from the crossroad. If the median crossover is unsignalized, the signal phasing would only apply at the major road/minor road junction. Typical signal cycle lengths for the MUTIT range from 60 to 120 seconds. If the left-turn volumes are heavy, shorter cycle lengths will reduce spillback into the intersection. The pedestrians move in the direction of traffic with signalized pedestrian phases. Signalized

pedestrian phases across the major road with wide medians might reduce the operational efficiency of the MUTIT when cross-street traffic is minimal but pedestrian presence is significant during the peak hour periods.

Signing Plan

Figure 12 shows the typical signing plan for MUTIT in Michigan. Figures 13a to 13e show several examples of "innovative" signing treatments for MUTITs executed in Michigan. Sisoupiku and Aylsworth-Bonzelet (7) observed several motorists violating the turn prohibition and executing direct left-turns from the crossroad at rural sites. At intersections where violations were observed, there existed standard indirect left-turn signs and overhead signing prohibiting left-turns. Positive guidance communicated through additional signs may be beneficial in reducing driver confusion and ensuring higher rates of driver compliance.

Figure 10. Scatter plot of U-turn capacity versus conflicting traffic flow for unsignalized median openings.
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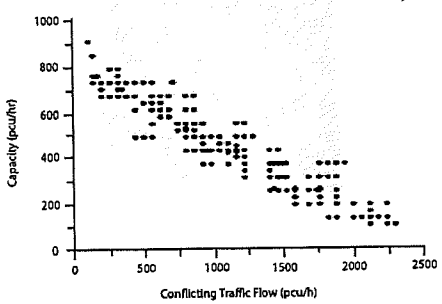


Traffic Operational Performance

Reid and Hummer (13) compared traffic operations along a typical arterial highway with MUTITs versus conventional designs with two-way left-turn lanes (TWLTL). The analysis corridor was a 4.02-km (2.5-mi) section of the Northwestern Highway Corridor in Detroit, MI. The section consisted of five major signalized intersections with varied spacing from 0.5 to 1.1 km (1,600 to 3,500 ft) and annual average daily traffic (AADT) ranging from 52,000 to 60,000 vehicles per day. Researchers used CORSIM to simulate traffic performance and used SYNCHRO to develop optimized signal timings. Four time periods were considered in the analysis, including peak periods in the morning, noon, midday (2:00 p.m. to 3:00 p.m.), and evening. Average measures of effectiveness (MOEs) were developed for a total of 48 CORSIM runs. The MUTIT showed a 17 percent decrease in total travel time within the study area network compared to TWLTL.

Figure 11. Example of typical signal phasing for the MUTIT.

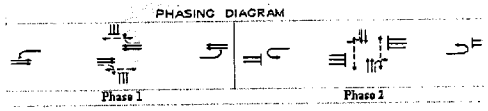


Figure 12. Example of typical signing plan for the MUTIT in Michigan.

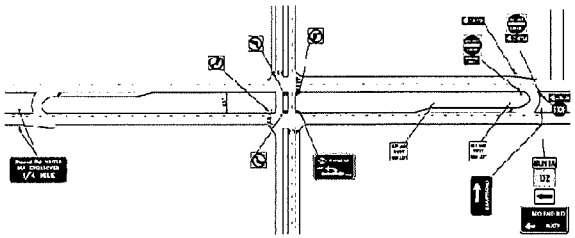


FIGURE 13. EXAMPLES OF "INNOVATIVE" SIGNING PLANS FOR THE MUTIT IN MICHIGAN.

Figure 13a. Example 1 of innovative signing. (Credit: Lee Rodegerdts)

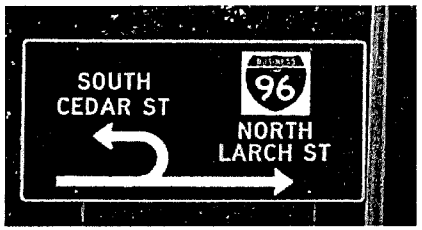


Figure 13b. Example 2 of innovative signing.
(Credit: Chris J. Bessert, www.michiganhighways.org)

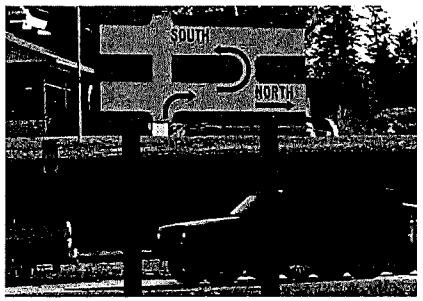


Figure 13c. Example 3 of innovative signing.
(Credit: Warren Hughes)

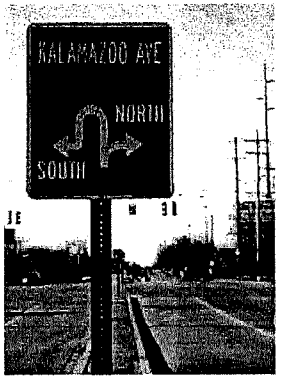
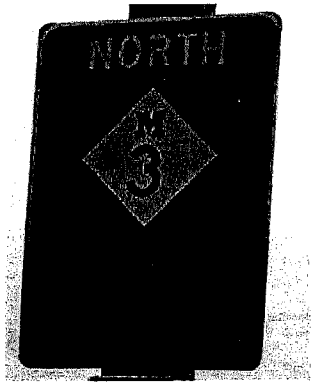


Figure 13d. Example 4 of innovative signing.
(Credit: Shawn Glynn)

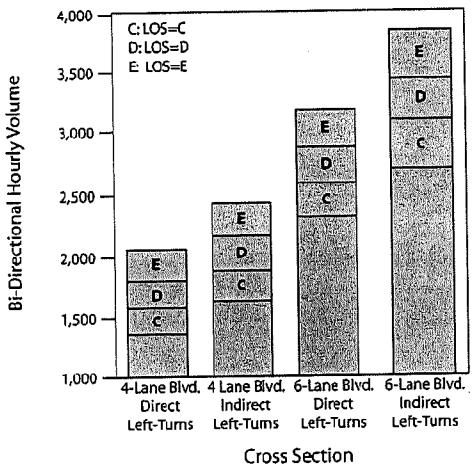


Average speeds increased by 25 percent for MUTIT compared to the TWLTL. The average number of stops increased for the MUTIT compared to the TWLTL. The analysis indicated that the MUTIT had the potential to significantly improve system travel times and speeds in the corridor during the busiest hours of the day to not compromise system travel times during off-peak periods. Reid and Hummer (14) later used CORSIM to compare the traffic performance of seven unconventional arterial intersection designs, including the quadrant, median U-turn, superstreet, bowtie, jughandle, split intersection, and continuous flow intersections. The study used turning movement volumes from existing isolated intersections in Virginia and North Carolina. Off-peak, peak, and volumes corresponding to 15 percent higher than the peak volumes were examined. A total of 36 to 42 CORSIM simulation runs of 30-minute durations were analyzed for each intersection. For MUTITs, the CORSIM models used unsignalized U-turn crossovers for two-lane collector roads and signalized U-turn crossovers for four-lane collector roads. Entering volumes for the simulated intersections ranged from 4,500 vehicles per hour (vph) to 7,500 vph.

The MUTIT produced significantly lower average total travel times in comparison to the conventional intersection. The change in overall travel times for all movements through the intersection, when compared to a conventional intersection, was −21 to +6 percent during peak conditions. The overall change in the number of stops when compared to a conventional intersection was −2 to +30 percent during peak conditions.

Maki (15) compared the MUTIT and the conventional TWLTL on 4-lane and 6-lane boulevards and found a 20 to 50 percent increase in capacity (throughput) for the MUTIT. Figure 14 shows the level of service (LOS) comparison between corridors with MUTITs and conventional intersections.

Figure 14. LOS comparison of divided highways.
(Source: Robert Maki, City of Surprise, AZ)



Bared and Kaiser (16) studied the traffic operational benefits of signalized median U turns on a typical 4-lane road intersecting a 4-lane road using CORSIM. The cross-street left turn movement was allowed at the major road/cross street intersection resulting in a three-phase signal. An acceleration lane was provided for the right-turning vehicles from the major road to the cross street. These two features used in the study are different from the typical MUTIT implementations in Michigan. Entering volumes at the intersections used in the simulations ranged from 2,000 vph to 7,000 vph. The key findings of the study were:

- Considerable savings of travel time were observed for the U-turn design at higher entering flows (greater than 6,000 vph) compared to conventional intersections with 10 percent and 20 percent left-turning volumes.
- On average, the proportion of vehicles stopping on the network was lower for the U-turn design. For 10 percent left-turning volumes, differences ranged from 20 percent to 40 percent. For 20 percent left turns, a noticeable reduction in percent stops started at about 4,500 vph.
- Providing an acceleration lane on the crossroad was recommended to improve traffic operational efficiency.
- Longer offsets for the U-turn crossovers resulted in increased travel time but benefited the network at higher traffic volumes by providing adequate storage for the U-turning vehicles and preventing spillback into the intersection.

Dorothy et al. (17) evaluated traffic operational measures to study the differences in the performance of MUTITs compared to the conventional TWLTLs. The TRAF-NETSIM model was used to simulate these situations for 1-hour periods. The simulated network had signals every 0.8 km (0.5 mi) with the directional crossovers every 0.4 km (0.25 mi). A 60/40 split between the entering volumes on major road and cross street was assumed. When turning percentages were low, the crossovers were modeled as STOP-controlled; with higher volumes, signal control was assumed in the model. The signal cycle was 80 seconds with a 60/40 distribution of green time for the major road phase and cross-street phase, respectively. The median width varied from 12.2 to 30.5 m (40 to 100 ft). The key findings were:

- When the left-turning traffic percentage was 10 percent, MUTITs with signalized directional crossovers had lower left-turn total travel times than conventional intersections. The differences were 20 seconds/vehicle, 40 seconds/vehicle and 150 seconds/vehicle at 30 percent, 50 percent and 70 percent mainline saturation, respectively. Similarly, MUTITs with signalized directional crossovers had lower left-turn total travel times than conventional intersections when the left-turning traffic percentage was 25 percent. The differences were 20, 30, and 70 seconds/vehicle at 30 percent, 70 percent, and 90 percent mainline saturation, respectively.
- The MUTITs provided consistently lower network travel times compared to the five-lane TWLTL design.
- For low left-turning percentages, the directional median crossovers with stop control had approximately the same left turn total

time and network total time, as compared to directional medians with signalized crossovers.

Topp and Hummer (18) compared median crossovers on the cross street with median crossovers on the arterial highway for MUTITs using CORSIM. The left-turning volumes on the major road varied from 100 vph to 400 vph, the through volumes on the major road varied from 1,000 vph to 2,000 vph, the left turns on the cross street varied from 50 vph to 200 vph, and the through volumes on the cross street varied from 500 vph to 1,000 vph. The median crossovers were signalized wherever warranted. Results showed that the MUTIT design with the U-turn movement located along the cross street reduced percent stops, total travel time, and delay for most of the volume combinations analyzed in comparison to the crossover on the arterial.

Savage (19) studied the conversion of five-lane roadway with a TWLTL to a MUTIT in Michigan and found a 20 to 50 percent increase in the corridor capacity. Koepke et al. (20) found that the directional crossover design provides about 14 to 18 percent more capacity than the conventional dual left-turn lane designs. The results of critical lane volume analyses, after taking into account overlapping traffic movements, revealed reductions of about 7 to 17 percent in critical lane volumes, depending upon the number of arterial lanes (six or eight) and the traffic mix. Lower critical lane volumes translate into higher traffic flow capacity at the intersection. A study by Stover (21) computed critical lane volumes for the intersection of two six-lane, arterial roads. The effects of redirecting left turns were computed using these volumes. The provision of dual left-turn lanes on all approaches reduces critical lane volumes by 12 percent compared to providing single left-turn lanes but still requires multiphase traffic signal controls. The rerouting of left turns via directional crossovers and their prohibition at the main intersection reduces critical lane volumes by 17 percent.

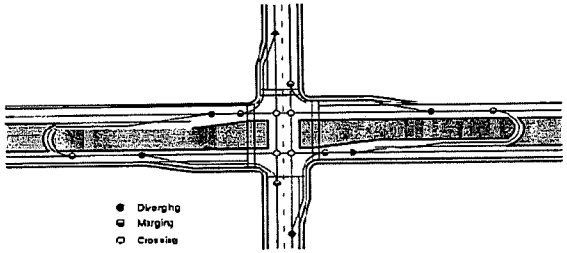
Overall, the literature shows that reducing signal phases and redirecting the left-turning movement at the intersection for the MUTIT provided significant benefits in terms of increased roadway capacity and reductions in travel time and vehicular delay when compared to conventional intersections.

Traffic Safety Performance

Table 2 from the FHWA Signalized Intersections: Informational Guide (22) shows the number of conflict points at a four-leg signalized intersection as compared to the MUTIT. The MUTIT eliminates all crossing (left turn) conflict points and reduces the number of merge/diverge conflict points as compared to a four-leg signalized intersection. Figure 15 shows the conflict point diagram for a MUTIT.

Observations indicated a 60 percent reduction in total crash frequencies and 75 percent reduction in total injuries. Reductions of 17 percent, 96 percent, and 61 percent were observed for rear-end crashes, angle crashes, and side-swipe crashes, respectively.

Figure 15. Conflict point diagram for the MUTIT.



Kach (23) compared the safety performance of conventional signalized intersections to MUTIT locations in the State of Michigan. The final comparison study subset consisted of 15 MUTIT locations and 30 conventional intersections.

Table 2. Number of conflict points at a four-leg signalized intersection compared to the MUTIT.

Conflict Type	Four-Leg Signalized Intersection	MUTIT
Merging/diverging	16	12
Crossing (left turn)	12	0
Crossing (angle)	4	4
Total	32	16

Maki (15) evaluated the safety benefits of replacing existing conventional signalized intersections with the MUTITs on Grand River

Avenue in Wayne County, MI. The 0.7-km (0.43-mi) study segment on Grand River Avenue was from the east of Poinciana to west of Delaware Street. The analysis period for the before-after study was 1990 to 1995.

The crossroads in all cases were undivided with crossroads intersecting at either 90 degrees or on a skew. Crash data for the years 1986-1990 were obtained for each site. Table 3 shows the safety performance of the MUTITs in comparison to conventional intersections. "Alpha" in Table 3 denotes the confidence level that the two rates are statistically different. Table 4 shows the estimated reduction in the expected number of crashes by crash type for all crashes, injury crashes, and property damage only (PDO) crashes for a road with 60,000 AADT.

Castronovo et al. (24) analyzed the MUTIT safety benefits versus conventional intersections as a function of traffic signal density using data from 123 segments of boulevards totaling 363.7 km (226 mi). The results indicated that as traffic signal density increased, the MUTIT had increasingly lower crash rates (measured in crashes per 161 million vehicle kilometers (100 million vehicle miles). For typical suburban conditions, with signal densities of one or more signals per 1.61 km (1 mi), the crash rate for MUTITs was about one half of the rate for conventional intersections. For typical rural conditions, with signal densities of one or less signal per 1.61 km (1 mi), the reduction in crashes for MUTITs was 36 percent when compared to conventional intersections.

In NCHRP Report 524 (25), researchers studied the safety performance of unsignalized median openings. The research results indicated that access management strategies that increase U-turn volumes at unsignalized median openings can be used safely and effectively. Analyses of collision data found that collisions related to U-turn and left-turn maneuvers at unsignalized median openings occur infrequently. In urban arterial corridors, unsignalized median openings had an average of 0.41 U-turn-plus-left-turn accidents per median opening per year. In rural arterial corridors, unsignalized median openings experienced an average of 0.20 U-turn-plus-left-turn accidents per median opening per year. On the basis of these limited collision frequencies, the authors concluded that there is no indication that U turns at unsignalized median openings are a general safety concern.

CONCLUSIONS

Based on the literature review conducted, the following summarizes the major conclusions:

- Michigan and other States have successfully used the MUTIT for over four decades without major problems related to traffic operational failures or safety hazards.
- Positive guidance communicated through additional signs and pavement markings at MUTIT sites may be beneficial in reducing driver confusion and enhancing traffic safety.
- With respect to driver expectancy, the MUTIT should not be mixed with other indirect and direct left-turn strategies on corridor level implementations.
- Though the MUTIT is typically a corridor treatment, the concept has been used successfully for isolated intersections to improve traffic operations and safety.
- Loons can be installed to accommodate larger U-turning vehicles, so the MUTIT can be a feasible treatment for corridors with narrow medians.
- Directional median crossovers provide better operational and safety benefits compared to bidirectional median crossovers.
- Reducing signal phases at the intersection provides increased capacity for the MUTIT in comparison to the conventional intersections. The capacity increases are typically in the range of 20 percent to 50 percent.
- The total network travel time savings can and usually does outweigh the additional travel time required for left-turning vehicles from the major road and cross street for corridors with the MUTIT compared to conventional intersections.
- The safety performance of MUTIT is better than conventional intersections because they have fewer vehicle-vehicle conflict points. Typical total crash reductions range from 20 percent to 50 percent.
- Head-on and angle crashes that have high probabilities of injury are significantly reduced for the MUTIT compared to conventional intersections.

Table 3. Safety comparison of MUTITs and conventional intersections.

Dataset	Rate Type	Group	Mean Crash Rates (Crashes/MVE)	Standard Deviation	Alpha
Corridor	All	MUTIT *(Reduction)*	1.554 *(14%)*	0.784	73
		Conventional	1.806	0.679	
Intersection Related	All	MUTIT *(Reduction)*	1.388 *(16%)*	0.593	80
		Conventional	1.644	0.643	
	PDO	MUTIT *(Reduction)*	0.982 *(9%)*	0.392	49
		Conventional	1.077	0.467	
	Injury	MUTIT *(Reduction)*	0.407 *(30%)*	0.266	97
		Conventional	0.58	0.252	

Table 4. Expected crashes for MUTITs and conventional intersections for a 5-year period [WH12].

Crash Type	Injury Crashes				PDO Crashes				All Crashes			
	Conventional		MUTTIT		Conventional		MUTTIT		Conventional		MUTTIT	
	%	Expected Crashes	%	Expected Crashes	%	Expected Crashes	%	Expected Crashes	%	Expected Crashes	%	Expected Crashes
Overturn	1.53	0.97	0.92	0.41	0.64	0.75	0.27	0.29	0.95	1.71	1.03	1.57
Fixed Object	3.56	2.26	4.25	1.89	4.77	5.62	6.97	7.5	4.36	7.85	6.13	9.38
Head-on	0.80	0.51	0.27	0.12	0.43	0.51	0.33	0.35	0.56	1.01	0.35	0.53
Angle St	36.87	23.4	19.77	8.8	18.35	21.63	9.06	9.75	24.73	44.53	12.12	18.54
Rear End	37.99	24.11	65.93	29.35	51.67	60.9	69.85	75.14	46.94	84.51	68.29	104.44
Angle Turn	3.56	2.26	4.76	2.12	6.71	7.91	7.74	8.33	5.62	10.12	6.84	10.46
Rear End Lt	1.53	0.97	0.81	0.36	4.18	4.93	0.93	1	3.27	5.89	0.88	1.35
Rear End Rt	0.20	0.13	0.65	0.29	1.45	1.71	1.43	1.54	1.02	1.84	1.19	1.82
Sdswipe Opp	0.20	0.13	0.13	0.06	0.27	0.32	0.22	0.24	0.25	0.45	0.20	0.3
Head-on Lt	13.75	8.73	2.52	1.12	10.89	12.84	2.75	2.96	11.87	21.37	2.66	4.07
Sdswpipe same	0.00	0	0.00	0	0.64	0.75	0.44	0.47	0.42	0.76	0.31	0.47
Σ	100.00	63.47	100.00	44.52	100.00	117.87	100.00	107.57	100.00	180.04	100.00	152.93

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Key Words—Traffic operation; safety; median U-turn; traffic modeling

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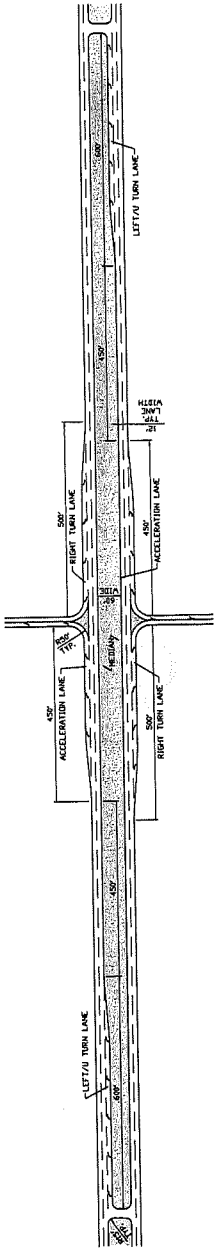

Travel Run Summary for Honoapiilani Highway

From	To	Distance Miles	A.M. Peak Hour		P.M. Peak Hour		Comments
			Eastbound	Westbound	Eastbound	Westbound	
Bridge	Transfer Station	0.3	49.9	41.3	44.5	42.9	Bridge or culvert at dry stream at approximately mile marker 16.5
Transfer Station	Access west of Mgrs. House	0.8	48.8	44.8	45.1	41.7	Unmarked access about 0.4 miles from general store
Access west of Mgrs. House	General Store/Mgrs. House	0.4	40.4	36.5	36.7	34.7	
General Store/Mgrs. House	Luawai St.	0.5	43.9	46.4	45.5	44.9	
Luawai St.	Mile Marker 14	0.6	47.7	51.9	49.9	50.3	
Mile Marker 14	New Access Intersection 1	0.8	50.5	50.6	51.0	53.7	Newly constructed intersection, no street name shown
New Access Intersection 1	New Access Intersection 2	0.7	50.6	53.0	50.9	58.3	End at about mile marker 12.5. Newly constructed intersection, no name
Eastbound is to Maalea							
Westbound is towards Lahaina							

Travel runs made 10/27 - 10/28

TABLE 2

Generalized **Annual Average Daily** Volumes for Florida's **Areas Transitioning into Urbanized Areas** OR **Areas Over 5,000 Not In Urbanized Areas**[1]

10/4/10

STATE SIGNALIZED ARTERIALS

Class I (>0.00 to 1.99 signalized intersections per mile)

Lanes	Median	B	C	D	E
2	Undivided	8,900	14,100	15,200	***
4	Divided	26,900	32,100	33,800	***
6	Divided	41,500	48,600	51,000	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Median	B	C	D	E
2	Undivided	**	9,400	13,700	14,700
4	Divided	**	22,700	30,000	31,700
6	Divided	**	35,700	45,400	47,800

Class III (more than 4.5 signalized intersections per mile)

Lanes	Median	B	C	D	E
2	Undivided	**	4,700	10,700	13,400
4	Divided	**	11,500	25,500	28,900
6	Divided	**	18,000	39,800	43,900

Non-State Signalized Roadway Adjustments

(Alter corresponding state volumes by the indicated percent.)

Major City/County Roadways - 10%
Other Signalized Roadways - 35%

State & Non-State Signalized Roadway Adjustments

(Alter corresponding volume by the indicated percent.)

Divided/Undivided & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

One-Way Facility Adjustment

Multiply the corresponding two-directional volumes in this table by 0.6.

FREEWAYS

Lanes	B	C	D	E
4	42,600	57,600	68,700	73,600
6	63,900	86,600	103,300	113,700
8	85,200	115,600	137,600	153,700
10	106,400	145,600	172,400	192,800

Freeway Adjustments

Auxiliary Lanes	Ramp Metering
+ 20,000	+5%

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Median	B	C	D	E
2	Undivided	8,000	15,100	21,100	26,800
4	Divided	31,400	45,400	58,800	66,600
6	Divided	47,200	68,100	88,200	100,000

Uninterrupted Flow Highway Adjustments

Lanes	Median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	+5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

26,800 X 1.05 = 28,140

BICYCLE MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.

Paved Shoulder/ Bicycle Lane Coverage	B	C	D	E
0-49%	**	2,800	7,300	>7,300
50-84%	2,200	3,400	13,100	>13,100
85-100%	4,100	>4,100	***	***

PEDESTRIAN MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	B	C	D	E
0-49%	**	**	5,000	14,400
50-84%	**	**	11,300	18,800
85-100%	**	11,400	18,800	>18,800

[1] Values shown are presented as two-way annual average daily volumes for levels of service and are for the automobile/truck modes unless specifically stated. Although presented as daily volumes, they actually represent peak hour direction conditions with applicable K and D factors applied. This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, Pedestrian LOS Model and Transit Capacity and Quality of Service Manual, respectively for the automobile/truck, bicycle, pedestrian and bus modes.

[2] Level of service for the bicycle and pedestrian modes in this table is based on number of motorized vehicles, not number of bicyclists or pedestrians using the facility.

** Cannot be achieved using table input value defaults.

*** Not applicable for that level of service letter grade. For the automobile mode, volumes greater than level of service D become F because intersection capacities have been reached. For the bicycle mode, the level of service letter grade (including F) is not achievable because there is no maximum vehicle volume threshold using table input value defaults.

Source:
Florida Department of Transportation
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450

END

APPENDIX P-1.

Traffic Impact Analysis Report

Olowalu Town
Traffic Impact Analysis Report

Prepared for:

Olowalu Town, LLC

Prepared by:

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Consulting Transportation Engineer

231 Tollison Road
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April 14, 2015

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Introduction, Purpose and Methodology

The Olowalu Town Master Plan is proposing to re-establish the once thriving village of Olowalu, located on the west side of the island of Maui. The subject property encompasses the lower coastal reaches of Olowalu ahupua`a; between the base of the south-west facing slopes of West Maui Mountains and the shoreline of Olowalu, as shown in Figure 1. Olowalu Town will be a small-scale and mixed-use community designed to be a pedestrian-friendly community which will allow residents to live within walking distance of corner stores, schools, parks, employment opportunities, community centers, beaches, and social and civic resources, ultimately reducing reliance on automobiles. The Master Plan is guided by values and principles of sustainability by balancing the needs of Maui's growing population; yet maintaining and respecting our cultural, historical and natural resources.

The new town will be designed to be self-sustaining in that commercial uses will in general be expected to operate to a very large degree based on the anticipated activities of the residents. At the same time, it is expected that the majority of the base of labor needed in the town can come from residents of the town.

A Preliminary Traffic Impact Analysis Report (TIAR) was prepared to support the Draft Environmental Impact Statement (EIS). This Final TIAR was prepared to support the Final EIS. The purpose of this Final TIAR in coordination with the State Department of Transportation (HDOT) is to provide a general assessment of the expected traffic impacts of the proposed project and a general framework for the anticipated traffic and transportation system mitigations that may be needed at full buildout of the project.

The preliminary TIAR reviewed the expected traffic impacts based on existing daily traffic volumes and future traffic volumes which are predicted to occur due to the Olowalu Town project. This final TIAR will concentrate on predicted daily traffic volumes and on more general traffic needs. It will utilize the same general process by providing an assessment of existing conditions, prediction of trip generation, distribution and assignment for the new town, and analysis of future-year traffic volumes and traffic flow conditions.

This report utilizes data from several other TIARs which have been done for other projects on the west side of Maui over the last five years. It also uses information from previous master transportation studies of the island conducted by HDOT in 1997 and 2002, as well as studies done by Maui County.

As noted above, the Final TIAR was prepared to address and incorporate comments received during review of the Draft EIS, including the HDOT. The Final TIAR will address peak hour traffic flows and utilize the methods that are normally employed in standard traffic assessments. This TIAR will also analyze in detail the predicted traffic operations at the access points to Honoapi`ilani Highway. It will assess the need for any mitigation and analyze the need for traffic control measures and devices that may be required for proper functioning of the street system. This final report will not cover all items that may be studied and analyzed due to specific future

refinement of project design when more site specific detailed TIARs will be prepared as the project progresses through the development process.

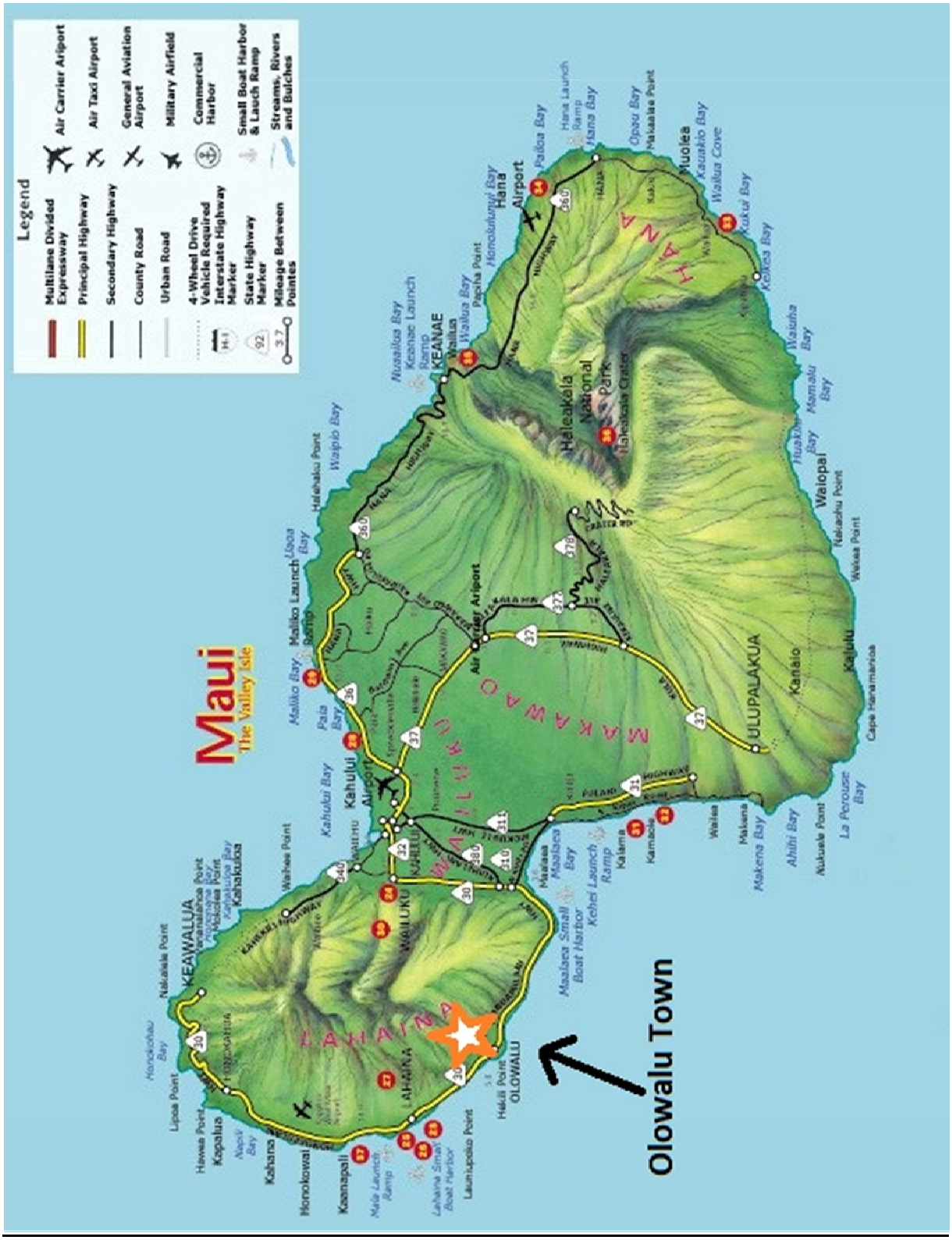
The methods of study employed in this report rely upon daily traffic volumes that exist or will be created by the activities of the proposed Olowalu Town. Analysis of capacity and traffic flow utilizes approaches that were developed by the Florida Department of Transportation, based on the Highway Capacity Manual and as reviewed and concurred with by the HDOT. These methods take into account the peaking that occurs in morning and afternoon hours but they also consider the overall traffic flow on a facility over a 24-hour period. The level of analysis in this final TIAR does not include detailed analysis of all traffic movements at individual intersections which will occur later when more site specific plans are developed.

This report is intended to illustrate that the increase in vehicular traffic along the Honoapi`ilani Highway attributed to Olowalu Town will be successfully mitigated by way of implementing the proposed transportation plan and the related improvements, including the relocation and widening of the segment of Honoapi`ilani Highway which traverses the subject property.

As indicated in Figure 1, the proposed Olowalu Town is located about half-way between the town of Lahaina and Mā`alaea along Honoapi`ilani Highway. It should be noted that the existing roadway would be retained and preserved as part of the interanal street system of the new town. Many of the land uses may be preserved as well so that traffic generated by them would essentially be part of the new town's total traffic.

Due to the complexity of being precise with estimates, it was decided not to attempt to estimate the number of trips that would be eliminated as compared to the total traffic that would be generated by the new town. As a result, the numbers in this report for trip generation would be considered an over estimate since there may be many trips made to existing land uses that will be absorbed by the new town. This may likely include the general store, the manager's house meeting facility, the camp and certain other existing land uses. All told, therefore, we believe we have an estimate of traffic generation that will be conservative on the high side and that actual traffic generation will be less than estimated in this report.

Figure 1 Location of Olowalu Town



Description of Olowalu Town

At final build-out, Olowalu Town will consists of approximately 1,500 residential dwelling units to be built concurrent with appropriate infrastructure in phases spread out over a period of approximately 10 years. There will be a wide variety of single-family and multi-family dwelling types, including houses, apartments, live-work units, cottages, rural homes and farmsteads, to be offered at a wide-range of income levels, including both rental and fee-ownership. A substantial portion of the homes are planned for much-needed affordable housing and senior living.

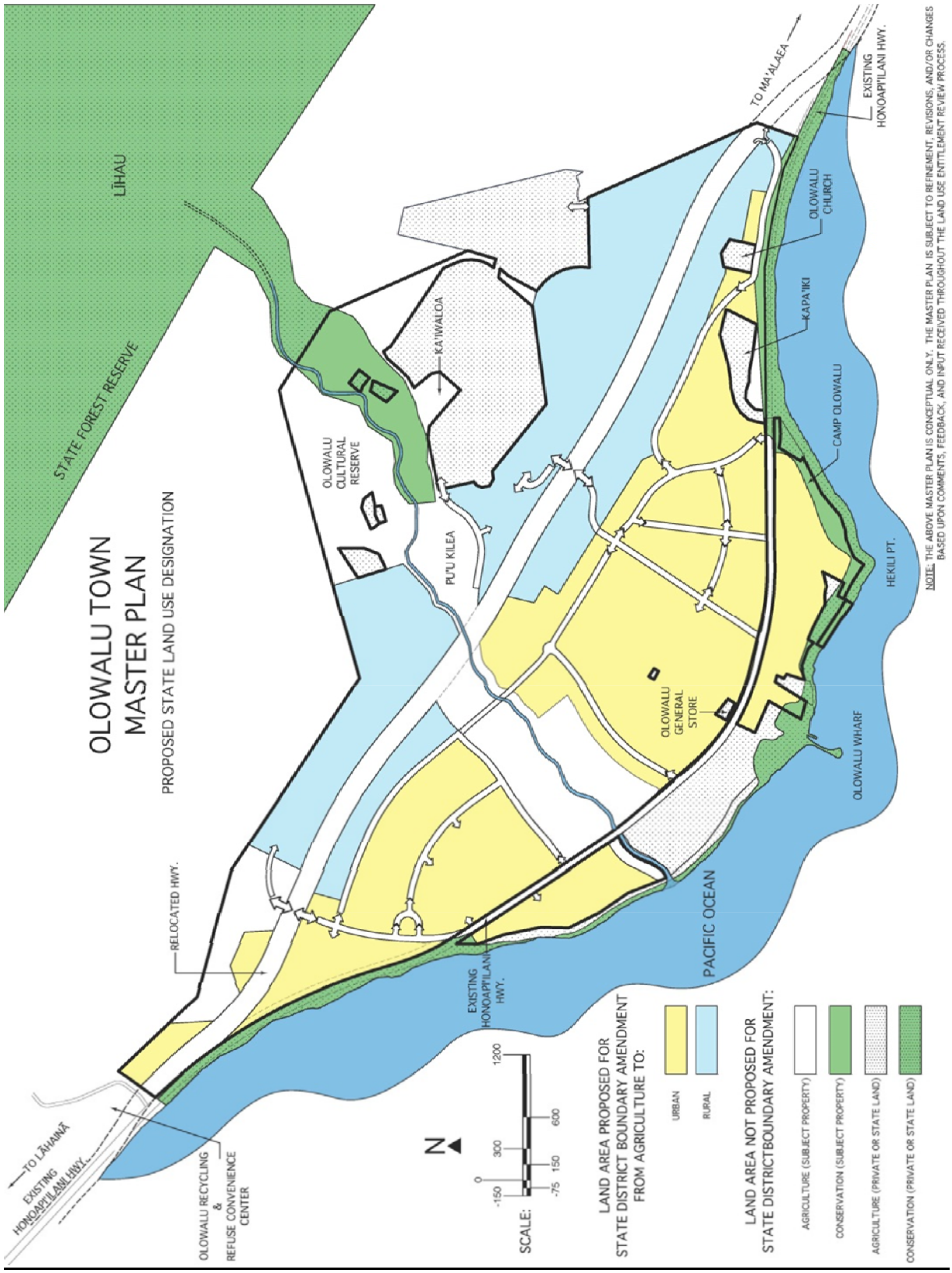
The design of Olowalu Town incorporates smart growth and sustainable land use principles of New Urbanism. As a result, Olowalu Town's spatial layout of land uses, varying density, connective transportation, parks/greenways, civic/social facilities, housing, employment and other land uses are balanced to create a mixed-use community. Neighborhood town centers provide economic sustainability with a range of business and employment opportunities. Olowalu Town is also designed to meet the certification requirements of *Leadership in Energy and Environmental Design for Neighborhood Development* (LEED ND). As such, the Master Plan will be built using strategies aimed at improving performance in regards to energy savings, water efficiency, reducing CO2 emissions, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

Olowalu Town's proposed infrastructure improvements will be constructed concurrently with the project and will incorporate innovative, efficient, and sustainable technology to minimize adverse impacts upon the natural environment. Olowalu Town's Transportation system includes the corridor for the relocation of the existing high speed/high volume Honoapi`ilani highway away from coastal resources to a new mauka alignment, which will be designed to accommodate mass transit or light rail, if needed in future.

The existing highway corridor with monkey-pod trees will be preserved and converted to low speed/low volume coastal roadway. The project includes an internal roadway network, as well as, an assortment of interconnected greenways and bikeways links throughout the community and supports overall well-being and health of residents; reducing dependency on automobiles.

Additionally, other infrastructure system improvements will require an expansion of both the existing potable and non-potable water system, the likely addition of a second ground water well to supplement the existing well; and an extensive drainage system to capture storm-water runoff. The project will also include the construction of an onsite decentralized wastewater treatment facility, which will include R-1 water storage tank, a constructed vertical flow wetland, and a soil aquifer treatment system. The wastewater treatment facility will produce clean recycled water for irrigation, and thereby eliminate the need for injection wells. The Olowalu Town consists of four general land use categories as defined by the State of Hawai`i Land Use Commission, as shown in Figure 2.

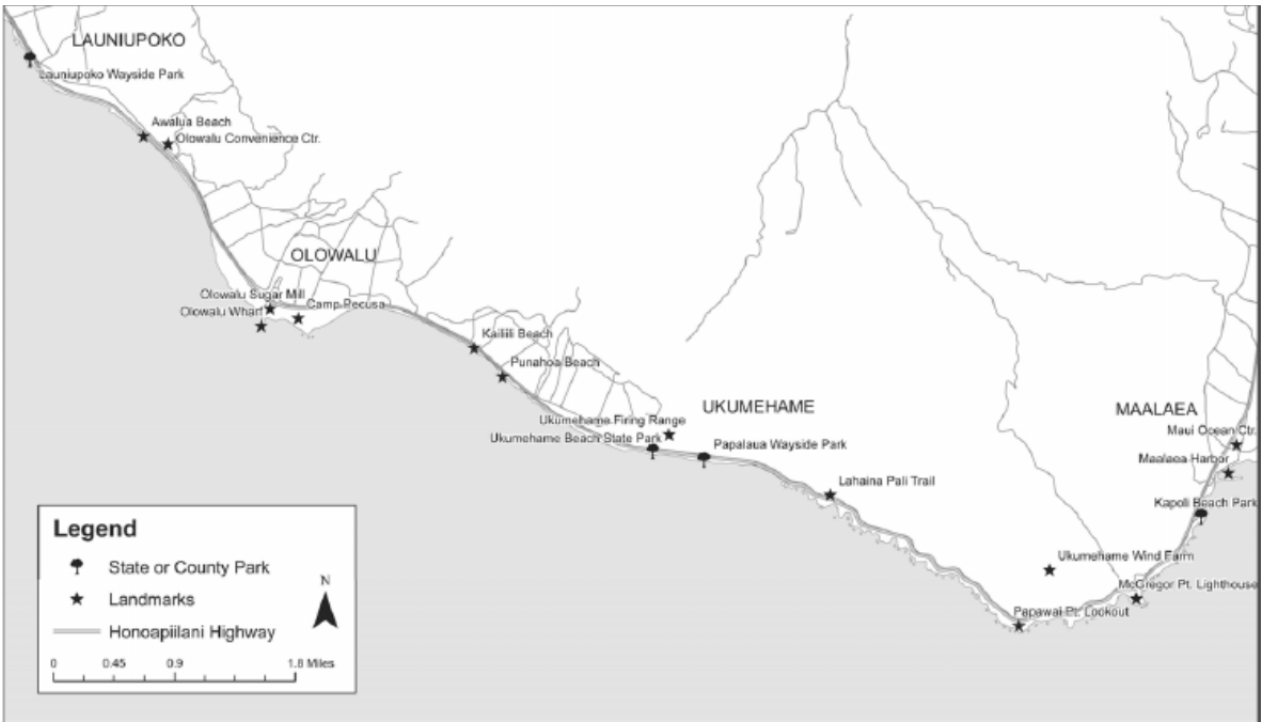
Figure 2 Land Use Categories for Olowalu Town



As shown in the above figure, there are conservation districts, shown in green, along the shore of the Pacific Ocean and in the areas upland to the mauka side of the proposed relocated Route 30. The green areas with the dots delineate the conservation areas which are not part of the subject properties.

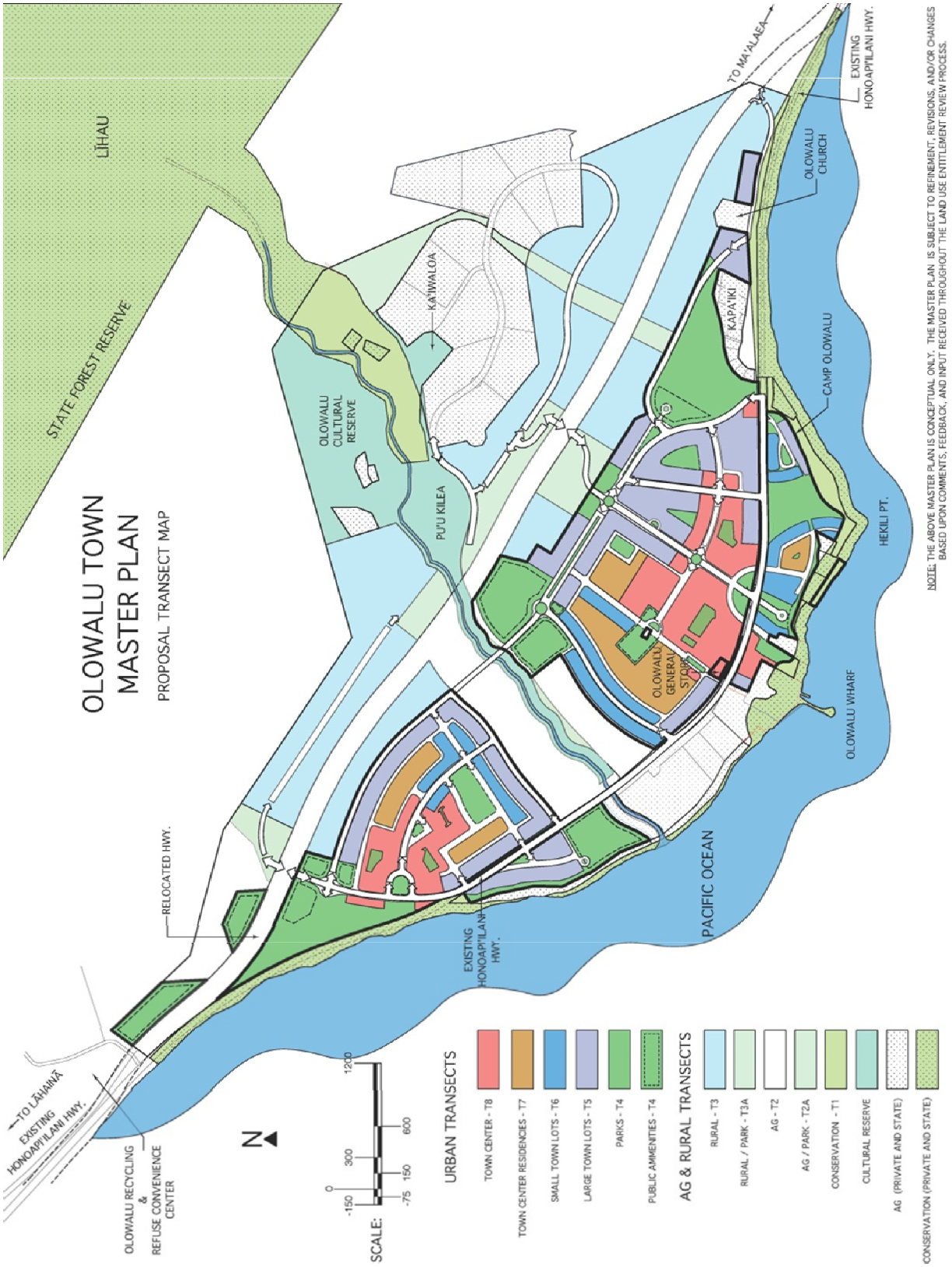
The site for the Olowalu Town includes both rural designations as shown in the blue color and urban areas as shown in the lighter beige color. Agricultural designations which are not proposed for reclassification are shown in white. Agricultural land areas which are not part of the subject properties are shown in the same colors but with dots.

Figure 3 shows the proposed land uses within the Olowalu Town. The sketch below shows major area landmarks.



Area landmarks

Figure 3 Proposed Land Uses in Olowalu Town



As shown in Figure 3 there are generally two neighborhood town centers on either side of Olowalu Stream, with smaller tracts of rural along both sides of the future corridor of the realigned Honoapi`ilani Highway. All the tracts on the mauka side of the future corridor of the realigned Honoapi`ilani Highway are either rural or agricultural lots ranging from ½ to 2 acres.

The urban areas, shown in yellow in Figure 2, will have commercial developments along with a variety of residential units including apartments, townhouses and single-family house. Areas in green along the Pacific Ocean in Figure 3 will contain recreational facilities and include beach access. The street patterns in the urban footprint areas will be modified grids following the principles of new urbanism.

A portion of the overall site will be located mauka of what will be the relocated and improved Honoapi`ilani Highway. There will be small numbers of trips made from the mauka direction of the new highway to and from the bulk of the new town towards the Pacific Ocean. An allowance for this travel pattern is made and will be discussed later in this report.

There will be a connection made between each side of the newly relocated highway that will provide access without entering the highway via a grade separation. This will allow most travel from one side of the highway to the other to be made unencumbered and will lessen impacts to the new roadway. This connection will be useable by motor vehicles as well as bicycles and pedestrians.

View looking north towards Lahaina on approach to Transfer Station access

Review of Existing Road and Traffic Conditions

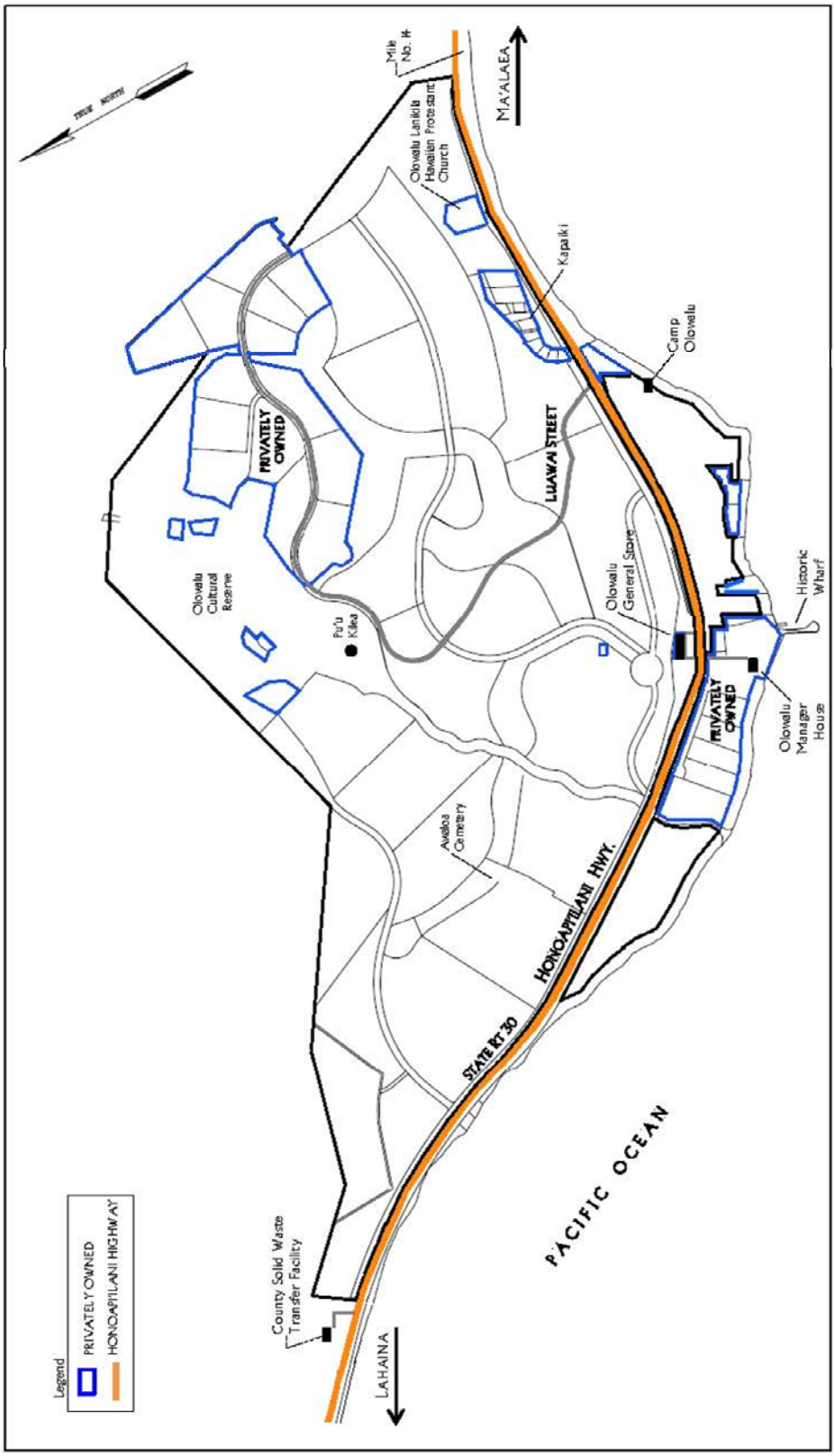
The site of the proposed Olowalu Town is situated on both sides of Honoapi`ilani Highway on the west side of the island of Maui. Honoapi`ilani Highway is the major surface transportation route for the west side of Maui and it provides a connection from the town of Lāhainā to Mā`alaea.

The highway is on the HDOT road system as Route 30. It is classified as a major arterial roadway and it has several different design cross-sections as it winds its way along the Pacific Ocean coastline and inland to Lahaina and Mā`alaea. Within the boundaries of Olowalu Town, the roadway is primarily a two-lane highway with turn lanes in place at intersections and access points.

The site for the proposed project is traversed by approximately 2.6 miles of the existing Honoapi`ilani Highway. Photographs of the roadway are included in the appendices. The following Figure 4 depicts existing conditions with area landmarks shown.

This highway is located in very close proximity to the Pacific Ocean and in some locations its centerline elevation is only a few feet above mean sea level. Due to the high volumes of traffic and its importance as the only connecting roadway on the west side of the island, there are potential issues related to the closeness to the water's edge, especially in time of storms. There are also issues with use of the shoulders and adjacent areas for parking and access to the beach and ocean that impact the overall ability of the roadway to carry the daily volumes required in an efficient manner. Within the appendices are included some parking accumulation data as well as traffic counts and speed surveys made in 2013.

Figure 4 Existing Conditions with Area Landmarks



Trip Generation Methodology

Trip generation for Olowalu Town was estimated using the methods of the Institute of Transportation Engineers (ITE) that are generally endorsed by HDOT and Maui County. The ITE methodology uses tables that relate units of land use to predicted trips into and out a site or development for peak hours of travel and for an entire day. Trips were predicted using the latest version of the ITE Trip Generation, Edition 9.

Table 1 shows the predicted total daily single use trips for the Olowalu Town. As indicated in Table 1, it is estimated that the Olowalu Town would generate approximately 28,764 trips per day at full buildout. This would include all trips within the town and to and from the Town via Honoapi`ilani Highway. Table 1 shows the predicted single-use trips that would be generated by the Olowalu Town at full buildout, taking into account the ITE trip generation rates. This table does not take into account internal community capture. The nature of the new town is that the commercial and retail developments that will occur will be integral to the town, with a large percentage of the ability of the commercial areas existence being a direct result of the residential components of the town. Therefore it is expected that none of the businesses will rely upon traffic from outside the town, but rather will rely upon customers and employees who will live within the new town. Further analysis of community capture including designation of internal and external trips will be made in a subsequent section. The detailed printouts a spreadsheet used for trip generation calculations are provided in the appendices.

Table 2 shows the predicted total a.m. peak hour trips for Olowalu Town. As indicated in Table 2, it is estimated that Olowalu Town will generate approximately 1,671 trips in the a.m. peak hour at full buildout. This would include all trips within the town and to and from the Town via Honoapi`ilani Highway. Further analysis of community capture including designation of internal and external trips will be made in a subsequent section. This table does not take into account internal community capture. The nature of the new town is that the commercial and retail developments that will occur will be integral to the town, with a large percentage of the ability of the commercial areas existence being a direct result of the residential components of the town. Therefore it is expected that none of the businesses will rely upon traffic from outside the town, but rather will rely upon customers and employees who will live within the new town. Further analysis of community capture including designation of internal and external trips will be made in a subsequent section. The detailed printouts a spreadsheet used for trip generation calculations are provided in the appendices.

Table 3 shows the predicted total p.m. peak hour trips for Olowalu Town. As indicated in Table 3, it is estimated that Olowalu Town will generate approximately 2,582 trips in the p.m. peak hour at full buildout. This would include all trips within the town and to and from the Town via Honoapi`ilani Highway. Further analysis of community capture including designation of internal and external trips will be made in a subsequent section. This table does not take into account internal community capture. The nature of the new town is that the commercial and retail developments that will occur will be integral to the town, with a large percentage of the ability of the commercial areas existence being a direct result of the residential components of the town. Therefore it is expected that none of the businesses will rely upon traffic from outside

the town, but rather will rely upon customers and employees who will live within the new town. Further analysis of community capture including designation of internal and external trips will be made in a subsequent section. The detailed printouts a spreadsheet used for trip generation calculations are provided in the appendices.

View looking southward on approach to intersection at Transfer Station

Table 1 Summary of Daily Trip Generation for Olowalu Town

ITE Code	Land Use	# Units	Unit	Unit Con-vert	Trip Rate Per Unit	Total Trips	Directional Distr.		Trip Generation	
							In	Out	In	Out
110	Gen. Light Industrial	26.0	KSF	1000	6.97	181	0.5	0.5	91	91
210	Single Family Homes	523	DU	1	9.52	4,979	0.5	0.5	2,489	2,489
220	Apartment	260	DU	1	6.65	1,729	0.5	0.5	865	865
220	Apartment	593	DU	1	6.65	3,943	0.5	0.5	1,972	1,972
230	Condo/ Townhouse	174	DU	1	5.81	1,011	0.5	0.5	505	505
310	Hotel	58	Room	1	8.17	474	0.5	0.5	237	237
417	Regional Park	77.0	Acre	1	4.57	352	0.5	0.5	176	176
520	Elem School	300	Students	1	1.29	388	0.5	0.5	194	194
590	Library	5.0	KSF	1000	56.24	281	0.5	0.5	141	141
710	General Office	60.0	KSF	1000	11.03	662	0.5	0.5	331	331
730	Govt Office Building	15.0	KSF	1000	68.93	1,034	0.5	0.5	517	517
732	US Post Office	5.0	KSF	1000	108.19	541	0.5	0.5	270	270
820	Shopping Center	114.0	KSF	1000	42.70	4,868	0.5	0.5	2,434	2,434
820	Shopping Center	125.0	KSF	1000	42.70	5,338	0.5	0.5	2,669	2,669
944	Gasoline/ Service Station	20	Fuel. Pos.	1000	168.56	3,371	0.5	0.5	1,686	1,686
Totals						29,152	0.5	0.5	14,576	14,576

Table 2 Summary of A.M. Peak Hour Trip Generation for Olowalu Town

ITE Code	Land Use	# Units	Unit	Unit Con-vert	Trip Rate Per Unit	Total Trips	Directional Distr.		Trip Generation	
							In	Out	In	Out
110	Gen. Light Industrial	26.0	KSF	1000	0.92	24	88%	12%	21	3
210	Single Family Homes	523	DU	1	0.75	392	25%	75%	98	294
220	Apartment	260	DU	1	0.51	133	20%	80%	27	106
220	Apartment	593	DU	1	0.51	302	20%	80%	60	242
230	Condo/ Townhouse	174	DU	1	0.44	77	17%	83%	13	64
310	Hotel	58	Room	1	0.53	31	59%	41%	18	13
417	Regional Park	77.0	Acre	1	0.15	12	57%	43%	7	5
520	Elem School	300	Students	1	0.45	136	80%	20%	74	61
590	Library	5.0	KSF	1000	1.04	5	71%	29%	4	2
710	General Office	60.0	KSF	1000	1.56	94	88%	12%	82	11
730	Govt Office Building	15.0	KSF	1000	5.88	88	84%	16%	74	14
732	US Post Office	5.0	KSF	1000	8.23	41	52%	48%	21	20
820	Shopping Center	114.0	KSF	1000	0.96	109	62%	38%	68	42
820	Shopping Center	125.0	KSF	1000	0.96	120	62%	38%	74	46
944	Gasoline/ Service Station	20	Fuel. Pos.	1000	12.16	243	51%	49%	124	119
Totals						1,806			692	979

Note: To account for trips made to the mauka direction of the anticipated relocated Honoapi`ilani Highway it was necessary to make some assumptions as to travel between the two sides of the town. Since the amount of development on the mauka side is small compared to the development on the makai side, it was decided to assign a small number of trips that would exit or enter from the mauka side. The amount used for the a.m. and p.m. peak hours was set at 20 vehicles for each movement or a total of 60 vehicles entering the mauka side and 60 vehicles leaving the mauka side, equally divided between the two directions on Honoapi`ilani Highway and the other side of the roadway. These vehicles were calculated as baseline adds to the future nobuild condition. In essence they represent a slight overestimation since the amounts were not deducted from the overall trip generation due to the difficulty in assigning small percentages to the large number of land uses. It is felt this method provides an overly conservative view of traffic impacts since actual numbers will likely be less than shown in the tables for the a.m. and p.m. peak hours. It was felt this level of precision was appropriate for this study but it can be addressed in greater detail with subsequent updates of the study as required by HDOT.

Table 3 Summary of P.M. Peak Hour Trip Generation for Olowalu Town

ITE Code	Land Use	# Units	Unit	Unit Con-vert	Trip Rate Per Unit	Total Trips	Directional Distr.		Trip Generation	
							In	Out	In	Out
110	Gen. Light Industrial	26.0	KSF	1000	6.97	25	12%	88%	3	22
210	Single Family Homes	523	DU	1	9.52	523	63%	37%	329	194
220	Apartment	260	DU	1	6.65	161	65%	35%	105	56
220	Apartment	593	DU	1	6.65	368	65%	35%	239	129
230	Condo/ Townhouse	174	DU	1	5.81	90	67%	33%	61	30
310	Hotel	58	Room	1	8.17	35	51%	49%	18	17
417	Regional Park	77.0	Acre	1	4.57	15	45%	55%	7	8
520	Elem school	300	Students	1	0.15	45	80%	20%	22	23
590	Library	5.0	KSF	1000	56.24	37	48%	52%	18	19
710	General Office	60.0	KSF	1000	11.03	89	17%	83%	15	74
730	Govt Office Building	15.0	KSF	1000	68.93	18	31%	69%	6	13
732	US Post Office	5.0	KSF	1000	108.19	56	51%	49%	29	27
820	Shopping Center	114.0	KSF	1000	42.70	423	48%	52%	203	220
820	Shopping Center	125.0	KSF	1000	42.70	464	48%	52%	223	241
944	Gasoline/ Service Station	20	Fuel. Pos.	1000	168.56	277	50%	50%	139	139
Totals						2,627			1,393	1,189

Note: To account for trips made to the mauka direction of the anticipated relocated Honoapi`ilani Highway it was necessary to make some assumptions as to travel between the two sides of the town. Since the amount of development on the mauka side is small compared to the development on the makai side, it was decided to assign a small number of trips that would exit or enter from the mauka side. The amount used for the a.m. and p.m. peak hours was set at 20 vehicles for each movement or a total of 60 vehicles entering the mauka side and 60 vehicles leaving the mauka side, equally divided between the two directions on Honoapi`ilani Highway and the other side of the roadway. These vehicles were calculated as baseline adds to the future nobuild condition. In essence they represent a slight overestimation since the amounts were not deducted from the overall trip generation due to the difficulty in assigning small percentages to the large number of land uses. It is felt this method provides an overly conservative view of traffic impacts since actual numbers will likely be less than shown in the tables for the a.m. and p.m. peak hours. It was felt this level of precision was appropriate for this study but it can be addressed in greater detail with subsequent updates of the study as required by HDOT.

Allocation of Trips Generated to Internal Community Capture

It is expected that the new town will support a large component of retail and commercial activity based on its own population. In addition, there will be large amounts of trips made to and from the proposed recreational areas and to and from the governmental offices and other land uses. The following Table 4 shows the proportional allocation of trips generated by the individual land uses in the town. This table was used to apportion the total trips generated so as to identify trips that would be made internal to the town without any travel on Honoapi`ilani Highway. The remaining trips would then be the trips that would enter or leave the town to and from Honoapi`ilani Highway.

A significant effort was made to develop a methodology for internal and community capture for this project. Extensive research was undertaken and a report was prepared by Mr. John Edwards, P.E. This report and other information are included in the appendices, numbers 6, 7 and 8.

Table 4 Internal Community Capture of Trips in Olowalu Town

ITE Code	Land Use	Proportion of Trips Internal to Olowalu Town	Proportion of Trips External to Olowalu Town
110	Gen. Light Industrial	30%	70%
210	Single Family Homes	45%	55%
220	Apartment	45%	55%
220	Apartment	45%	55%
230	Condo/ Townhouse	45%	55%
310	Hotel	10%	90%
417	Regional Park	50%	50%
520	Elem School		
590	Library	90%	10%
710	General Office	30%	70%
730	Govt Office Building	85%	15%
732	US Post Office	95%	5%
820	Shopping Center	75%	25%
820	Shopping Center	75%	25%
944	Gasoline/ Service Station	95%	5%

As seen in Table 4, the percentages of trips allocated to the individual land uses in the new town vary from 10% to 95%. For example, the proportion of trips shown as being internal to the town for the general light industrial land use is seen to be 30%. This means that we are assuming that 30% of the trips generated to and from the general light industrial land uses would be made to or from other land uses within the new town. The remaining 70% of the trips would then have to be made externally to or from the town onto or from Honoapi`ilani Highway. Other land uses have different percentages of internal or community capture trips. For example, it is expected that virtually all trips to and from the post office would be made internally, with only 5% being made to or from areas outside the new town. This means that

just 5% of the single use trips to and from the post office facility would be made to or from Honoapi`ilani Highway. It would seem logical that the vast majority of trips to the post office would be made by local residents and businesses. It would not seem reasonable that many trips would be made to or from the post office by residents not living within the town. Post offices are of course available in the nearest residential communities that are about 6 miles away in either direction on Honoapi`ilani Highway. The 85% value for internal or community capture for the government office building would reflect the fact that the government offices would provide services needed by residents of the town. This might include police or fire services or general government services. Again, it would not be expected that these services would be as likely to be needed by non-residents of the town but this would also allow for as many as 15% to be made by employees who may reside in other areas.

View looking south towards intersection at Ehehene Street

It was also assumed that trips that would be made to and from the new town on Honoapi`ilani Highway for the various single land uses in the town could also be made by drivers that might already be on Honoapi`ilani Highway . Essentially these would be passby made by vehicles already on Honoapi`ilani Highway. The following Table 5 shows the values assigned to reflect the trips made externally into or from the new town by drivers already on Honoapi`ilani Highway. Again, as with Table 4, these values vary based on the land use and they reflect the potential that the new external trips would represent diversions from other locales by drivers already using Honoapi`ilani Highway.

Table 5 Passby Trips from/to Olowalu Town on Honoapi`ilani Highway

ITE Code	Land Use	Proportion of Trips To/from Olowalu Town already on Honoapi'ilani Highway	Proportion of Trips To/from Olowalu Town Not already on Honoapi'ilani Highway
110	Gen. Light Industrial	20%	80%
210	Single Family Homes	20%	80%
220	Apartment	20%	80%
220	Apartment	20%	80%
230	Condo/Townhouse	20%	80%
310	Hotel	20%	80%
417	Regional Park	20%	80%
520	Elem School	80%	20%
590	Library	20%	80%
710	General Office	20%	80%
730	Govt Office Building	50%	50%
732	US Post Office	80%	20%
820	Shopping Center	80%	20%
820	Shopping Center	80%	20%
944	Gasoline/Service Station	90%	10%

The factors from Tables 4 and 5 were then used to apply to the trip generation data in Tables 1, 2 and 3 to account for internal or community capture and for passby or diverted trips on Honoapi`ilani Highway. The results of the application of the internal capture and passby rates for trip generation are shown in Tables 6, 7 and 8.

Table 6 shows the daily predicted trips for the new town at full buildout. Table 7 shows the predicted a.m. peak hour trips and Table 8 shows the predicted p.m. peak hour trips for the new town in relation to its connection to what will be the new and relocated Honoapi`ilani Highway.

Table 6 Trips for New Olowalu Town on Daily Basis

ITE Code	Land Use	Total Trips	Total Trip Generation		Internal Community Capture		Total Trips		Proportion of External Trips on Honoapi`ilani Highway		Apportioned Trips on Honoapi`ilani Highway		External Trips on Honoapi`ilani Highway	
			In	Out	In	Out	Internal	External	New	Passby	New	Passby	In	Out
110	Gen. Light Industrial	181	91	91	0.30	0.70	54	127	0.80	0.20	101	25	51	51
210	Single Family Homes	4,979	2,489	2,489	0.45	0.55	2,241	2,738	0.80	0.20	2,191	548	1,095	1,095
220	Apartment	1,729	865	865	0.45	0.55	778	951	0.80	0.20	761	190	380	380
220	Apartment	3,943	1,972	1,972	0.45	0.55	1,775	2,169	0.80	0.20	1,735	434	868	868
230	Condo/ Townhouse	1,011	505	505	0.45	0.55	455	556	0.80	0.20	445	111	222	222
310	Hotel	474	237	237	0.10	0.90	47	426	0.80	0.20	341	85	171	171
417	Regional Park	352	194	194	0.90	0.10	348	39	0.80	0.20	31	8	15	15
520	Elem School	388	141	141	0.90	0.10	253	28	0.80	0.20	22	6	11	11
590	Library	281	331	331	0.30	0.70	199	463	0.80	0.20	371	93	185	185
710	General Office	662	517	517	0.85	0.15	879	155	0.50	0.50	78	78	39	39
730	Govt Office Building	1,034	270	270	0.95	0.05	514	27	0.20	0.80	5	22	3	3
732	US Post Office	541	2,434	2,434	0.75	0.25	3,651	1,217	0.20	0.80	243	974	122	122
820	Shopping Center	4,868	2,669	2,669	0.75	0.25	4,003	1,334	0.20	0.80	267	1,068	133	133
820	Shopping Center	5,338	1,686	1,686	0.95	0.05	3,203	169	0.10	0.90	17	152	8	8
944	Gasoline/ Service Station	3,371	91	91	0.30	0.70	54	127	0.80	0.20	101	25	51	51
	Totals	29,152	14,576	14,576	0.63	0.37	18227	10537	0.64	0.36	6718	3819	3359	3359

As seen in Table 6, it is predicted that there would be 3,359 new trips into the new Olowalu Town from Honoapi`ilani Highway on a daily basis and 3,359 new trips out of the new Olowalu Town on a daily basis. The total traffic into and out of the new Olowalu Town on a daily basis is predicted to be 10,538, or 5,269 trips in and 5,269 trips out. Therefore, there would be 3,820 trips into and out of the town total that were from vehicles already on Honoapi`ilani Highway. In summary, the net daily effect of traffic added due to trips generated by the land uses in the new town would be as follows in Table 7.

Table 7 Net Summary Effect of Trips Generated by Olowalu Town on Daily Basis

Classification	Type	In	Out	Total
Internal to Town Only				18,227
External to/from Honoapi`ilani Highway	New	3,359	3,359	6,718
	Passby	1,910	1,910	3,820
	Total	5,269	5,269	10,538

Table 8 Trips for New Olowalu Town for A.M. Peak Hour

ITE Code	Land Use	Total Trips	Total Trip Generation		Internal Community Capture		Total Trips		Proportion of External Trips on Honoapi`ilani Highway		Apportioned Trips on Honoapi`ilani Highway		External Trips on Honoapi`ilani Highway	
			In	Out	In	Out	Internal	External	New	Passby	New	Passby	In	Out
110	Gen. Light Industrial	24	21	3	0.30	0.70	7	17	0.80	0.20	13	3	15	2
210	Single Family Homes	392	98	294	0.45	0.55	177	216	0.80	0.20	173	43	54	162
220	Apartment	133	27	106	0.45	0.55	60	73	0.80	0.20	58	15	15	58
220	Apartment	302	60	242	0.45	0.55	136	166	0.80	0.20	133	33	33	133
230	Condo/ Townhouse	77	13	64	0.45	0.55	34	42	0.80	0.20	34	8	7	35
310	Hotel	31	18	13	0.10	0.90	3	28	0.80	0.20	22	6	16	11
417	Regional Park	12	7	5	0.90	0.10	6	6	0.80	0.20	5	1	3	2
520	Elem School	135	74	61	0.90	0.10	122	14	0.80	0.20	11	3	7	6
590	Library	5	4	2	0.30	0.70	5	1	0.80	0.20	0	0	0	0
710	General Office	94	82	11	0.85	0.15	28	66	0.50	0.50	52	13	58	8
730	Govt Office Building	88	74	14	0.95	0.05	75	13	0.20	0.80	7	7	11	2
732	US Post Office	41	21	20	0.75	0.25	39	2	0.20	0.80	0	2	1	1
820	Shopping Center	109	68	42	0.75	0.25	82	27	0.20	0.80	5	22	17	10
820	Shopping Center	120	74	46	0.95	0.05	90	30	0.10	0.90	6	24	19	11
944	Gasoline/ Service Station	243	124	119	0.30	0.70	231	12	0.80	0.20	1	11	6	6
	Totals	1806	766	1040	0.58	0.42	973	698	0.73	0.27	510	188	255	443

As seen in Table 8, it is predicted that there would be 255 trips into the new Olowalu Town from Honoapi`ilani Highway in the a.m. peak hour and 443 trips out of the new Olowalu Town in the a.m. peak hour. There would be 188 trips made by drivers already on Honoapi`ilani Highway and 510 that were not already using the road. In summary, the net effect of traffic added due to trips generated by the land uses in the new town in the a.m. peak hour would be as follows in Table 9.

Table 9 Net Summary Effect of Trips Generated by Olowalu Town in A.M. Peak Hour

Classification	Type	In	Out	Total
Internal to Town Only				973
External to/from Honoapi`ilani Highway	New	186	324	510
	Passby	69	119	188
	Total	255	443	698

Table 10 Trips for New Olowalu Town for P.M. Peak Hour

ITE Code	Land Use	Total Trips	Total Trip Generation		Internal Community Capture		Total Trips		Proportion of External Trips on Honoapi`ilani Highway		Apportioned Trips on Honoapi`ilani Highway		External Trips on Honoapi`ilani Highway	
			In	Out	In	Out	Internal	External	New	Passby	New	Passby	In	Out
110	Gen. Light Industrial	25	3	22	0.30	0.70	8	18	0.80	0.20	14	4	2	16
210	Single Family Homes	523	329	194	0.45	0.55	235	288	0.80	0.20	230	58	181	106
220	Apartment	161	105	56	0.45	0.55	73	89	0.80	0.20	71	18	58	31
220	Apartment	368	239	129	0.45	0.55	165	202	0.80	0.20	162	40	131	71
230	Condo/ Townhouse	90	61	30	0.45	0.55	41	50	0.80	0.20	40	10	33	16
310	Hotel	35	18	17	0.10	0.90	3	31	0.80	0.20	25	6	16	15
417	Regional Park	15	7	8	0.90	0.10	8	8	0.80	0.20	6	2	3	4
520	Elem School	45	22	23	0.90	0.10	41	5	0.80	0.20	4	1	2	2
590	Library	37	18	19	0.30	0.70	33	4	0.80	0.20	3	1	2	2
710	General Office	89	15	74	0.85	0.15	27	63	0.50	0.50	50	13	11	52
730	Govt Office Building	18	6	13	0.95	0.05	15	3	0.20	0.80	1	1	1	2
732	US Post Office	56	29	27	0.75	0.25	53	3	0.20	0.80	1	2	1	1
820	Shopping Center	423	203	220	0.75	0.25	317	106	0.20	0.80	21	85	51	55
820	Shopping Center	464	223	241	0.95	0.05	348	116	0.10	0.90	23	93	56	60
944	Gasoline/ Service Station	277	139	139	0.30	0.70	264	14	0.80	0.20	1	12	7	7
	Totals	2627	1393	1189	0.62	0.38	1630	997	0.65	0.35	652	345	555	441

As seen in Table 10, it is predicted that there would be 555 trips into the new Olowalu Town from Honoapi`ilani Highway in the a.m. peak hour and 441 trips out of the new Olowalu Town in the a.m. peak hour. There would be 345 trips made by drivers already on Honoapi`ilani Highway and 652 that were not already using the road. In summary, the net effect of traffic added due to trips generated by the land uses in the new town in the a.m. peak hour would be as follows in Table 11.

Table 11 Net Summary Effect of Trips Generated by Olowalu Town in P.M. Peak Hour

Classification	Type	In	Out	Total
Internal to Town Only				1630
External to/from Honoapi`ilani Highway	New	361	291	652
	Passby	194	150	345
	Total	555	441	996

Additional Scenario Review for Hawai`i DOT

At the request of the HDOT, an additional scenario was reviewed. In this scenario, the HDOT requested that an analysis be made that limited internal community capture to 25%. Therefore an additional set of trip generation numbers with 25% internal community capture and the remaining 75% being external to the new town was developed. Detail printouts of the calculations are provided in the appendices. The following Table 12 provides a summary of the scenario as requested by HDOT for trip generation. As can be noted this scenario as requested by HDOT shows a substantial increase in external trips. The owners and developers of this project, as well as the project traffic engineer, believe that the predictions in our Tables 1 – 11 present an accurate picture of anticipated trip generation. Nonetheless, at the request of HDOT, the scenario depicted in Table 12 will be analyzed.

Table 12 Summary of Predicted Trip Generation for Scenario Requested by HDOT

Time Period	Total Single Use Trips from ITE Trip Generation Data	Internal Community Capture at 25%	Resulting External Trips at 75%	Trips Entering Town	Trips Exiting Town
Daily	29,152	7,288	21,864	10,932	10,932
A.M. Peak Hour	1,806	452	1,354	519	734
P.M. Peak Hour	2,627	657	1970	1,045	892

Background Traffic Growth

Several studies were made available which analyzed traffic growth trends on Honoapi'ilani Highway and in the west Maui area. Data from these studies are included in the appendices.

Based on a review of available data, it was decided that an annual traffic volume growth rate of approximately 1% would be appropriate for Honoapi'ilani Highway, resulting in a total growth of 9% between 2015 and full buildout of the Olowalu Town in 2024. This 9% growth rate was applied to the existing through traffic volumes on Honoapi'ilani Highway to derive future year traffic volumes without the Olowalu Town project in place.

The current average annual daily traffic on Honoapi'ilani Highway was estimated with a 24-hour machine traffic count made in February 2013. This data from 2013 was updated using the 1% annual increase for 2 years. Therefore the background growth shown from 2013 to the full buildout in 2024 was taken to be 11%.

Studies have indicated there are approximately 5% trucks with 3 axles or more in the traffic stream on Honoapi'ilani Highway. Using the assumption of 5% trucks, the count made in February of 2013 indicates a daily traffic volume of 25,810. This count was made slightly north of the solid waste transfer station which is just beyond the northern boundary of the proposed Olowalu Town site. Assuming the growth rate of 11% from 2013 to 2024, the background traffic volume growth on Honoapi'ilani Highway would be 2,840 vehicles resulting in an average daily traffic volume of 28,650 in the future year of 2024 without the project in place.

Traffic Analysis in Year 2024 without Olowalu Town Project

A brief analysis was made of the traffic flow on Honoapi'ilani Highway in the year 2024 without the project in place. This analysis assumed the background traffic volume growth would continue, resulting in a total increase of 9% in the daily traffic volumes on Honoapi'ilani Highway. The analysis assumed that that all peak hour and directional factors and truck factors remained the same. The results of the use of the Highplan software are given in Figure 6. As noted in Figure 6, the volume to capacity ratio would increase to 0.73 and the level of service when considering speed would be at an E. The volume to capacity ratio of 0.73 indicates there would be the ability to add more traffic to the roadway on a daily basis, although peak hour traffic speeds would continue to decrease.

Additional information on the Highplan software and its outputs is available in the appendices. See Figure 7 for existing 24-hour traffic volumes on Honoapi'ilani Highway and Figure 8 for the predicted traffic volumes in the year 2024 without the project in place.

This project is unique in that the existing major roadway will be relocated and revised significantly with the development of the Olowalu Town. So, it is not as meaningful as it would normally be to compare the existing or future no build traffic conditions to the build condition, since there is going to be a marked change in the roadway with the coming of the new town. Leaving the existing road as is or in an improved condition without building the town is not an option and the road improvements only occur with the development of the town.

Figure 6 Output from Highplan Software for Honoapi'ilani Highway for Year 2024 without Project in Place

HIGHPLAN 2012 Conceptual Planning Analysis

Project Information

Analyst	RDD	**Highway Name**	HP Hwy	**Study Period**	**Kother**
Date Prepared	4/22/2011 1:23:21 PM	**From**	Transfer Center	**Analysis Type**	Two-Lane Segment
Agency	F&W	**To**	Mile Marker 14	**Program**	HIGHPLAN 2012
Area Type	Rural Undeveloped	**Peak Direction**	Northbound	**Version Date**	12/12/2012
File Name	C:\2000 - Olowalu New Town\HighPlan Analysis\Highplan Future NO Build as rural undev 0909.xhp				
User Notes	Daily future without project				

Highway Data

Roadway Variables				Traffic Variables			
Segment Length	2.600	**Median**	Yes	**AADT**	28650	**PHF**	0.930
# Thru Lanes	2	**Left Turn Impact**	No	**K**	0.070	**% Heavy Vehicles**	5.0
Terrain	Level	**Pass Lane Length**	N/A	**D**	0.535	**Base Capacity**	1700
Posted Speed	45	**% NPZ**	100	**Peak Dir. Hrly. Vol.**	1073	**Local Adj. Factor**	1.00
Free Flow Speed	50	**Class**	1	**Off Peak Dir. Hrly. Vol.**	933	**Adjusted Capacity**	1785

LOS Results

v/c Ratio	0.65	**Density**	N/A	**PTSF**	89.3	**ATS**	32.9	**% FFS**	65.8
FFS Delay	97.2	**LOS Thresh. Delay**	97.2	**Service Measure**	PTSF	**LOS**	E		

Service Volumes

Note: The maximum normally acceptable directional service volume for LOS E in Florida for this facility type and area type is 1500 veh/h/ln.

	A	B	C	D	E
Lanes	**Hourly Volume In Peak Direction**				
1	*	*	130	490	1660
2					
3					
4					
Lanes	**Hourly Volume In Both Directions**				
2	*	*	250	920	3110
4					
6					
8					
Lanes	**Annual Average Daily Traffic**				
2	*	*	3600	13200	44500
4					
6					
8					

* Cannot be achieved based on

Trip Distribution

Trips were distributed based on the existing pattern of traffic on Honoapi'ilani Highway and trip data available from a recent update of the Maui Long Range Transportation Plan (MLRTP). The MLRTP update was prepared for HDOT by a consulting firm utilizing the TransCad model. This model predicts trip generation using equations for production and attraction of trips for the traffic analysis zones (TAZs) established for the island. The gravity model distributes trips to and from the TAZs using a complicated algorithm.

The study established some 400 TAZs for the island, as indicated in materials in the appendices. The model then assigns trips to the existing (and proposed) network of streets using equations that take into account the capacity of the street network and anticipated speeds on the network.

One of the results of this effort is the development of a trip table that indicates the number of trips to and from each TAZ on the island. This table was used in developing the trip distribution used in this study and detail printouts are available in the appendices.

Available traffic counts on Honoapi'ilani Highway indicate the direction of traffic flow by hour of the day nearby the project site. This information was used as background information in determining the distribution of trips.

Trips were distributed using information from the Maui LRTP and a review of the trip length frequency curves from the latest update of the island's LRTP. By analyzing this data and by being aware of the location of various traffic generators on the island, distribution values for each land use were developed.

The trip distribution pattern for external trips shows trips that would leave Olowalu Town to travel to or from the north (Lahaina and beyond) or the central and south portions of Maui. The following Table 13 shows the distribution of trips generated for each land use in the Olowalu Town.

Table 13 Trip Distribution for New External Trips Generated in Olowalu Town

ITE Land Use Code	Land Use Description	Percentage on Honoapi'ilani Hwy To/from Lahaina	Percentage on Honoapi'ilani Hwy To/from Ma'alea
730	Government Office Building	46%	54%
110	General Light Industrial	58%	42%
590	Library	54%	46%
520	Elementary School	54%	46%
415/417	Regional Park with Beach	46%	54%
310	Hotel	72%	28%
732	United States Post Office	54%	46%
230	Condominium/Townhouse	60%	40%
944	Gasoline/Service Station	50%	50%
220	Apartments	60%	40%
210	Single-Family Detached Housing	60%	40%
820	Commercial Retail	60%	40%
710	General Office	60%	40%
Total	All Land Uses	60%	40%

A similar process was used for pass-by or diverted trips to and from Olowalu Town that would be added to traffic on Honoapi'ilani Highway. The following Table 4 shows the distribution of pass-by trips for the various land uses in Olowalu Town.

Table 14 Trip Distribution for Passby Trips Generated to and from Olowalu Town

ITE Land Use Code	Land Use Description	Percentage on Honoapi'ilani Hwy To/from Lahaina	Percentage on Honoapi'ilani Hwy To/from Ma'alea
730	Government Office Building	46%	54%
110	General Light Industrial	58%	42%
590	Library	54%	46%
520	Elementary School	54%	46%
415/417	Regional Park with Beach	46%	54%
310	Hotel	72%	28%
732	United States Post Office	54%	46%
230	Condominium/Townhouse	60%	40%
944	Gasoline/Service Station	50%	50%
220	Apartments	60%	40%
210	Single-Family Detached Housing	60%	40%
820	Commercial Retail	60%	40%
710	General Office	60%	40%
Total	All Land Uses		

Traffic Assignment

Trips were assigned to the three proposed access points to the Olowalu Town, based on the general preliminary site development plan. Assumptions were made as to the selection of the point of access that made the most sense for drivers leaving or entering the new town in comparison to the location of the individual land uses.

Trips from the residential and commercial components of Olowalu Town were assigned mostly to the two primary access points along the relocated Honoapi'ilani Highway. These two access points are expected to be designed as non-signalized intersections with the use of median U-turns in an arrangement generally known as the "Michigan U-turn." The design has been called the "O-turn" to refer to Olowalu Town. The "Michigan U-turn" frequently utilizes traffic signals, however it is expected that the "O-turns" will operate with U-turns required for all left turns

out of the site (after a right turn), for left turns into the site and for straight-through movements from one side of Honoapi'ilani Highway to the other.

It is generally envisioned that no traffic signals will be required for through traffic along the new Honoapi'ilani Highway and that traffic control for vehicles entering or leaving Olowalu Town will be via stop signs or yield signs. The third access point planned is a right-in/right-out access point on the southern end of the site, which will have limited use compared to the other two major access points.

Trip assignments were made to each of the three proposed access points based on the number of residential units and the square footage of commercial and other space planned for Olowalu Town, including the proposed recreational areas. The amount of trips generated by the mauka side of Honoapi'ilani Highway will be very small in comparison to the total trips generated by the entire site and will have a relatively small impact on traffic flow. In addition, there is a connector road planned to link the mauka and makai sides that will allow for traffic flow without the need to utilize either of the "O-turns." This connector should minimize the trips that would be made through the "O-turns."

The Wintass software program was used to assign trips to the street network with trips allocated based on the distribution data described earlier and the allocation of trips to the three proposed access points. Generally, trips were allocated by land use to the most logical access point, depending upon the direction of travel away from Olowalu Town. These trips are only for travel external to Olowalu Town. Overall, a small percentage of trips were assigned to the proposed right-in/right-out access point that will be located on the southern end of the project. The remaining trips were allocated to the two major access points that will operated as the "O-turns." The following Table 15 shows the general allocation of trips to the three access points.

Table 15 Allocation of External Trips to Proposed Olowalu Town Access Points

Access Point	Percentage of External Trips Entering and Exiting Olowalu Town	Comments
O-turn 1	35%	Values vary slightly for individual land uses
O-turn 2	58%	Values vary slightly for individual land uses
RIRO	7%	Assumes fewer entries than exits due to location and design of access point.

It was assumed that new trips generated to and from the site would be apportioned as 60% to and from the Lahaina direction and 40% to and from the Mā`alaea direction. For the passby and/or diverted trips already on Honoapi'ilani Highway, the trips were apportioned based on the existing traffic flow in the a.m. and p.m. peak hours. So, these trips were apportioned at 60% to and from Lahaina in the a.m. peak hour with the remaining 40% to and from Mā`alaea. For the p.m. peak hour the volumes are virtually the same in each direction on Honoapi'ilani Highway, so these trips were apportioned at 50% to and from Lahaina and 50% to and from Mā`alaea. See Table 16.

Table 16 Apportioning of Trips Generated by Olowalu Town by Peak Hour

Time Period	New Trips		Passby/Diverted Trips	
	To/from Lahaina	To/from Mā`alaea	To/from Lahaina	To/from Mā`alaea
A.M. Peak Hour	60%	40%	60%	60%
P.M. Peak Hour	60%	40%	50%	50%

Detailed percentage values for each land use for each access point and direction of travel are provided in the appendices, however the overall average was used as indicated in Table 16 due to the complexity of the town and the uncertainty relating to temporal changes as the town develops.

As noted earlier with Tables 2 and 3, this analysis does not include detailed estimation of travel from the mauka side to and from the makai side of the Olowalu Town. The amount of land development on the mauka side of Honoapi'ilani Highway compared to the makai side is very low, so that a very small percentage of trips will be made from one side to the other and these would be essentially internal trips.

To address this, a nominal amount of left turns, right turns and crossing movements at 20 each per each peak hour were added to the predicted traffic volumes. This would equate to about 1,000 trips per day total into and out of the mauka side of the new town.

This analysis also does not address the internal trips made from the mauka side to the makai side of Honoapi'ilani Highway via a connector that does not require access to Honoapi'ilani Highway.

Development of Future Traffic Data

Traffic volumes were predicted for the future development of the entire Olowalu Town using the Wintass software mentioned earlier. This software takes existing traffic volumes and adds background growth and trips that are assigned to the street network at each node and for each turning movement. This preliminary TIAR focuses only on the total daily traffic volumes for the proposed Olowalu Town. Trip generation for the Olowalu Town included new external trips that would use Honoapi'ilani Highway either for entry to or exit from Olowalu Town. It also included the allocation of pass-by trips that would have already been on Honoapi'ilani Highway. The following schematic Figure 6 shows the street network with the Olowalu Town in place, not including a proposed internal connector from the mauka side to the makai side of Honoapi'ilani Highway.

As discussed earlier, a background growth factor of 9% was used to account for growth in traffic on Honoapi'ilani Highway without the Olowalu Town being in place. This factor was applied to all traffic movements on Honoapi'ilani Highway that would exist without Olowalu Town. Trips were allocated as indicated in Tables 1 – 5. Detailed printouts from the Wintass software are included in the appendices.

Figure 7 provides a schematic diagram showing the existing average daily traffic volumes on Honoapi'ilani Highway for the study network. Figure 8 shows the predicted traffic volumes on Honoapi'ilani Highway in the year 2024 without the project in place. Figure 9 shows the new trips added to the street network with Olowalu Town in place at its full buildout in the year 2024, with the relocated and widened Honoapi'ilani Highway in place. Figure 10 shows the total traffic volumes on the street network at full buildout of the Olowalu Town in the year 2024 with the background growth of 11%. Again, Figure 10 includes the relocation of Honoapi'ilani Highway mauka of the existing highway along with its widening to four lanes.

Figure 7 Existing Traffic Volumes on Honoapi'ilani Highway

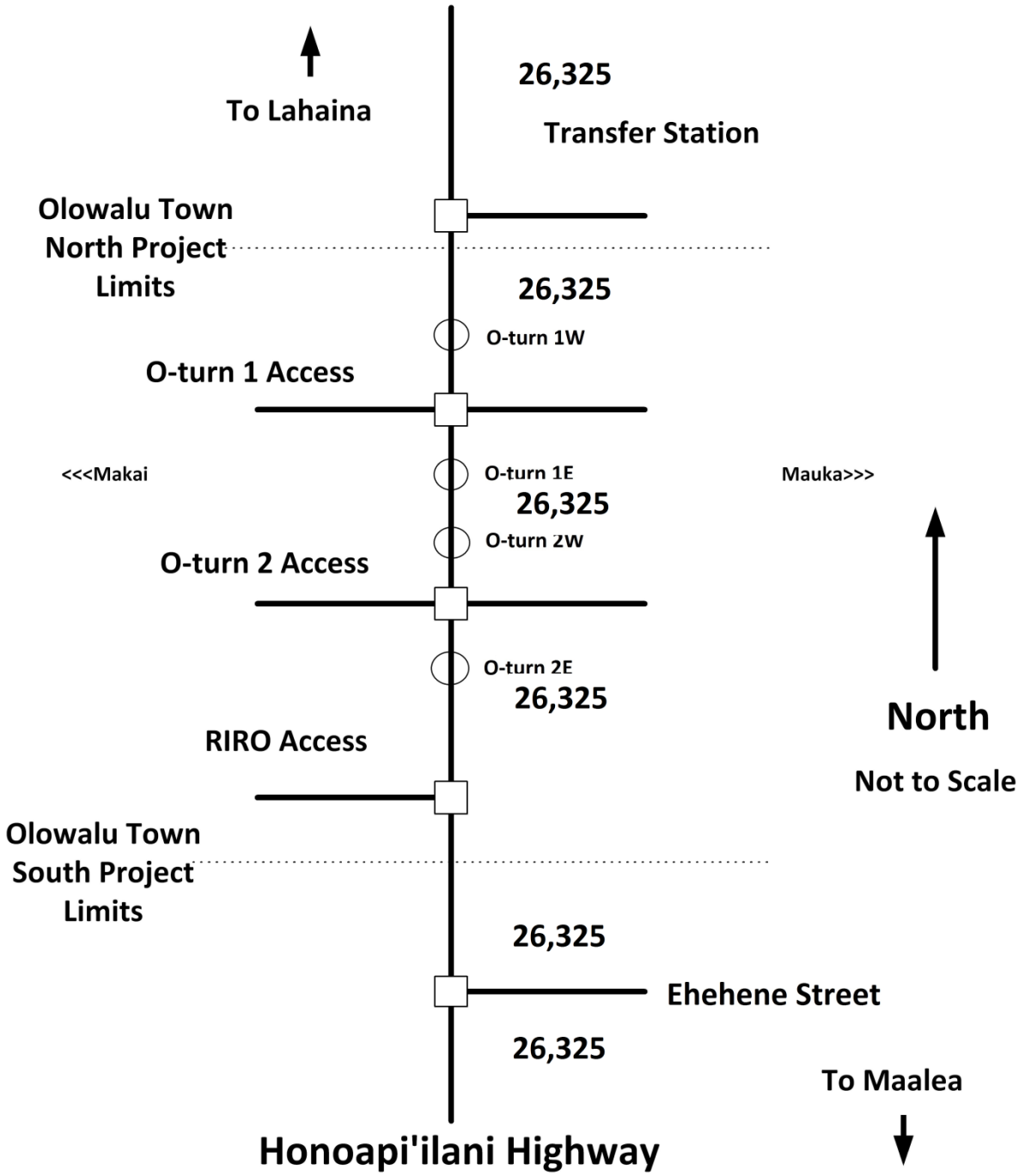


Figure 8 Future Year 2024 Traffic Volumes without Project on Honoapi'ilani Highway

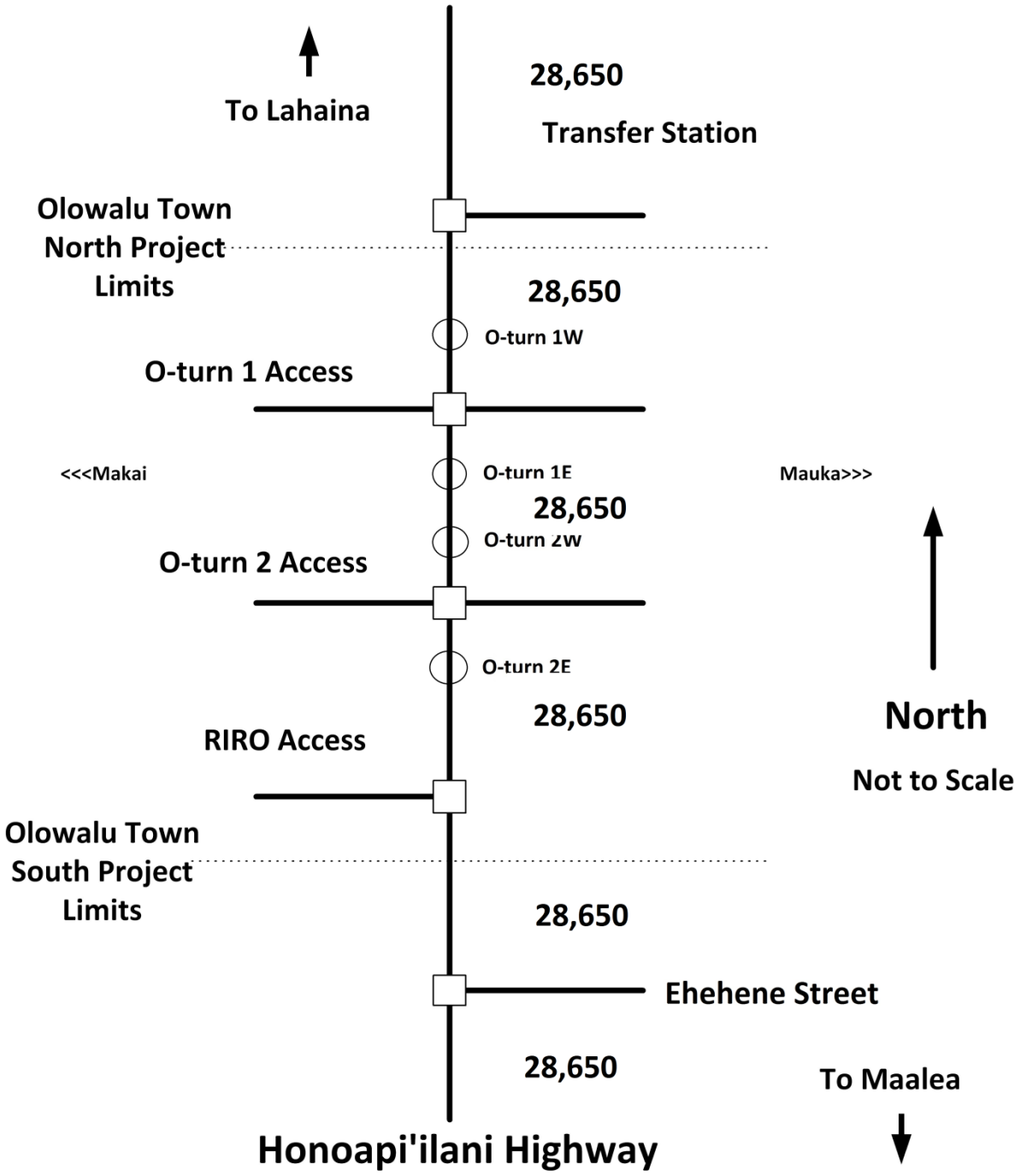


Figure 9 Traffic Added from Olowalu Town Project

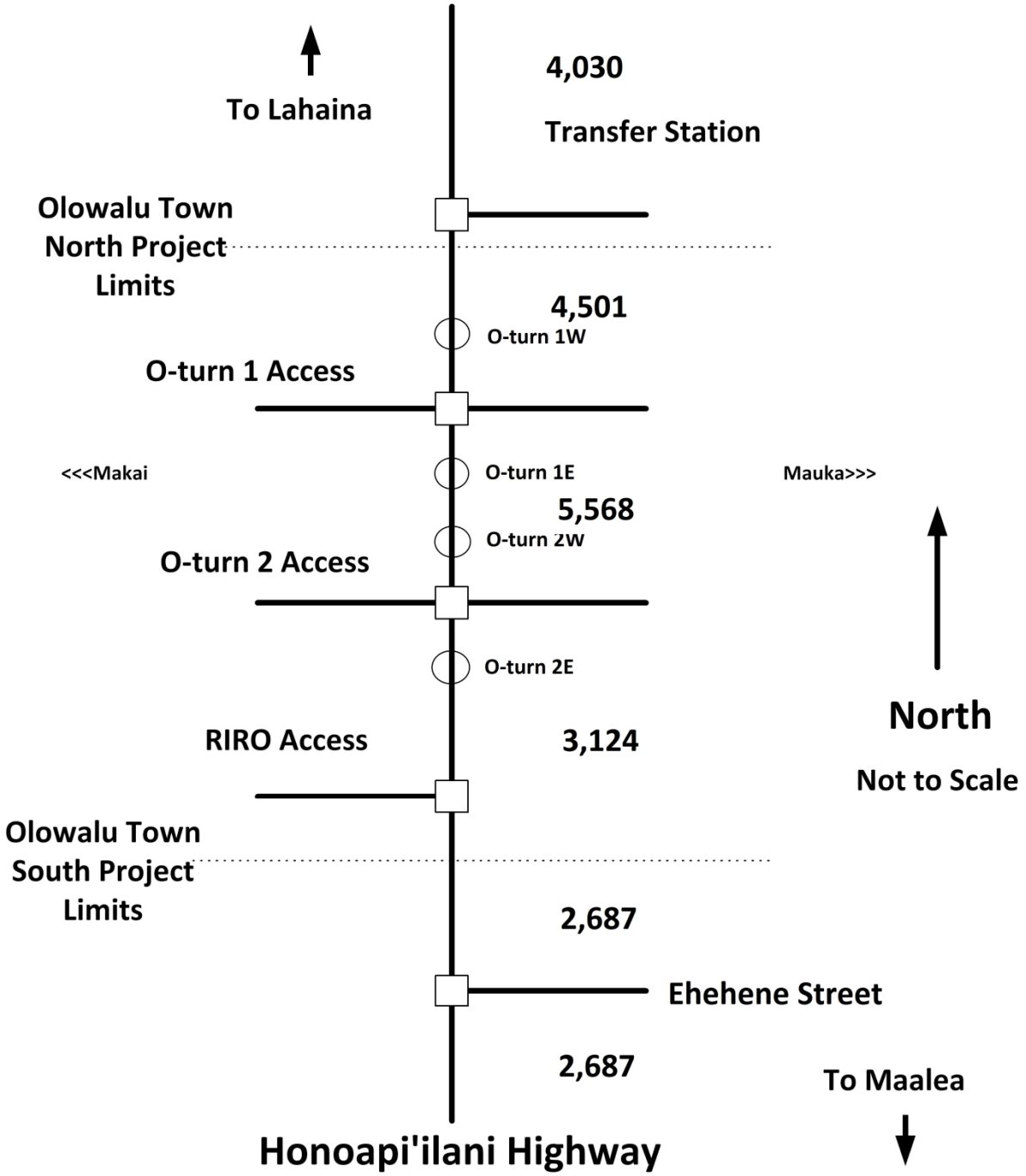
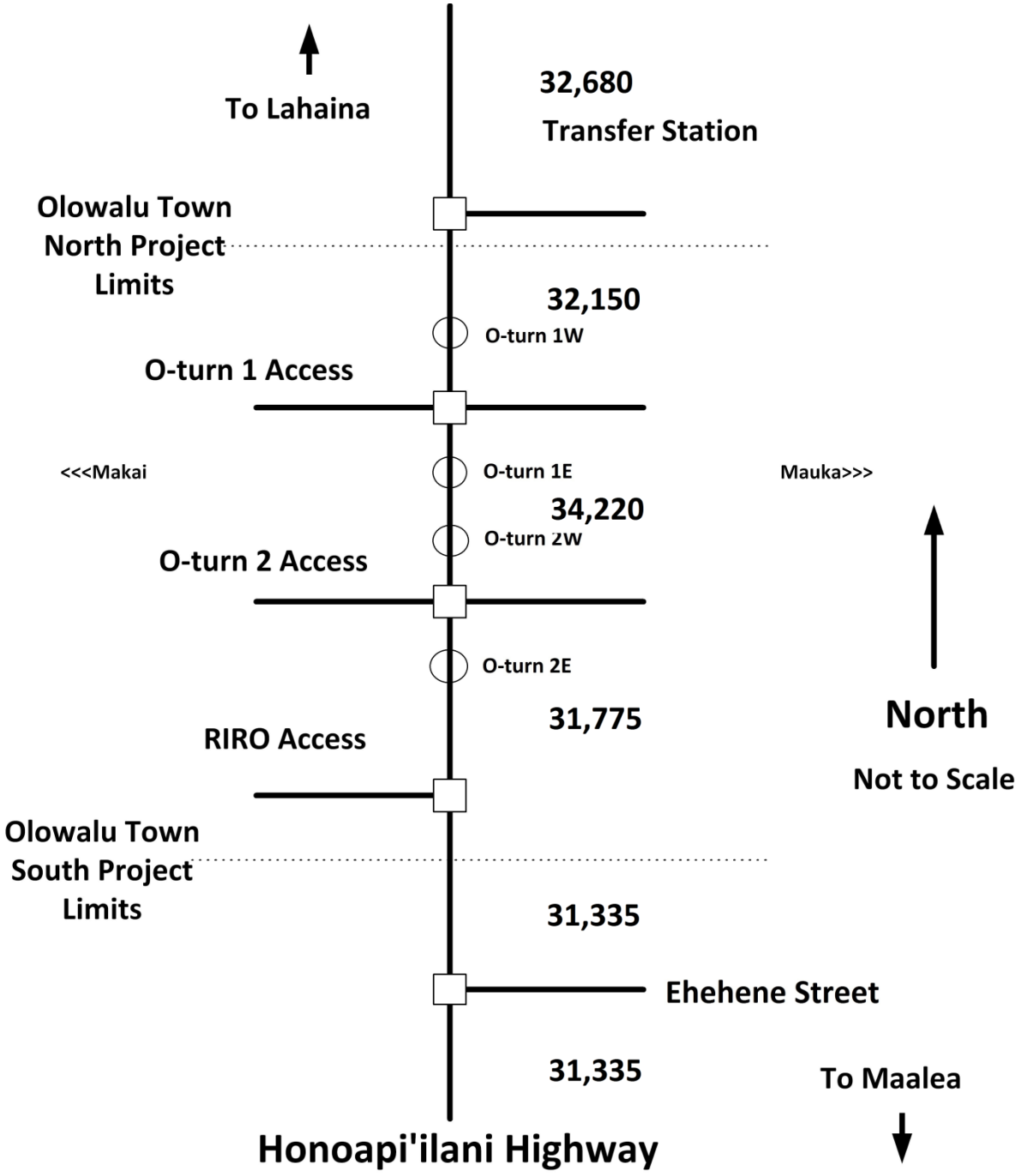


Figure 10 Olowalu Town Study Network Traffic with Full Buildout of Project in Place



Future Roadway Network

The following Figure 11 shows the conceptual design of the O-turns for the relocated Honoapi'ilani Highway (Route 30). As shown in the Figure 11, the roadway will be widened to four lanes with two through lanes plus necessary acceleration and deceleration lanes in each direction.

Access to Olowalu Town will be via three new intersections. Two of the intersections will operate with the modified "Michigan U-turn," named the "O-Turn." The remaining access point will be a right-in/right-out connection with only a limited amount of traffic predicted to use it.

As shown in Figure 11, the "O-Turn" would have a deceleration lane and a stacking lane for right turns into each new access point. For right turns from the "O-Turn," a driver simply makes a right turn and uses an acceleration lane to reach highway speed.

For left turns out of Olowalu Town to go to Lahaina, a driver makes a right turn and then moves to the left lane and enters a left turn deceleration and stacking area and then makes a U-turn to go north.

For left turns into Olowalu Town from the Ma'alea direction, the reverse maneuver is made, with a left turn followed by a U-turn, then with travel to the south followed by a right turn into Olowalu Town. Detailed analysis using Synchro and its SimTraffic module was used in TIAR to assess detailed traffic operations for the peak hours.

Based on preliminary reviews it appears the future traffic volumes predicted for the various movements at the "O-Turns" on a daily basis are well within the expected capacity of the design for an acceptable level of service.

Figure 11 Anticipated Roadway Connections for O-Turns on Relocated Honoapi'ilani Highway

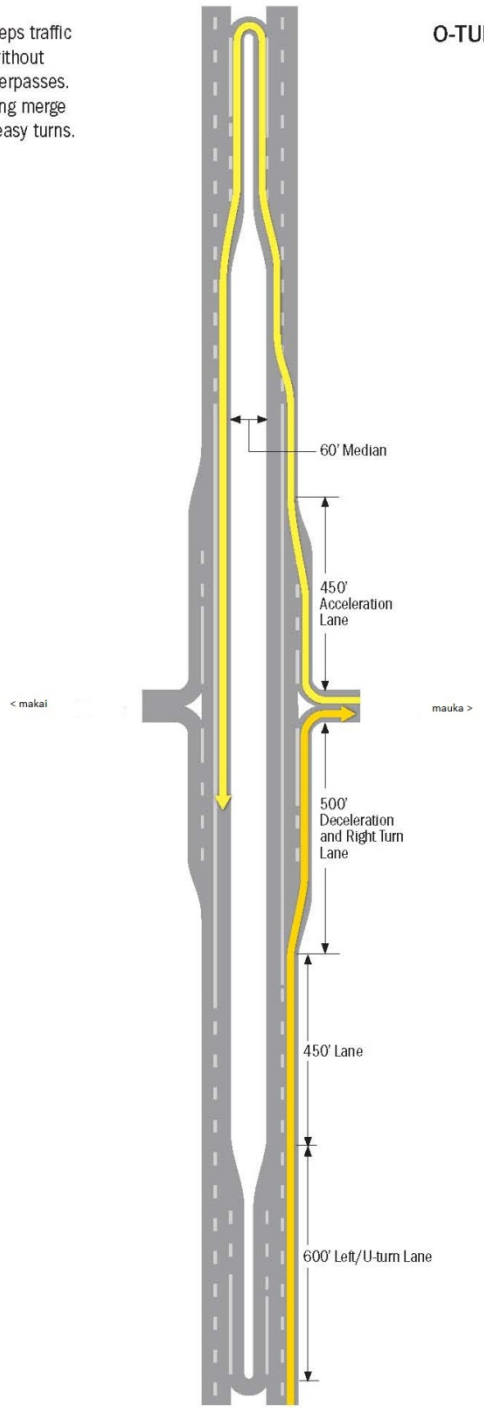
Olowalu Town PRELIMINARY STUDIES FOR POTENTIAL HIGHWAY LOCATIONS

The Olowalu O-turn keeps traffic flowing continuously without stoplights or over/ underpasses. The design features long merge lanes which allow for easy turns.

How the O-Turn Works

The Olowalu Turn or O-Turn works by preventing drivers from making left turns across traffic. Drivers safely take a U-turn with the help of merge lanes and enter into the flow of traffic going in the reverse direction. Then, by merging to the right lane, drivers may turn right and reach their destination. Meetings with the Department of Transportation have been productive and they have been receptive to these innovative ideas.

O-TURN EXPLAINED



Analysis of Impacts of Olowalu Town Project

As seen in Figure 10, the predicted average daily traffic volumes on Honoapi'ilani Highway with the Olowalu Town in place at its full buildout will vary from 31,335 to about 34,220. With the proposed Olowalu Town project, there will be a relocation of Honoapi'ilani Highway and widening to provide for two through lanes in each direction for the extent of the project. South of the project, the roadway would return to its current status with one through lane in each direction plus turn lanes at intersections. A review was made of the general overall impacts of Olowalu Town by analyzing the predicted ADTs versus the daily capacity of the roadway. To achieve this preliminary analysis, the methods of the Florida Department of Transportation (FDOT) were used. The FDOT methodology is based on the Highway Capacity Manual (HCM) which is published by the Federal Highway Administration (FHWA) as well as extensive research in the state of Florida on capacity of highway facilities. The software modules available from FDOT include Highplan, which provides estimated daily capacities for highway facilities such as Honoapi'ilani Highway. While Honoapi'ilani Highway in its current state does have direct access, the number of access points is limited and their approach volumes are quite low. All major intersections have turn lanes in place. Generally, Honoapi'ilani Highway operates more like a controlled access highway rather than an arterial street. Therefore it appears to be appropriate to use the Highplan software to estimate capacity of Honoapi'ilani Highway. Additional information on the Highplan software is provided in the appendices.

Figure 12 shows the output from the Highplan software for Honoapi'ilani Highway with the relocation and widening in place with the buildout of the new town. As indicated in Figure 12, the estimated daily maximum capacity for Honoapi'ilani Highway is approximately 55,500. For the portion of Honoapi'ilani Highway south of Olowalu Town with its current status of two through lanes and turn lanes, the estimated maximum daily capacity is shown to be 33,300.

The following Table 17 shows the predicted daily capacities and ADTs without and with the Olowalu Town project in place at its potential full buildout in the year 2024. As seen in Table 6, the widened and relocated Honoapi'ilani Highway will have more than adequate capacity to handle the existing traffic plus the background growth of 9% plus the new traffic added from the Olowalu Town.

At the junction of the widened and relocated section to the existing section, the level of service will reduce to E but the calculations indicate the total capacity will not be exceeded at full buildout of the Olowalu Town. As seen in the appendices and Figures 12 the predicted overall average speed for the portion of Honoapi'ilani Highway south of Olowalu Town is approximately 29 mph, while the predicted speed in the relocated and widened segment of the highway is approximately 45 mph. The speeds in the proposed relocated and widened segment assume a design free-flow speed of 50 mph with a posted speed limit of 45 mph. See the appendices for detailed program outputs.

Figure 12 Output from Highplan Software with Relocated and Widened Honoapi'ilani Highway in Place at Full Buildout of Olowalu Town

Project Information

Analyst	RDD	**Highway Name**	HP Hwy	**Study Period**	**Kother**
Date Prepared	4/22/2011 1:23:21 PM	**From**	Transfer Center	**Analysis Type**	Multilane Segment
Agency	F&W	**To**	Mile Marker 14	**Program**	HIGHPLAN 2012
Area Type	Rural Developed	**Peak Direction**	Northbound	**Version Date**	12/12/2012

File Name	C:\2000 - Olowalu New Town\HighPlan Analysis\Highplan analysis for 4 lanes 20150411.xhp
User Notes	Daily future with project in 4 lane section

Highway Data

Roadway Variables				Traffic Variables			
Segment Length	5.000	**Median**	No	**AADT**	8000	**PHF**	1.000
# Thru Lanes	4	**Left Turn Impact**	No	**K**	0.095	**% Heavy Vehicles**	4.0
Terrain	Level	**Pass Lane Length**	N/A	**D**	0.575	**Base Capacity**	2100
Posted Speed	50	**% NPZ**	N/A	**Peak Dir. Hrly. Vol.**	437	**Local Adj. Factor**	0.88
Free Flow Speed	55	**Class**	3	**Off Peak Dir. Hrly. Vol.**	323	**Adjusted Capacity**	1721

LOS Results

v/c Ratio	0.13	**Density**	4.8	**PTSF**	N/A	**ATS**	55.0	**% FFS**	100.0
FFS Delay	0.0	**LOS Thresh. Delay**	27.3	**Service Measure**	Density	**LOS**	A		

Service Volumes

Note: The maximum normally acceptable directional service volume for LOS E in Florida for this facility type and area type is 1850 veh/h/ln.

	A	B	C	D	E
Lanes	**Hourly Volume In Peak Direction**				
1					
2	540	1260	1980	2580	3030
3	810	1890	2970	3870	4550
4	1080	2520	3960	5160	6060
Lanes	**Hourly Volume In Both Directions**				
2					
4	940	2200	3450	4490	5270
6	1410	3290	5170	6740	7920
8	1880	4390	6890	8980	10540
Lanes	**Annual Average Daily Traffic**				
2					
4	9900	23200	36400	47300	55500
6	14900	34700	54500	71000	83400
8	19800	46300	72600	94600	111000

*** Cannot be achieved based on**

Table 17 Capacity, ADTs and Levels of Service for Honoapi'ilani Highway In Full Buildout Year of 2024

Segment of Honoapi'ilani Highway	Daily Maximum Capacity(1)	Predicted ADT	Volume to Capacity Ratio	Predicted LOS(Based on daily volume)(2)	Comments
North of Transfer Station	55,500	32,680	0.59	D	Assumes widening to two through lanes in each direction
Transfer Station to O-turn 1	55,500	33,150	0.60	D	
O-turn 1 to O-turn 2	55,500	34,220	0.62	D	
O-turn 2 To RIRO	55,500	31,775	0.57	D	
RIRO to Existing Roadway	55,500	31,775	0.57	D	
Existing Roadway South of Olowalu Town Project	33,300	31,335	0.94	E	Under capacity on daily basis

(1) From Highplan calculations. See appendices for detailed outputs and information on Highplan.
(2) Note: Based on hourly peak volumes, LOS is C.

Analysis of Peak Hour Traffic Operations

An analysis was made of peak hour traffic operations at full buildout of the Olowalu Town in the year 2024 using the methods of the Highway Capacity Manual and the Synchro software package including its SimTraffic simulation model. This software provides estimates of traffic congestion measures including delays and queue lengths.

Analysis was made for the a.m. and p.m. peak hours for weekday. A review of queuing was made as well for both peak hours using the SimTraffic simulation module. Peak hours were determined based on existing traffic flow data collected in February, 2013 on a typical weekday. Based on data collected and the expectation of traffic generation by the site, it was decided the hours reviewed would be 7:00 to 8:00 a.m. and 4:00 to 5:00 p.m. since these hours would also tend to coincide with the peak hours of traffic generation for the new town.

Because of the complexity of the proposed network, it was decided that the SimTraffic module of Synchro provided the best tool for analysis of predicted traffic flows. For each analysis done, there were a total of five runs made with the model. Subsequent results posted in tables and figures are based on the summary averages of the five runs. This was done to help insure a quality data set for comparison of data for various alternatives.

The primary measure of traffic flow quality for the study used the concept of Level of Service (LOS) as defined by the HCM. Generally, for intersections the concept of LOS relates the quality of traffic flow to the delay time experienced by drivers. The HCM provides guidance on the use of the concept of level of service for streets and intersections. A tiered system has been established to describe traffic flow and congestion as related to observed and measured or predicted operational values. For intersections the measure is stopped time delay.

The following figure provides the HCM criteria for LOS for intersections. As noted, the LOS varies from “A” to “F”, with the quality of traffic service declining as the levels move from “A” towards “F”. With declining LOS, the ability to travel at the desired speed is inhibited by other vehicles either adjacent, opposite or in front of a driver.

Generally, in an urban area, it is expected that LOS D will be prevalent and be accepted in the morning and afternoon peak hours for most traffic movements. So, any traffic movements with LOS E or worse would need to be reviewed closely to determine if any changes or improvements could be made to move the LOS to an acceptable level. On heavily traveled streets such as Honoapi’ilani Highway, it is not uncommon for side street left turn movements to have LOS D or E due to the difficulty in making the maneuver. In some cases, LOS E may be considered acceptable if the volume of traffic experiencing the LOS E is low and/or if the impacts of mitigating the LOS E are not reasonable due to cost, disruption of natural resources or other reasons. Generally, efforts were made to avoid any movements having LOS E or to minimize the overall impacts however, there are some side street left turn movements where the cost of improving the LOS E is not reasonable and/or where it would have an undue effect on the major traffic flows on the arterial highway.

Table 18 below indicates LOS and the thresholds of delay:

Table 18 Levels of Service for Intersections

Level of Service	Signalized Intersections	Non-signalized Intersections
	Vehicular Delay (Seconds)	Vehicular Delay (Seconds)
A	< 10	<10
B	10 – 20	10 - 15
C	20 – 35	15 - 25
D	35 – 55	25 - 35
E	55 – 80	35 - 50
F	> 80	> 50

Level of service is graded from A to F to indicate increasing congestion, longer delays and greater limitation in mobility to drivers. Normally, level of service D is considered acceptable at intersections in an urban area. This means that if average delays are less than 55 seconds per vehicle for a particular approach at a traffic signal, then the level of service is considered acceptable. Similar statements can be made for non-signalized intersections, for example that LOS is C if the average delay is less than 25 seconds. Level of service E is generally considered to be "capacity." Level of service F indicates a condition where the capacity has been exceeded and extremely long lines of traffic can develop, if there is sufficient demand volume.

Alternatives Analyzed

As indicated before the proposed plan for the relocated an improved Honoapi'ilani Highway was considered the base for the analysis. This plan, as discussed on page 38, would provide a divided arterial highway with a central landscaped median. Access to the new town would be via three points to the makai side of the highway to the major portion of the town. One of these points would be a restricted right-in/right-out or "RIRO" access, allowing right turns in from the southbound direction from Lahaina and right turn exits from the town towards Mā`alaea. No access would be allowed via left turns into or from the town. Any movements into the town from the south would have to be made via another access point followed by internal connections to the RIRO. Left turns from the part of the town with RIRO access would have to be made via internal connection to another of the two points of access.

The two major points of access would be via a modified "Michigan left turn." With this system entries from the south would be made via a U-turn followed by a right turn into either of the two access points. Entries from the north, as well as those that make the U-turn from the south, would then be via right turns into the town. With this system, no traffic signals would be

needed. Left turns from the town to go to the north would make a right turn and then make the U-turn at the selected location to then reverse direction of travel. These locations for U-turns are noted on the sketches and in the software printouts as "O-turns" (for Olowalu turns).

In addition, at the request of HDOT, a system was analyzed that provided full traffic signal control at each of the two major points of access, along with the RIRO under stop control. The two signals would be fully-actuated and coordinated with each other in an attempt to minimize unnecessary stops and delay and maintain reasonable traffic speeds. One of the results of this analysis was to compare the recommended O-turns to the method with typical traffic signals.

There are also other alternatives to the full traffic signals that were requested for review by HDOT. These would include using the typical "Michigan left" which employs traffic signals for crossing movements at the side streets but not for left turns into or out of the side streets, which in this case would access the new town. Also, there is an option to provide signal control of left turn movements into and from the town, but not for crossing maneuvers. These two additional options were reviewed and the results are included in the appendices as separate pieces of analysis if signals were indeed considered as necessary for the access plan. All previous reviews and public input on this project have indicated the desire to not have any traffic signals on Honoapi'ilani Highway.

Further, the HDOT has requested that another scenario regarding internal or community capture be analyzed. Under this scenario, the internal or community capture would be limited to 25% with the remaining 75% of trips being generated to and from the town from outside the town. This would of course greatly increase the amount of additional new traffic on Honoapi'ilani Highway. This scenario was analyzed and will be discussed separately as the HDOT scenario.

Results of Traffic Analysis

Detailed printouts from the SimTraffic module of Synchro are included in the appendices for all alternatives reviewed.

The following Table 19 shows a comparison of the overall results for the entire network for the O-turns and full traffic signal options for the base scenario using the internal community capture ratio recommended in this study. As discussed earlier in this report, the resulting internal community capture ratios for this scenario are as follows in Table 19.

Table 19 Internal/Community Capture Ratios for Olowalu Town

Time Period	Internal/Community Capture Ratio	External Trip Ratio
Daily	0.64	0.36
A.M. Peak Hour	0.61	0.39
P.M. Peak Hour	0.62	0.38

As seen in Table 19, there is a slight variability in the internal community capture based on the peak hour of the day, due to the nature of the trip generation of the land uses.

The HDOT scenario has a summary of internal community ratios as shown in Table 20.

Table 20 HDOT Scenario for Internal/Community Capture Ratios for Olowalu Town

Time Period	Internal/Community Capture Ratio	External Trip Ratio
Daily	0.25	0.75
A.M. Peak Hour	0.25	0.75
P.M. Peak Hour	0.25	0.75

Obviously the HDOT scenario for internal community capture results in a much higher volume of trips made to and from the externalities of the town. The resulting differential in trips into and out of the town to and from Honoapi'ilani Highway is shown in Table 21.

Table 21 Differential in Trips to and from Olowalu Town With HDOT Scenario for Internal/Community Capture

Time Period	Using Olowalu Town Recommended Internal/Community Capture Ratio	Using HDOT Requested Internal/Community Capture Ratio
Daily	1.00	2.56
A.M. Peak Hour	1.00	2.44
P.M. Peak Hour	1.00	2.48

In other words, the HDOT scenario will essentially increase trips to and from the town via Honoapi'ilani Highway by a factor of 2.56 for the full day with an increase of 2.44 for the a.m. peak hour and 2.48 for the p.m. peak hour.

The authors support and defend the recommended internal capture methodology and results as discussed further in the appendices. While perhaps no one can precisely predict the actual internal community capture for the new town, we are confident that our methodology and resulting capture rates as shown in Table 19 are accurate based on what is planned for the town. The basic design of the town itself including its purposed and the formulation of the town itself lends itself to the higher rate of internal capture we have developed and which we recommend. Nonetheless the additional analysis was made at the request of HDOT and is included in this report.

Results of Analysis of Traffic Flow Conditions at Full Buildout of Olowalu Town with Recommended Internal Community Capture

The following Table 22 provides a summary of the overall results of the analysis of traffic flow at the a.m. and p.m. peak hours for the base scenario for the O-turn and traffic signals options.

Table 22 Summary of Overall Traffic Flow Measures for Base Scenario For Options with O-turns and Traffic Signals for A.M. Peak Hour

Measure	O-Turns	Signals	Differential (Signals /O-turns)	Comments
Total delay in hours	13.9	28.4	2.04	Much more delay with signals
Average speed in mph	27	34	1.26	Increase in overall speeds
Total stops	908	1887	2.08	Many more stops with signals
Delay in sec per vehicle	16.6	36.4	2.19	Much more delay with signals
Arterial speeds northbound	41	36	0.88	Slightly lower speed with signals
Arterial speeds southbound	29	36	1.24	Higher speeds with signals
Fuel used (gal)	146.4	136.9	0.94	No major difference
CO emissions(g)	40,713	74,821	1.87	More with signals
NOx emissions(g)	5,772	10,281	1.78	More with signals
HC emissions(g)	2,100	2,915	1.39	More with signals

The following Table 23 provides a summary of the overall results of the analysis of traffic flow at the a.m. and p.m. peak hours for the base scenario for the O-turn and traffic signals options.

Table 23 Summary of Overall Traffic Flow Measures for Base Scenario For Options with O-turns and Traffic Signals for P.M. Peak Hour

Measure	O-Turns	Signals	Differential (Signals /O-turns)	Comments
Total delay in hours	50.6	66.1	1.31	More delay with signals
Average speed in mph	24	29	1.21	Higher speeds with signals
Total stops	1,814	3,851	2.12	Many more stops with signals
Delay in sec per vehicle	44.3	62.6	1.41	More delay with signals
Arterial speeds northbound	37	36	0.97	Slightly lower speed with signals
Arterial speeds southbound	29	27	0.93	Slightly lower speed
Fuel used(gal)	209.9	196.0	0.94	No major difference
CO emissions(g)	61,364	112,032	1.83	More with signals
NOx emissions(g)	8,387	14,580	1.74	More with signals
HC emissions(g)	3,065	4,315	1.41	More with signals

SimTraffic Analysis of O-turn Scenario for Peak Hours

The following Table 24 provides detail results for the intersections in the network for the a.m. and p.m. peak hours.

Table 24 Traffic Flow Measures with Recommended Internal Capture with O-turns

Location	Move-ment	A.M. Peak Hour				P.M. Peak Hour			
		Speed	Delay	LOS	95%Q(ft)	Speed	Delay	LOS	95%Q(ft)
Transfer Station	NBD	28	2.5	A		28	2.9	A	
	SBD	29	0.2	A		29	0.2	A	
	WBD	NA	8.7	A	10		14.4	B	24
O-Turn 1W	NBD Lt	23	2.6	A	11	22	2.7	B	22
	NBD	27	0.3	A		27	1.1	A	6
	SBD	29	1.0	A		29	1.7	A	2
	WBD Lt	NA	2.1	A	50		4.2	A	64
Olowalu Access 1	SBD	28	0.4	A		28	0.6	A	
	SBD Rt	23	2.2	A		23	2.0	A	
	NBD	28	0.8	A		28	0.9	A	
	EBD Rt	NA	1.8	A	22		2.1	A	55
	Wbd	NA	0.7	A			4.2	A	5
O-Turn 1E	SBD	27	3.2	A	21	26	1.7	A	27
	SBD Lt	23	1.4	A	10	22	3.7	A	17
	EBD Lt	11	1.8	A	54		2.2	A	58
	NBD	28	1.2	A		28	1.3	A	3
O-Turn 2W	NBD Lt	24	3.2	A	25	23	3.6	A	45
	NBD	28	1.2	A		27	1.4	A	0
	SBD	29	0.8	A	3	28	1.2	A	5
	WBD Lt	NA	1.8	A	54		3.3	A	73
Olowalu Access 2	SBD	28	0.7	A		28	0.9	A	
	NBD	28	0.7	A		28	0.7	A	
	EBD	NA	2.2	A	41		3.0	A	104
	Wbd	NA	0.8	A	8		0.8	A	13
O-Turn 2E	SBD Lt	21	2.8	A	31		3.3	A	7
	SBD	25	1.5	A	67	25	1.9	A	50
	EBD Lt	NA	1.9	A	66		2.7	A	70
	NBD	28	1.6	A	10	28	1.7	A	4
RIRO	SBD	29	0.6	A		28	1.3	A	44
	SBD Rt	20	1.4	A		26	0.2	A	
	EBD	NA	0.5	A			0.6	A	
2-1Merge(19)	SBD	27	1.3	A		15	14.6	B	
Merge(21)	SBD	27	1.4	A		10	30.2	D	
Ehehene Street	SBD	27	4.3	A		27	5.5	A	
	SBD Lt	22	11.8	B	16	21	17.1	C	16
	NBD	27	2.1	A		26	3.1	A	22
	WBD	NA	57.0	F	29		>200	F	70

As seen in Table 24, the base traffic network and control plan with O-turns generally works well at both the a.m. and p.m. peak hours for virtually all movements in the network. The main line movements on Honoapi'ilani Highway are shown to have LOS A based on estimated delay. The predicted traffic queues do not affect the mainline through traffic on Honoapi'ilani Highway according to the Synchro SimTraffic runs.

At the intersection of Honoapi'ilani Highway at the Transfer Station, the LOS for the left turns from the Transfer Station are shown to be at B with queues not exceeding one vehicle in either hour studied. The LOS on the mainline of Honoapi'ilani Highway are shown to be at A for both directions and each peak hour. The average speeds are shown to be 42 to 43 mph.

At the O-turn 1W, which is the location west of the Olowalu Access 1, again the LOS for the mainline through movements are shown to be at A for both directions and for each hour. The U-turn movement coming from the south, noted as WBD Lt in the table are shown to be 5.2 seconds in the a.m. peak hour and 34.1 seconds for the p.m. peak hour for an LOS of D, which is of course very reasonable. During the p.m. peak hour, the estimated 95th % queue length for this U-turn movement is 111 feet, or 5 vehicles, which again is very reasonable.

At the Olowalu Access 1, the exit from the town which would be right turns out eastbound is shown to be very low at 1.4 and 2.7 seconds for the a.m. and p.m. peak hours with queues of one vehicle in the a.m. peak hour and seven vehicles in the p.m. peak hour.

At the O-turn 1E, which is the location east of the Olowalu Access 1, again the mainline through movements are shown to have speeds of 34 and 32 southbound and 38 and 37 northbound for the a.m. and p.m. peak hours. The O-turn for traffic leaving the Olowalu Access 1 to go north towards Lahaina is predicted to be 32.7 seconds which is still an LOS D with an estimated queue of 104 feet or five vehicles in the a.m. peak hour, which is very reasonable.

At the O-turn 2W, which is west of Olowalu Access 2, the left turn WBD is the U-turns being made from the south to travel to enter Olowalu Access 2 in the p.m. peak hour. This movement is shown to have a predicted queue of 119 feet or 5 vehicles with delay times of 61.2 seconds. For the northbound left turn off of Honoapi'ilani Highway, the predicted delay is 186.8 seconds with a queue of 791 feet or 32 vehicles. So, this movement would have some queueing for the O-turn being made from the south to eventually enter Olowalu Access 2. However, the SimTraffic module does not show any effects of the queueing for the O-turns on the mainline through traffic on Honoapi'ilani Highway. There would be sufficient storage for this stacking.

At the Olowalu Access 2, there no significant issues with queuing or congestion seen at either peak hour.

AT the O-turn 2E, the eastbound left turn which is the O-turn movement for traffic to go northward on Honoapi'ilani Highway, the predicted delay is 49.2 seconds with LOS F and a queue of 140 feet or six vehicles in the p.m. peak hour. Again, the SimTraffic model does not show any effects of this queuing on the mainline through traffic on Honoapi'ilani Highway.

At the Access 3 RIRO the estimated queues for the exits from the town are shown to be at two vehicles or less in both peak hours.

At Ehehene Street, the predicted LOS for the side street is shown to be at F for the a.m. and p.m. peak hours due to the difficulty of making left turns onto Honoapi'ilani Highway. However, this affects only a very small volume of traffic and these vehicles could make a right turn and then an O-turn and be able to travel southbound. So, it would be possible to prohibit left turns at Ehehene Street and eliminate this issue. There would be only a very few drivers needed to make such a maneuver, although they would need to travel about ½ mile to make the U-turn.

SimTraffic Analysis of Traffic Signals Scenario for Peak Hours

An analysis was made of the a.m. and p.m. peak hours at full buildout of the Olowalu Town with traffic signals provided at the two main access points to the town, as requested by HDOT, with the results shown in Table 25.

Table 25 Traffic Flow Measures for Recommended Internal Capture with Traffic Signals

Location	Move-ment	A.M. Peak Hour				P.M. Peak Hour			
		Speed	Delay	LOS	95%Q(ft)	Speed	Delay	LOS	95%Q(ft)
Transfer Station	NBD	38	5.3	A	0	38	5.7	A	0
	SBD	43	0.4	A	27	42	0.7	A	23
	WBD	NA	18.4	C	10	NA	47.8	D	19
Olowalu Access 1	NBD Lt	15	54.6	D	65	15	52.4	D	79
	NBD	30	13.4	B	266	29	14.5	B	289
	SBD Lt	29	13.2	B	31	26	20.5	C	36
	SBD	34	10.3	B	172	30	17.1	B	321
	EBD Lt	NA	44.7	D	101	NA	47.7	D	113
	EBD Th	NA	32.4	C	35	NA	34.1	C	38
	EBD Rt	NA	1.1	A	16	NA	1.5	A	39
	WBD Lt	NA	49.9	D	54	NA	50.5	D	64
	WBD Th	NA	48.4	D	50	NA	49.5	D	48
	WBD RT	NA	1.2	A	50	NA	1.1	A	48
Olowalu Access 2	NBD Lt	11	51.0	D	72	12	45.8	D	111
	NBD	28	10.9	B	225	28	11.4	B	253
	SBD Lt	22	27.5	C	39	18	39.3	D	59
	SBD	31	13.0	B	185	25	22.8	C	363
	EBD Lt	NA	41.9	D	104	NA	54.3	D	170
	EBD Th	NA	32.3	C	152	NA	36.0	D	33
	EBD Rt	NA	1.4	A	21	NA	2.1	A	57
	WBD Lt	NA	46.9	D	43	NA	44.1	D	42
	WBD Th	NA	53.3	D	33	NA	48.9	D	42
	WBD RT	NA	0.7	A	33	NA	0.8	A	7
RIRO Access 3	NBD	42	0.9	A	0	42	0.9	A	0
	SBD Th	36	3.8	A	0	32	7.0	A	0
	SBD Rt	30	5.2	A	0	28	6.9	A	0
	EBD	NA	4.7	A	33	NA	12.5	B	40
Ehehene Street	NBD	40	1.8	A	0	34	2.6	A	0
	SBD Lt	33	8.7	A	9	20	24.9	C	15
	SBD	41	2.4	A	0	40	2.9	A	95
	WBD	NA	63.2	E	20	NA	>200	F	41

As seen in Table 25, there are generally good LOS and reasonable delays with traffic signals in place at both the a.m. and p.m. peak hours for the entire study network. There are only a few movements with LOS worse than D shown. At the Transfer Station, the left turn exit shows LOS D in the p.m. peak hour. This is problematic due to the large volumes of traffic on Honoapi'ilani Highway. At Ehehene Street, the LOS is F for the p.m. peak hour for the westbound left turn traffic due to the high volumes of traffic on Honoapi'ilani Highway. As discussed earlier it may be possible to prohibit this maneuver and force a U-turn at the signal at the first major access to Olowalu Town at Access 2. This might be appropriate for the low volume of left turns from Ehehene Street onto Honoapi'ilani Highway. Queues shown are reasonable and would not appear to affect through movements on Honoapi'ilani Highway and vice versa. However these predicted queues should be taken into account when designing the length of the left and right turn lanes on the approaches to the intersections under this scenario.

In summary, the option with signals does show reasonable traffic flow measures, although as seen in Tables 24 and 25, the overall operations appear to be better with the O-turns than with the plan that would require traffic signals.

Results of Analysis Traffic Flow Conditions at Full Buildout of Olowalu Town with HDOT Internal Community Capture

A review was made of the expected traffic operations at full buildout assuming the internal community capture is limited to 25%, as requested by HDOT. The following Table 26 shows some of the pertinent traffic flow measures for the overall network with the O-turns in place and with the internal capture limited to 25% for the a.m. peak hour.

Table 26 Summary of Overall Traffic Flow Measures for HDOT 25% Internal Capture Scenario For Options with O-turns and Traffic Signals for A.M. Peak Hour

Measure	O-Turns	Signals	Differential (Signals /O-turns)	Comments
Total delay in hours	20.7	51.9	2.28	Significant increase
Average speed in mph	26	30	1.15	Moderate increase in speed
Total stops	895	3415	3.31	Large increase in stops
Delay in sec per vehicle	18.4	25.4	1.24	Significant increase in delay
Arterial speeds northbound	27	34	1.21	Noticeable increase in speeds
Arterial speeds southbound	27	33	1.13	Slight increase
Fuel consumed(gal)	178.3	179.1	0.97	No significant difference
CO emissions(g)	57,517	98,186	1.75	Significantly more CO emissions
NOx emissions(g)	7,954	12,537	1.64	Significantly more NOx emissions
HC emissions(g)	2,885	3,602	1.32	Noticeable increase in HC emissions

As seen in Table 26, there would still be reasonable traffic operations in the a.m. peak hour with the internal capture limited to 25% as requested by HDOT. In comparing Tables 25 and 26, it is seen that the traffic operations would be significantly worse with the HDOT internal capture of 25%, although traffic operations are shown to be acceptable when looking at the overall network. Tables 27 and 28 show a comparison of overall traffic flow measures for the network with the recommended internal capture and with the HDOT requested internal capture of 25%.Detailed printouts of individual intersections in the system are provided in the appendices for further review.

The following Table 27 shows some of the pertinent traffic flow measures for the overall network with the O-turns in place and with the internal capture limited to 25% for the p.m. peak hour.

Table 27 Summary of Overall Traffic Flow Measures for HDOT 25% Internal Capture Scenario For Options with O-turns and Traffic Signals for P.M. Peak Hour

Measure	O-Turns	Signals	Differential (Signals/O-turns)	Comments
Total delay in hours	131.7	163.9	1.24	Significantly more
Average speed in mph	19	21	1.11	Slightly better
Total stops	5795	6599	1.14	Somewhat more stops
Delay in sec per vehicle	88.0	116.4	1.32	Significantly more
Arterial speeds northbound	34	34	1.00	No change
Arterial speeds southbound	29	18	0.62	Noticeable decline
Fuel consumed(gal)	271.1	256.7	0.95	Slightly better
CO emissions(g)	80,329	130,019	1.62	Significantly more
NOx emissions(g)	10,327	16,199	1.57	Significantly more
HC emissions(g)	3,688	4,829	1.31	Significantly more

View looking north towards intersection at Ehehene Street

Table 28 Traffic Flow Measures with HDOT 25% Internal Capture with O-turns

Location(node)	Move-ment	A.M. Peak Hour				P.M. Peak Hour			
		Speed	Delay	LOS	95%Q(ft)	Speed	Delay	LOS	95%Q(ft)
Transfer Station	NBD	28	3.0	A	0	27	3.3	A	0
	SBD	29	0.2	A	0	29	0.3	A	8
	WBD Lt	NA	14.6	B	10	NA	17.9	C	21
O-Turn 1W	NBD Lt	22	2.9	A	25	16	0.7	A	165
	NBD	27	1.2	A	15	26	0.8	A	81
	SBD	29	1.2	A	3	28	2.1	A	13
	WBD Lt	NA	2.8	A	59	7	9.2	A	78
Olowalu Access 1	SBD	28	0.1	A	0	28	0.8	A	0
	SBD Rt	23	0.1	A	0	23	3.3	A	0
	NBD	28	0.9	A	0	28	1.0	A	7
	EBD Rt	NA	3.0	A	92	NA	6.7	A	199
	Wbd	NA	0.6	A	5	NA	0.6	A	5
O-Turn 1E	SBD	25	2.2	A	32	24	3.3	A	63
	SBD Lt	21	5.0	A	57	20	5.9	A	45
	EBD Lt	NA	2.6	A	68	NA	2.2	A	69
	NBD	28	1.4	A	4	28	1.5	A	14
O-Turn 2W	NBD Lt	23	3.4	A	40	10	36.5	E	426
	NBD	27	1.4	A	15	26	2.4	A	326
	SBD	29	1.0	A	3	28	1.8	A	14
	WBD Lt	NA	2.2	A	70	NA	10.4	B	82
Olowalu Access 2	SBD	28	0.6	A	0	28	1.1	A	28
	SBD Rt	23	2.8	A	0	21	5.2	A	0
	NBD	27	0.7	A	0	27	0.7	A	0
	EBD	NA	0.6	A	148	NA	11.2	B	332
	Wbd	NA	0.7	A	7	NA	0.8	A	8
O-Turn 2E	SBD Lt	19	3.9	A	39	14	10.8	B	217
	SBD	23	2.4	A	0	16	9.4	A	235
	EBD Lt	NA	2.6	A	74	NA	4.4	A	79
	NBD	28	1.8	A	9	28	1.8	A	14
RIRO(17)	SBD	29	0.2	A	0	26	56.6	F	751
	SBD Rt	26	0.0	A	0	25	3.7	A	358
	EBD	NA	0.6	A	0	NA	0.6	A	8
2-1Merge (19)	SBD	27	1.5	A	0	5	76.4	F	0
Merge (21)	SBD	27	1.7	A	0	7	50.4	E	0
Ehehene Street	SBD	27	4.6	A	0	27	5.5	A	0
	SBD Lt	21	17.8	C	11	9	118.3	F	21
	NBD	27	0.8	C	0	24	5.3	A	0
	WBD	NA	90.1	F	32	NA	>200	F	115

Table 29 Traffic Flow Measures with HDOT 25% Internal Capture with Traffic Signals

Location	Move-ment	A.M. Peak Hour				P.M. Peak Hour			
		Speed	Delay	LOS	95%Q(ft)	Speed	Delay	LOS	95%Q(ft)
Transfer Station	NBD	37	5.8	A	0	37	5.7	A	0
	SBD	43	0.5	A	0	41	0.6	A	0
	WBD	NA	7.0	A	9	NA	>200	F	19
Olowalu Access 1	NBD Lt	15	55.3	D	83	17	45.1	D	125
	NBD	27	17.7	B	309	28	16.4	B	313
	SBD Lt	25	23.9	C	38	24	24.6	C	73
	SBD	30	16.2	B	224	25	26.1	C	433
	EBD Lt	NA	41.2	D	171	NA	102.8	F	249
	EBD Th	NA	26.6	C	35	NA	37.1	D	32
	EBD Rt	NA	1.8	A	50	NA	5.2	A	116
	WBD Lt	NA	50.6	D	58	NA	49.8	D	55
	WBD Th	NA	44.2	D	48	NA	49.6	D	48
	WBD RT	NA	1.1	A	48	NA	1.2	A	48
Olowalu Access 2	NBD Lt	12	45.4	D	115	13	43.7	D	198
	NBD	26	14.2	B	263	28	11.7	B	258
	SBD Lt	19	36.9	E	59	16	48.9	D	74
	SBD	27	18.9	B	234	18	42.5	D	458
	EBD Lt	NA	47.4	D	226	NA	207.1	F	486
	EBD Th	NA	27.2	C	34	NA	73.9	F	899
	EBD Rt	NA	2.5	A	82	NA	8.5	A	532
	WBD Lt	NA	48.2	D	44	NA	48.1	D	46
	WBD Th	NA	51.2	D	44	NA	45.2	D	37
	WBD RT	NA	0.7	A	44	NA	0.7	A	37
RIRO Access	NBD	42	0.9	A	0	42	0.9	A	0
	SBD Th	33	5.5	A	0	14	43.4	D	863
	SBD Rt	30	5.1	A	0	13	41.1	D	880
	EBD	NA	8.4	A	49	NA	41.5	D	70
2 lane/4 lane Transition	NBD	40	1.2	A	0	39	1.5	A	0
	SBD	29	8.3	A	174	6	104.4	F	1214
Ehehene Street	NBD	40	2.1	A	0	33	6.4	A	0
	SBD Lt	28	18.7	B	10	13	57.2	E	13
	SBD	41	2.7	A	0	40	2.8	A	0
	WBD	NA	58.0	F	19	NA	>200	F	132

Review of Predicted Speeds with Various Scenarios At Full Buildout of Olowalu Town

Further review was made of the predicted speeds in the study network with the base and HDOT scenarios with O-turns and with signals in place for comparison of the alternative access plans and levels of trips added to Honoapi`ilani Highway.

The following Table 30 shows the predicted speeds with the recommended internal capture with the O-turns in place.

Table 30 Predicted Speeds from SimTraffic for Study Network for Olowalu Town With Recommended Internal Capture and O-turns in Place

Street Reference	A.M. Peak Hour		P.M. Peak Hour	
	Northbound	Southbound	Northbound	Southbound
	Speeds	Speeds	Speeds	Speeds
Transfer Station	28	29	28	29
O-turn 1W	27	29	27	29
Olowalu Town Access 1	28	28	28	28
O-turn 1E	28	27	28	26
O-turn 2W	28	29	27	28
Olowalu Town Access 2	28	28	28	28
O-turn 2E		25		25
RIRO	27	29	26	28
Merge Southbound		27		15
Junction 2-lane/4-lane	28	27	28	10
Ehehene Street	27	27	26	27

As seen in Table 30 the speeds are generally lower in the afternoon peak hour, particularly in the southbound direction, due to the congestion at the merge from two to one southbound lane. However, the speeds shown would be considered very reasonable and very acceptable for a four lane arterial in a developing area with the volumes of traffic predicted for the highway. If the new highway were considered to be a multi-lane highway with average speeds of 28 mph, then the LOS for the highway would range from C to E based on the density of the highway. However, due to the access points on the highway, the facility cannot be strictly considered as a multilane highway. If the facility is considered more like a Class II urban arterial street with typical free flow speeds of 40mph, then the overall LOS based on speeds of approximately 28 mph would be C. Since the location is currently somewhat remote to developed areas, it is difficult to pin down a specific facility type for the new relocated highway. Based on anticipated traffic flow, we feel the classification as an urban arterial street would be more appropriate, but with a lower free flow speed of 40 mph.

The following Table 31 shows the predicted average speeds in the study network if traffic signals were in place instead of the O-turns with the recommended internal capture rate.

Table 31 Predicted Speeds from SimTraffic for Study Network for Olowalu Town With Recommended Internal Capture and Signals in Place

Street Reference	A.M. Peak Hour Speeds		P.M. Peak Hour Speeds	
	Northbound	Southbound	Northbound	Southbound
Transfer Station	39	45	39	44
Olowalu Town Access 1	31	35	30	30
Olowalu Town Access 2	29	32	29	26
RIRO	43	38	43	34
Merge Southbound	39	35	39	11
Junction 2-lane/4-lane	41	34	40	27
Ehehene Street	42	42	40	41

As seen in Table 31, the speeds are generally comparable between the options with O-turns and signals and would be acceptable for a four-lane arterial in a developing area. There is shown to be a reduction in speeds with the signals in place as compared to the O-turns at the merge in the southbound direction in the p.m. peak hour. Again, assuming the facility would be considered more like an urban Class II arterial street, based on the speeds varying from 29 to 41, the LOS would be mostly B and C, but with a F at the merge point in the southbound direction.

The following Table 32 shows the predicted speeds with the HDOT limited internal capture of 25% with the modified O-turns in place.

Table 32 Predicted Segmental Speeds in Study Network with O-Turns in Place at Full Buildout with HDOT 25% Internal Capture

Street Reference	A.M. Peak Hour Speeds		P.M. Peak Hour Speeds	
	Northbound	Southbound	Northbound	Southbound
Transfer Station	28	29	27	29
O-turn 1W	27	29	26	28
Olowalu Town Access 1	28	28	28	28
O-turn 1E	28	25	28	24
O-turn 2W	27	29	26	28
Olowalu Town Access 2	27	28	27	28
O-turn 2E	28	23	28	16
RIRO	27	29	28	6
Merge Southbound	26	27	28	5
Bend Southbound	28	27	26	7
Junction 2-lane/4-lane	26	23	26	9
Bend point node	26	11	26	11
Ehehene	27	27	24	27

As seen in Table 32, the speeds would be somewhat lower with the HDOT internal capture ratio of 25 with the O-turns in place for both the a.m. and p.m. peak hours. In the a.m. peak hour most of the segments would have speeds between 25 and 30 mph, except for the southbound direction as the transition is made from 2 to 1 southbound lane. This occurs also in the p.m. peak hour with the effects extending further upstream to approximately the Olowalu Town Access 2. This is because of the significant added volume due to the restriction on the internal capture to 25%. It is interesting to note that the speeds are basically the same once passing Ehehene Street in the southbound direction at either peak hour. This is a function of the capacity of the one lane southbound, and simply shows the queues at the lane drop and merge extending further to the north. In comparing Tables 31 and 33, it is seen there is a substantial decrease in speeds on Honoapi`ilani Highway, owing to the larger volumes of traffic created to and from the highway with the lower rate of internal capture of a maximum of 25%.

Table 33 shows the predicted average speeds in the study network if traffic signals were in place instead of the O-turns with the HDOT internal capture rate of 25%.

Table 33 Predicted Segmental Speeds in Study Network with Traffic Signals in Place at Full Buildout with HDOT 25% Internal Capture

Street Reference	A.M. Peak Hour Speeds		P.M. Peak Hour Speeds	
	Northbound	Southbound	Northbound	Southbound
Transfer Station	38	45	39	42
Olowalu Town Access 1	27	31	28	26
Olowalu Town Access 2	26	29	28	19
RIRO	43	37	43	15
Merge Southbound	39	29	38	6
Junction 2-lane/4-lane	40	32	39	27
Ehehene Street	41	41	34	41

As seen in Table 33, the predicted speeds with signals in place instead of the O-turns are generally similar. The speeds in the southbound direction at the merge from two to one southbound lane are also shown to be low in both the a.m. and p.m. peak hours. Speeds are more consistent throughout the corridor with the O-turns than with signals with the HDOT internal capture rate in effect.

View looking south at Olowalu Store

Conclusions

Based on a review of the preliminary development plan for Olowalu Town and a review of the traffic data for daily 24-hour traffic volumes and daily 24-hour trip generation, the following conclusions are made:

1. The new Olowalu Town would generate about 29,152 trips per day if all land uses are considered separately using ITE trip generation rates.

2. Based on our review of ITE methodology and the island wide master transportation model, the recommended internal community capture is expected to be approximately 63%, meaning that only 37% of the trips generated by the new town will be trips external to the town on a daily basis. It is expected that 42% of the trips would be external as to origin or destination in the a.m. peak hour and that 38% would be external as to origin or destination in the p.m. peak hour.

3. The predicted trips into and out of the new town to and from Honoapi'ilani Highway are expected to be 698 in the a.m. peak hour and 996 in the p.m. peak hour.

4. The recommended relocation of Honoapi'ilani Highway as a divided arterial highway with very limited access should be able to satisfactorily handle the expected volumes of traffic on a daily and peak hour basis, based on calculations provided in this report. It is expected a posted speed limit of 45 mph would be appropriate, given the nature of the highway and its anticipated traffic volumes. However, it may be necessary to design the highway for a higher speed, depending upon HDOT requirements and anticipated funding sources that might include federal funds.

5. The recommended modified Michigan U-turn access plan, generally referred to as the O-turns, can work effectively for the a.m. and p.m. peak hours, as shown in the tables provided that show HCM traffic flow results for the base scenario.

6. The recommended modified Michigan U-turn access plan, generally referred to as the O-turns, can work acceptably for the a.m. and p.m. peak hours, as shown in the tables provided that show HCM traffic flow results for the scenario requested by HDOT with a limitation of 25% for internal community capture of trips generated. This scenario would require some modifications to the roadway plan but the predicted speeds, delays and queues should be acceptable even with the higher entering and exiting traffic volumes as indicated in the tables that show traffic flow measures. The SimTraffic module runs show a reduction in speeds in the southbound direction due to the drop of a lane in that direction in both the a.m. and p.m. peak hours, as expected.

7. The HDOT requested access plan with full traffic signals at the two major access points to the town on Honoapi'ilani Highway would work well with the predicted traffic volumes from the base scenario at the a.m. and p.m. peak hours.

8. The HDOT requested access plan with full traffic signals at the two major access points to the town on Honoapi'ilani Highway would work acceptably with the predicted traffic volumes from the HDOT scenario having a limitation of 25% internal community capture at the a.m. and p.m. peak hours. With this option, it was necessary to revise slightly the lane configuration of the relocated Honoapi`ilani Highway to allow for reasonable modeling of traffic flow with the SimTraffic simulation module. It is felt the modifications would better reflect lane usage by drivers on Honoapi`ilani Highway.

9. There are some alternative treatments that could be considered in lieu of the full traffic signals as suggested by HDOT. The option to install a scissors-type signal with no control for the northbound direction on Honoapi'ilani Highway but signal control for the other approaches has been shown to be very acceptable for the a.m. and p.m. peak hours with the base scenario of trip generation. Even with the HDOT limitation of 25% internal community capture, this option is shown to be acceptable at the a.m. and p.m. peak hours. See photo of existing scissors-type signal below and sketch in appendices.

Aerial view of scissors-type signal in place on US Route 278 in Hilton Head, SC. Note that only one direction of traffic on US278 is required to stop at the signal. Exits from the side street to the left accelerate and merge with traffic on US278. AADT on US278 is between 25,000 and 30,000.

Recommendations

Based on a review of the data analyzed in this report and the above conclusions, the following recommendations are made:

1) The proposed access plan should be approved with the O-turns. The design of the O-turns should include the following general concepts:

    A. For both O-turns there should be channelized right turns exiting the town on both sides of Honoapi'ilani Highway for traffic entering from both makai and mauka of the highway. There should acceleration lanes in conformance to HDOT standards associated with the channelized right turns.

    B. For both O-turns there should be channelized right turns for traffic entering the town both makai and mauka of the highway with deceleration lanes. These should have added lanes into the town so as to allow free flow off the highway. At some point there would need to be tapers down to the expected internal roadway design.

    C. At the U-turn locations in each direction in each O-turn, there should be acceleration lanes for traffic entering Honoapi'ilani Highway that would then merge over to enter the right turn deceleration lanes to enter the town.

    D. The O-turns, including the actual locations for U-turns should be designed to accommodate trucks as per HDOT standards.

    E. Adequate signing for the new town should be provided to provide advice of destinations for drivers on Honoapi'ilani Highway. It will be necessary to distinguish between the portions of the town makai and mauka of the highway with names or a naming convention to be determined. This is needed so as to eliminate confusion for first-time visitors to the town so that they get into the proper deceleration lane for travel into the correct O-turn both makai and mauka of the highway.

    F. Provisions should be made to include technology and accommodations for a "smart highway" in the design phase. This might include the provision of video cameras and other detection devices that could be part an HDOT or island operated traffic center in the future. Provisions for potential underground conduit should be considered in the utility plan development process.

    G. Provisions for adequate roadway lighting should be considered early in the design process.

H. Provision for pedestrian facilities along Honoapi'ilani Highway should be considered early in the design process. While it is anticipated the town plan will include a grade separated access from makai of the highway to mauka of the highway, there should also be considerations given to the possibility of pedestrian and bicycle crossings of the highway to and from the town and/or along any pathways adjacent to the highway in the future. This effort will need to take into account any HDOT standard policies for non-motorized traffic facilities and amenities.

2) A staging plan will be required for the future for the anticipated building of the new highway and for the transition from the existing highway to the new divided highway facility.

3) There should be consideration of a staging plan wherein one O-turn may be built at a time with some sort of temporary access for the other location(s). Additional study would be needed at some point in the future for this possible scenario. Generally this would be covered in the HDOT stipulation for an update of this report every three years.

4) There should be some consideration to the possible removal of the RIRO if the O-turns are going to be the access plan. This is due to the close proximity of the RIRO to the O-turn location on the south side of the Olowalu Town Access 2. If the RIRO were removed it would provide a longer distance for stacking for the O-turn as well as longer acceleration lane lengths. Since the volume using the RIRO is so low, it is expected the net effect on the other two main access points would be negligible. This option can be reviewed further as the development takes shape. It may be desirable to retain a RIRO further south as an emergency access only.

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1. Additional Development Plan Information
2. Traffic Count Information
3. Traffic Speed Information
4. Trip Distribution Information
5. Trip Assignment and Urban Transportation Demand Model Information
6. Traditional Neighborhood Design Information
7. Internal and Community Capture Information
8. Analysis of Recommended Internal Capture Plan (Mr. John Edwards, P.E.)
9. O-turn and Michigan U-turn Information
10. Florida D.O.T. Highway Capacity Tables
11. Highplan Software Runs for Existing and Future Conditions
12. SimTraffic Runs for Base Scenario with O-Turns for A.M. Peak Hour
13. SimTraffic Runs for Base Scenario with O-Turns for P.M. Peak Hour
14. SimTraffic Runs for Base Scenario with Signals for A.M. Peak Hour
15. SimTraffic Runs for Base Scenario with Signals for P.M. Peak Hour
16. SimTraffic Runs for HDOT Internal Capture Scenario with O-Turns for A.M. Peak Hour
17. SimTraffic Runs for HDOT Internal Capture Scenario with O-Turns for P.M. Peak Hour
18. SimTraffic Runs for HDOT Internal Capture Scenario with Signals for A.M. Peak Hour
19. SimTraffic Runs for HDOT Internal Capture Scenario with Signals for P.M. Peak Hour
20. Schematic of Alternative Signal Conceptual Design

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PREPARED FOR: **MR. BILL FRAMPTON**
OLOWALU TOWN LLC
2073 Wells Street, Suite 201
Wailuku, Hawaii 96793

EFFECTIVE DATE: **May 1, 2011**

ASSESSMENT OF ECONOMIC AND FISCAL IMPACTS, OLOWALU TOWN MASTER PLAN DEVELOPMENT, OLOWALU, ISLAND OF MAUI, HAWAII

ACM CONSULTANTS, INC.

June 14, 2011 10-9106B

Mr. Bill Frampton
OLOWALU TOWN LLC
2073 Wells Street, Suite 101
Wailuku, Hawaii 96793

Re: An Assessment of Economic and Fiscal Impacts for the proposed Olowalu Town Master Plan Development in Olowalu, Island and County of Maui

Dear Mr. Frampton

In accordance with your request, we have analyzed the proposed Olowalu Town Master Plan Development in Olowalu, District of Lahaina, Island and County of Maui, in order to provide a study of its potential economic and fiscal impacts. This *counseling report*, and the conclusions herein, is based on the on-site inspection of the property, a study of current political and economic conditions, and a historical review of the real estate market in the West Maui region.

The subject consists of approximately 635 acres of land and is currently zoned State Agricultural District. The proposed project is identified as Olowalu Town and will be located along Honoapiilani Highway between Maalaea and Lahaina. Olowalu Town will be a community comprised of residential uses, commercial and civic uses, parks and recreation sites, agricultural uses, and a cultural preserve.

At full build-out, Olowalu Town is expected to be comprised of approximately 1,500 living units, including single-family, multi-family and live-work units, together with up to 300,000 square feet of commercial and civic space. Within the 1,500 living units, on-site affordable housing units will also be included in compliance with the County of Maui's Residential Workforce Housing Policy.

The focus of this assignment essentially has three parts: (1) to define and delineate the subject and its market area; (2) to identify and analyze potential economic impacts with regard to the project; and (3) identify and analyze potential fiscal impacts with regard to the project.

The following report presents a narrative review of the assessment and our analysis of data along with other pertinent materials on which this report is predicated. It contains data and exhibits gathered in our investigations, and will include a description of the analytical process and our conclusions, as of May 1, 2011.

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Thank you for allowing us the opportunity to work on this interesting assignment.

Respectfully submitted,
ACM Consultants, Inc.

Glenn K. Kunihisa, MAI, CRE
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2011

Dominic J. Suguitan
Certified General Appraiser,
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Exhibit A Copy of County of Maui Residential Workforce Housing Policy
Exhibit B Selected Pages from County of Maui 2010 Affordable Sales Price Guidelines

ADDENDA

Definitions
Limiting and Contingent Conditions
Qualifications of the Consultant

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PART I – INTRODUCTION

A. EXECUTIVE SUMMARY

Background

The proposed Olowalu Town Master Plan Development is located on both sides of Honoapiilani Highway in Olowalu, Island and County of Maui. The subject is primarily zoned State Agricultural District and consists of approximately 635 acres of land. The project, which is still in its preliminary planning stage, will consist of approximately 1,500 residential units, including single-family, multi-family and live-work units; passive parks and open space, such as cultural preserves, neighborhood parks, and archaeological sites; active parks/community services, such as coastal parks, community centers, schools and police/fire facilities; up to 300,000 square feet of commercial space (inclusive of live-work and civic uses); and, an on-site wastewater treatment facility. Potable water for the project will be provided by a private water well. According to the Developer, the proposed land use is as follows:

Proposed Land Use	Acreage
Urban Residential/Commercial	290 acres
Rural Residential	170 acres
Agricultural	160 acres
Conservation	15 acres
	Total: ± 635 acres

Preliminary plans call for 400 to 800 single-family units, 600 to 900 multi-family/apartment units, and 150 to 200 live-work units. The Developer has estimated an 8- to 10-year build out for Olowalu Town.

Study Objectives

ACM Consultants, Inc. has been retained by Olowalu Town LLC to assess the potential economic and fiscal impacts related to this proposed project. In particular, the Consultants studied economic trends and demographics, and supply and demand factors for residential and commercial properties. Residential properties included single-family residences, single-family house lots, and condominium/apartment units. Commercial properties included vacant developable lots as well as improved properties. In the process, they gathered as much information as possible on real estate activity on Maui while focusing on the West Maui, Central Maui, and the South Maui market.

The objectives of the economic and fiscal impact assessment were as follows: (1) to define and delineate the subject and its market area; (2) to identify and analyze potential economic impacts with regard to the project; and (3) identify and analyze potential fiscal impacts with regard to the project.

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Conclusion

The development of this project will generate significant expenditures by the developer of this subdivision, in addition to the eventual homeowners. These investments are expected to favorably impact the Maui economy on a broad scale, and in a multitude of ways.

- Site work and infrastructure construction for this project will immediately infuse capital into the Maui economy. Numerous consultants will be involved in the initial planning stages, and the construction trades will benefit from the job creation of this project.

- Advertising for the project and marketing of the units will benefit graphic artists, advertising companies, newspapers, real estate sales agents, escrow companies, etc.

- Individual site development will again result in additional work for engineers, architects, material suppliers, equipment rentals and sales, landscaping companies, and other related industries.

- The new housing units will have an indirect affect on retail businesses, restaurants and service establishments as the expanded work force purchases goods and services. This should pass through the entire community, causing a ripple effect and increase the amount of capital flowing through Maui.

- Upkeep of the residential, commercial and light industrial buildings will also translate into work for maintenance companies, painting companies, real estate management and leasing groups, etc.

- Fiscal benefits of this development will include increases in real estate taxes and various fees collected by the County of Maui, as well as additional conveyance tax, income tax and general excise tax inflow for the State of Hawaii.

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SUMMARY OF ECONOMIC IMPACTS

From Development Activities	
Total Construction Expenditures	$394,125,000
Total Indirect Sales	$495,809,250
Total Employment	4,040 jobs
Total Payroll	$189,656,381
Total Residents Supported	9,310 residents
Total Households Supported	2,970 units
Total Excise Tax	$28,422,000
At Full Build-Out	
Annual Taxable Property Values	$52,500,000
Annual Property Tax Revenue	$969,000
In-Migrant Residents	224 residents
Annual In-Migrant Resident County Expenditures	$(641,000)
Annual In-Migrant Resident General Excise Tax	$141,000
Annual In-Migrant Resident State Expenditures	$(1,459,000)

SUMMARY OF FISCAL IMPACTS, COUNTY OF MAUI

Net Annual Revenues at Full Build-Out	$327,000

SUMMARY OF FISCAL IMPACTS, STATE OF HAWAII

Cumulative Net Revenues from Development	$45,862,000
Net Annual Revenues at Full Build-Out	$(994,000)

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B. PURPOSE OF THE REPORT

The purpose of this report, as of May 1, 2011, is to generate an economic and fiscal impact assessment with respect to the proposed Olowalu Town Master Plan Development.

C. INTENDED USE OF THE REPORT

The intended use or function of this report is to provide potential economic and fiscal information and real estate market data to our client to be used in the entitlement process for the Olowalu Town Master Plan Development.

D. SCOPE OF THE REPORT

The Consultant has agreed to provide a current economic and fiscal impact assessment of this project by (1) defining and delineating the market area; (2) identifying and analyzing potential economic impacts with regard to the project; and (3) identifying and analyzing potential fiscal impacts with regard to the project. The assessment will be developed and prepared in conformity with, and subject to, the requirements of the Code of Professional Ethics and the Standards of Appraisal Practice of the Appraisal Institute, and the Uniform Standards of Professional Appraisal Practice.

E. STATEMENT OF COMPETENCY

ACM Consultants, Inc. (formerly ACM Real Estate Appraisers, Inc.) has been actively involved in the real estate appraisal and consulting business since 1982. Our business emphasis has focused mainly on the research, consultation and valuation of residential and commercial properties located within the State of Hawaii. The company considers itself competent to conduct an economic and fiscal impact assessment for a proposed master plan development in Olowalu, Island and County of Maui.

F. EXTRAORDINARY ASSUMPTIONS AND HYPOTHETICAL CONDITIONS

As of May 2011, the subject was still in the preliminary stages of planning. A land use map from the Developer provided a visual indication of the proposed layout of the project district. Several discussions were held with the Developer to better understand the housing products and complementary land uses planned for the subject. The Consultant is not liable for any changes in the project plan past this date, nor for information that has not been released or communicated to the Consultant.

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The Consultant has no control over economic conditions and other international events that could have an affect upon Hawaii's economy and the Maui real estate market. As a result, this report has not made any assumptions regarding potential conflicts with other nations, or global external factors affecting economic conditions here.

Estimated construction costs, multipliers, tax rates, interest rates, earnings estimates, demographic information and per capita government expenditures were utilized by the Consultant in determining the economic and fiscal impacts of this proposed residential subdivision. These figures and statistics were obtained through conversations with those active in the construction industry, in addition to the review of various construction budgets, demographic and governmental reports. This consulting report has been based on the assumption that all information gleaned from third party sources is accurate for analytical purposes.

All conclusions in this counseling report have been stated in 2010 dollars, rounded to the nearest $1,000. In doing so, the Consultant has assumed that all construction costs, multipliers, tax rates, interest rates, earnings estimates, demographic information and per capita government expenditures will remain constant throughout the build-out period. Although the cyclical nature of the real estate market would undoubtedly produce varied annual assessments and impacts, for the purposes of this report, they have been reported as unweighted averages. Furthermore, total category impacts may not equate to the sum of the respective sub-categories due to rounding.

The counseling report is also subject to standard "Limiting and Contingent Conditions" located in the pages following.

G. CONFIDENTIALITY PROVISION

The contents of this economic and fiscal impact assessment are confidential. Release of this counseling report by ACM Consultants, Inc. is limited to you and for your preparation and submission of an Environmental Impact Statement for the proposed Wai'ale Master Plan Development. The intended users of this report include A&B Properties, Inc. and the appropriate government agencies to which this report will be submitted. Any further release of this report, or portions herein, is strictly prohibited and you shall accept the risk and liability for any such release without the previous written consent of ACM Consultants, Inc. Further, you shall indemnify and defend ACM Consultants, Inc., and its individual consultants/appraisers, from any claims arising out of any such unauthorized disclosure.

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H. CERTIFICATION

The undersigned does hereby certify that except as otherwise noted in this appraisal report:

1. The Consultants' compensation is not contingent upon the reporting of a predetermined value or direction in value that favors the cause of the client, the amount of the value estimate, the attainment of a stipulated result, or the occurrence of a subsequent event.

2. The Consultants have no present or prospective interest in the property that is the subject of this report, and no personal interest or bias with respect to the parties involved. Any "Estimate(s) of Market Value" in the consulting report is not based in whole or in part upon the race, color, or national origin of the prospective owners or occupants of the properties in the vicinity of the property appraised.

3. The Consultants have personally inspected the property, and are signatories of this Certification.

4. To the best of the Consultants' knowledge and belief, all statements of fact and information in this report are true and correct, and the Consultants have not knowingly withheld any significant information.

5. No other person provided significant professional assistance to the person(s) signing this report.

6. The reported analyses, opinions and conclusions are limited only by the reported assumptions and limiting conditions, and are the Consultants' personal unbiased professional analyses, opinions and conclusions.

7. All analyses, opinions and conclusions were developed, and this report has been prepared, in conformity with the Uniform Standards of Appraisal Practice.

8. This counseling report is subject to and in conformance with the Code of Professional Ethics and Standards of Professional Conduct of the Appraisal Institute. The analyses, opinions and conclusions of this counseling report have been made in conformity with, and is subject to, the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

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9. This counseling report is to be used only in its entirety and no part is to be used without the whole report. All conclusions and opinions concerning the real estate are set forth in the counseling report were prepared by the Consultants whose signatures appears on the counseling report. No change of any item in the counseling report shall be made by anyone other than the Consultants, and the Consultants shall have no responsibility for any such unauthorized change.

10. The Appraisal Institute, of which the Consultants are members, has a legal right to review this report.

11. The qualifications of the Consultants, including completed educational requirements of their candidacy are located in the Addendum to this report. Any member signing the report has completed the requirements of the Appraisal Institute's continuing education program.

ACM Consultants, Inc.

_____

Glenn K. Kunihisa, MAI, CRE
Certified General Appraiser,
State of Hawaii, CGA-039
Expiration: December 31, 2011

_____

Dominic J. Suguitan
Certified General Appraiser,
State of Hawaii, CGA-576
Expiration: December 31, 2011

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I. LIMITING AND CONTINGENT CONDITIONS

1) This is a Counseling Report which is intended to comply with the reporting requirements set forth under Standards Rule 5 of the Uniform Standards of Professional Appraisal Practice for a Counseling Report. The information contained in this report is specific to the needs of the client and for the intended use stated in this report. The Consultant is not responsible for unauthorized use of this report.

   This report has not been prepared for federally-related mortgage financing purposes, and has not been prepared in compliance with the requirements of Title XI of the Federal Financial Institutions Reform, Recovery, and Enforcement Act of 1989.

2) No responsibility is assumed for legal or title considerations. Title to the property is assumed to be good and marketable unless otherwise stated in this report.

3) The property analyzed is free and clear of any or all liens and encumbrances unless otherwise stated in this report.

4) Responsible ownership and competent property management are assumed unless otherwise stated in this report.

5) The information furnished by others is believed to be reliable. However, no warranty is given for its accuracy.

6) All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property.

7) It is assumed that there are no hidden or unapparent conditions of the property, subsoil, or structures that render it more or less valuable. No responsibility is assumed for such conditions or for arranging for engineering studies that may be required to discover them.

8) It is assumed that there is full compliance with all applicable federal, state, and local environmental regulations and laws unless otherwise stated in this report.

9) It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a nonconformity has been stated, defined, and considered in this counseling report.

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10) It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

11) Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

12) It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report.

13) The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the analysis process.

14) Unless otherwise stated in this report, the subject property is evaluated without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

15) Any proposed improvements are assumed to be completed in a good workmanlike manner in accordance with the submitted plans and specification.

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16) The distribution, if any, of the total valuation in this report between land and improvements applies only under the stated program of utilization. The separate allocations for land and buildings must not be used in conjunction with any other appraisal and are invalid if so used.

17) Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purpose by any person other than the party to whom it is addressed without the written consent of the consultant, and in any event, only with property written qualification and only in its entirety.

18) Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

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PART II – DESCRIPTION OF THE PROPOSED DEVELOPMENT

A. LAND USE

The proposed Olowalu Town Master Plan Development is located on both sides of Honoapiilani Highway in Olowalu, Island and County of Maui. The subject is primarily zoned State Agricultural District and consists of approximately 635 acres of land. The project, which is still in its preliminary planning stage, will consist of approximately 1,500 residential units, including single-family, multi-family and live-work units; passive parks and open space, such as cultural preserves, neighborhood parks, and archaeological sites; active parks/community services, such as coastal parks, community centers, schools and police/fire facilities; up to 300,000 square feet of commercial space (inclusive of live-work and civic uses); and, an on-site wastewater treatment facility. Potable water for the project will be provided by a private water well. According to the Developer, the proposed land use is as follows:

Proposed Land Use	Acreage
Urban Residential/Commercial	290 acres
Rural Residential	170 acres
Agricultural	160 acres
Conservation	15 acres
	Total: ± 635 acres

Preliminary plans call for 565 single-family units, 785 multi-family/apartment units, and 150 live-work units. The Developer has estimated an 8- to 10-year build out for Olowalu Town.

B. UNIT TYPES

Preliminary plans called for approximately 300 single-family units and approximately 450 multi-family units. For purposes of this analysis, the typical single-family unit is assumed to include three bedrooms with an average living area of about 1,200 square feet, and the typical multi-family unit is assumed to include two bedrooms and about 750 square feet.

C. AFFORDABLE PRICE UNITS

Based on the current County of Maui Workforce Housing Ordinance, the subject will be required to offer 50 percent of its proposed 1,500 housing units as on-site affordable units. The current Workforce Housing Ordinance also specifies the following minimum affordable housing unit allocation:

Gap Income (141 to 160% of Maui median income)	20 percent
Above Moderate Income (121 to 140%)	20 percent

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Moderate Income (101 to 120%)	30 percent
Below Moderate Income (81 to 100%)	30 percent

Based on the Workforce Housing Ordinance, approximately 375 affordable housing units would be required. The developer has proposed to provide 750 affordable units. For purposes of this analysis, the following breakdown of 750 affordable units has been assumed. The actual allocation will be based on discussions and agreement with the Maui County Department of Housing and Human Concerns.

Single-Family & Multi-Family

Gap Income	150 units (20 percent)
Above Moderate Income	150 units (20 percent)
Moderate Income	225 units (30 percent)
Below Moderate Income	225 units (30 percent)
Total Affordable Single-family Housing Units	750 units

D. COMMERCIAL/INDUSTRIAL COMPONENT

Based on preliminary plans, the Olowalu Town Master Plan Development will feature approximately 300,000 square feet of Commercial space, including neighborhood commercial, light industrial and village mixed-use. While some of the economic and fiscal impacts attributed to the development of these areas have been estimated, other impacts are more difficult to account for.

For example, at full build-out, there would be additional revenue to the State of Hawaii in the form of conveyance taxes, should commercial or industrial condominium units be constructed. However, this would not be the case if leasable multi-tenant structures were built. Furthermore, the general excise tax to be paid from ongoing sales within these projects cannot be accurately gauged, without knowing the tenant mix. A retail business would likely have gross revenue very different from a professional office user. Another example might be a light industrial space utilized for storage versus a wholesale distribution warehouse. Many of these factors will be determined by future market conditions. As a result, this analysis has conservatively limited its focus to those primary areas of economic impact, with emphasis on the Olowalu Town Master Plan Development's residential component.

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PART III – ECONOMIC IMPACTS OF THE PROPOSED DEVELOPMENT

A. ECONOMIC IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Construction of the Subdivision Improvements

The Developer has estimated that vertical construction costs for the single-family units to be approximately $150 per square foot and about $175 per square foot for the multi-family units. Research of projects offering similar entry level housing units revealed this range to be reasonable. On average, the typical three-bedroom single-family unit will have approximately 1,200 square feet of living area, while the living area for the typical two-bedroom multi-family unit will average approximately 750 square feet. Vertical construction expenditures for the 1,500 proposed housing units totaled approximately $226,125,000. It should be noted that this figure included the residential component of the "live/work" units in the Village Mixed-Use area.

Other estimated vertical construction costs from the Developer were as follows: $75,000,000 for the neighborhood commercial and village mixed use areas; $50,000,000 for the internal roadways and utilities; and $15,000,000 for the wastewater treatment facility and R-1 transmission line; $18,000,000 for the new highway and bridge; $5,000,000 for parks improvements; and, $5,000,000 for a small-scale renewable energy system. The construction expenditures for the Olowalu Town Master Plan Development totaled approximately $394,125,000.

Indirect Sales

Development and construction activities will also generate indirect sales, through the supply of goods and services to the various construction companies, in addition to the families of their employees. By the same token, these suppliers and their families will purchase goods and services from other companies. This chain reaction continues over and over, with some of the revenues leaking out of Hawaii's economy with each cycle. Based on State economic multipliers, off-island indirect sales were estimated at about $291,652,500 over the term of the project. Meanwhile, Maui indirect sales were estimated at about $204,156,750 over the term of the project. Indirect sales attributed to the development totaled approximately $495,809,250.

Direct and Indirect Employment

New job opportunities created by this development will start with the design and entitlement process, employing architects, engineers, surveyors, and land use planners. Site work, road work and the installation of utility and drainage lines typically utilize heavy equipment operators, tractor-trailer drivers and utility personnel. Vertical construction of the housing units, commercial buildings, village

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mixed-use projects and light industrial facilities will employ masons, carpenters, sheet metal workers, roofers, drywall installers, plumbers, electricians and painters. Finish work will require cabinet makers, carpet and tile installers, interior decorators, and landscapers. Application of State economic multipliers resulted in a forecasted annual average of 158 jobs directly related to the construction of this development.

The increase in construction will also create the need for supplementary companies to strengthen their labor force. These jobs may be from building supply companies, hardware stores, equipment rental companies, and shipping/warehousing companies. In addition, the construction laborers and their families will patronize local goods and services providers. Grocers, restaurants, service stations, auto repair shops, financial institutions, recreational venues, medical facilities and personal care businesses could be considered potential companies that would need to bolster their employee count. Based on State economic multipliers, indirect jobs on Maui were forecasted to average 162 jobs annually, resulting in an estimated annual average of 319 Maui jobs directly and indirectly tied to the development of the project. Meanwhile, indirect employment on Oahu could possibly add an average 85 jobs per year. Employment attributed to the development totaled approximately 4,040 jobs over the term of the project.

Direct and Indirect Payroll

Payroll directly related to the development of the project was estimated to be $9,219,258 per annum, based on statistics gleaned from the State of Hawaii Department of Labor and Industrial Relations (DLIR) and job counts determined in the previous section. It should be noted that most construction positions are expected to be filled by Maui laborers.

Indirect Maui payroll came out to about $6,111,737 per year, while indirect Oahu payroll was around $3,634,643 annually. Total direct and indirect payroll attributed to the development of the subject was forecasted to be close to $189,656,381 over the term of the project.

Population Supported by Project Development

Statistical information obtained from the DLIR indicated Maui residents supported by construction jobs attributed to this development are forecasted to average of 373 residents per year, while residents supported by indirect jobs may amount to an average of 383 residents per year.

Oahu residents supported by indirect jobs created by this development were estimated to average 175 residents per year. In

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all, approximately 9,310 residents on Maui and Oahu will potentially be supported by the development of this project.

Housing for Supported Population

Statistical information obtained from the DLIR indicated Maui housing units supported by construction jobs attributed to this development are forecasted to average 118 units per year, while housing units supported through indirect jobs would average about 121 units per year.

Oahu housing units supported through indirect jobs created by this development were estimated to average 59 units per year. In all, about 2,970 housing units on Maui and Oahu will potentially be supported by the development of this project. It should be noted that this category does not necessarily represent additional housing units needed for direct and indirect employees, but indicates the potential number of households that would be financially linked to monies earned by such workers.

B. ECONOMIC IMPACTS AT FULL BUILD-OUT

Property Values at Full Build-Out

For this analysis, the average **market value** for the single-family units (600 units) was estimated at $470,000, while the average **market value** for the multi-family units (900 units) was estimated at $290,000. Based on the unit breakdown provided by the Developer, the total property value of the 1,500 units, at full build-out was estimated at approximately $543,000,000. With an estimated 300,000 square feet of potential commercial space in the project, the estimated total property value, based on $175 per square foot, calculates to $52,500,000.

Long Term Employment

In addition to construction related employment, the commercial and industrial components will provide long term employment opportunities. At full build-out this could result in approximately 850 jobs just in the commercial and industrial sectors within the project. It is recognized that not all of these jobs would be new, since existing Maui businesses could be relocating to the project.

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PART IV – FISCAL IMPACTS, COUNTY OF MAUI

A. FISCAL IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Development Activities

Typically, the County accumulates revenue from developments in the form of fees, such as for building permits and impacts attributed to the development. In this case, fee revenue would be generated from the construction of the overall Olowalu Town Master Plan Development, as well as from the subsequent development of the individual project lots.

Net Taxable Value, Project Housing Units

The Olowalu Town Master Plan Development will feature approximately 600 three-bedroom single-family units and 900 two-bedroom multi-family units. For this analysis, approximately 85 percent of the single family units and 75 percent of the multi family units were assumed to be owner occupied. Accordingly, about 315 market and affordable single-family units and 428 market and affordable multi-family units will be owner-occupied. As such, these homeowners would qualify for the County of Maui homeowner exemption, which currently stands at up to $300,000 per qualified housing unit. The single-family unit owners would be able to claim a $300,000 exemption. Meanwhile, the multi-family unit owners would be exempt for $275,000, or the full value of their property, only owing the County of Maui minimum tax (currently at $150 per year). After deduction of the homeowner exemptions, the net taxable value of the project, including commercial property values, amounted to approximately $215,912,000.

B. FISCAL IMPACTS AT FULL BUILD-OUT

At full build-out, County revenue would primarily be generated in the form of real property taxes. As previously discussed, the net taxable value of the project was determined to be about $215,912,000. Residential owner-occupants who qualify for the County homeowner exemption are assessed at PITT Code 900 (Homeowner). Currently, this tax class has a mill rate of $2.00 per $1,000 of assessed value. The tax obligation for the owner-occupied single-family units was calculated at $263,000 per year. The unoccupied and renter-occupied single-family units will be assessed at PITT Code 100 (Improved Residential). Currently, this tax class has a mill rate of $5.00 per $1,000 of assessed value. The tax obligation for the unoccupied and renter-occupied single-family units amounted to close to $118,000 per year.

As previously discussed, the owner-occupied multi-family units will be fully exempt, but still pay the $150 minimum annual property tax. Thus, the tax obligation for the owner occupied multi-family units amounted to about $117,000 per year. Meanwhile, the unoccupied

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and renter-occupied multi-family units will be assessed at PITT Code 200 (Apartment). Currently, this tax class has a mill rate of $5.00 per $1,000 of assessed value. The tax obligation for the unoccupied and renter-occupied multi-family units was forecasted at $173,000 per year. The tax obligation for the commercial spaces amounted to $328,125. The total estimated annual real property tax attributed to the residential and commercial portion of the project is estimated at $999,000 per year at full build-out.

The Olowalu Town Master Plan Development is slated to be built on the following State of Hawaii Tax Map Keys: (2) 4-8-03, Parcels 005, 071, 072, 084, 098 through 117, 124 and 124. According to the County of Maui Real Property Tax Division, the Developer currently pays approximately $30,972 in property taxes for these parcels. This amount was deducted from the annual revenues at full build-out, as the County will no longer receive this income. The resulting net real property tax revenue at full-build out was estimated to be about $969,000 annually.

County of Maui annual expenditures at full build-out were considered to be for general services, infrastructure maintenance and public safety. This would also include upkeep of public recreational facilities, such as the parks to be provided by the project. Assuming that the majority of the development's future residents already live on Maui, some of these expenses would be incurred by the County no matter where they live. As such, there would not necessarily be an additional cost to the County for *each* resident moving into the Olowalu Town Master Plan Development. Based on demographic statistics for West Maui, it was estimated that the Olowalu Town Master Plan Development will have approximately 4,471 residents. For the purposes of this analysis, it was assumed that 95 percent will be already living on Maui, with the remaining 5 percent, or about 224 residents, being in-migrant residents. The additional cost to the County attributed to these in-migrant residents was estimated to be $599,000 per year, plus debt service of $43,000 per year.

Thus, the net revenue attributed to the project, at full build-out, was estimated to be negative $327,000 per year. It should be noted that since this project will consist mostly of owner-occupant workforce housing units, its property tax base is significantly reduced by the homeowner exemptions. Furthermore, the County of Maui's property tax system is structured in a way that owner-occupant subdivisions such as the subject are essentially subsidized by revenue received from other property classes. The majority of Maui's property tax revenue is generated by time share, hotel/resort, industrial and commercial properties, which have substantially higher mill rates.

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PART V – FISCAL IMPACTS, STATE OF HAWAII

A. FISCAL IMPACTS RELATED TO DEVELOPMENT ACTIVITIES

Although the State of Hawaii will recognize revenue from the project through various taxes, including Conveyance Tax, and Personal Income Tax, this analysis will focus on the Excise Tax as the primary additional revenue source.

Excise tax is based on two rates, 4.166 percent for final sales and 0.5 percent for intermediate sales. The cumulative tax expectancy for final sales amounted to about $25,514,647, while intermediate sales should be close to $2,907,332. Excise tax attributed to the development totaled approximately $28,421,979.

B. FISCAL IMPACTS AT FULL BUILD-OUT

At full build-out, State revenue would be generated by Personal Income Tax, Excise Tax, and Other Revenues. Similar to the previous section, this analysis has focused on Excise Tax. In this case, the Excise Tax to be received from in-migrant residents was estimated to be $141,000 per year.

Annual expenditures to the State were expected to be from services to residents, and debt service attributed to general improvements. It has been estimated for this analysis that the Olowalu Town Master Plan Development will have 224 in-migrant residents, in addition to 34 in-migrant students. At full build-out, the additional students are estimated to increase cost to the State by about $415,000 per year. At the same time, annual expenditure for services from in-migrant residents was forecasted at approximately $961,000 and annual general improvement debt service came out to close to around $83,000. Examples of services to residents include operation of civic, health and social services; as well as maintenance to highways, parks and recreational areas. General improvement debt service was based on typical per-capita figures currently carried by residents in Hawaii. Total annual expenditure at full build-out attributed to in-migrant residents was approximately $1,459,000. When deducted from the total annual revenues from the previous paragraph, the net annual revenue at full build-out was forecasted to be negative $994,000.

The negative net annual revenue at full build-out was primarily attributed to the household income levels within this subdivision. Since The Olowlau Town Master Plan Development will be geared toward the workforce market segment, annual household income is expected to be on the lower side of the range. As excise tax estimates were based on percentages of household income, it is not surprising that total annual revenues were outpaced by total annual expenditures. In

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general, State services to workforce residential communities are subsidized by revenues received from the visitor industry, businesses and communities with higher annual household incomes.

Furthermore, as previously discussed, this assessment has not considered all of the potential impacts from the commercial, village mixed-use and industrial areas upon full build-out. There will need to be a significant number of employees for these areas, which would increase State's personal income tax revenues. Granted, many of these positions would be filled by those already in the workforce, yet those coming of working age and transplants from off-island would also be potential employees. With regard to general excise tax, some sales generated by the subject's commercial, village mixed-use and industrial areas may take away from sales of existing businesses. However, new sales will also contribute to the amount of general excise tax collected by businesses.

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PART VI – REFERENCES

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County of Maui, Maui County Code, Title 2, Chapter 2.96, "Residential Workforce Housing Policy", December 2006, revised 2007, 2008 & 2010

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Realtors Association of Maui, Inc., "Maui Sales Statistics", 2008 through December 2010

County Of Maui, Department of Housing and Human Concerns, Housing Division, "2010 Affordable Sales Price Guidelines", effective June 1, 2010

State of Hawaii, Hawaii Workforce Infonet, "2009 Employment and Payrolls in Hawaii", December 2010

Claritas, Inc., "Demographic Snapshot Comparison Reports- Maui County and West Maui", August 2010

County of Maui, Department of Finance, Real Property Tax Division, 2010

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County of Maui, Office of Economic Development, "Maui County Data Book 2010", May 2011

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EXHIBITS

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EXHIBIT A

Copy of County of Maui
Residential Workforce Housing Policy

Chapter 2.96

RESIDENTIAL WORKFORCE HOUSING POLICY

Sections:

2.96.010 Purpose.
2.96.020 Definitions.
2.96.030 Applicability.
2.96.040 Residential workforce housing requirements.
2.96.050 Residential workforce housing credits.
2.96.060 Residential workforce housing restrictions--ownership units.
2.96.070 Residential workforce housing restrictions--rental units.
2.96.080 Residential workforce housing agreement.
2.96.090 Applicant selection process--ownership units.
2.96.100 Applicant selection process--rental units.
2.96.110 Review requirements.
2.96.120 Rules.
2.96.130 Property assessment value.
2.96.140 Incentives.
2.96.150 Qualified housing providers.

2.96.010 Purpose.

The purpose of this chapter is to enhance the public welfare by ensuring that the housing needs of the County are addressed. The council finds that there is a critical shortage of affordable housing, making home acquisition by the majority of County resident workers extremely difficult, and creating a shortage of affordable rental units. The resident workforce is leaving the County in search of affordable housing, and new employees are being deterred by the high cost of living. To maintain a sufficient resident workforce in all fields of employment, and to ensure the public safety and general welfare of the residents of the County, resident workforce housing needs must be addressed. It is the intent of this chapter to encourage the provision and maintenance of residential workforce housing units, for both purchase and rental, to meet the needs of income-qualified households for the workforce, students, and special housing target groups. (Ord. 3418 § 1 (part), 2006)

2.96.020 Definitions.

Whenever used in this chapter, unless a different meaning clearly appears from the context:

"Community land trust" means a nonprofit organization that acquires land that:

1. Is held in perpetuity;
2. Is primarily for conveyance under a long-term ground lease for the creation of dwelling units that shall be sold or rented to applicants within the income-qualified groups established by this chapter; and
3. Retains an option to purchase any dwelling unit at a price determined by formula that is designed to ensure that the dwelling unit remains affordable in perpetuity.

"Council" means the Maui County council.

"Density bonus" means a density increase over the otherwise allowed residential density

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under the applicable zoning and land use designation, without the need for further council approval, subject to enabling legislation.

"Department" means the department of housing and human concerns.

"Director" means the director of housing and human concerns, County of Maui.

"Disabled" means a person who is determined, by a medical doctor, to have a physical, mental, or emotional impairment that:

1. Is expected to be of long-continued and indefinite duration;
2. Substantially impedes his or her ability to live independently; and
3. Is of such a nature that the ability to live independently could be improved by more suitable housing conditions.

"Division" means the housing division of the department of housing and human concerns, County of Maui.

"Elderly" means a person who has attained the age of sixty-two years.

"Employed" means working for compensation in the County for any number of hours.

"Homeless" means:

1. An individual or family who lacks a fixed, regular, and adequate nighttime residence; or
2. An individual or family who has a primary nighttime residence that is:
    a. A supervised shelter designed to provide temporary living accommodations; or
    b. A place not designed for or ordinarily used as sleeping accommodations for human beings.

"HUD" means the United States Department of Housing and Urban Development.

"Improved land" means land that has necessary infrastructural improvements to support a public use project or a use density of at least a single-family or a two-family residential building per acre, in conformity with state and County zoning laws and building permit requirements.

"Lot" means any improved or unimproved land that has been subdivided.

"Median family income" means the middle income in a series of incomes ranked from smallest to largest as determined by HUD for the County, or as adjusted by the department, for Hana, Lanai, and Molokai.

"Off-site" means any area outside the boundaries of the development within the community plan area.

"On-site" means the area on, or within the boundaries of, the approved development within the community plan area.

"Prevailing interest rate" means the average interest rate of two mortgage lenders in the County, acceptable to the director, for a thirty year fixed loan with no discount points.

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"Qualified housing provider" means a community land trust, nonprofit agency, or other private or public organization, agency, or entity authorized and designated by the department in accordance with section 2.96.150 to own, develop, construct, administer, operate or otherwise provide residential workforce housing required under this chapter.

"Resident" means a person who meets one of the following criteria:

1. Currently employed in the County;
2. Retired from employment in the County, having worked in the County immediately prior to retirement;
3. A full-time student residing in the County;
4. A disabled person residing in the County who was employed in the County prior to becoming disabled;
5. The parent or guardian of a disabled person residing in the County;
6. A spouse or dependent of any such employee, retired person, student, or disabled person residing in the County; or
7. In the event of the death of the employee, retired person, student, or disabled person, the spouse or dependent of any such person residing in the County.

"Residential workforce housing unit" means a unit or lot to be sold or rented to residents within one of the following income groups as established by the department:

1. "Very low income," which are those households whose gross annual family income is fifty percent or less of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai;
2. "Low income," which are those households whose gross annual family income is more than fifty percent, but not more than eighty percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai;
3. "Below-moderate income," which are those households whose gross annual family income is more than eighty percent, but not more than one hundred percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai;
4. "Moderate income," which are those households whose gross annual family income is more than one hundred percent, but not more than one hundred twenty percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai;
5. "Above-moderate income," which are those households whose gross annual family income is more than one hundred twenty percent, but not more than one hundred forty percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai; and
6. "Gap income," which are those households whose gross annual family income is more than one hundred forty percent, but not more than one hundred sixty percent of the area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai.

"Special housing target group" means a group of residents that can be demographically defined as having a special or unique housing need, including but not limited to, the elderly, homeless, and disabled.

"Unimproved land" means land not classified as "improved land."

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"Wait list area" means Hana, Lanai, Maui (excluding Hana), or Molokai. (Ord. No. 3719, § 1, 2010; Ord. 3512 § 1, 2007; Ord. 3418 § 1 (part), 2006)

2.96.030 Applicability.

A. Any development, including the subdivision of land and/or the construction of single-family dwelling units, two-family dwelling units, multifamily dwelling units, or hotels, as defined in section 19.04.040 of this code, whether constructed at one time or over several years, shall be subject to this chapter upon final subdivision or building permit approval, whichever is applicable and occurs first, if it will result in the creation of the following:

1. Five or more dwelling units, excluding farm labor dwellings or a second farm dwelling, as defined in section 19.04.040 of this code; provided that, such farm labor dwelling or farm dwelling is in full compliance with chapter 205, Hawaii Revised Statutes, and is not part of a condominium property regime, as set forth in chapter 514A, Hawaii Revised Statutes;
2. Five or more new lots;
3. A combination of dwelling units and new lots totaling five or more;
4. Three or more lodging, dwelling, or time share units in a hotel;
5. A conversion of one or more hotel units to dwelling units or time share units; or
6. Any hotel redevelopment or renovation project that increases the number of lodging or dwelling units in a hotel.

B. Exemptions. This chapter shall not apply to any development that falls into one or more of the following categories:

1. A development subject to an affordable housing requirement, evidenced by an executed affordable housing agreement with the County, currently in effect and approved prior to the effective date of this chapter;
2. A development subject to a change in zoning condition that requires affordable or residential workforce housing, unless the condition expressly allows for the application of the affordable housing or residential workforce housing policy set forth herein;
3. A subdivision granted preliminary subdivision approval prior to the effective date of this chapter;
4. A building permit application submitted prior to the effective date of this chapter;
5. A family subdivision, for immediate family members, as described in sections 18.20.280.B.1 and B.2 of this code; or
6. A development by a government entity; a project pursuant to section 201H-H, Hawaii Revised Statutes; a community land trust; or an affordable housing project with more than the residential workforce housing units, in-lieu fees, or in-lieu land required by section 2.96.040 of this chapter, as approved by the director.

C. Adjustment.

1. A developer of any development subject to this chapter may appeal to the council for a reduction, adjustment, or waiver of the requirements based upon the absence of any reasonable relationship or nexus between the impact of the development and the number of residential workforce housing units or in-lieu fees/land required.
2. Any such appeal shall be made in writing and filed with the County clerk prior to final subdivision approval or issuance of a building permit for the development, whichever is applicable. Any such appeal shall administratively stay the processing of the development's subdivision or building permit, whichever is applicable, until a decision on the appeal is rendered. The appeal shall set forth in detail the factual and legal basis for the claim of reduction, adjustment, or waiver, and the developer shall bear the burden of presenting substantial evidence to support the appeal, including comparable and relevant

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technical information.

3. The council, or if the appeal is assigned to a council committee, the council committee, shall convene a meeting within forty-five days of the County clerk's receipt of the appeal, to consider the appeal. The council shall approve or disapprove the appeal by resolution within forty-five days from the date the developer has concluded its presentation of evidence supporting the appeal in a council or committee meeting.

4. If the council or a council committee has not convened a meeting within forty-five days of the County clerk's receipt of the appeal, or if the council does not approve or disapprove the appeal by resolution within forty-five days from the date the developer has concluded its presentation of evidence at the council or council committee meeting, the appeal, as submitted by the developer, shall be deemed approved by the council.

5. If a reduction, adjustment, or waiver is granted by the council, any subsequent substantive change or modification in use within the development, as determined by the director, shall invalidate the reduction, adjustment, or waiver previously granted. (Ord. 3546 § 1, 2008; Ord. 3418 § 1 (part), 2006)

2.96.040 Residential workforce housing requirements.

A. Prior to final subdivision approval or issuance of a building permit for a development subject to this chapter, the department shall require the developer to enter into a residential workforce housing agreement that requires the following:

1. Where the residential workforce housing requirement is satisfied exclusively through the provision of on-site units:

a. When more than fifty percent of the dwelling units and/or new lots in the development are offered for sale for less than $600,000, at least twenty-five percent of the total number of units and/or lots shall be sold or rented to residents within the income-qualified groups established by this ordinance; or

b. When fifty percent or more of the dwelling units and/or new lots in the development are offered for sale for $600,000 or more, at least fifty percent of the total number of units and/or lots shall be sold or rented to residents within the income-qualified groups established by this ordinance.

2. Where the residential workforce housing requirement is satisfied through the provision of off-site units:

a. When more than fifty percent of the dwelling units and/or new lots in the development are offered for sale for less than $600,000, then the number of off-site residential workforce housing units due shall be equal to fifty percent of the total number of on-site market rate units; or

b. When fifty percent or more of the dwelling units and/or new lots in the development are offered for sale for $600,000 or more, then the number of off-site residential workforce housing units due shall be equal to fifty percent of the total number of on-site market rate units.

3. When three or more new lodging, dwelling, or time share units in a hotel are created, or when there is a conversion of one or more hotel units to dwelling units or time share units, or when any hotel redevelopment or renovation project increases the number of lodging or dwelling units in the hotel, or when five or more new dwelling units for rental purposes are created, then forty percent of the total number of new, additional and/or converted units shall be sold or rented to residents within the income-qualified groups established by this ordinance.

B. The requirement may be satisfied by one or a combination of the following, which shall be determined by the director and stated in the residential workforce housing agreement:

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1. Offer for sale, single-family dwelling units, two-family dwelling units, or multi-family dwelling units as residential workforce housing within the community plan area;
2. Offer for rent, multi-family dwelling units within the community plan area. A developer may partner with a nonprofit organization or community land trust on a specific affordable project to either construct new multi-family dwelling units or renovate existing nonhabitable multi-family dwelling units, paying an amount that represents the difference in unit costs for a family of four at one hundred percent and one hundred forty percent of median income pursuant to HUD affordable sales price guidelines as adjusted by the department by wait list area. The developer's requirement shall be deemed satisfied upon receipt of payment. Moneys shall be deposited into the affordable housing fund;
3. In lieu of directly selling or renting units pursuant to subsection B.1 or B.2, the developer may convey such units to a qualified housing provider subject to department approval pursuant to section 2.96.150; or
4. In lieu of providing residential workforce housing units, the residential workforce housing requirement may be satisfied by payment of a fee, by providing improved land, or by providing unimproved land. Any fee must be approved by council resolution. Any donation of land must be approved by the council pursuant to section 3.44.015 of this code.

a. The in-lieu fee per unit for sale/ownership units shall be equal to thirty percent of the average projected sales price of the market rate dwelling units and/or new lots in the development. The in-lieu fee per unit for hotel, time share, converted or rental units shall be an amount that represents the difference in unit costs for a family of four at one hundred percent and one hundred sixty percent of median income pursuant to HUD affordable sales price guidelines, or as adjusted by the department, for Hana, Lanai, and Molokai. The in-lieu fee shall be designated in the residential workforce housing agreement, and be secured by a lien on the units if not paid before the units are constructed or converted. The in-lieu fee shall accrue to the affordable housing fund, which shall be established in the County budget for the purpose of enhancing and supporting housing needs and programs of income-qualified households and special housing target groups; and

b. The value of the improved land shall not be less than the in-lieu fee that would otherwise have been required under this chapter. The value of the unimproved land shall be at least equal to twice the value of the improved land. The in-lieu land shall be used to address the housing needs of income-qualified households and special housing target groups. Such land shall have a minimum lot size of six thousand square feet or the minimum lot size allowed by the applicable zoning, whichever is greater. Such land must be acceptable to the department and may be used by the County or others approved by the County to develop residential workforce housing, resource centers for the homeless, day care centers for seniors, or other public use projects that address the housing needs of income-qualified households and special housing target groups. (Ord. No. 3719, § 2, 2010; Ord. 3438 § 1, 2007: Ord. 3418 § 1 (part), 2006)

2.96.050 Residential workforce housing credits.

A. Credits may be given under the following circumstances:

1. One residential workforce housing credit shall be given for every single-family dwelling unit, two-family dwelling unit, or multifamily dwelling unit constructed in excess of the residential workforce housing required by section 2.96.040 of this chapter; and
2. One residential workforce housing credit shall be given for every ten market rate units

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that contain a deed restriction requiring an owner to occupy the unit for a minimum of three years, and share with the County fifty percent of any profits realized from a sale of that unit within the three-year owner-occupancy period.

B. The credit must be used in the same community plan area in which the unit was constructed.

C. The credit must be applied toward the same type of unit constructed.

D. The credit must be used for the same income group in which the credit was earned, when the credit is earned by constructing more residential workforce housing units than required.

E. The credit must be used for the "gap income" group when the credit is earned by creating a deed restriction.

F. The credit may be used for a future development, but may not be used for an affordable housing or residential workforce housing unit owed at the time the credit is given. (Ord. 3418 § 1 (part), 2006)

2.96.060 Residential workforce housing restrictions--ownership units.

A. Ownership units shall be subject to this chapter for twenty-five years from the initial sale of the unit.

B. Unless an exemption is granted by the director, the percentage of ownership units within each income group shall be as follows:

1. Thirty percent of the ownership units shall be for "below-moderate income" residents;
2. Thirty percent of the ownership units shall be for "moderate income" residents;
3. Twenty percent of the ownership units shall be for "above-moderate income" residents; and
4. Twenty percent of the ownership units shall be for "gap income" residents.

C. Timing of Completion.

1. Residential workforce housing units shall be made, available for occupancy either before or concurrently with market rate units at the same ratio required of the development; and
2. Certificates of occupancy shall not be issued and/or final inspections shall not be passed for the market rate units unless certificates of occupancy are issued and/or final inspections are passed for the residential workforce housing units concurrently or sooner.

D. Deed Restrictions.

1. The unit must be owner-occupied;
2. The unit must remain affordable for twenty-five years from the initial sale, with the owner notifying the department upon a decision to sell; and
3. Under special circumstances an owner of a residential workforce housing unit may appeal to the department for a waiver of the owner-occupancy deed restriction; these circumstances would include, but are not limited to, assignment to active duty military or short-term contracts for off-island employment.

E. Sales Price—Single-Family Dwelling Units. The sales price of a new single-family dwelling unit shall be set by the department, at the time the developer is ready to market the unit, using the following guidelines:

1. A down payment of five percent shall be assumed;
2. The prevailing interest rate shall be used;
3. The price of a one-bedroom unit shall be based upon seventy percent of the median income of the wait list area, adjusted to the respective target income group;
4. The price of a two-bedroom unit shall be based upon eighty-five percent of the median income of the wait list area, adjusted to the respective target income group;
5. The price of a three-bedroom unit shall be based upon one hundred percent of the median income of the wait list area, adjusted to the respective target income group;

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6. The price of a four-bedroom unit shall be based upon one hundred fifteen percent of the median income of the wait list area, adjusted to the respective target income group; and

7. Applicants in each income group shall be assumed to pay no more than thirty percent of the gross annual income of the highest percentage in the applicant's group.

F. Sales Price—Two-Family or Multifamily Dwelling Units. The sales price of a new two-family or multifamily dwelling unit shall be ninety percent of the price of a single-family dwelling unit, as established in subsection E of this section.

G. Resale Price. The maximum resale price shall be established by the department using the following guidelines:

1. An appraisal of the property shall be required before occupancy;

2. A second appraisal shall be required upon a decision to sell the unit; and

3. Twenty-five percent of the difference between the two appraisals shall be added to the owner's purchase price.

H. Foreclosures.

1. The County shall have the first option to purchase the unit; and

2. If the County does not exercise its right to purchase, the units may be offered at an affordable price, set by the director, with the same deed restrictions. (Ord. 3418 § 1 (part), 2006)

2.96.070 Residential workforce housing restrictions--rental units.

A. Rental units shall be subject to this chapter for the life of the unit, as determined by a building inspector with the development services administration of the department of public works and environmental management.

B. Unless an exemption is granted by the director, the percentage of rental units within each income group shall be as follows:

1. One-third of the rental units shall be for "very low income" and "low income" residents;

2. One-third of the rental units shall be for "below-moderate income" residents; and

3. One-third of the rental units shall be for "moderate income" residents.

C. Timing of Completion.

1. Except when the developer is partnering with a nonprofit organization or community land trust as allowed in section 2.96.040.B.2 of this chapter, residential workforce housing units shall be made available for occupancy either prior to or concurrently with market rate units at the same ratio required of the development. Certificates of occupancy shall not be issued and/or final inspections shall not be passed for the market rate units unless certificates of occupancy are issued and/or final inspections are passed for the residential workforce housing units concurrently or sooner; and

2. When the developer is partnering with a nonprofit organization or community land trust, the payment to the nonprofit organization or community land trust must be made prior to final subdivision approval or issuance of a building permit for the market rate units. The residential workforce housing units must be constructed within three years of the date the certificates of occupancy are issued and/or the final inspections are passed for the market rate units.

D. Vacancies. Any rental unit vacancy must be filled by an applicant in the appropriate income group to better maintain an equal distribution of rentals across the "very low income" and "low income," "below-moderate income," and "moderate income" groups.

E. Deed Restrictions.

1. The rental unit must remain affordable for the life of the unit;

2. The owner must notify the department upon a decision to sell the rental development;

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and

3. Any new owner must comply with the deed restrictions.

F. Rental Rates. The monthly rental rates shall be set by the department based on HUD income limits.

G. Foreclosures.

1. The County will have the first option to purchase the rental development; and

2. If the County does not exercise its right to purchase, the rental development may be sold with the same deed restrictions. (Ord. 3418 § 1 (part), 2006)

2.96.080 Residential workforce housing agreement.

A. Before final subdivision approval or issuance of a building permit, the developer shall enter into a residential workforce housing agreement that sets forth the detailed terms and conditions of compliance with the residential workforce housing policy, including but not limited to:

1. Sales or rental periods for the residential workforce housing units, which specify procedures for the release of units from the residential workforce housing requirements should units not be sold or rented following the expiration of the sales or rental periods;
2. Identification of the number, type, and location of units;
3. Designation of units for specific income and/or special housing target groups;
4. Marketing process for the residential workforce housing units;
5. Eligibility of income-qualified households;
6. Provision for residential workforce housing credits, as applicable;
7. Payment of in-lieu fees or provision of in-lieu land; and
8. Resale restrictions, which may include buy-back provisions, shared equity, and encumbrances.

B. The residential workforce housing agreement shall be recorded with the bureau of conveyances of the State of Hawaii or the land court of the State as the case may be, so that the terms and conditions of the agreement run with the land and bind and constitute notice to all subsequent grantees, assignees, mortgagees, lienors, and any other persons who claim an interest in such property. The agreement shall be enforceable by the County by appropriate action at law or suit in equity, against the developer, its successors, and assignees. (Ord. 3418 § 1 (part), 2006)

2.96.090 Applicant selection process--ownership units.

A. Wait List Procedure.

1. The developer, its partner, or its management company shall establish wait lists of interested applicants by development;

2. Prior to initiating the wait list, the developer, its partner, or its management company shall publish in at least five issues of a newspaper of general circulation within the County, a public notice that shall contain all information that is relevant to the establishment of the wait list. The public shall also be informed in a like manner, of any decision that would substantially affect the maintenance and use of the wait list; and

3. Selection for purchase shall be made by a lottery administered by the developer, its partner, or its management company and overseen by the department, subject to the applicant meeting the eligibility criteria established in subsection B of this section.

B. Eligibility Criteria. In order to be eligible for a residential workforce housing unit, an applicant must meet the following criteria:

1. Be a citizen of the United States or a permanent resident alien who is a resident of the

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County;

2. Be eighteen years of age or older;

3. Have a gross annual family income (not to include the income of minors) which does not exceed one hundred sixty percent of the County's area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai. Initial determination for compliance with the maximum gross annual family income provision shall be made by the developer, its partner, or its management company for the initial sale of residential workforce housing units, on the basis of the information provided on the ownership application. The ownership application will be completed when a specific unit is being considered. Final determination for compliance with the maximum gross annual family income provision shall be made by the prospective lender at the time the applicant's income verification data is received;

4. Have assets that do not exceed one hundred sixty percent of the County's area median income as established by HUD, or as adjusted by the department, for Hana, Lanai, and Molokai. Assets shall include all cash, securities, stocks, bonds and real property. Real property shall be valued at fair market value less liabilities on such real property;

5. For a period of three years before the submittal of the ownership application, have not had an interest of fifty percent or more in real property in fee or leasehold in the United States, where the unit or land is deemed suitable for dwelling purposes, unless the applicant is selling an affordable unit and purchasing a different affordable unit that is more appropriate for the applicant's family size; and

6. Pre-qualify for a loan with the applicant's choice of lender.

C. Notification of Change. Each applicant shall be responsible for notifying the developer, its partner, or its management company in writing of any changes in mailing address, telephone number, fax number, and/or e-mail address. If an applicant fails to properly notify the developer, its partner, or its management company of such changes and the developer, its partner, or its management company is unable to contact the applicant, the developer, its partner, or its management company shall remove the applicant's name from the wait list.

D. Selection Priority.

1. Residents on the wait list shall receive first priority for the available units. Nonresidents on the wait list may purchase a residential workforce housing unit once the wait list has been exhausted of all residents;

2. The developer, its partner, or its management company may do a mass mailing of housing applications to applicants on the wait list;

3. The residential workforce housing units must be offered to residents in the order in which their names were drawn in the lottery, provided that there is a unit available in the income group for which they qualify. Nonresidents will be offered residential workforce housing units in the order in which their names were drawn in the lottery; and

4. In the event that units are not sold within the first ninety days after they are offered for sale, and the developer has made a good faith effort, as determined by the director, to contact and qualify applicants on the wait list, the sale of remaining units shall be conducted as follows:

a. For the next ninety-day period, units shall be offered for sale to the next-higher income preference group, at the original sales price. For example, units targeted for families earning up to one hundred twenty percent of the median income may be sold to families earning up to one hundred forty percent of the median income. All other eligibility criteria shall apply;

b. Units shall be offered to the next higher income group every ninety days until the units are sold or there are no more income groups available;

c. Units shall then be offered to nonresidents on the wait list in the order in which their

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names were drawn in the lottery, for the next ninety-day period, provided that the applicant's income is within the residential workforce housing income groups; and

d. Any units that remain unsold may be offered at market rate without deed restrictions. Upon the sale of the unit, the County shall receive fifty percent of the difference between the original sales price of the unit and the actual market rate sales price, for deposit into the affordable housing fund. In this event, the developer shall still be deemed to have satisfied the requirement for producing a residential workforce housing unit.

5. The developer shall submit copies of the following information to the department to verify the sale of residential workforce housing units to eligible buyers:

a. Applicant's completed ownership application;

b. Executed sales contract;

c. Pre-qualification notice from lender;

d. All signed federal and state tax returns used to determine eligibility, or any other documents used to determine eligibility by the lender; and

e. Escrow company's settlement statement.

6. An owner of a residential workforce housing unit that is being resold must sell the unit to an income-qualified household and notify the department of the sale. The department shall verify the sales price. (Ord. 3418 § 1 (part), 2006)

2.96.100 Applicant selection process--rental units.

A. Wait List Procedure.

1. The developer, its partner, or its management company shall establish wait lists of interested applicants by rental development;

2. Prior to initiating the wait list, the developer, its partner, or its management company shall initiate the wait list process by publishing in at least five issues of a newspaper of general circulation within the County, a public notice that shall contain all information that is relevant to the establishment of the wait list. The public shall also be informed in a like manner, of any decision that would substantially affect the maintenance and use of the wait list; and

3. Selection for rental units shall be made by a lottery administered by the developer, its partner, or its management company and overseen by the department, subject to the applicant meeting the eligibility criteria established in subsection B of this section.

B. Eligibility Criteria. The eligibility criteria for rentals shall be established on a project-by-project basis by the director in the following manner:

1. If the project is receiving federal and/or state assistance, the applicable federal and/or state eligibility criteria shall apply; and

2. If the project is not receiving federal and/or state assistance, all eligibility criteria in section 2.96.090.B of this chapter shall apply, except for section 2.96.090.B.6 of this chapter.

C. Notification of Change. Each applicant shall be responsible for notifying the developer, its partner, or its management company in writing of any changes in mailing address, telephone number, fax number, and/or e-mail address. If an applicant fails to properly notify the developer, its partner, or its management company of such changes and the developer, its partner, or its management company is unable to contact the applicant, the applicant's name shall be removed from the applicable wait list.

D. Selection Priority.

1. Residents on the wait list shall receive first priority for the available units. Nonresidents on the wait list may rent a residential workforce housing unit once the wait list has been

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exhausted of all residents.

2. The developer, its partner, or its management company may do a mass mailing of housing applications to applicants on the wait list.

3. The residential workforce housing units shall be offered to residents in the order in which their names were drawn in the lottery, provided that there is a unit available in the income group for which they qualify. Nonresidents will then be offered residential workforce housing units in the order in which their names were drawn in the lottery, provided that there is a unit available in the income group for which they qualify.

4. The developer, its partner, or its management company shall submit copies of the following information to the department to verify the rental of residential workforce housing units to eligible renters:

a. Applicant's completed final rental application;

b. Executed rental lease; and

c. All signed federal and state tax returns used to determine eligibility, or any other documents used to determine eligibility by the developer, its partner, or its management company.

5. The developer, its partner, or its management company shall maintain a wait list for the development after all of the units are rented, which shall be used to fill any vacancy.

6. Any rental unit vacancy shall be filled by an applicant in the same income group as the original tenant to maintain an equal distribution of rentals across the "very low income" and "low income," "below-moderate income," and "moderate income" groups.

7. An owner of a residential workforce housing rental development intending to sell the development shall notify the department in writing prior to the closing of the sale, and shall provide documentation to the department that the prospective new owner acknowledges and is aware of the terms, conditions, and restrictions encumbering the development as set forth in section 2.96.070. (Ord. 3546 § 2, 2008; Ord. 3418 § 1 (part), 2006)

2.96.110 Review requirements.

A. The council shall review this chapter every two years.

B. The director shall provide an annual report to the council on the status of the housing policy that shall include the following:

1. The number of units built for sale and rent, categorized by number of bedrooms, income group, and sales price if for sale;

2. The number of purchasers who resold units, categorized by number of bedrooms, income group, and sales price; and

3. The number of developers, their partner(s), or their management companies maintaining a wait list, and the number of applicants on each wait list.

C. For rental developments, the developer, its partner, or its management company shall submit an annual report of rental units to the department that includes the following:

1. The tenant's move-in date; and

2. The income group of the tenant or family. (Ord. 3418 § 1 (part), 2006)

2.96.120 Rules.

The director shall adopt administrative rules to implement this chapter, pursuant to chapter 91, Hawaii Revised Statutes, within one hundred eighty days after the effective date of the ordinance codified in this chapter. (Ord. 3418 § 1 (part), 2006)

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2.96.130 Property assessment value.

The annual tax assessed value, as determined by the County, will take into account the limited resale value of the residential workforce housing property. (Ord. 3418 § 1 (part), 2006)

2.96.140 Incentives.

A. For developments subject to this chapter, and under the jurisdiction of the development services administration of the department of public works and environmental management, decisions on permits will be made by all departments within sixty days of the date the permit application is deemed complete by the development services administration. Decisions on permits that require review by any outside agency will be made within thirty days of receipt by the development services administration of the last approval from an outside agency; provided, that decisions on applications that require special management area permit review, or environmental review pursuant to chapter 343, Hawaii Revised Statutes, shall be issued within ninety days of completion of the applicable review.
B. For developments subject to this chapter, and if applicable, the council will schedule the initial meeting for such application within six months of the referral to the appropriate committee. The council will vote to approve or deny the application within one year of the referral to committee.
C. Developments that include on-site residential workforce housing units may be entitled to a density bonus, subject to enactment of enabling legislation. (Ord. 3418 § 1 (part), 2006)

2.96.150 Qualified housing providers.

Where the department determines that such an agreement will further the purposes of this chapter, the department shall enter into an agreement, on a project-by-project basis, with a qualified housing provider. Such an agreement may provide, without limitation, that the qualified housing provider shall:
A. Receive, own, manage, rent, operate and sell residential workforce housing units provided by developers pursuant to section 2.96.040 of this chapter;
B. Enter into agreements with developers pursuant to section 2.96.040.B.2 of this chapter, subject to the department's approval, pursuant to which residential workforce housing units are developed, constructed, renovated, or otherwise made available to satisfy the purposes of this chapter;
C. Receive land and in-lieu fees provided by developers pursuant to section 2.96.040.B.4 of this chapter;
D. Receive disbursements from the affordable housing fund and other funds provided for the purposes of this chapter; and/or
E. Administer the selection processes under sections 2.96.090 and 2.96.100 of this chapter, subject to the department's oversight.

1. Where a qualified housing provider receives, owns, develops, rents, operates or sells residential workforce housing units, such units shall be rented or sold to applicants qualified under this chapter, as set forth in the qualified housing provider's agreement with the department;
2. Selection of purchasers or renters for a qualified housing provider's units shall be made in accordance with sections 2.96.090 and 2.96.100 of this chapter or with other selection processes permitted under the qualified housing provider's agreement with the department;
3. All qualified housing provider rentals or sales shall be on terms, conditions and

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restrictions set forth in the agreement, which shall be at least as restrictive as the terms, conditions and restrictions applicable to developer rentals or sales under this chapter, and may be more restrictive; and

4. All qualified housing provider agreements shall require detailed reports to the department, on no less than an annual basis, of the qualified housing provider's implementation of, and compliance with, the agreement. This report shall include an annual financial audit. (Ord. 3418 § 1 (part), 2006)

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EXHIBIT B

Selected Pages from County of Maui
2010 Affordable Sales Price Guidelines

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ADDENDA

DEFINITIONS

The purpose of this Glossary is to assist the reader in understanding specific terminology used in this report.

Appraisal (noun) the act or process of developing an opinion of value; an opinion of value (adjective) of or pertaining to appraising and related functions such as appraisal practice or appraisal services.

Cash Equivalent A price expressed in terms of cash, as distinguished from a price expressed totally or partly in terms of the face amounts of notes or other securities that cannot be sold at their face amounts.

Counseling Providing competent, disinterested, and unbiased advice and guidance on diverse problems in the broad field of real estate; may involve any or all aspects of the business such as merchandising, leasing, management, acquisition/disposition planning, financing, development, cost-benefit studies, feasibility analysis, and similar services. Counseling services are often associated with evaluation, but they are beyond the scope of appraisal.

Discounting A procedure used to convert periodic incomes, cash flows, and reversions into present value; based on the assumption that benefits received in the future are worth less than the same benefits received now.

Extraordinary Assumption An assumption, directly related to a specific assignment, which, if found to be false, could alter the consultant's opinions or conclusions. Extraordinary assumptions presume as fact otherwise uncertain information about physical, legal, or economic characteristics of the subject property; or about conditions external to the property such as market conditions or trends; or about the integrity of data used in an analysis. An extraordinary assumption may be used in an assignment only if:

- It is required to properly develop credible opinions and conclusions;
- The consultant has a reasonable basis for the extraordinary assumption;
- Use of the extraordinary assumption results in a credible analysis; and
- The consultant complies with the disclosure requirements set forth in USPAP for extraordinary assumptions.

Fair Value The cash price that might reasonably be anticipated in a current sale under all conditions requisite to a fair sale. A fair sale means that buyer and seller are each acting prudently, knowledgeably, and under no necessity to buy or sell-, i.e., other than in a forced or liquidation sale. The consultant should estimate the cash price that might be received upon exposure to the open market for a reasonable time, considering the property type and local market conditions. ***When a current sale is unlikely-i.e., when it is unlikely that the sale can be completed within 12 months-the consultant must discount all cash flows generated by the property to obtain the estimate of fair value.*** These cash flows include, but are not limited to, those arising from ownership, development, operating, and sale of the property. The discount applied shall reflect the consultant's judgment of what a prudent, knowledgeable purchase under o necessity to buy would be willing to pay to purchase the property in a current sale.

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Fee Simple Estate Absolute ownership encumbered by any other interest or estate, subject only to the limitations imposed by the governmental powers of taxation, eminent domain, police power, and escheat.

Hawaiian Terms The Hawaiian words "mauka" and "makai" are commonly used in the islands as indicators of direction. The word "mauka" means toward the mountain, and "makai" means toward the ocean.

Highest and Best Use The reasonably probable and legal use of vacant land or an improved property, which is physically possible, appropriately supported, financially feasible, and that results in the highest value. The four criteria the highest and best use must meet are legal permissibility, physical possibility, financial feasibility, and maximum profitability.

Highest and Best Use of Land or a Site as Though Vacant Among all reasonable, alternative uses, the use that yields the highest present land value, after payments are made for labor, capital, and coordination. The use of a property based on the assumption that the parcel of land is vacant or can be made vacant by demolishing any improvements.

Highest and Best Use of Property as Improved The use that should be made of a property as it exists. An existing improvement should be renovated or retained as is so long as it continues to contribute to the total market value of the property, or until the return from a new improvement would more than offset the cost of demolishing the existing building and constructing a new one.

Hypothetical Condition That which is contrary to what exists, but is supposed for the purpose of analysis. Hypothetical conditions assume conditions contrary to known facts about physical, legal, or economic characteristics of the subject property; or about conditions external to the property, such as market conditions or trends; or about the integrity of data used in an analysis. A hypothetical condition may be used in an assignment only if:

- Use of the hypothetical condition is clearly required for legal purposes, for purposes of reasonable analysis, or for purposes of comparison;
- Use of the hypothetical condition results in a credible analysis; and
- The consultant complies with the disclosure requirements set forth in USPAP for hypothetical conditions

Leased Fee Interest An ownership interest held by a landlord with the rights of use and occupancy conveyed by lease to others. The rights of the lessor (the leased fee owner) and the lessee are specified by contract terms contained within the lease.

Leasehold Interest The interest held by the lessee (the tenant or renter) through a lease transferring the rights of use and occupancy for a stated term under certain conditions.

Market Rent The most probable rent that a property should bring in a competitive and open market reflecting all conditions and restrictions of the specified lease agreement including term, rental adjustment and revaluation, permitted uses,

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use restrictions, and expense obligations; the lessee and lessor each acting prudently and knowledgeably, and assuming consummation of a lease contract as of a specified date and the passing of the leasehold from lessor to lessee under conditions whereby:

- Lessee and lessor are typically motivated.
- Both parties are well informed or well advised, and acting in what they consider their best interests.
- A reasonable time is allowed for exposure in the open market.
- The rent payment is made in terms of cash in United States dollars, and is expressed as an amount per time period consistent with the payment schedule of the lease contract.
- The rental amount represents the normal consideration for the property leased unaffected by special fees or concessions granted by anyone associated with the transaction.

Market Value

The major focus of most real property appraisal assignments. Both economic and legal definitions of market value have been developed and refined. Continual refinement is essential to the growth of the appraisal profession.

The most widely accepted components of market value are incorporated in the following definition:

"The most probable price, as of a specified date, in cash, or in terms equivalent to cash, or in other precisely revealed terms, for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress."

Market value is defined in the Uniform Standards of Professional Appraisal Practice (USPAP) as follows:

"A type of value, stated as an opinion, that presumes the transfer of a property (i.e., a right of ownership or a bundle of such rights), as of a certain date, under specific conditions set forth in the definition of the term identified by the consultant as applicable in an appraisal."

The following definition of market value is used by agencies that regulate federally insured financial institutions in the United States:

"The most probable price which a property should bring in a competitive and open market under all conditions requisite to a fair sale, the buyer and seller each acting prudently and knowledgeably, and assuming the price is not affected by undue stimulus. Implicit in this definition is the consummation of a sale as of a specified date and the passing of title from seller to buyer under conditions whereby:"

- Buyer and seller are typically motivated;
- Both parties are well informed or well advised, and acting in what they consider their best interests;
- A reasonable time is allowed for exposure in the open market;
- Payment is made in terms of cash in U.S. dollars or in terms of financial arrangements comparable thereto; and

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- The price represents the normal consideration for the property sold unaffected by special or creative financing or sales concessions granted by anyone associated with the sale.

Prospective Market Value Upon Completion of Construction

The prospective future value of a property on the date that construction is completed, based upon market conditions forecast to exist as of the completion date.

Prospective Value Opinion

A forecast of the value expected at a specified future date. A prospective value opinion is most frequently sought in connection with real estate projects that are proposed, under construction, or under conversion to a new use, or those that have not achieved sellout or a stabilized level of long-term occupancy at the time the appraisal report is written.

Report

Any communication, written or oral, of an appraisal, appraisal review, or appraisal consulting service that is transmitted to the client upon completion of an assignment. The types of written reports listed below apply to real property appraisals:

Self-Contained Appraisal Report: A written appraisal report prepared under Standards Rule 2-2(a) of the Uniform Standards of Professional Appraisal Practice. A self-contained appraisal report sets forth the data considered, the appraisal procedures followed, and the reasoning employed in the appraisal, addressing each item in the depth and detail required by its significance to the appraisal and providing sufficient information so that the client and the users of the report will understand the appraisal and not be misled or confused.

Summary Appraisal Report: A written report prepared under Standards Rule 2-2(b) or 8-2(b). A summary appraisal report contains a summary of all information significant to the solution of the appraisal problem. The essential difference between a self-contained appraisal report and a summary appraisal report is the level of detail of presentation.

Restricted Appraisal Report: A written report prepared under Standards Rule 2-2(c), 8-2(c), or 10-2(b). A restricted use appraisal report is for client use only. The restricted use appraisal report should contain a brief statement of information significant to the solution of the appraisal problem.

Uniform Standards of Professional Appraisal Practice

Current standards of the appraisal profession, developed for consultants and the users of appraisal services by the Appraisal Standards Board of The Appraisal Foundation. The Uniform Standards set forth the procedures to be followed in developing an appraisal, analysis, or opinion and the manner in which an appraisal, analysis, or opinion is communicated. They are endorsed by the Appraisal Institute and by other professional appraisal organizations.

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LIMITING AND CONTINGENT CONDITIONS
ACM Consultants, Inc.

1. The property is appraised as though free and clear of any or all liens and encumbrances unless otherwise stated in this report. The Consultant will not be responsible for matters of a legal nature that affect either the property being appraised or the title to it. The Consultant assumes that the title is good and marketable, and therefore, will not render any opinions about the title.

2. Legal descriptions referenced in the report were obtained from public documents from the State of Hawaii, Bureau of Conveyances, or were furnished by the client, and were assumed to be correct.

3. It is assumed that all applicable zoning and use regulations and restrictions have been complied with, unless a nonconformity has been stated, defined, and considered in this appraisal report.

4. It is assumed that all required licenses, certificates of occupancy or other legislative or administrative authority from any local, state, or national governmental or private entity or organization have been or can be obtained or renewed for any use on which the value estimates contained in this report are based.

5. It is assumed that the utilization of the land and improvements is within the boundaries or property lines of the property described and that there is no encroachment or trespass unless otherwise stated in this report. Responsible ownership and competent property management are assumed unless otherwise stated in this report.

6. The Consultant has inspected as far as possible, by observation, the land and the improvements; however, it was not possible to personally observe conditions beneath the soil or hidden structurally or by other components. The appraisal assumes that there are no hidden, unapparent, or apparent conditions of the property site, subsoil, or structures or toxic material which would render it more or less valuable. The Consultant and firm have no responsibility for any such conditions or for any expertise or engineering to discover them. All mechanical components are assumed to be in operable condition and status standard for properties of the subject type. Conditions of heating, cooling, ventilation, electrical and plumbing equipment is considered to be commensurate with the conditions of the balance of the improvements unless otherwise stated. No judgment may be made by us as to adequacy of insulation, type of insulation, or energy efficiency of the improvements or equipment, and no representations are made herein as to these matters unless specifically stated and considered in the report.

7. Information provided by third parties including government agencies, financial institutions, realtors, buyers, sellers, property owners and others and contained in this report were obtained from sources considered reliable and believed to be true and correct. However, no warranty is assumed for possible misinformation.

8. All engineering is assumed to be correct. Any plot plans and illustrative material in this report are included only to assist the reader in visualizing the property. Any sketch in this report may show approximate dimensions and is included to assist the reader in visualizing the property. Maps and exhibits found in this report are provided for reader reference purposes only. No guarantee as to accuracy is expressed or implied unless otherwise stated in this report. No survey has been made for the purpose of this report.

9. The Consultant is not qualified to detect hazardous waste and/or toxic materials. Any comment by the Consultant that might suggest the possibility of the presence of such substances should not be taken as confirmation of the presence of hazardous waste and/or toxic materials. Such determination would require investigation by a qualified expert in the field of environmental assessment. The presence of substances such as asbestos, urea-formaldehyde foam insulation, or other potentially hazardous materials may affect the value of the property. The Consultant's value estimate is predicated on the assumption that there is no such material on or in the property that would cause a loss in value unless otherwise stated in this report. No responsibility is assumed for any environmental conditions, or for any expertise or engineering knowledge required to discover them. The Consultant's descriptions and resulting comments are the result of the routine observations made during the appraisal process.

10. If analysis contained in this appraisal involves partial interests in real estate, the value of the fractional interest plus the value of all other fractional interests may or may not equal the value of the entire fee simple estate considered as a whole.

11. Unless otherwise stated in this report, the subject property is appraised without a specific compliance survey having been conducted to determine if the property is or is not in conformance with the requirements of the Americans with Disabilities Act. The presence of architectural and communications barriers that are structural in nature that would restrict access by disabled individuals may adversely affect the property's value, marketability, or utility.

12. Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purposed by any person other than the party to whom it is addressed without the written consent of the Consultant, and in any event, only with proper written qualification and only in its entirety.

13. The Consultant(s) or those assisting in preparation of the report will not be asked or required to give testimony in court or hearing because of having made the appraisal, in full or in part, nor engage in post appraisal consultation with client or third parties except under separate and special arrangement and at additional fee. If testimony or deposition is required because of subpoena, the client shall be responsible for any additional time, fees, and charges regardless of issuing party.

14. Neither all nor any part of the contents of this report (especially any conclusions as to value, the identity of the Consultant, or the firm with which the Consultant is connected) shall be disseminated to the public through advertising, public relations, news sales, or other media without prior written consent and approval of the Consultant.

ACCEPTANCE OF, AND/OR USE OF THIS APPRAISAL REPORT BY CLIENT OR ANY THIRD PARTY CONSTITUTES ACCEPTANCE OF THE ACM CONSULTANTS, INC., CERTIFICATION, LIMITING AND CONTINGENT CONDITIONS. CONSULTANT LIABILITY EXTENDS ONLY TO STATED CLIENT, NOT SUBSEQUENT PARTIES OR USERS OF ANY TYPE, and the total liability of Consultant(s) and firm is limited to the amount of fee received by Consultant.

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PROFESSIONAL QUALIFICATIONS

Glenn K. Kunihisa, MAI, CRE

STATE LICENSING

State Certified General Appraiser,
State of Hawaii, License No. CGA 39, July 17, 1991
Expiration: December 31, 2011

PROFESSIONAL AFFILIATIONS

Member, Appraisal Institute, MAI Designation, Hawaii Chapter No. 67
Member, The Counselors of Real Estate, CRE Designation, Hawaii Chapter
Member, International Right of Way Association
Member, National Association of Realtors, Maui Board of Realtors

PROFESSIONAL INVOLVEMENT

Past President – Hawaii Chapter of the Appraisal Institute – 2009
Hawaii Chapter Chair – The Counselors of Real Estate - 2011
Education Committee Chairperson – Hawaii Chapter of the Appraisal Institute – 2004 and 2005
Former Committee Member - Multiple Listing Service (MLS) – Realtors Association of Maui

COMMUNITY AFFILIATIONS

St. Anthony Parish School Board
- Board Member 1995 to 2008
- Board President 1997 and 1998

Alii Community Care, Inc. – A non-profit health care corporation
- Board Member 2004 to 2006

EMPLOYMENT

President
ACM Consultants, Inc.
May, 1997 to present

Previously associated with the following:
- ACM, Real Estate Appraisers, Inc. - 1986 to 1997
- A&B Commercial Company; a division of Alexander & Baldwin, Inc. - 1979 to 1985
- Bank of Hawaii - 1976 to 1979

GENERAL EDUCATION

University of Hawaii at Manoa
- Master of Business Administration (MBA) - Executive MBA Program V, 1988
- Bachelor of Business Administration (BBA), 1976

Iolani School, 1971

LEGAL & CONSULTING

Qualified as an expert witness in the Second Circuit Court of the State of Hawaii
Qualified as an expert in testimony to the State Land Use Commission
Experienced in real estate arbitration assignments in the State of Hawaii

APPRAISAL EDUCATION

<u>Appraisal Institute</u>

Seminar *Appraisal Curriculum Overview (2-day general)*
Honolulu, Hawaii – July 2010

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Seminar	*Online Valuation of Green Residential Properties* Chicago, Illinois – July 2010
Seminar	*Hotel Valuation* Honolulu, Hawaii – February 2010
Seminar	*Online Small Hotel/Motel Valuation* Chicago, Illinois – November 2009
Seminar	*Business Practices and Ethics* Honolulu, Hawaii – September 2009
Seminar	*Hawaii Lands, Historical Review* Lihue, Hawaii – August 2009
Seminar	*Appraisal Challenges: Declining Markets and Sales Concessions* Cambria, California – October 2008
Course	*7-Hour National USPAP Update Course* Honolulu, Hawaii – September 2008
Course	*Online 7-Hour National USPAP Equivalent Course* Chicago, Illinois – October 2007
Course	*Valuation of Conservation Easements* Denver, Colorado – October 2007
Seminar	*Uniform Standards for Federal Land Acquisitions ("Yellow Book")* *Practical Applications for Fee Appraisers* Honolulu, Hawaii – December 2006
Seminar	*California Conservation Easements* Sacramento, California – November 2005
Course 400	*7-Hour National USPAP Update Course* Honolulu, Hawaii – October 2005
Seminar	*Case Studies in Limited Partnership and Partial Interest Valuation* Honolulu, Hawaii – May 2005
Seminar	*Appraisal Consulting: A Solutions Approach for Professionals* Honolulu, Hawaii – February 2005
Seminar	*Real Estate Finance, Value and Investment Performance* Honolulu, Hawaii – February 2005
Seminar	*Fannie Mae Residential Presentation* Honolulu, Hawaii - July 2004
Seminar	*Subdivision Analysis* Chicago, Illinois - August 2003
Seminar	*Supporting Capitalization Rates* Chicago, Illinois - August 2003
Seminar	*The Technology Assisted Appraiser* Chicago, Illinois - August 2003
Seminar	*Scope of Work: Expanding Your Range of Services* Chicago, Illinois - August 2003
Course 400	*National Uniform Standards of Professional Practice* Honolulu, Hawaii - May 2003
Course 420	*Business Practices and Ethics* Honolulu, Hawaii - May 2003
Seminar	*The Private Conservation Market* Honolulu, Hawaii - July 2002
Seminar	*Finance Reporting Valuations Parts I and II* Honolulu, Hawaii - July 2002
Seminar	*Future of Appraisal Profession from a Global Perspective* Honolulu, Hawaii - July 2002

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Seminar	*Appraisal Office Management* Honolulu, Hawaii - July 2002
Course 540	*Report Writing* Denver, Colorado - December 2000
Seminar	*Partial Interests: Theory and Case Law* Las Vegas, Nevada - July 2000
Seminar	*Easement Valuation* Las Vegas, Nevada - July 2000
Seminar	*Bridging the Gap: Marketability Discounts for Real Estate Interests* Las Vegas, Nevada - July 2000
Course 430	*Standards of Professional Practice, Part C* Honolulu, Hawaii - September 1999
Seminar	*Litigation Skills for the Appraiser: An Overview* Honolulu, Hawaii - May 1998
Seminar	*Special Purpose Properties* Honolulu, Hawaii - September 1997
Seminar	*Highest and Best Use Applications* Honolulu, Hawaii - September 1997
Seminar	*Detrimental Conditions* Honolulu, Hawaii - July 1997
Seminar	*The Appraiser As Expert Witness* Honolulu, Hawaii - August, 1995
Seminar	*How to Appraise FHA-Insured Property* Los Angeles, California - January, 1995
Seminar	*Understanding Limited Appraisals and Reporting Options* Honolulu, Hawaii - August, 1994
Seminar	*Valuation of Leasehold Interests* Honolulu, Hawaii - May, 1993
Seminar	*Valuation of Leased Fee Interests* Honolulu, Hawaii - May, 1993
Seminar	*Valuation Considerations: Appraising Non-Profits* Boston, Massachusetts - July, 1992
Seminar	*Americans With Disabilities Act* Boston, Massachusetts - July, 1992
Seminar	*Valuation in Today's Capital and Financing Markets* Honolulu, Hawaii - June 1992
Seminar	*Arbitration Principles, Procedures and Pitfalls* Honolulu, Hawaii - June, 1992
Seminar	*Institutional Real Estate in the 1990's* Honolulu, Hawaii - June, 1992
Seminar	*FIRREA and its Impact on Appraisers* Honolulu, Hawaii - June, 1992
Course 410/420	*Standards of Professional Practice, Parts A & B* Honolulu, Hawaii - April, 1991

<u>The American Society of Farm Managers and Rural Appraisers, Inc.</u>

Seminar	*Agricultural Lease Valuation* Honolulu, Hawaii – March 2006

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Maui Coastal Land Trust

Seminar *Understanding the New Tax Incentives: Conservation Easements & Other Charitable Contributions*
Wailuku, Hawaii – June 2007

Society of Real Estate Appraisers

Course 101 *Introduction to Appraising Real Property*
Dallas, Texas – 1987

Course 102 *Applied Residential Property Valuation*
Honolulu, Hawaii - July 1990

Course 201 *Principles of Income Property Appraising*
Chicago, Illinois, 1987

Course 202 *Applied Income Property Valuation*
San Diego, California - 1988

Seminar *Professional Practice and the Society of Real Estate Appraisers*
Honolulu, Hawaii - 1988

Seminar *Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies*
Honolulu, Hawaii - April, 1988

Seminar *Appraisal Standards Seminar - Federal Home Loan Bank Board Guidelines, Regulations and Policies*
Honolulu, Hawaii - April, 1988

American Institute of Real Estate Appraisers

Seminar *Rates, Ratios and Reasonableness*
Honolulu, Hawaii - 1989

Seminar *Discounted Cash Flow Analysis*
Honolulu, Hawaii - 1989

Seminar *Highest and Best Use*
Honolulu, Hawaii - 1989

Seminar *Capitalization Overview - Part A*
Honolulu, Hawaii - 1990

Seminar *Capitalization Overview - Part B*
Honolulu, Hawaii – 1990

Seminar *Accrued Depreciation*
Honolulu, Hawaii - 1990

International Right of Way Association

Course 410 *Reviewing Appraisals in Eminent Domain*
San Diego, California – February 2011

Course 101 *Appraisal*
Las Vegas, Nevada - October 1998

Course 101 *Negotiation*
Las Vegas, Nevada - October 1998

National Business Institute, Inc.

Seminar *Commercial Real Estate Leasing In Hawaii*
Honolulu, Hawaii - 1989

American Arbitration Association

Seminar *Real Estate Dispute Resolution - Mediation and Arbitration*
Kahului, Maui, Hawaii - October, 1990

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PROFESSIONAL QUALIFICATIONS
of
Dominic J. Suguitan

STATE LICENSING

State Certified General Appraiser,
State of Hawaii, License No. CGA-576, April 17, 1995
Expiration: December 31, 2011

ASSOCIATION MEMBERSHIPS

General Associate Member - Appraisal Institute

Realtor-Appraiser, National Association of Realtors, Maui Board of Realtors, Inc.

EXPERIENCE AND EDUCATION

Employment

Vice President, Commercial Division
ACM Consultants, Inc. (formerly ACM, Real Estate Appraisers, Inc.)
April, 1991 to present

Previously associated with the following:

Yamaguchi & Yamaguchi, Inc.
Real Estate Appraisers and Consultants

General Education

University of Hawaii at Manoa
Bachelor of Arts Degree, Communications, 1990

Maui Community College, 1985-86

Baldwin High School, 1985

Appraisal Education

Appraisal Institute Courses

"Appraising the Single Family Residence"
Honolulu, Hawaii - January, 1991

"Foundations of Real Estate Appraisal"
Honolulu, Hawaii - February, 1991

Course 1BA – "Capitalization Theory & Techniques, Part A"
San Jose, California - July, 1992.

Course 1BB – "Capitalization Theory & Techniques, Part B"
San Jose, California - July, 1992.

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Course I410 – "Standards of Professional Practice, Part A (USPAP)"
Honolulu, Hawaii - April, 1993

Course II420 – "Standards of Professional Practice, Part B (USPAP)"
Honolulu, Hawaii - April, 1993.

Course II430 – "Standards of Professional Practice, Part C (USPAP)"
Honolulu, Hawaii - September, 1999.

Course I400 – "7-Hour National USPAP Update Course"
Honolulu, Hawaii - May, 2003.

Course II420 – "Business Practices and Ethics"
Honolulu, Hawaii - May, 2003

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – November, 2005

Course 520 – "Highest & Best Use and Market Analysis"
Seattle, Washington – September 2006

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – November, 2007

"Online 7-Hour National USPAP Equivalent Course" – Online Course
Chicago, Illinois – September, 2009

"Online Business Practices and Ethics" – Online Course
Chicago, Illinois – November, 2009

<u>Appraisal Institute Seminars</u>

"Data Confirmation and Verification Methods" - Seminar
Honolulu, Hawaii - October, 1995

"Residential Property Construction and Inspection" - Seminar
Honolulu, Hawaii - October, 1995

"Appraisal of Retail Properties" - Seminar
Honolulu, Hawaii - May, 1996

"Detrimental Conditions in Hawaii" - Seminar
Honolulu, Hawaii - July, 1997

"Special Purpose Properties" - Seminar
Honolulu, Hawaii - September, 1997

"Highest and Best Use Applications" - Seminar
Honolulu, Hawaii - September, 1997

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"Appraising From Blueprints and Specs" - Seminar
Honolulu, Hawaii - May, 1998

"New Industrial Valuation" - Seminar
Honolulu, Hawaii - October, 1998

"Eminent Domain & Condemnation Appraising" - Seminar
Honolulu, Hawaii - October, 1998

"Online Analyzing Operating Expenses" – Online Seminar
Chicago, Illinois - September, 2001

"Real Estate Disclosure" - Seminar
Honolulu, Hawaii - October, 2001

"Online Internet Search Strategies for R.E. Appraisers" – Online Seminar
Chicago, Illinois - October, 2001

"Online Valuation of Detrimental Conditions in Real Estate" – Online Seminar
Chicago, Illinois - December, 2001

"The Appraisal Institute Commercial Database & AppraiserLoop, Part I" - Seminar
Honolulu, Hawaii - July, 2002

"Statistical Analysis Using the Database, Part I" - Seminar
Honolulu, Hawaii - July, 2002

"The Aftermath: Our World Post-Sept 11" - Seminar
Honolulu, Hawaii - July, 2002

"Statistical Modeling & GIS: Applications for Income Properties" - Seminar
Honolulu, Hawaii - July, 2002

"Real Estate Finance, Value and Investment Performance" – Seminar
Honolulu, Hawaii – February, 2005

"Introduction to GIS Applications for Real Estate Appraisal" – Online Seminar
Chicago, Illinois – August, 2005

"Online Small Hotel/Motel Valuation" – Online Seminar
Chicago, Illinois – October, 2005

"Hawaii Lands, Historical Review"
Kahului, Hawaii – September, 2009

"Online Real Estate Finance Statistics and Valuation Modeling" – Online Seminar
Chicago, Illinois – October, 2009

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Society of Real Estate Appraisers

Course 101 – "Introduction to Appraising Real Property"
Tempe, Arizona - June, 1991

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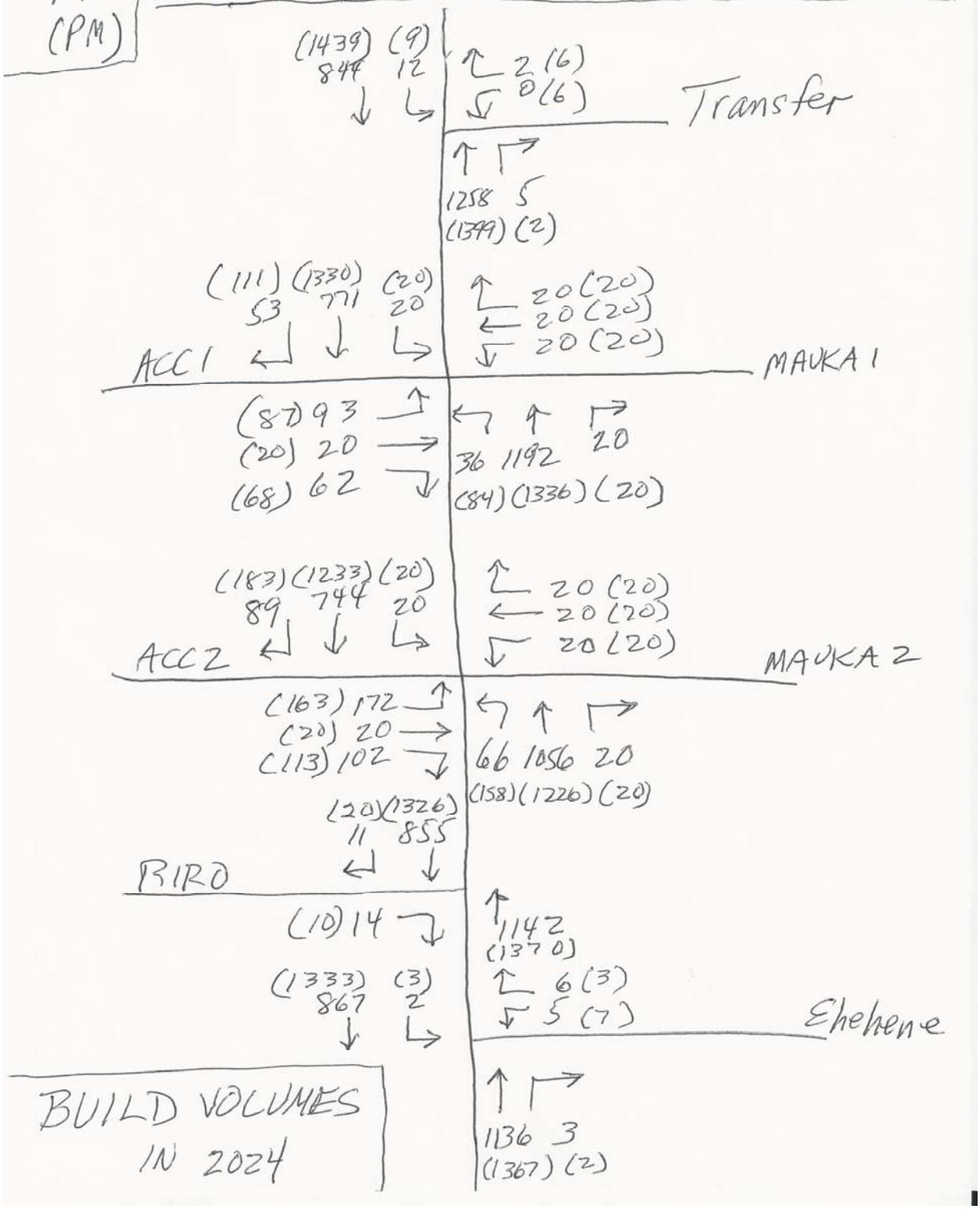
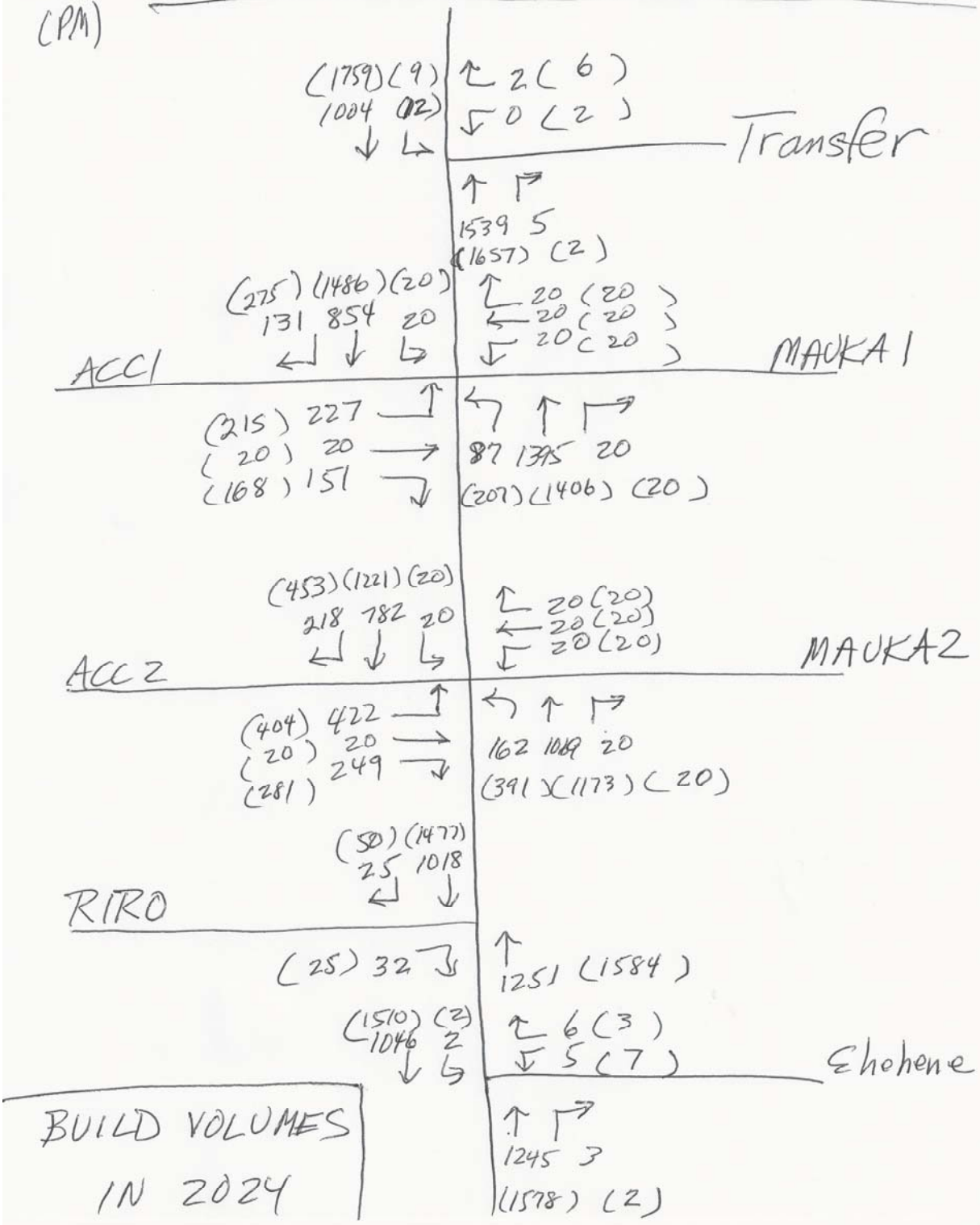
AM (PM) | BUILD OUR INT CAPT SIGNALS



BUILD VOLUMES IN 2024

AM (PM) BUILD HDOT INT. CAPT. (25%) SIGNALS



BUILD VOLUMES IN 2024

Palmetto Traffic Group, LLC

File Name : Ehehene St TMC
Site Code :
Start Date : 2/14/2013
Page No : 1

Groups Printed- Unshifted - Bank 1 - Bank 2

	Ehehene St From North					HP HWY from Maalea From East					From South					HP HWY from Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:00	0	0	0	0	0	0	123	0	0	123	0	0	0	0	0	0	106	0	0	106	229
06:15	0	0	0	0	0	0	160	0	0	160	0	0	0	0	0	0	91	0	0	91	251
06:30	1	0	0	0	1	1	255	0	0	256	0	0	0	0	0	0	115	1	0	116	373
06:45	0	0	0	0	0	1	211	0	0	212	0	0	0	0	0	0	126	0	0	126	338
Total	1	0	0	0	1	2	749	0	0	751	0	0	0	0	0	0	438	1	0	439	1191
07:00	1	0	0	0	1	0	255	0	0	255	0	0	0	0	0	0	123	0	0	123	379
07:15	1	0	1	0	2	0	275	0	0	275	0	0	0	0	0	0	167	0	0	167	444
07:30	0	0	0	0	0	0	211	0	0	211	0	0	0	0	0	0	136	2	0	138	349
07:45	1	0	0	0	1	0	170	0	1	171	0	0	0	0	0	0	172	0	1	173	345
Total	3	0	1	0	4	0	911	0	1	912	0	0	0	0	0	0	598	2	1	601	1517
08:00	0	0	0	0	0	1	219	0	0	220	0	0	0	0	0	0	159	0	0	159	379
08:15	0	0	0	0	0	1	221	0	0	222	0	0	0	0	0	0	164	0	1	165	387
08:30	0	0	0	0	0	0	214	0	1	215	0	0	0	0	0	0	174	0	2	176	391
08:45	1	0	0	0	1	1	212	0	2	215	0	0	0	0	0	0	170	1	0	171	387
Total	1	0	0	0	1	3	866	0	3	872	0	0	0	0	0	0	667	1	3	671	1544
09:00	0	0	0	0	0	1	158	0	1	160	0	0	0	0	0	0	195	1	0	196	356
09:15	0	0	0	0	0	2	157	0	1	160	0	0	0	0	0	0	214	0	1	215	375
*** BREAK ***																					
Total	0	0	0	0	0	3	315	0	2	320	0	0	0	0	0	0	409	1	1	411	731
*** BREAK ***																					
15:00	0	0	0	0	0	0	235	0	0	235	0	0	0	0	0	0	210	0	0	210	445
15:15	1	0	2	0	3	2	268	0	0	270	0	0	0	0	0	0	239	2	1	242	515
15:30	1	0	0	0	1	1	301	0	1	303	0	0	0	0	0	0	268	0	0	268	572
15:45	1	0	0	0	1	0	286	0	3	289	0	0	0	0	0	0	276	2	0	278	568
Total	3	0	2	0	5	3	1090	0	4	1097	0	0	0	0	0	0	993	4	1	998	2100
16:00	1	0	1	0	2	0	235	0	2	237	0	0	0	0	0	0	255	0	0	255	494
16:15	1	0	0	0	1	0	286	0	0	286	0	0	0	0	0	0	260	2	0	262	549
16:30	1	0	0	0	1	0	261	0	0	261	0	0	0	0	0	0	278	2	2	282	544
16:45	1	0	0	0	1	0	255	0	0	255	0	0	0	0	0	0	277	2	0	279	535
Total	4	0	1	0	5	0	1037	0	2	1039	0	0	0	0	0	0	1070	6	2	1078	2122
17:00	0	0	0	0	0	0	263	0	0	263	0	0	0	0	0	0	296	0	0	296	559
17:15	0	0	0	0	0	2	262	5	0	269	0	0	0	0	0	0	254	1	0	255	524
17:30	1	0	1	0	2	1	210	0	0	211	0	0	0	0	0	0	241	0	0	241	454
17:45	3	0	0	0	3	0	174	0	0	174	0	0	0	0	0	0	251	2	0	253	430
Total	4	0	1	0	5	3	909	5	0	917	0	0	0	0	0	0	1042	3	0	1045	1967
18:00	0	0	0	0	0	0	182	0	0	182	0	0	0	0	0	0	167	0	0	167	349
18:15	0	0	0	0	0	0	162	0	0	162	0	0	0	0	0	0	204	0	0	204	366
Grand Total	16	0	5	0	21	14	6221	5	12	6252	0	0	0	0	0	0	5588	18	8	5614	11887
Apprch %	76.2	0	23.8	0		0.2	99.5	0.1	0.2		0	0	0	0		0	99.5	0.3	0.1		
Total %	0.1	0	0	0	0.2	0.1	52.3	0	0.1	52.6	0	0	0	0	0	0	47	0.2	0.1	47.2	
Unshifted	16	0	5	0	21	14	6177	5	12	6208	0	0	0	0	0	0	5538	18	8	5564	11793
% Unshifted	100	0	100	0	100	100	99.3	100	100	99.3	0	0	0	0	0	0	99.1	100	100	99.1	99.2
Bank 1	0	0	0	0	0	0	28	0	0	28	0	0	0	0	0	0	20	0	0	20	48
% Bank 1	0	0	0	0	0	0	0.5	0	0	0.4	0	0	0	0	0	0	0.4	0	0	0.4	0.4
Bank 2	0	0	0	0	0	0	16	0	0	16	0	0	0	0	0	0	30	0	0	30	46
% Bank 2	0	0	0	0	0	0	0.3	0	0	0.3	0	0	0	0	0	0	0.5	0	0	0.5	0.4

File Name : Ehehene St TMC
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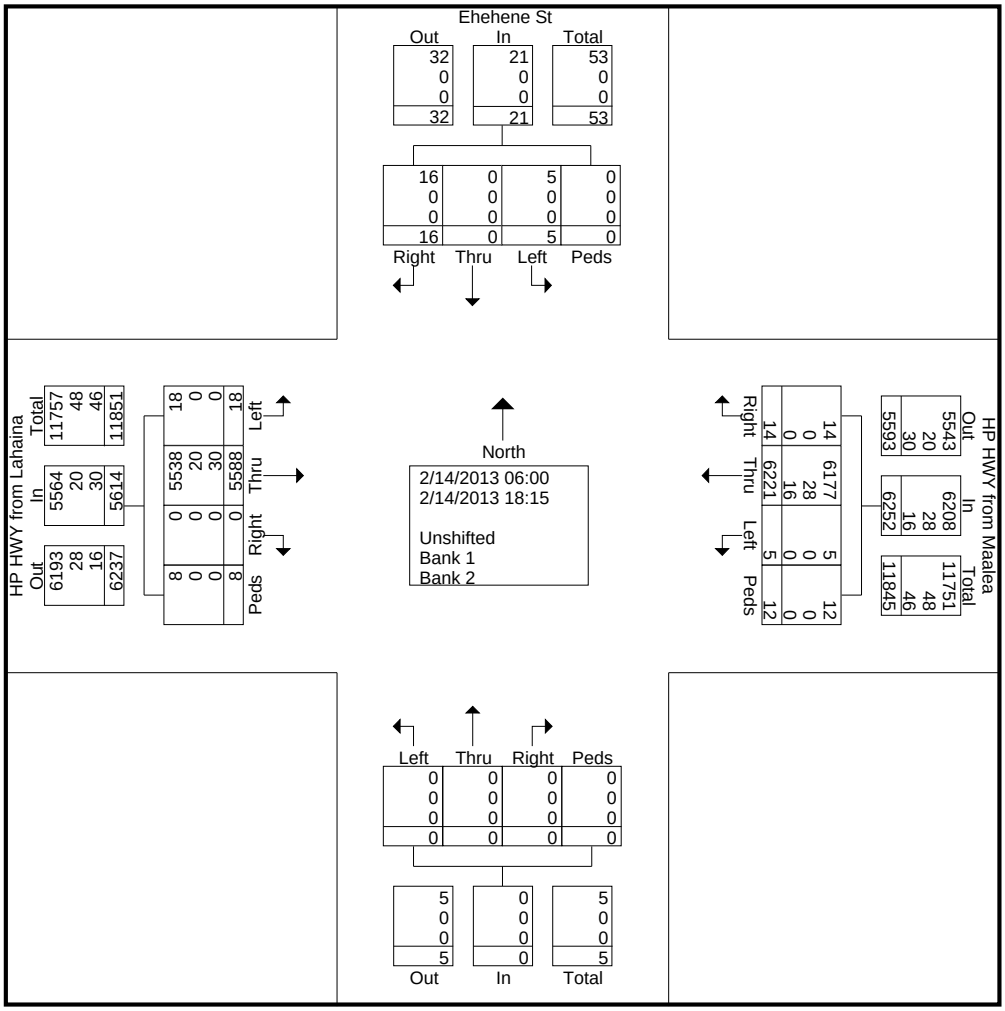

File Name : Ehehene St TMC
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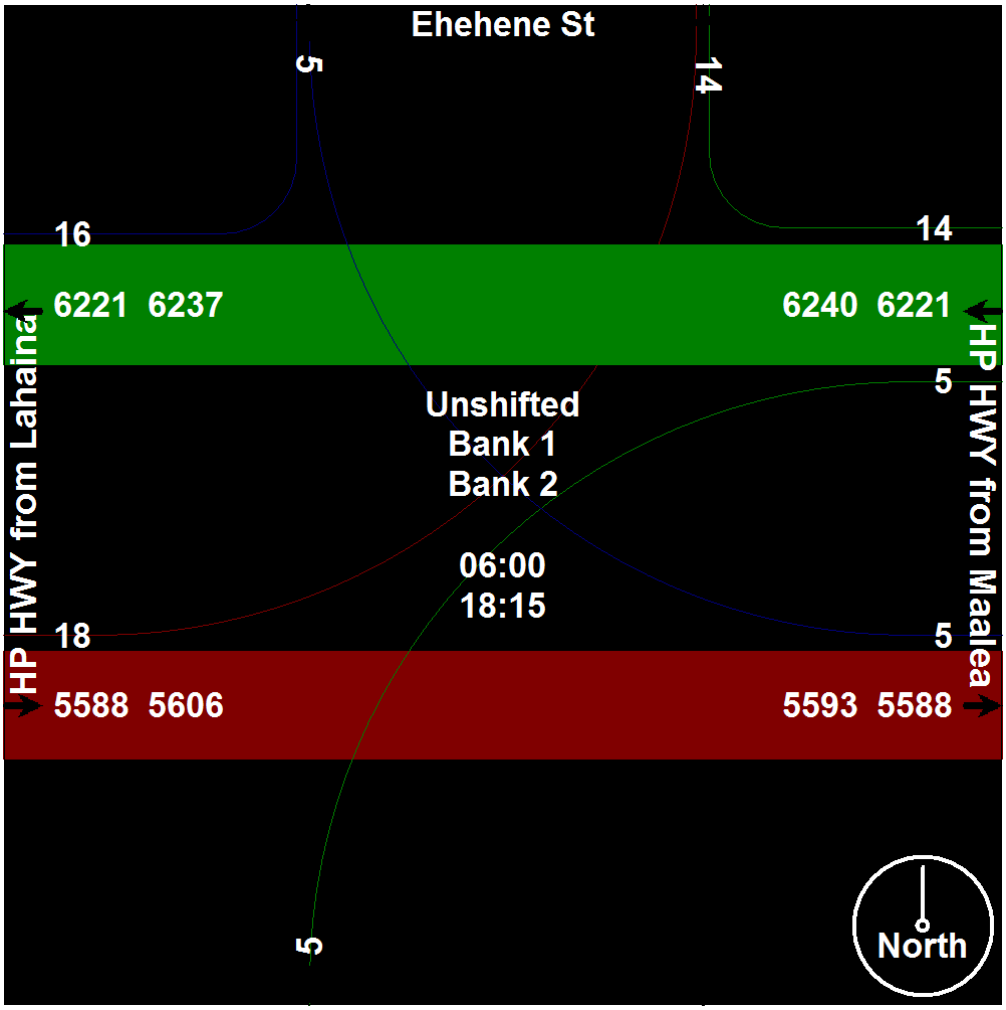

	Ehehene St From North					HP HWY from Maalea From East					From South					HP HWY from Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00																					
08:00	0	0	0	0	0	**1**	219	0	0	220	0	0	0	0	0	0	159	0	0	159	379
08:15	0	0	0	0	0	1	**221**	0	0	**222**	0	0	0	0	0	0	164	0	1	165	387
08:30	0	0	0	0	0	0	214	0	1	215	0	0	0	0	0	0	**174**	0	**2**	**176**	**391**
08:45	**1**	0	0	0	**1**	1	212	0	**2**	215	0	0	0	0	0	0	170	**1**	0	171	387
Total Volume	1	0	0	0	1	3	866	0	3	872	0	0	0	0	0	0	667	1	3	671	1544
% App. Total	100	0	0	0		0.3	99.3	0	0.3		0	0	0	0		0	99.4	0.1	0.4		
PHF	.250	.000	.000	.000	.250	.750	.980	.000	.375	.982	.000	.000	.000	.000	.000	.000	.958	.250	.375	.953	.987

File Name : Ehehene St TMC
Site Code :
Start Date : 2/14/2013
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	Ehehene St From North					HP HWY from Maalea From East					From South					HP HWY from Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Each Approach Begins at:																					
	06:30					06:30					06:00					08:30					
+0 mins.	**1**	0	0	0	1	**1**	255	0	0	256	0	0	0	0	0	0	174	0	**2**	176	
+15 mins.	0	0	0	0	0	1	211	0	0	212	0	0	0	0	0	0	170	**1**	0	171	
+30 mins.	1	0	0	0	1	0	255	0	0	255	0	0	0	0	0	0	195	1	0	196	
+45 mins.	1	0	**1**	0	**2**	0	**275**	0	0	**275**	0	0	0	0	0	0	**214**	0	1	**215**	
Total Volume	3	0	1	0	4	2	996	0	0	998	0	0	0	0	0	0	753	2	3	758	
% App. Total	75	0	25	0		0.2	99.8	0	0		0	0	0	0		0	99.3	0.3	0.4		
PHF	.750	.000	.250	.000	.500	.500	.905	.000	.000	.907	.000	.000	.000	.000	.000	.000	.880	.500	.375	.881	
Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 16:15																					
16:15	1				1		286			286								2			
16:30	1	0	0	0	1	0	261	0	0	261	0	0	0	0	0	0	278	2	2	282	544
16:45	1	0	0	0	1	0	255	0	0	255	0	0	0	0	0	0	277	2	0	279	535
17:00	0	0	0	0	0	0	263	0	0	263	0	0	0	0	0	0	296	0	0	296	559
Total Volume	3	0	0	0	3	0	1065	0	0	1065	0	0	0	0	0	0	1111	6	2	1119	2187
% App. Total	100	0	0	0		0	100	0	0		0	0	0	0		0	99.3	0.5	0.2		
PHF	.750	.000	.000	.000	.750	.000	.931	.000	.000	.931	.000	.000	.000	.000	.000	.000	.938	.750	.250	.945	.978

Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	15:15					15:30					12:00					16:15				
+0 mins.	**1**	0	**2**	0	**3**	**1**	**301**	0	1	**303**	0	0	0	0	0	0	260	**2**	0	262
+15 mins.	1	0	0	0	1	0	286	0	**3**	289	0	0	0	0	0	0	278	2	**2**	282
+30 mins.	1	0	0	0	1	0	235	0	2	237	0	0	0	0	0	0	277	2	0	279
+45 mins.	1	0	1	0	2	0	286	0	0	286	0	0	0	0	0	0	**296**	0	0	**296**
Total Volume	4	0	3	0	7	1	1108	0	6	1115	0	0	0	0	0	0	1111	6	2	1119
% App. Total	57.1	0	42.9	0		0.1	99.4	0	0.5		0	0	0	0		0	99.3	0.5	0.2	
PHF	1.000																			

File Name : Ehehene St TMC
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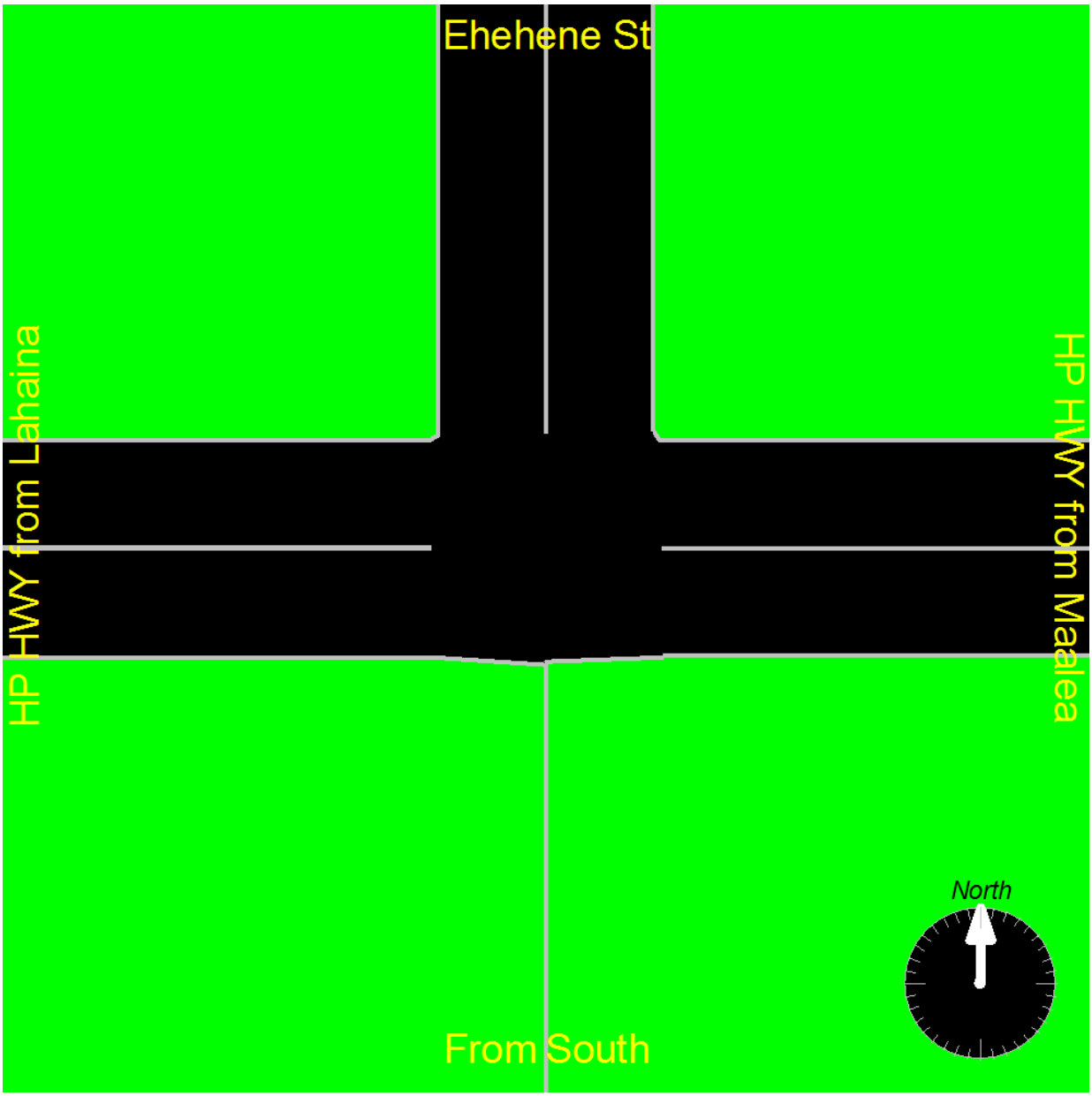

Palmetto Traffic Group, LLC

File Name : Not Named 9
Site Code :
Start Date : 2/12/2013
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Groups Printed- Unshifted - Bank 1 - Bank 2

	Landfill From North					Landfill From East					From Olowalu From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00	0	137	1	1	139	0	0	0	0	0	1	243	0	0	244	0	0	0	0	0	383
07:15	0	158	0	0	158	1	0	0	0	1	2	251	0	0	253	0	0	0	0	0	412
07:30	0	177	0	0	177	0	0	0	0	0	0	220	0	2	222	0	0	0	0	0	399
07:45	0	152	4	0	156	1	0	0	0	1	2	209	0	2	213	0	0	0	0	0	370
Total	0	624	5	1	630	2	0	0	0	2	5	923	0	4	932	0	0	0	0	0	1564
08:00	0	162	2	0	164	4	0	0	0	4	0	191	0	3	194	0	0	0	0	0	362
08:15	0	207	4	2	213	0	0	3	0	3	0	199	0	1	200	0	0	0	0	0	416
08:30	0	187	2	0	189	4	0	0	0	4	2	216	0	1	219	0	0	0	0	0	412
08:45	0	181	4	6	191	2	0	0	0	2	0	173	0	3	176	0	0	0	0	0	369
Total	0	737	12	8	757	10	0	3	0	13	2	779	0	8	789	0	0	0	0	0	1559
*** BREAK ***																					
15:00	0	248	2	1	251	0	0	0	0	0	0	264	0	0	264	0	0	0	0	0	515
15:15	0	271	2	0	273	1	0	3	0	4	0	258	0	0	258	0	0	0	0	0	535
15:30	0	245	1	0	246	2	0	2	0	4	1	286	0	0	287	0	0	0	0	0	537
15:45	0	254	1	0	255	1	0	0	0	1	1	267	0	1	269	0	0	0	0	0	525
Total	0	1018	6	1	1025	4	0	5	0	9	2	1075	0	1	1078	0	0	0	0	0	2112
16:00	0	278	2	1	281	4	0	1	0	5	0	288	0	0	288	0	0	0	0	0	574
16:15	0	259	2	0	261	0	0	0	0	0	0	289	0	3	292	0	0	0	0	0	553
16:30	0	270	2	0	272	0	0	1	0	1	0	260	0	0	260	0	0	0	0	0	533
16:45	0	258	3	1	262	2	0	0	0	2	2	227	0	0	229	0	0	0	0	0	493
Total	0	1065	9	2	1076	6	0	2	0	8	2	1064	0	3	1069	0	0	0	0	0	2153
17:00	0	179	1	0	180	4	0	0	0	4	2	175	0	0	177	0	0	0	0	0	361
17:15	0	265	0	1	266	1	0	0	0	1	3	246	0	0	249	0	0	0	0	0	516
17:30	0	245	2	0	247	3	0	0	0	3	0	216	0	0	216	0	0	0	0	0	466
17:45	0	208	0	0	208	0	0	0	0	0	2	225	0	1	228	0	0	0	0	0	436
Total	0	897	3	1	901	8	0	0	0	8	7	862	0	1	870	0	0	0	0	0	1779
18:00	0	172	0	0	172	1	0	0	0	1	1	159	0	0	160	0	0	0	0	0	333
18:15	0	174	1	0	175	3	0	0	0	3	0	195	0	1	196	0	0	0	0	0	374
Grand Total	0	4687	36	13	4736	34	0	10	0	44	19	5057	0	18	5094	0	0	0	0	0	9874
Apprch %	0	99	0.8	0.3		77.3	0	22.7	0		0.4	99.3	0	0.4		0	0	0	0		
Total %	0	47.5	0.4	0.1	48	0.3	0	0.1	0	0.4	0.2	51.2	0	0.2	51.6	0	0	0	0	0	
Unshifted	0	4618	36	13	4667	33	0	10	0	43	18	5007	0	18	5043	0	0	0	0	0	9753
% Unshifted	0	98.5	100	100	98.5	97.1	0	100	0	97.7	94.7	99	0	100	99	0	0	0	0	0	98.8
Bank 1	0	58	0	0	58	1	0	0	0	1	1	39	0	0	40	0	0	0	0	0	99
% Bank 1	0	1.2	0	0	1.2	2.9	0	0	0	2.3	5.3	0.8	0	0	0.8	0	0	0	0	0	1
Bank 2	0	11	0	0	11	0	0	0	0	0	0	11	0	0	11	0	0	0	0	0	22
% Bank 2	0	0.2	0	0	0.2	0	0	0	0	0	0	0.2	0	0	0.2	0	0	0	0	0	0.2

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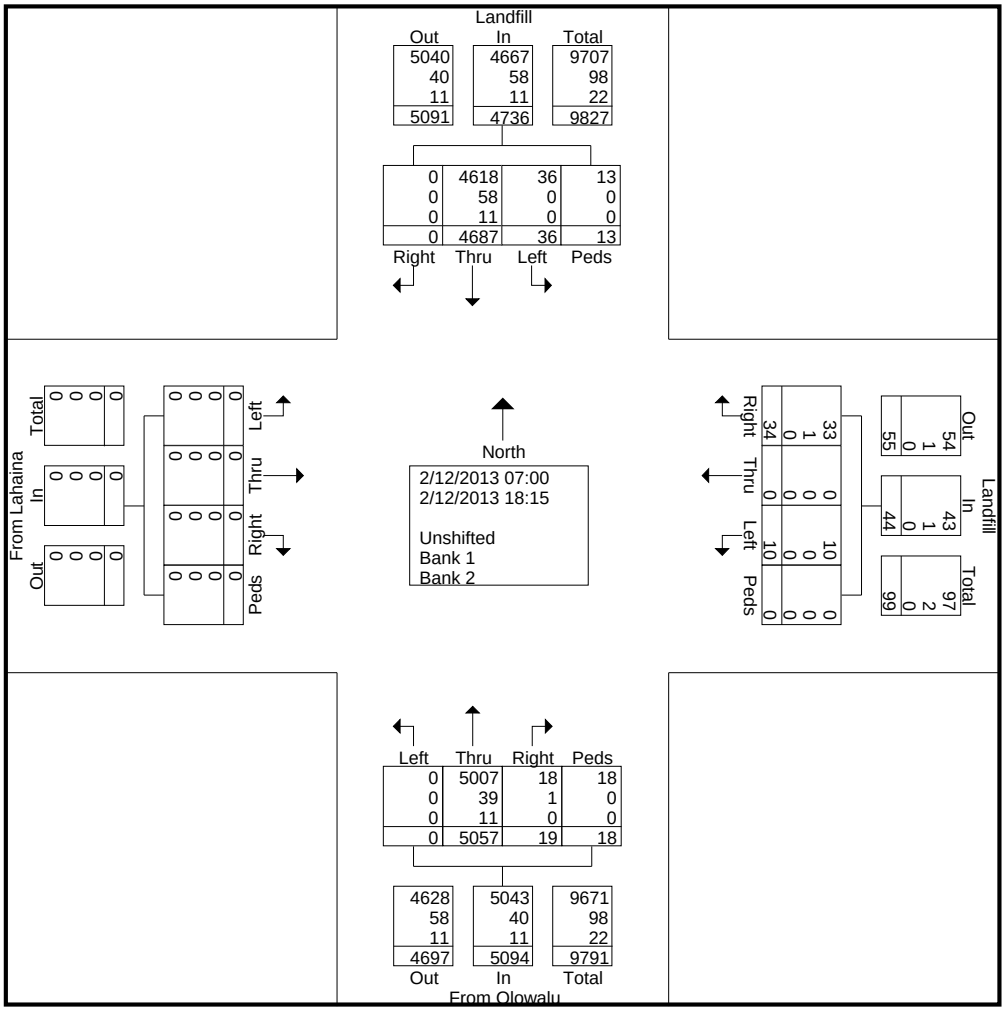

File Name : Not Named 9
Site Code :
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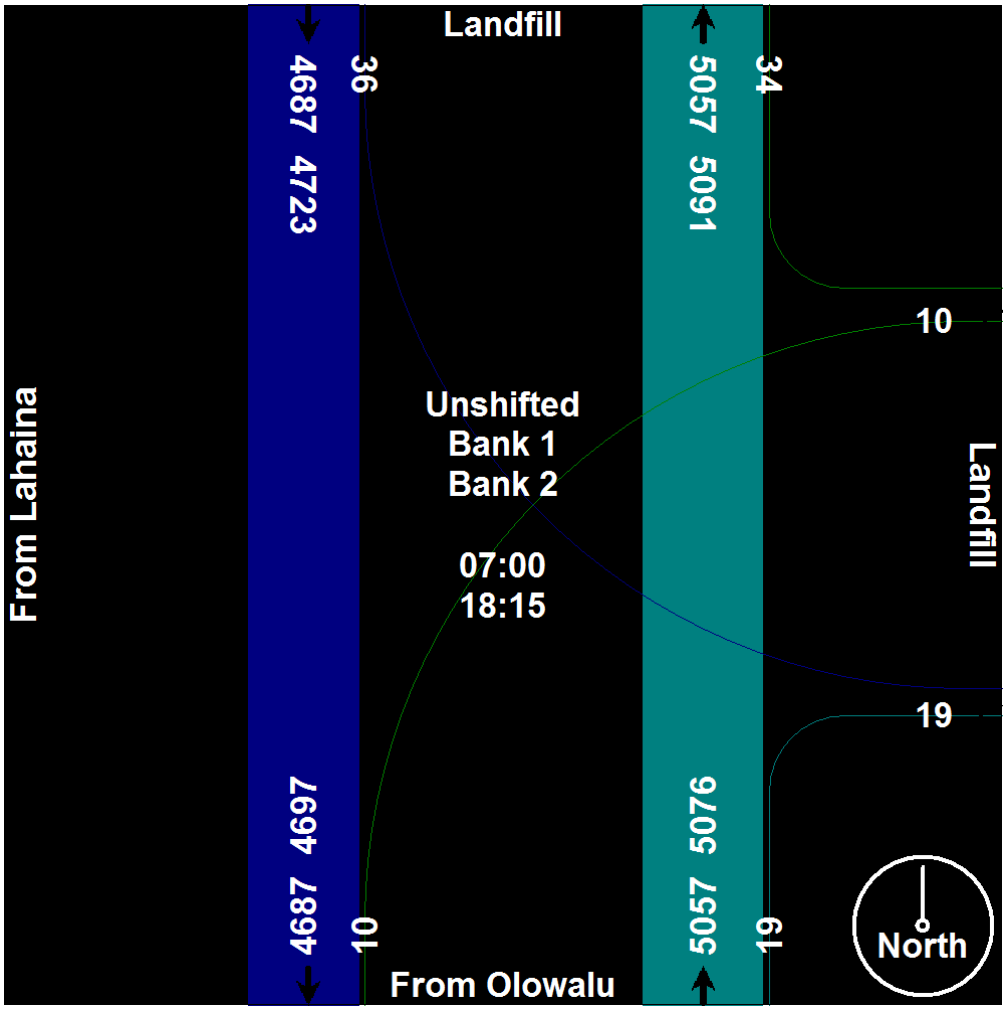

	Landfill From North					Landfill From East					From Olowalu From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	0	137	1	**1**	139	0	0	0	0	0	1	243	0	0	244	0	0	0	0	0	383
07:15	0	158	0	0	158	**1**	0	0	0	**1**	**2**	**251**	0	0	**253**	0	0	0	0	0	**412**
07:30	0	**177**	0	0	**177**	0	0	0	0	0	0	220	0	**2**	222	0	0	0	0	0	399
07:45	0	152	**4**	0	156	1	0	0	0	1	2	209	0	2	213	0	0	0	0	0	370
Total Volume	0	624	5	1	630	2	0	0	0	2	5	923	0	4	932	0	0	0	0	0	1564
% App. Total	0	99	0.8	0.2		100	0	0	0		0.5	99	0	0.4		0	0	0	0		
PHF	.000	.881	.313	.250	.890	.500	.000	.000	.000	.500	.625	.919	.000	.500	.921	.000	.000	.000	.000	.000	.949

File Name : Not Named 9
Site Code :
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Page No : 4

	Landfill From North					Landfill From East					From Olowalu From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 07:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Each Approach Begins at:																					
	08:00					08:00					07:00					07:00					
+0 mins.	0	162	2	0	164	**4**	0	0	0	**4**	1	243	0	0	244	0	0	0	0	0	
+15 mins.	0	**207**	**4**	2	**213**	0	0	**3**	0	3	**2**	**251**	0	0	**253**	0	0	0	0	0	
+30 mins.	0	187	2	0	189	4	0	0	0	4	0	220	0	**2**	222	0	0	0	0	0	
+45 mins.	0	181	4	**6**	191	2	0	0	0	2	2	209	0	2	213	0	0	0	0	0	
Total Volume	0	737	12	8	757	10	0	3	0	13	5	923	0	4	932	0	0	0	0	0	
% App. Total	0	97.4	1.6	1.1		76.9	0	23.1	0		0.5	99	0	0.4		0	0	0	0		
PHF	.000	.890	.750	.333	.888	.625	.000	.250	.000	.813	.625	.919	.000	.500	.921	.000	.000	.000	.000	.000	
Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:30																					
15:30	**0**	**245**	**1**	**0**	**246**	**2**	**0**	**2**			**1**										
15:45	0	254	1	0	255	1	0	0	0	1	1	267	0	1	269	0	0	0	0	0	525
16:00	0	**278**	**2**	**1**	**281**	**4**	0	1	0	**5**	0	288	0	0	288	0	0	0	0	0	**574**
16:15	0	259	2	0	261	0	0	0	0	0	0	**289**	0	**3**	**292**	0	0	0	0	0	553
Total Volume	0	1036	6	1	1043	7	0	3	0	10	2	1130	0	4	1136	0	0	0	0	0	2189
% App. Total	0	99.3	0.6	0.1		70	0	30	0		0.2	99.5	0	0.4		0	0	0	0		
PHF	.000	.932	.750	.250	.928	.438	.000	.375	.000	.500	.500	.978	.000	.333	.973	.000	.000	.000	.000	.000	.953

Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	16:00					15:15					15:30					12:00				
+0 mins.	0	**278**	2	**1**	**281**	1	0	**3**	0	4	**1**	286	0	0	287	0	0	0	0	0
+15 mins.	0	259	2	0	261	2	0	2	0	4	1	267	0	1	269	0	0	0	0	0
+30 mins.	0	270	2	0	272	1	0	0	0	1	0	288	0	0	288	0	0	0	0	0
+45 mins.	0	258	**3**	1	262	**4**	0	1	0	**5**	0	**289**	0	**3**	**292**	0	0	0	0	0
Total Volume	0	1065	9	2	1076	8	0	6	0	14	2	1130	0	4	1136	0	0	0	0	0
% App. Total	0	99	0.8	0.2		57.1	0	42.9	0		0.2	99.5	0	0.4		0	0	0	0	
PHF	.000	.958	.750	.500	.957	.500	.000	.500	.000	.700	.500	.978	.000	.333	.973	.000	.000	.000	.000	.000

File Name : Not Named 9
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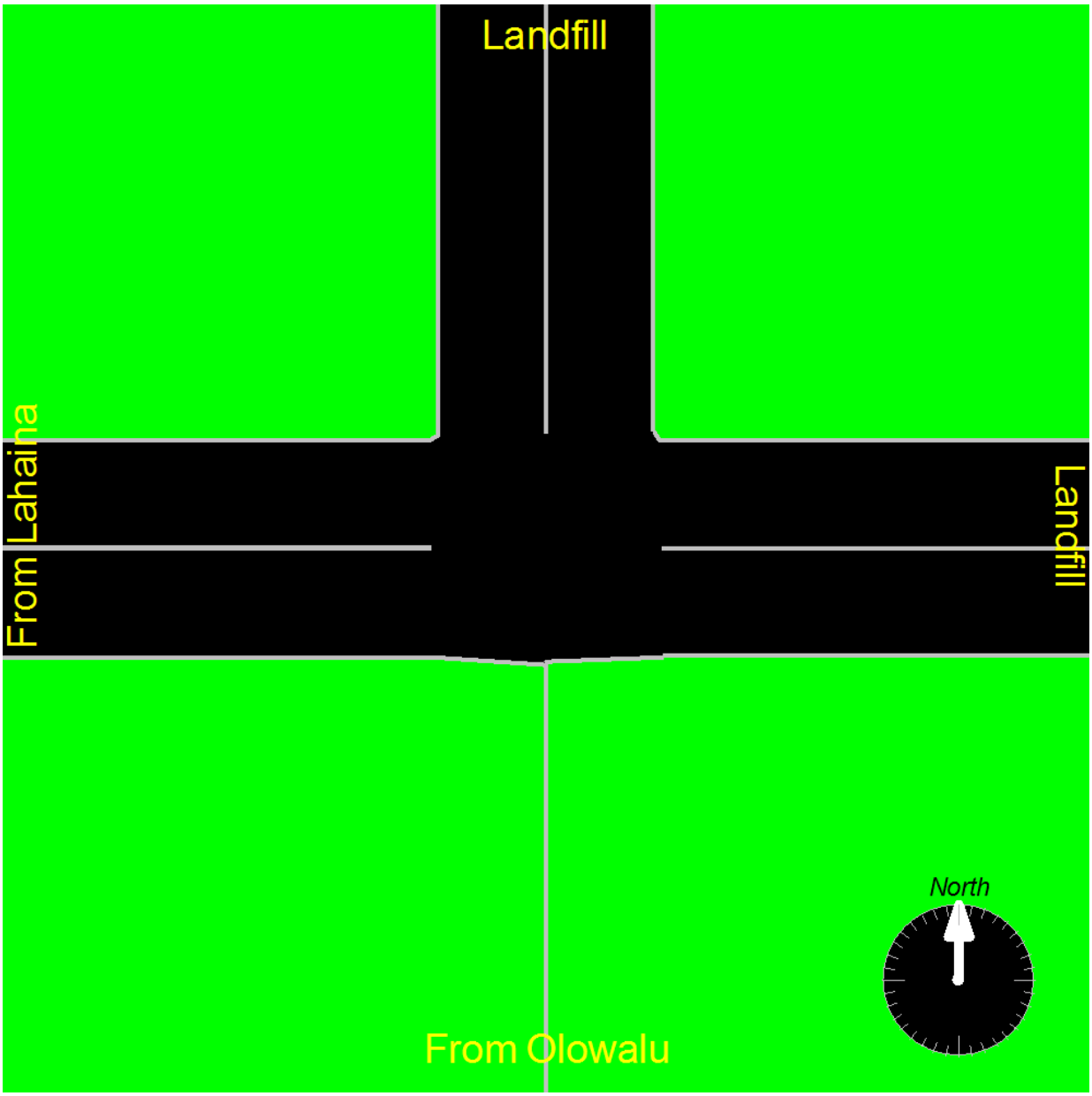

Palmetto Traffic Group, LLC

File Name : Launiupoko Beach Park TMC
Site Code : TMC
Start Date : 2/20/2013
Page No : 1

Groups Printed- Unshifted - Bank 1 - Bank 2

	Kai Hele Ku St From North					Honoapiilani Hwy From East					Launiupoko Beach Park From South					Honoapiilani Hwy From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:00	3	0	1	0	4	3	109	0	0	112	0	0	0	0	0	0	74	0	0	74	190
06:15	9	1	3	0	13	1	137	2	0	140	1	0	0	0	1	0	146	4	0	150	304
06:30	12	0	3	0	15	11	167	2	0	180	1	0	0	0	1	0	109	6	0	115	311
06:45	13	0	3	0	16	11	221	1	0	233	0	0	0	0	0	0	126	9	0	135	384
Total	37	1	10	0	48	26	634	5	0	665	2	0	0	0	2	0	455	19	0	474	1189
07:00	23	0	4	0	27	7	210	0	1	218	1	0	1	0	2	3	143	2	1	149	396
07:15	22	1	4	0	27	11	251	1	1	264	1	1	1	0	3	2	137	8	0	147	441
07:30	34	0	1	0	35	6	237	3	0	246	0	0	3	0	3	2	124	6	3	135	419
07:45	16	0	4	0	20	6	181	0	1	188	0	0	4	0	4	4	173	11	0	188	400
Total	95	1	13	0	109	30	879	4	3	916	2	1	9	0	12	11	577	27	4	619	1656
08:00	17	1	3	0	21	8	223	2	0	233	1	0	0	0	1	1	125	14	0	140	395
08:15	20	0	8	0	28	5	222	2	1	230	1	0	1	2	4	4	168	8	0	180	442
08:30	20	1	5	0	26	7	201	4	0	212	0	0	2	0	2	2	157	14	1	174	414
08:45	25	0	5	0	30	13	194	2	0	209	3	0	2	0	5	4	188	10	1	203	447
Total	82	2	21	0	105	33	840	10	1	884	5	0	5	2	12	11	638	46	2	697	1698
*** BREAK ***																					
15:00	16	1	12	0	29	6	241	4	0	251	0	1	8	0	9	5	249	26	3	283	572
15:15	15	3	15	0	33	7	222	0	0	229	6	1	6	0	13	7	256	23	3	289	564
15:30	10	1	12	1	24	5	236	5	0	246	1	1	3	0	5	2	222	16	0	240	515
15:45	15	3	15	0	33	8	233	7	4	252	3	1	7	1	12	3	249	16	2	270	567
Total	56	8	54	1	119	26	932	16	4	978	10	4	24	1	39	17	976	81	8	1082	2218
16:00	20	0	2	0	22	6	269	2	0	277	4	0	8	0	12	0	290	33	0	323	634
16:15	10	2	11	1	24	9	260	4	2	275	3	2	7	2	14	4	277	14	0	295	608
16:30	15	1	11	2	29	6	280	4	2	292	4	5	6	0	15	3	373	23	0	399	735
16:45	10	0	9	3	22	6	291	3	0	300	3	0	3	0	6	3	342	20	0	365	693
Total	55	3	33	6	97	27	1100	13	4	1144	14	7	24	2	47	10	1282	90	0	1382	2670
17:00	14	0	5	0	19	5	296	5	0	306	6	3	9	4	22	4	388	19	2	413	760
17:15	11	3	11	0	25	5	337	2	0	344	2	0	8	0	10	4	356	27	0	387	766
17:30	11	0	5	3	19	7	343	3	1	354	5	3	12	3	23	5	324	24	1	354	750
17:45	7	1	4	0	12	4	277	4	0	285	1	1	3	1	6	2	436	19	0	457	760
Total	43	4	25	3	75	21	1253	14	1	1289	14	7	32	8	61	15	1504	89	3	1611	3036
Grand Total	368	19	156	10	553	163	5638	62	13	5876	47	19	94	13	173	64	5432	352	17	5865	12467
Apprch %	66.5	3.4	28.2	1.8		2.8	95.9	1.1	0.2		27.2	11	54.3	7.5		1.1	92.6	6	0.3		
Total %	3	0.2	1.3	0.1	4.4	1.3	45.2	0.5	0.1	47.1	0.4	0.2	0.8	0.1	1.4	0.5	43.6	2.8	0.1	47	
Unshifted	367	19	155	10	551	162	5569	62	13	5806	47	19	91	13	170	62	5350	349	17	5778	12305
% Unshifted	99.7	100	99.4	100	99.6	99.4	98.8	100	100	98.8	100	100	96.8	100	98.3	96.9	98.5	99.1	100	98.5	98.7
Bank 1	0	0	1	0	1	0	44	0	0	44	0	0	2	0	2	2	38	3	0	43	90
% Bank 1	0	0	0.6	0	0.2	0	0.8	0	0	0.7	0	0	2.1	0	1.2	3.1	0.7	0.9	0	0.7	0.7
Bank 2	1	0	0	0	1	1	25	0	0	26	0	0	1	0	1	0	44	0	0	44	72
% Bank 2	0.3	0	0	0	0.2	0.6	0.4	0	0	0.4	0	0	1.1	0	0.6	0	0.8	0	0	0.8	0.6

File Name : Launiupoko Beach Park TMC
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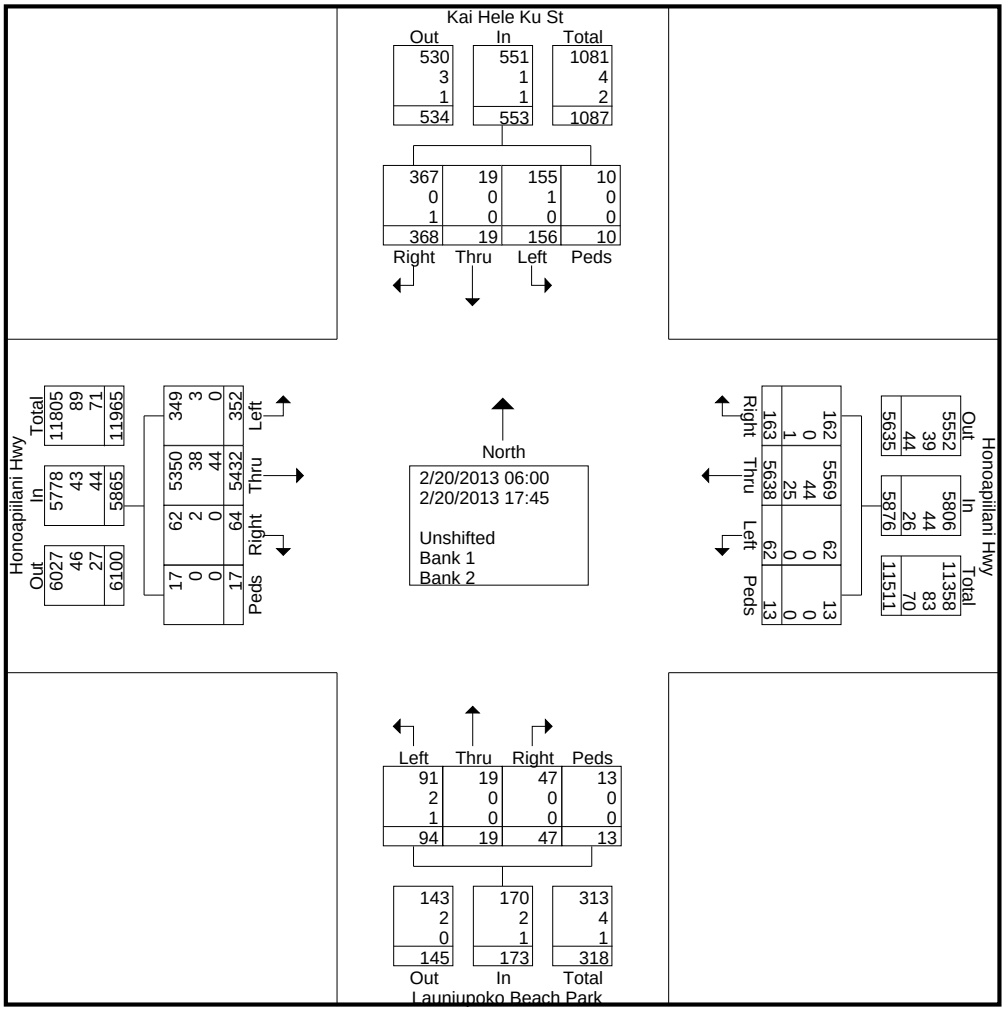

File Name : Launiupoko Beach Park TMC
Site Code : TMC
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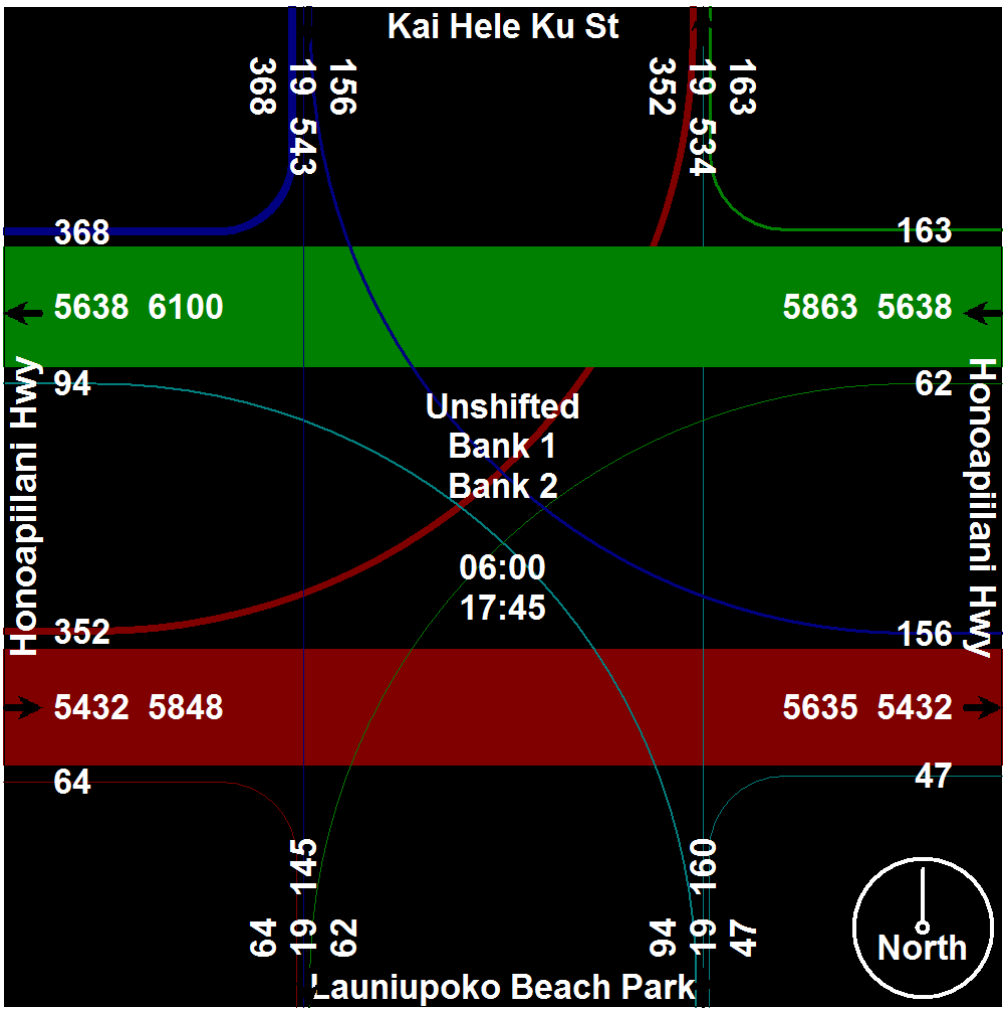

	Kai Hele Ku St From North					Honoapiilani Hwy From East					Launiupoko Beach Park From South					Honoapiilani Hwy From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00																					
08:00	17	**1**	3	0	21	8	**223**	2	0	**233**	1	0	0	0	1	1	125	**14**	0	140	395
08:15	20	0	**8**	0	28	5	222	2	**1**	230	1	0	1	**2**	4	**4**	168	8	0	180	442
08:30	20	1	5	0	26	7	201	**4**	0	212	0	0	**2**	0	2	2	157	14	**1**	174	414
08:45	**25**	0	5	0	**30**	**13**	194	2	0	209	**3**	0	2	0	**5**	4	**188**	10	1	**203**	**447**
Total Volume	82	2	21	0	105	33	840	10	1	884	5	0	5	2	12	11	638	46	2	697	1698
% App. Total	78.1	1.9	20	0		3.7	95	1.1	0.1		41.7	0	41.7	16.7		1.6	91.5	6.6	0.3		
PHF	.820	.500	.656	.000	.875	.635	.942	.625	.250	.948	.417	.000	.625	.250	.600	.688	.848	.821	.500	.858	.950

File Name : Launiupoko Beach Park TMC
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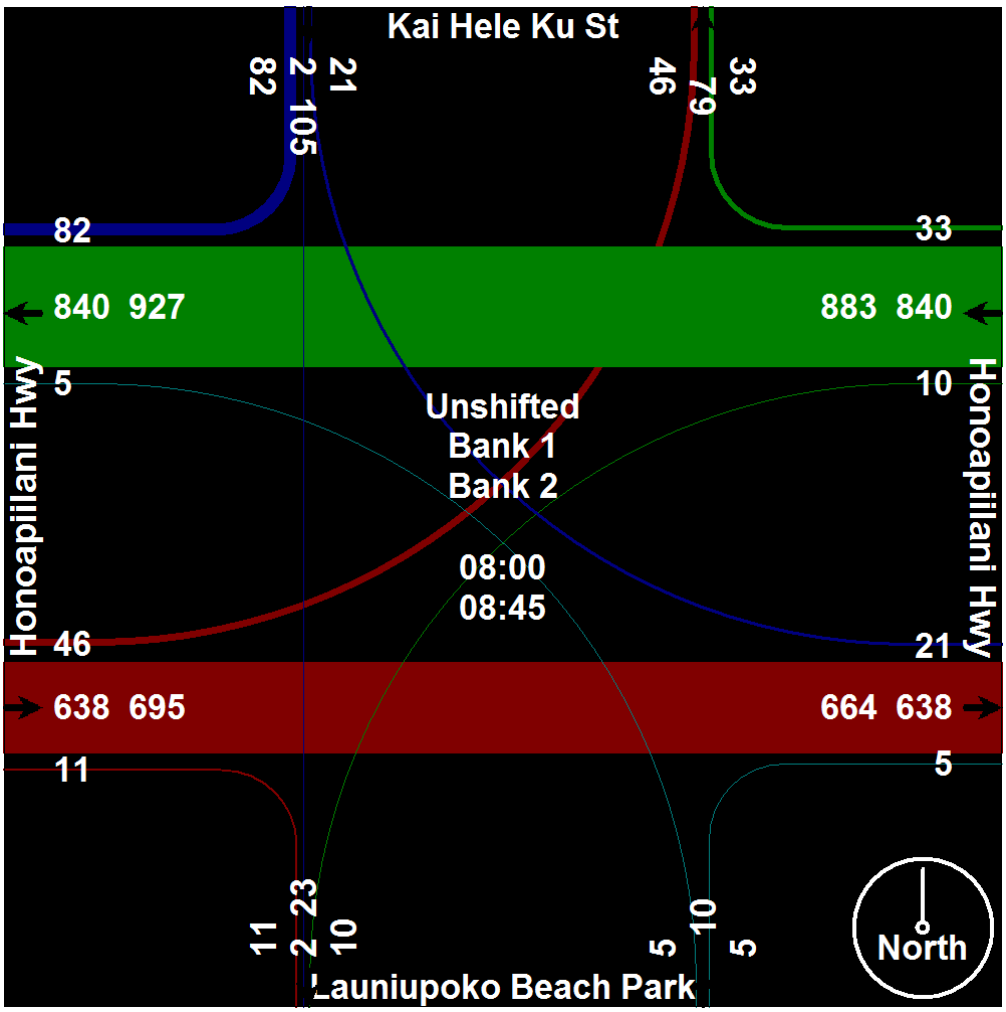

Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	07:00					06:45					07:00					08:00				
+0 mins.	23	0	**4**	0	27	**11**	221	1	0	233	**1**	0	1	0	2	1	125	**14**	0	140
+15 mins.	22	**1**	4	0	27	7	210	0	**1**	218	1	**1**	1	0	3	**4**	168	8	0	180
+30 mins.	**34**	0	1	0	**35**	11	**251**	1	1	**264**	0	0	3	0	3	2	157	14	**1**	174
+45 mins.	16	0	4	0	20	6	237	**3**	0	246	0	0	**4**	0	**4**	4	**188**	10	1	**203**
Total Volume	95	1	13	0	109	35	919	5	2	961	2	1	9	0	12	11	638	46	2	697
% App. Total	87.2	0.9	11.9	0		3.6	95.6	0.5	0.2		16.7	8.3	75	0		1.6	91.5	6.6	0.3	
PHF	.699	.250	.813	.000	.779	.795	.915	.417	.500	.910	.500	.250	.563	.000	.750	.688	.848	.821	.500	.858

File Name : Launiupoko Beach Park TMC
Site Code : TMC
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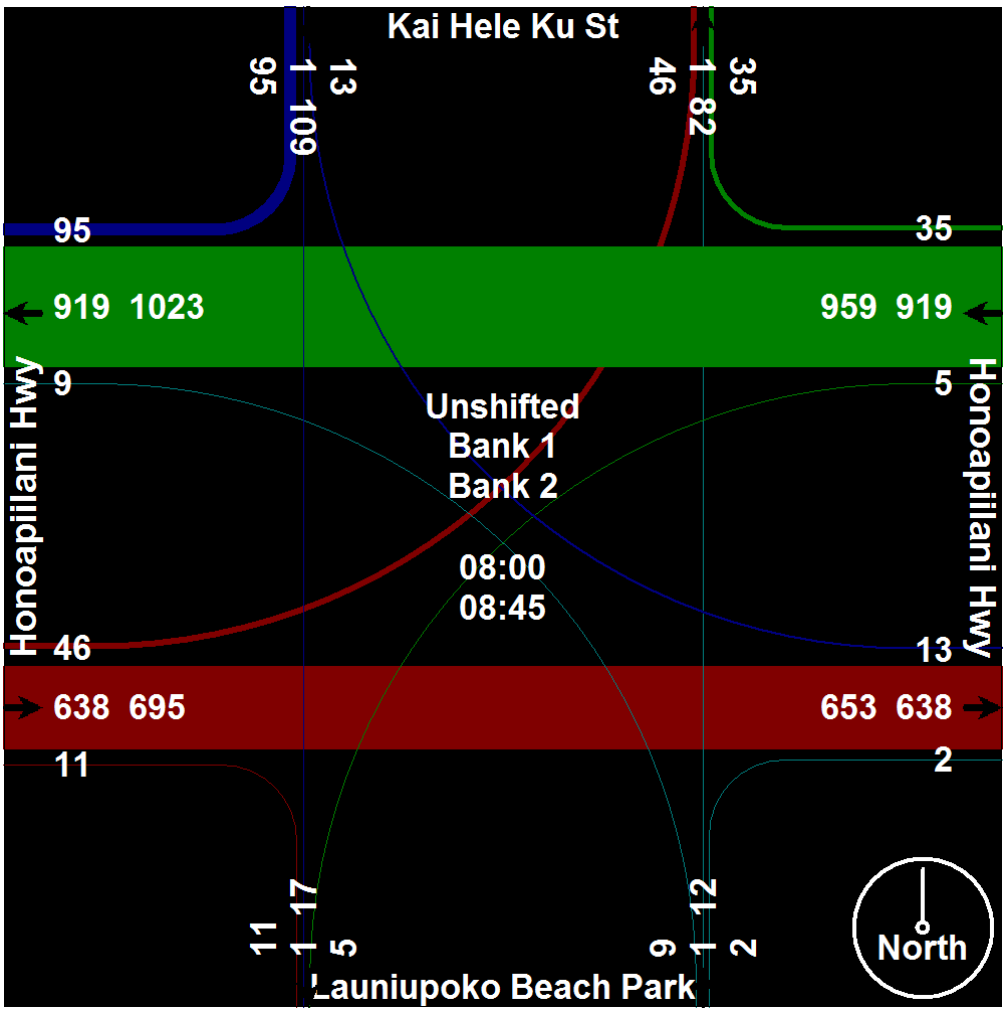

Peak Hour Analysis From 12:00 to 17:45 - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 17:00

17:00	**14**	0	5	0	19	5	296	**5**	0	306	**6**	**3**	9	**4**	22	4	388	19	**2**	413	760
17:15	11	**3**	**11**	0	**25**	5	337	2	0	344	2	0	8	0	10	4	356	**27**	0	387	**766**
17:30	11	0	5	**3**	19	**7**	**343**	3	**1**	**354**	5	3	**12**	3	**23**	**5**	324	24	1	354	750
17:45	7	1	4	0	12	4	277	4	0	285	1	1	3	1	6	2	**436**	19	0	**457**	760
Total Volume	43	4	25	3	75	21	1253	14	1	1289	14	7	32	8	61	15	1504	89	3	1611	3036
% App. Total	57.3	5.3	33.3	4		1.6	97.2	1.1	0.1		23	11.5	52.5	13.1		0.9	93.4	5.5	0.2		
PHF	.768	.333	.568	.250	.750	.750	.913	.700	.250	.910	.583	.583	.667	.500	.663	.750	.862	.824	.375	.881	.991

File Name : Launiupoko Beach Park TMC
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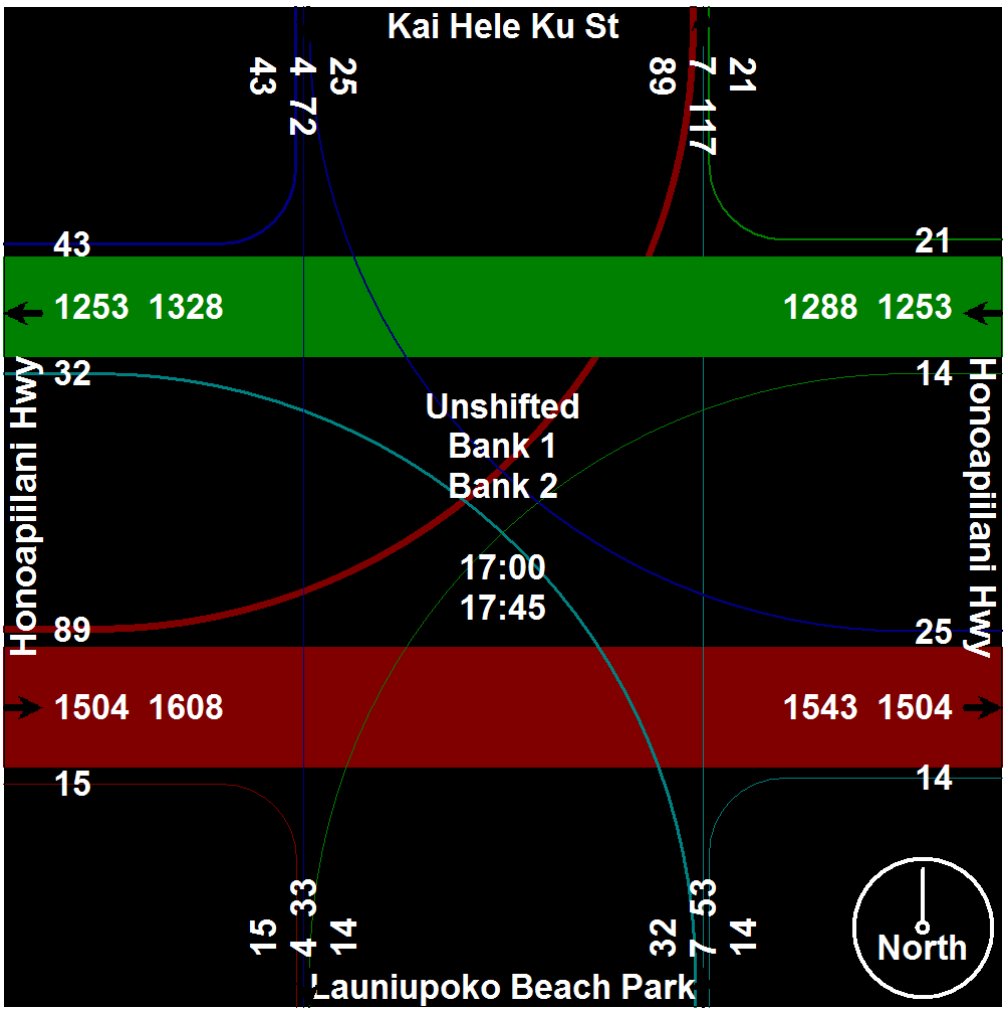

Peak Hour Analysis From 12:00 to 17:45 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	15:00					16:45					16:45					17:00				
+0 mins.	**16**	1	12	0	29	6	291	3	0	300	3	0	3	0	6	4	388	19	**2**	413
+15 mins.	15	**3**	**15**	0	**33**	5	296	**5**	0	306	**6**	**3**	9	**4**	22	4	356	**27**	0	387
+30 mins.	10	1	12	**1**	24	5	337	2	0	344	2	0	8	0	10	**5**	324	24	1	354
+45 mins.	15	3	15	0	33	**7**	**343**	3	**1**	**354**	5	3	**12**	3	**23**	2	**436**	19	0	**457**
Total Volume	56	8	54	1	119	23	1267	13	1	1304	16	6	32	7	61	15	1504	89	3	1611
% App. Total	47.1	6.7	45.4	0.8		1.8	97.2	1	0.1		26.2	9.8	52.5	11.5		0.9	93.4	5.5	0.2	
PHF	.875	.667	.900	.250	.902	.821	.923	.650	.250	.921	.667	.500	.667	.438	.663	.750	.862	.824	.375	.881

File Name : Launiupoko Beach Park TMC
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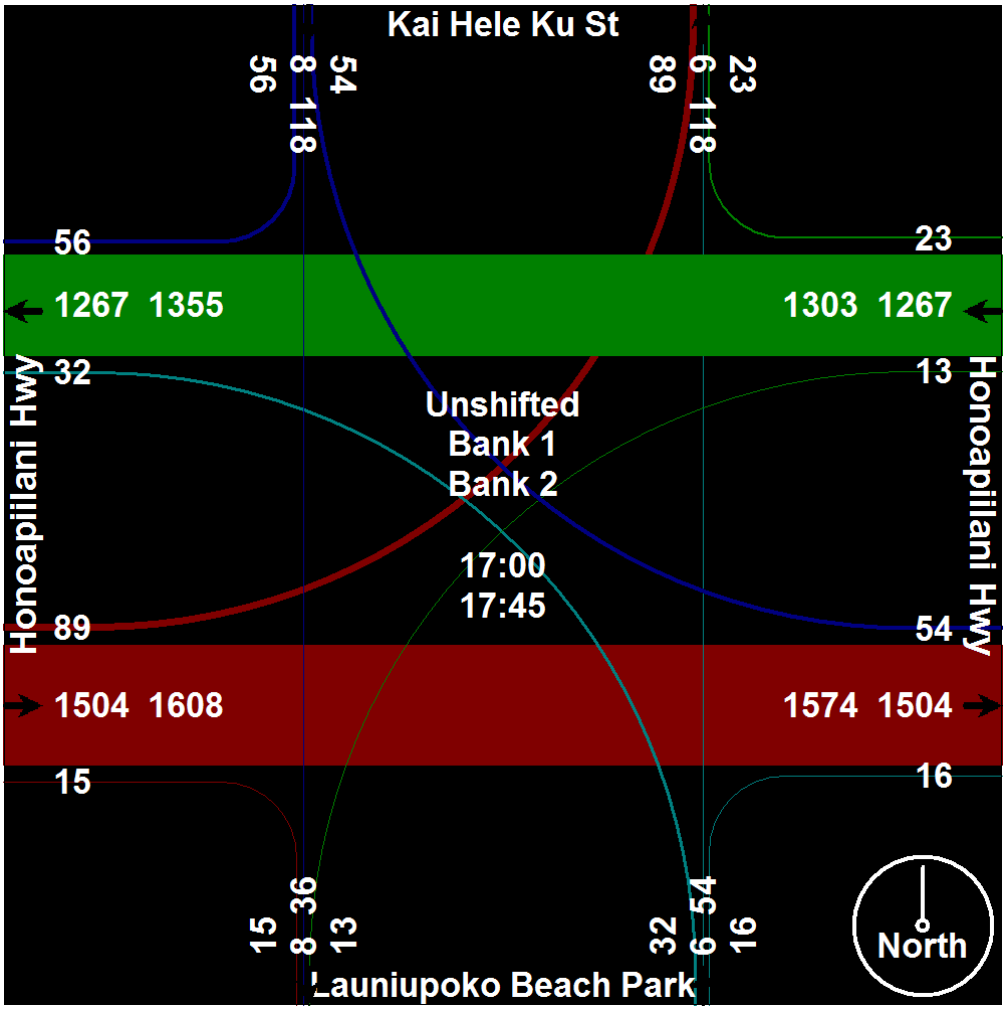

File Name : Launiupoko Beach Park TMC
Site Code : TMC
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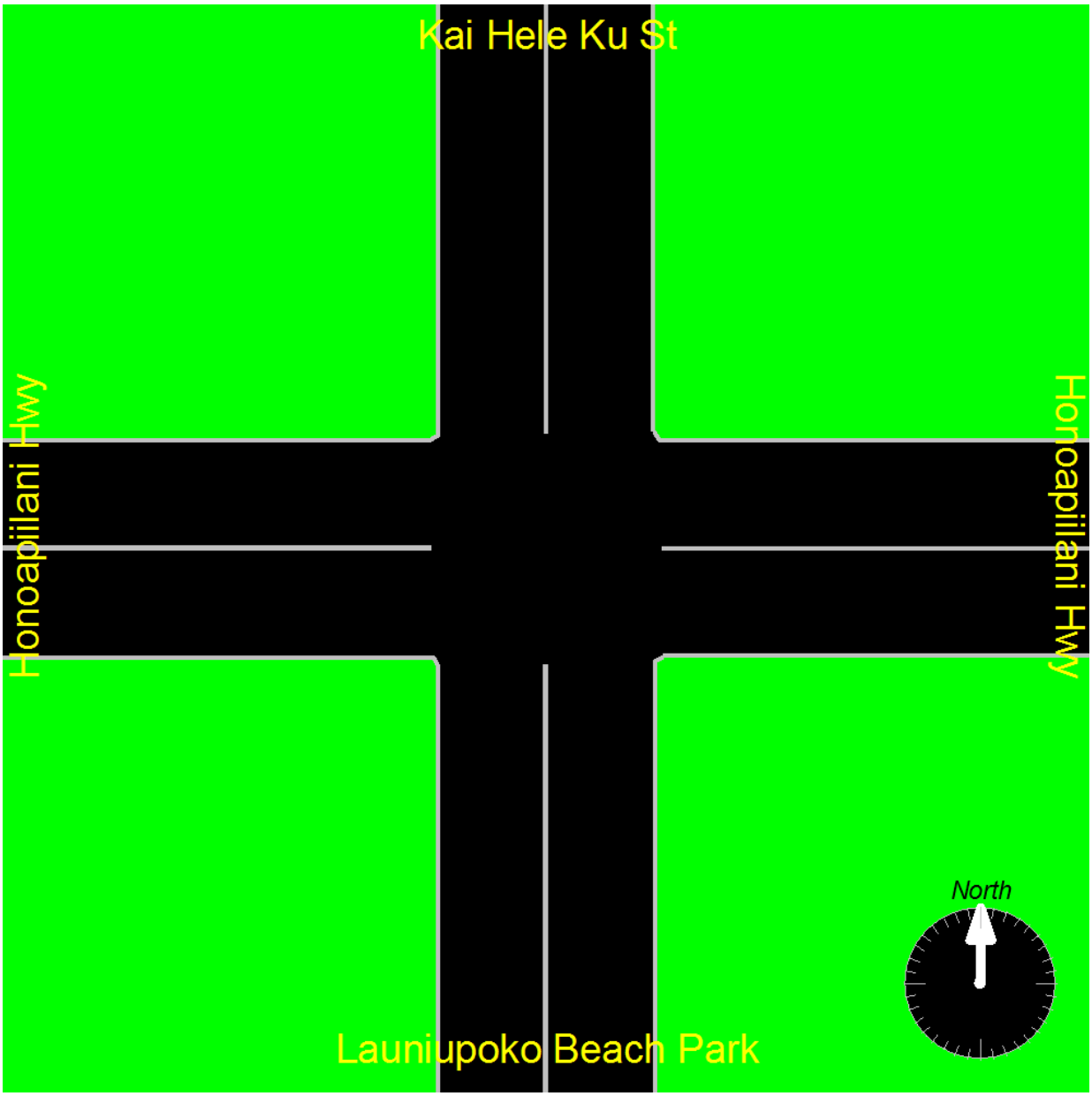

Palmetto Traffic Group, LLC

File Name : Not Named 10
Site Code : 33333333
Start Date : 2/13/2013
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Groups Printed- Unshifted - Bank 1 - Bank 2

	Luawai St From North					From Maalea From East					From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:00	0	0	0	0	0	0	108	0	0	108	0	0	0	0	0	0	82	1	0	83	191
06:15	0	0	1	0	1	0	164	0	0	164	0	0	0	0	0	0	114	1	0	115	280
06:30	1	0	1	0	2	2	222	0	0	224	0	0	0	0	0	0	72	0	0	72	298
06:45	0	0	0	0	0	0	216	0	0	216	0	0	0	0	0	0	132	0	0	132	348
Total	1	0	2	0	3	2	710	0	0	712	0	0	0	0	0	0	400	2	0	402	1117
07:00	2	0	1	0	3	1	226	0	0	227	0	0	0	0	0	0	116	8	0	124	354
07:15	2	0	1	0	3	1	262	0	0	263	0	0	0	0	0	0	160	0	0	160	426
07:30	1	0	2	0	3	2	212	0	0	214	0	0	0	0	0	0	153	0	0	153	370
07:45	1	0	1	0	2	0	196	0	0	196	0	0	0	0	0	0	129	0	0	129	327
Total	6	0	5	0	11	4	896	0	0	900	0	0	0	0	0	0	558	8	0	566	1477
08:00	1	0	0	1	2	1	235	0	0	236	0	0	0	0	0	0	136	0	1	137	375
08:15	3	0	2	0	5	0	219	0	2	221	0	0	0	0	0	0	175	0	0	175	401
08:30	0	0	0	0	0	1	208	0	0	209	0	0	0	0	0	0	190	0	0	190	399
08:45	0	0	0	0	0	1	182	0	0	183	0	0	0	0	0	0	207	0	2	209	392
Total	4	0	2	1	7	3	844	0	2	849	0	0	0	0	0	0	708	0	3	711	1567
09:00	0	0	0	0	0	0	158	0	8	166	0	0	0	0	0	0	184	0	0	184	350
09:15	0	0	1	0	1	2	164	0	3	169	0	0	0	0	0	0	210	0	2	212	382
*** BREAK ***																					
Total	0	0	1	0	1	2	322	0	11	335	0	0	0	0	0	0	394	0	2	396	732
*** BREAK ***																					
15:00	2	0	0	0	2	1	274	0	0	275	0	0	0	0	0	0	249	3	1	253	530
15:15	0	0	1	0	1	0	286	0	0	286	0	0	0	0	0	0	253	1	0	254	541
15:30	3	0	4	0	7	0	292	0	0	292	0	0	0	0	0	0	280	4	0	284	583
15:45	1	0	5	1	7	1	256	0	0	257	0	0	0	0	0	0	267	2	0	269	533
Total	6	0	10	1	17	2	1108	0	0	1110	0	0	0	0	0	0	1049	10	1	1060	2187
16:00	0	0	3	0	3	1	233	0	3	237	0	0	0	0	0	0	223	1	0	224	464
16:15	0	0	1	0	1	1	263	0	0	264	0	0	0	0	0	0	283	0	0	283	548
16:30	0	0	3	0	3	0	266	0	0	266	0	0	0	0	0	0	264	0	1	265	534
16:45	3	0	0	0	3	0	277	0	0	277	0	0	0	0	0	0	241	2	1	244	524
Total	3	0	7	0	10	2	1039	0	3	1044	0	0	0	0	0	0	1011	3	2	1016	2070
17:00	0	0	2	0	2	0	221	0	0	221	0	0	0	0	0	0	245	0	0	245	468
17:15	2	0	1	0	3	2	225	0	1	228	0	0	0	0	0	0	268	4	0	272	503
17:30	2	0	3	0	5	2	219	0	0	221	0	0	0	0	0	0	253	2	0	255	481
17:45	3	0	2	0	5	0	260	0	0	260	0	0	0	0	0	0	214	5	0	219	484
Total	7	0	8	0	15	4	925	0	1	930	0	0	0	0	0	0	980	11	0	991	1936
18:00	1	0	3	0	4	2	236	0	0	238	0	0	0	0	0	0	189	0	0	189	431
18:15	0	0	0	0	0	1	153	0	0	154	0	0	0	0	0	0	171	1	0	172	326
Grand Total	28	0	38	2	68	22	6233	0	17	6272	0	0	0	0	0	0	5460	35	8	5503	11843
Apprch %	41.2	0	55.9	2.9		0.4	99.4	0	0.3		0	0	0	0		0	99.2	0.6	0.1		
Total %	0.2	0	0.3	0	0.6	0.2	52.6	0	0.1	53	0	0	0	0	0	0	46.1	0.3	0.1	46.5	
Unshifted	28	0	38	2	68	21	6171	0	17	6209	0	0	0	0	0	0	5424	34	8	5466	11743
% Unshifted	100	0	100	100	100	95.5	99	0	100	99	0	0	0	0	0	0	99.3	97.1	100	99.3	99.2
Bank 1	0	0	0	0	0	1	44	0	0	45	0	0	0	0	0	0	11	0	0	11	56
% Bank 1	0	0	0	0	0	4.5	0.7	0	0	0.7	0	0	0	0	0	0	0.2	0	0	0.2	0.5
Bank 2	0	0	0	0	0	0	18	0	0	18	0	0	0	0	0	0	25	1	0	26	44
% Bank 2	0	0	0	0	0	0	0.3	0	0	0.3	0	0	0	0	0	0	0.5	2.9	0	0.5	0.4

Palmetto Traffic Group, LLC

File Name : Not Named 10
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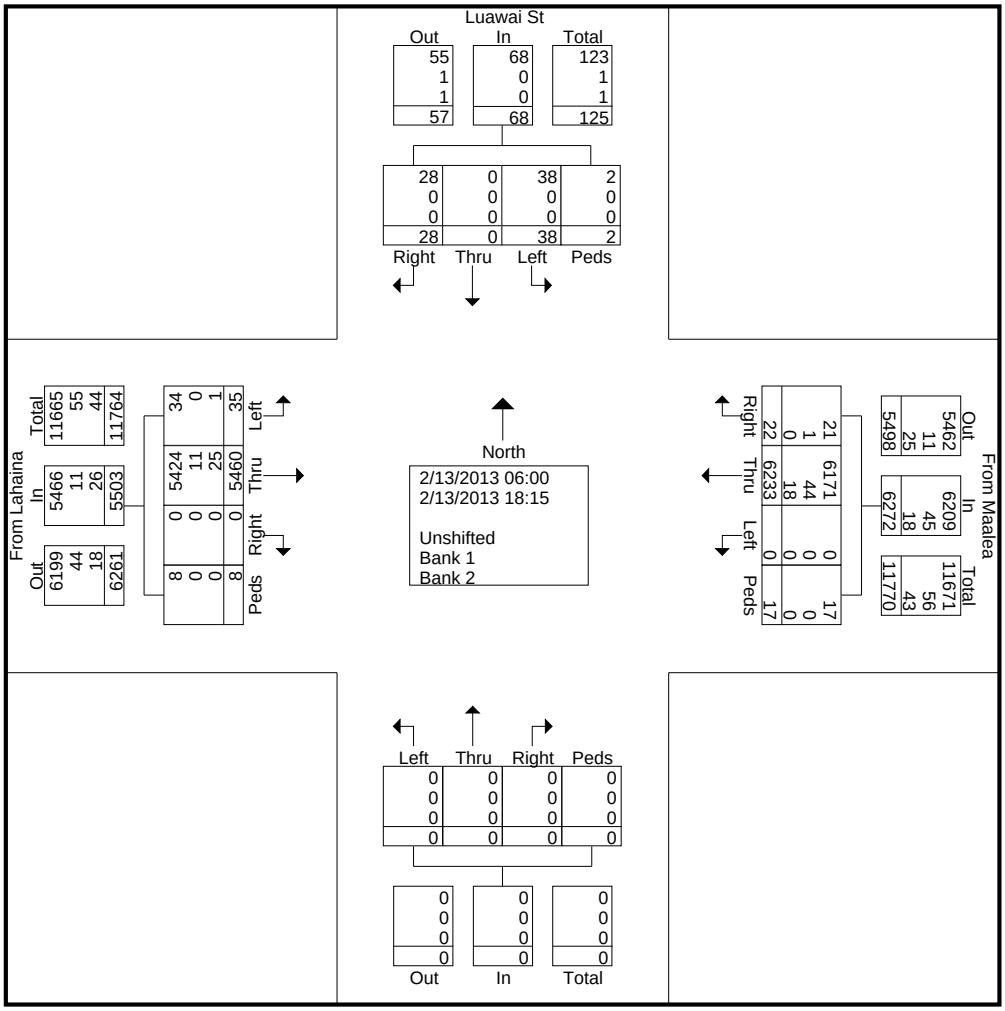
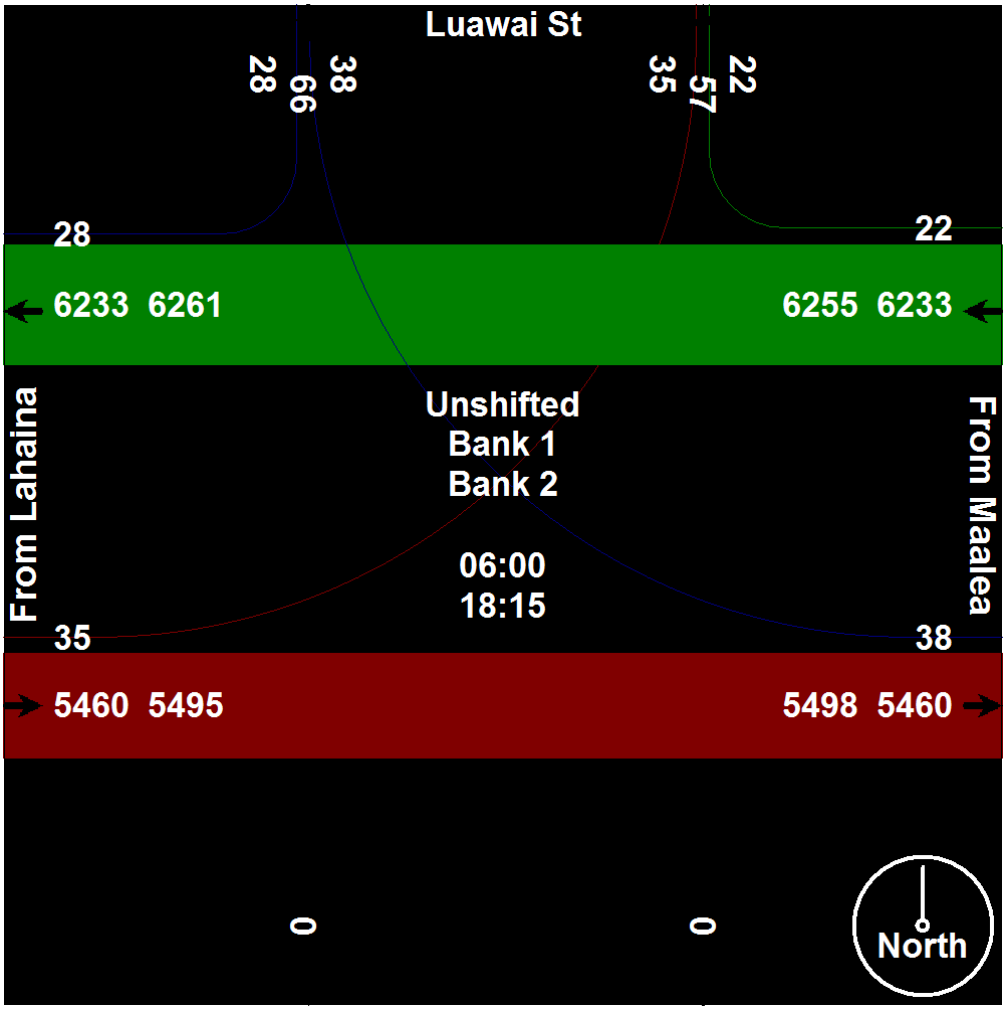


File Name : Not Named 10
Site Code : 33333333
Start Date : 2/13/2013
Page No : 3



	Luawai St From North					From Maalea From East					From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:00																					
08:00	1	0	0	**1**	2	**1**	**235**	0	0	**236**	0	0	0	0	0	0	136	0	1	137	375
08:15	**3**	0	**2**	0	**5**	0	219	0	**2**	221	0	0	0	0	0	0	175	0	0	175	**401**
08:30	0	0	0	0	0	1	208	0	0	209	0	0	0	0	0	0	190	0	0	190	399
08:45	0	0	0	0	0	1	182	0	0	183	0	0	0	0	0	0	**207**	0	**2**	**209**	392
Total Volume	4	0	2	1	7	3	844	0	2	849	0	0	0	0	0	0	708	0	3	711	1567
% App. Total	57.1	0	28.6	14.3		0.4	99.4	0	0.2		0	0	0	0		0	99.6	0	0.4		
PHF	.333	.000	.250	.250	.350	.750	.898	.000	.250	.899	.000	.000	.000	.000	.000	.000	.855	.000	.375	.850	.977

File Name : Not Named 10
Site Code : 33333333
Start Date : 2/13/2013
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	Luawai St From North					From Maalea From East					From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Each Approach Begins at:																					
	07:30					06:30					06:00					08:30					
+0 mins.	1	0	**2**	0	3	**2**	222	0	0	224	0	0	0	0	0	0	190	0	0	190	
+15 mins.	1	0	1	0	2	0	216	0	0	216	0	0	0	0	0	0	207	0	**2**	209	
+30 mins.	1	0	0	**1**	2	1	226	0	0	227	0	0	0	0	0	0	184	0	0	184	
+45 mins.	**3**	0	2	0	**5**	1	**262**	0	0	**263**	0	0	0	0	0	0	**210**	0	2	**212**	
Total Volume	6	0	5	1	12	4	926	0	0	930	0	0	0	0	0	0	791	0	4	795	
% App. Total	50	0	41.7	8.3		0.4	99.6	0	0		0	0	0	0		0	99.5	0	0.5		
PHF	.500	.000	.625	.250	.600	.500	.884	.000	.000	.884	.000	.000	.000	.000	.000	.000	.942	.000	.500	.938	
Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:00																					
15:00	**2**	**0**	**0**	**0**	**2**	1													1		
15:15	0	0	1	0	1	0	286	0	0	286	0	0	0	0	0	0	253	1	0	254	541
15:30	3	0	4	0	7	0	292	0	0	292	0	0	0	0	0	0	280	4	0	284	583
15:45	1	0	5	1	7	1	256	0	0	257	0	0	0	0	0	0	267	2	0	269	533
Total Volume	6	0	10	1	17	2	1108	0	0	1110	0	0	0	0	0	0	1049	10	1	1060	2187
% App. Total	35.3	0	58.8	5.9		0.2	99.8	0	0		0	0	0	0		0	99	0.9	0.1		
PHF	.500	.000	.500	.250	.607	.500	.949	.000	.000	.950	.000	.000	.000	.000	.000	.000	.937	.625	.250	.933	.938

Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	15:15					15:00					12:00					15:00				
+0 mins.	0	0	1	0	1	**1**	274	0	0	275	0	0	0	0	0	0	249	3	**1**	253
+15 mins.	**3**	0	4	0	**7**	0	286	0	0	286	0	0	0	0	0	0	253	1	0	254
+30 mins.	1	0	**5**	**1**	7	0	**292**	0	0	**292**	0	0	0	0	0	0	**280**	**4**	0	**284**
+45 mins.	0	0	3	0	3	1	256	0	0	257	0	0	0	0	0	0	267	2	0	269
Total Volume	4	0	13	1	18	2	1108	0	0	1110	0	0	0	0	0	0	1049	10	1	1060
% App. Total	22.2	0	72.2	5.6		0.2	99.8	0	0		0	0	0	0		0	99	0.9	0.1	
PHF	.333	.000	.650	.250	.643	.500	.949	.000	.000	.950	.000	.000	.000	.000	.000	.000	.937	.625	.250	.933

File Name : Not Named 10
Site Code : 33333333
Start Date : 2/13/2013
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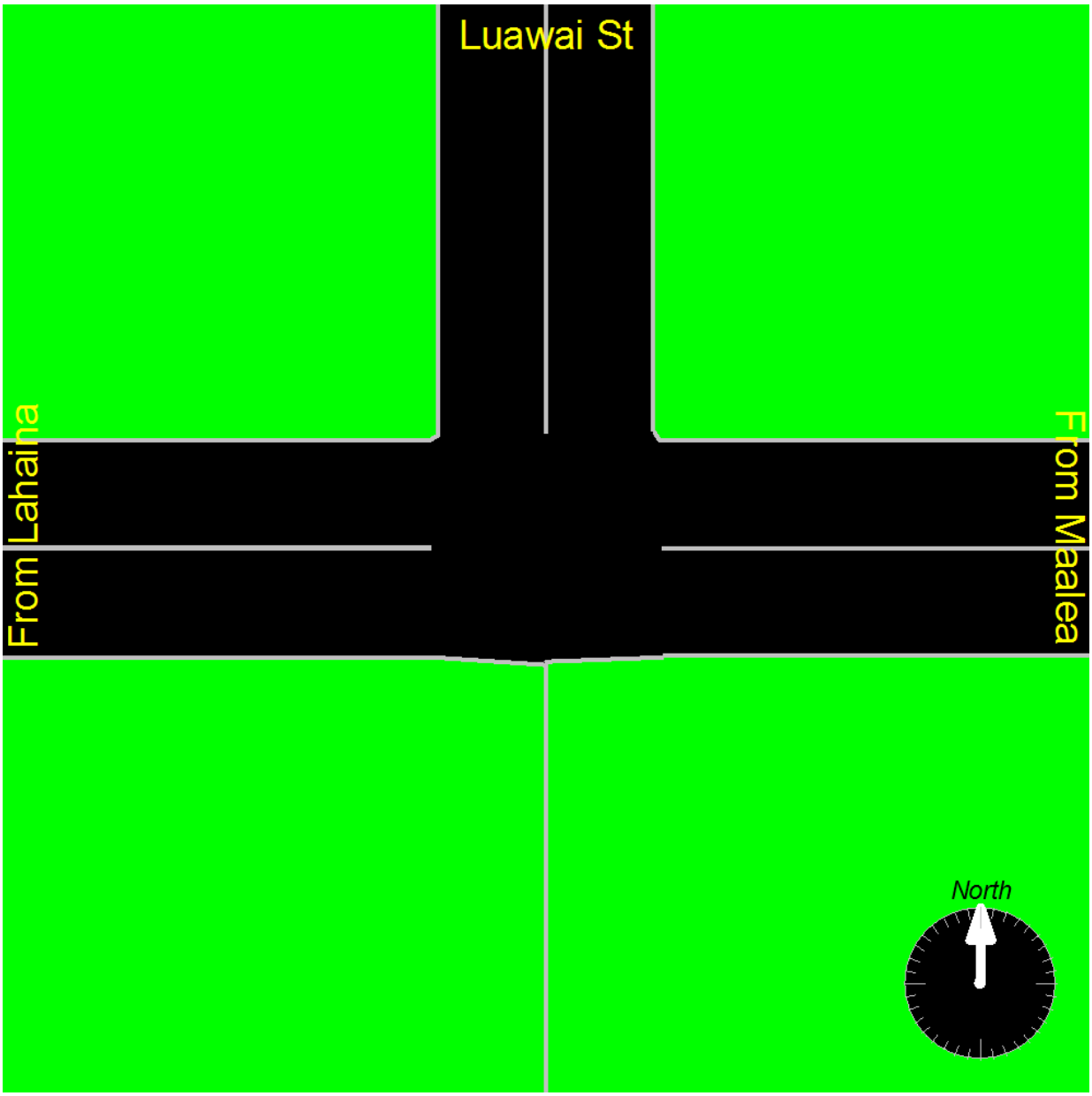

Palmetto Traffic Group, LLC

File Name : Not Named 35
Site Code : 77777777
Start Date : 2/13/2013
Page No : 1

Groups Printed- Unshifted - Bank 1

	Olowalu Access Rd From North					From Maalea From East					From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:00	1	0	0	0	1	0	224	0	0	224	0	0	0	0	0	0	213	0	0	213	438
06:15	0	0	0	0	0	0	315	0	0	315	0	0	0	0	0	0	226	0	0	226	541
06:30	0	0	1	0	1	2	379	0	0	381	0	0	0	0	0	0	241	0	0	241	623
06:45	2	0	0	0	2	0	388	0	0	388	0	0	0	0	0	0	298	0	0	298	688
Total	3	0	1	0	4	2	1306	0	0	1308	0	0	0	0	0	0	978	0	0	978	2290
07:00	1	0	2	0	3	0	471	0	0	471	0	0	0	0	0	0	221	0	0	221	695
07:15	1	0	0	0	1	0	344	0	3	347	0	0	0	0	0	0	276	0	0	276	624
07:30	1	0	0	0	1	0	322	0	0	322	0	0	0	0	0	0	338	0	0	338	661
07:45	1	0	0	0	1	1	388	6	0	395	0	0	0	0	0	0	224	0	0	224	620
Total	4	0	2	0	6	1	1525	6	3	1535	0	0	0	0	0	0	1059	0	0	1059	2600
08:00	0	0	0	0	0	0	308	0	0	308	0	0	0	0	0	0	206	0	1	207	515
08:15	2	0	0	0	2	1	345	0	2	348	0	0	0	0	0	0	213	1	0	214	564
08:30	0	0	0	0	0	0	214	0	0	214	0	0	0	0	0	0	258	0	0	258	472
08:45	0	0	0	0	0	0	278	0	1	279	0	0	0	0	0	0	264	0	2	266	545
Total	2	0	0	0	2	1	1145	0	3	1149	0	0	0	0	0	0	941	1	3	945	2096
09:00	2	0	0	0	2	1	216	0	1	218	0	0	0	0	0	0	212	0	0	212	432
09:15	0	0	0	0	0	1	263	0	3	267	0	0	0	0	0	0	335	2	1	338	605
*** BREAK ***																					
Total	2	0	0	0	2	2	479	0	4	485	0	0	0	0	0	0	547	2	1	550	1037
*** BREAK ***																					
15:00	1	0	1	1	3	2	0	0	0	2	0	0	0	0	0	0	1	1	0	2	7
15:15	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4
15:30	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
15:45	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	3
Total	2	0	4	1	7	4	0	0	0	4	0	0	0	0	0	0	1	3	0	4	15
16:00	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
16:15	1	0	1	0	2	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	4
*** BREAK ***																					
16:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1
Total	1	0	1	0	2	4	0	0	0	4	0	0	0	0	0	0	0	1	0	1	7
17:00	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
17:15	1	0	0	0	1	3	0	1	0	4	0	0	0	0	0	0	0	0	0	0	5
*** BREAK ***																					
17:45	1	0	2	0	3	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	5
Total	2	0	2	0	4	6	0	1	0	7	0	0	0	0	0	0	0	0	0	0	11
18:00	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	2
18:15	1	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	4
Grand Total	17	1	10	1	29	21	4455	7	10	4493	0	0	0	0	0	0	3526	10	4	3540	8062
Apprch %	58.6	3.4	34.5	3.4		0.5	99.2	0.2	0.2		0	0	0	0		0	99.6	0.3	0.1		
Total %	0.2	0	0.1	0	0.4	0.3	55.3	0.1	0.1	55.7	0	0	0	0	0	0	43.7	0.1	0	43.9	
Unshifted	17	1	10	1	29	21	4426	7	10	4464	0	0	0	0	0	0	3509	10	4	3523	8016
% Unshifted	100	100	100	100	100	100	99.3	100	100	99.4	0	0	0	0	0	0	99.5	100	100	99.5	99.4
Bank 1	0	0	0	0	0	0	29	0	0	29	0	0	0	0	0	0	17	0	0	17	46
% Bank 1	0	0	0	0	0	0	0.7	0	0	0.6	0	0	0	0	0	0	0.5	0	0	0.5	0.6

Palmetto Traffic Group, LLC

File Name : Not Named 35
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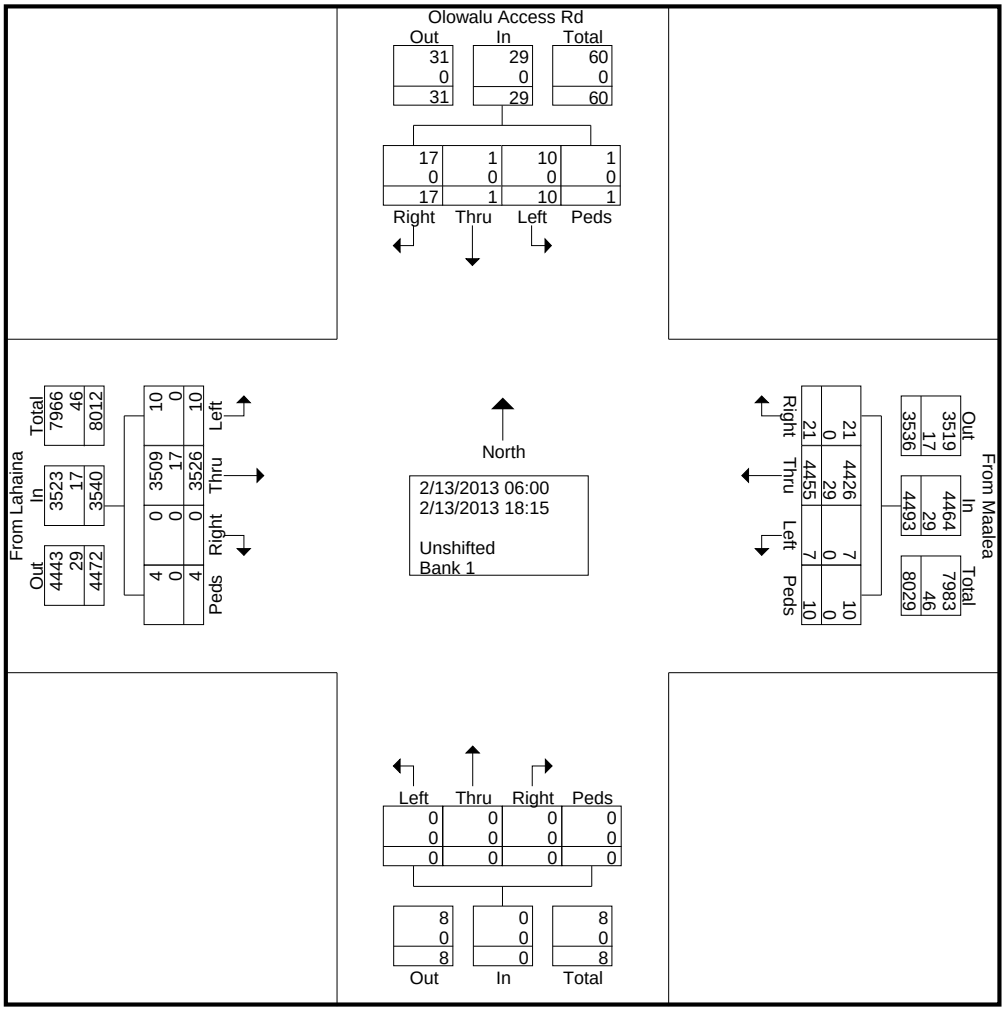

File Name : Not Named 35
Site Code : 77777777
Start Date : 2/13/2013
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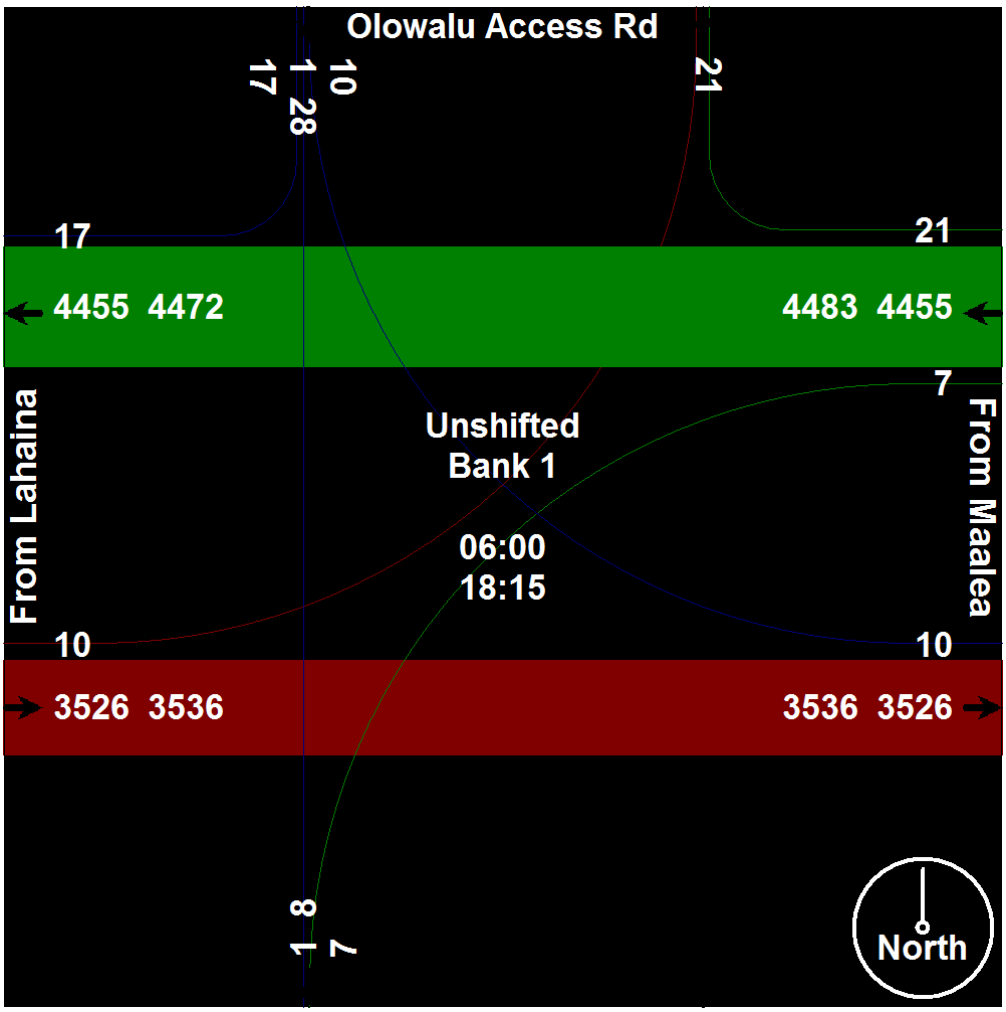

	Olowalu Access Rd From North					From Maalea From East					From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 06:45																					
06:45	**2**	0	0	0	2	0	388	0	0	388	0	0	0	0	0	0	298	0	0	298	688
07:00	1	0	**2**	0	**3**	0	**471**	0	0	**471**	0	0	0	0	0	0	221	0	0	221	**695**
07:15	1	0	0	0	1	0	344	0	**3**	347	0	0	0	0	0	0	276	0	0	276	624
07:30	1	0	0	0	1	0	322	0	0	322	0	0	0	0	0	0	**338**	0	0	**338**	661
Total Volume	5	0	2	0	7	0	1525	0	3	1528	0	0	0	0	0	0	1133	0	0	1133	2668
% App. Total	71.4	0	28.6	0		0	99.8	0	0.2		0	0	0	0		0	100	0	0		
PHF	.625	.000	.250	.000	.583	.000	.809	.000	.250	.811	.000	.000	.000	.000	.000	.000	.838	.000	.000	.838	.960

Palmetto Traffic Group, LLC

File Name : Not Named 35
Site Code : 77777777
Start Date : 2/13/2013
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	Olowalu Access Rd From North					From Maalea From East										From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Each Approach Begins at:																					
	06:30					06:30					06:00					06:45					
+0 mins.	0	0	1	0	1	**2**	379	0	0	381	0	0	0	0	0	0	298	0	0	298	
+15 mins.	**2**	0	0	0	2	0	388	0	0	388	0	0	0	0	0	0	221	0	0	221	
+30 mins.	1	0	**2**	0	**3**	0	**471**	0	0	**471**	0	0	0	0	0	0	276	0	0	276	
+45 mins.	1	0	0	0	1	0	344	0	**3**	347	0	0	0	0	0	0	**338**	0	0	**338**	
Total Volume	4	0	3	0	7	2	1582	0	3	1587	0	0	0	0	0	0	1133	0	0	1133	
% App. Total	57.1	0	42.9	0		0.1	99.7	0	0.2		0	0	0	0		0	100	0	0		
PHF	.500	.000	.375	.000	.583	.250	.840	.000	.250	.842	.000	.000	.000	.000	.000	.000	.838	.000	.000	.838	
Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:00																					
15:00	1			1	3	2				2							1	1		2	7
15:15	0	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	4
15:30	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
15:45	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	3
Total Volume	2	0	4	1	7	4	0	0	0	4	0	0	0	0	0	0	1	3	0	4	15
% App. Total	28.6	0	57.1	14.3		100	0	0	0		0	0	0	0		0	25	75	0		
PHF	.500	.000	.333	.250	.583	.500	.000	.000	.000	.500	.000	.000	.000	.000	.000	.000	.250	.750	.000	.500	.536

Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	15:00					17:00					12:00					15:00				
+0 mins.	**1**	0	1	**1**	**3**	1	0	0	0	1	0	0	0	0	0	0	**1**	**1**	0	**2**
+15 mins.	0	0	**3**	0	3	**3**	0	**1**	0	**4**	0	0	0	0	0	0	0	1	0	1
+30 mins.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+45 mins.	1	0	0	0	1	2	0	0	0	2	0	0	0	0	0	0	0	1	0	1
Total Volume	2	0	4	1	7	6	0	1	0	7	0	0	0	0	0	0	1	3	0	4
% App. Total	28.6	0	57.1	14.3		85.7	0	14.3	0		0	0	0	0		0	25	75	0	
PHF	.500	.000	.333	.250	.583	.500	.000	.250	.000	.438	.000	.000	.000	.000	.000	.000	.250	.750	.000	.500

File Name : Not Named 35
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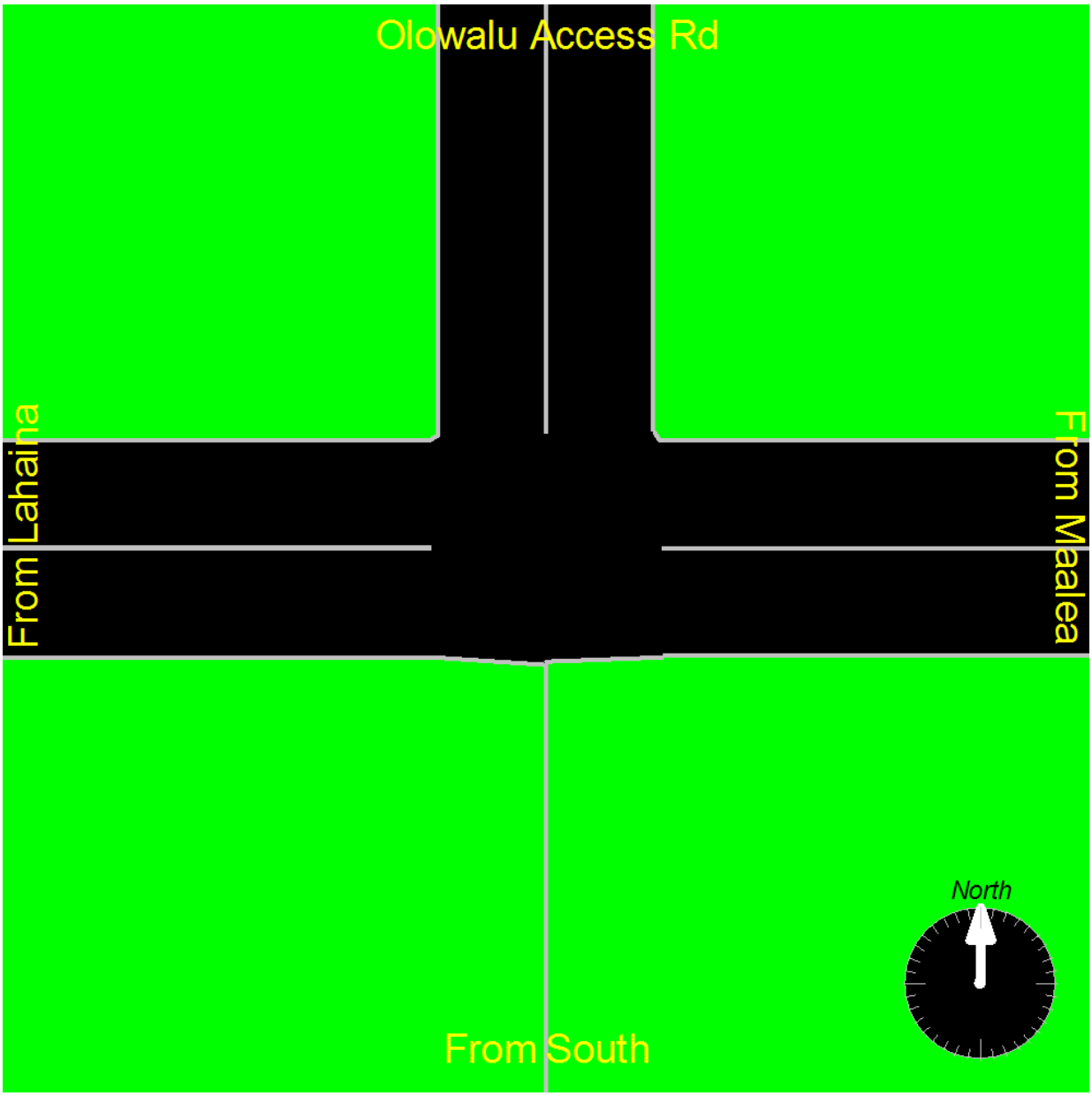

Palmetto Traffic Group, LLC

File Name : Not Named 34
Site Code : 77777777
Start Date : 2/12/2013
Page No : 1

Groups Printed- Unshifted - Bank 1 - Bank 2

	Olowalu Store From North					From Maalea From East					Managers House From South					From Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
07:00	0	0	2	0	2	0	207	0	0	207	1	0	1	0	2	1	172	3	0	176	387
07:15	0	0	0	0	0	0	311	0	0	311	0	0	0	0	0	0	207	0	0	207	518
07:30	2	0	0	0	2	5	286	0	3	294	2	2	2	0	6	1	315	1	0	317	619
07:45	2	0	0	0	2	2	317	0	3	322	2	0	0	0	2	3	391	3	0	397	723
Total	4	0	2	0	6	7	1121	0	6	1134	5	2	3	0	10	5	1085	7	0	1097	2247
08:00	2	0	0	0	2	6	488	4	1	499	1	0	0	0	1	1	374	0	2	377	879
08:15	3	0	0	0	3	7	446	1	0	454	1	0	1	0	2	1	393	0	4	398	857
08:30	2	0	1	0	3	2	416	1	2	421	0	1	0	0	1	1	413	1	0	415	840
08:45	6	0	1	0	7	6	315	3	1	325	1	0	2	0	3	1	302	1	6	310	645
Total	13	0	2	0	15	21	1665	9	4	1699	3	1	3	0	7	4	1482	2	12	1500	3221
*** BREAK ***																					
15:00	8	0	0	0	8	2	296	0	0	298	9	1	3	0	13	6	267	9	0	282	601
15:15	4	0	1	0	5	4	331	11	0	346	0	2	0	0	2	2	364	1	0	367	720
15:30	3	0	2	0	5	1	341	2	0	344	1	0	0	0	1	4	410	3	0	417	767
15:45	3	0	2	0	5	0	378	3	0	381	3	0	3	0	6	5	444	2	0	451	843
Total	18	0	5	0	23	7	1346	16	0	1369	13	3	6	0	22	17	1485	15	0	1517	2931
16:00	1	0	0	0	1	5	373	3	3	384	3	1	2	0	6	2	498	2	1	503	894
16:15	1	0	0	0	1	3	412	2	0	417	1	0	1	0	2	0	459	6	0	465	885
16:30	3	0	0	0	3	0	356	4	0	360	2	0	1	0	3	3	474	4	0	481	847
16:45	2	0	0	0	2	3	414	5	0	422	0	1	1	0	2	2	522	5	1	530	956
Total	7	0	0	0	7	11	1555	14	3	1583	6	2	5	0	13	7	1953	17	2	1979	3582
17:00	4	0	2	0	6	2	333	3	0	338	2	1	3	0	6	6	503	6	1	516	866
17:15	2	0	0	0	2	0	541	6	0	547	1	2	0	0	3	2	511	13	1	527	1079
17:30	1	0	0	0	1	1	433	4	1	439	1	1	2	2	6	4	553	5	0	562	1008
17:45	0	0	1	0	1	0	420	3	0	423	4	0	3	0	7	0	379	5	1	385	816
Total	7	0	3	0	10	3	1727	16	1	1747	8	4	8	2	22	12	1946	29	3	1990	3769
18:00	0	0	0	0	0	0	408	2	0	410	1	0	2	0	3	1	346	9	0	356	769
18:15	3	0	0	0	3	2	438	2	1	443	1	0	3	0	4	1	378	2	0	381	831
Grand Total	52	0	12	0	64	51	8260	59	15	8385	37	12	30	2	81	47	8675	81	17	8820	17350
Apprch %	81.2	0	18.8	0		0.6	98.5	0.7	0.2		45.7	14.8	37	2.5		0.5	98.4	0.9	0.2		
Total %	0.3	0	0.1	0	0.4	0.3	47.6	0.3	0.1	48.3	0.2	0.1	0.2	0	0.5	0.3	50	0.5	0.1	50.8	
Unshifted	52	0	12	0	64	51	8217	59	15	8342	37	12	30	2	81	47	8610	81	17	8755	17242
% Unshifted	100	0	100	0	100	100	99.5	100	100	99.5	100	100	100	100	100	100	99.3	100	100	99.3	99.4
Bank 1	0	0	0	0	0	0	31	0	0	31	0	0	0	0	0	0	37	0	0	37	68
% Bank 1	0	0	0	0	0	0	0.4	0	0	0.4	0	0	0	0	0	0	0.4	0	0	0.4	0.4
Bank 2	0	0	0	0	0	0	12	0	0	12	0	0	0	0	0	0	28	0	0	28	40
% Bank 2	0	0	0	0	0	0	0.1	0	0	0.1	0	0	0	0	0	0	0.3	0	0	0.3	0.2

Palmetto Traffic Group, LLC

File Name : Not Named 34
Site Code : 77777777
Start Date : 2/12/2013
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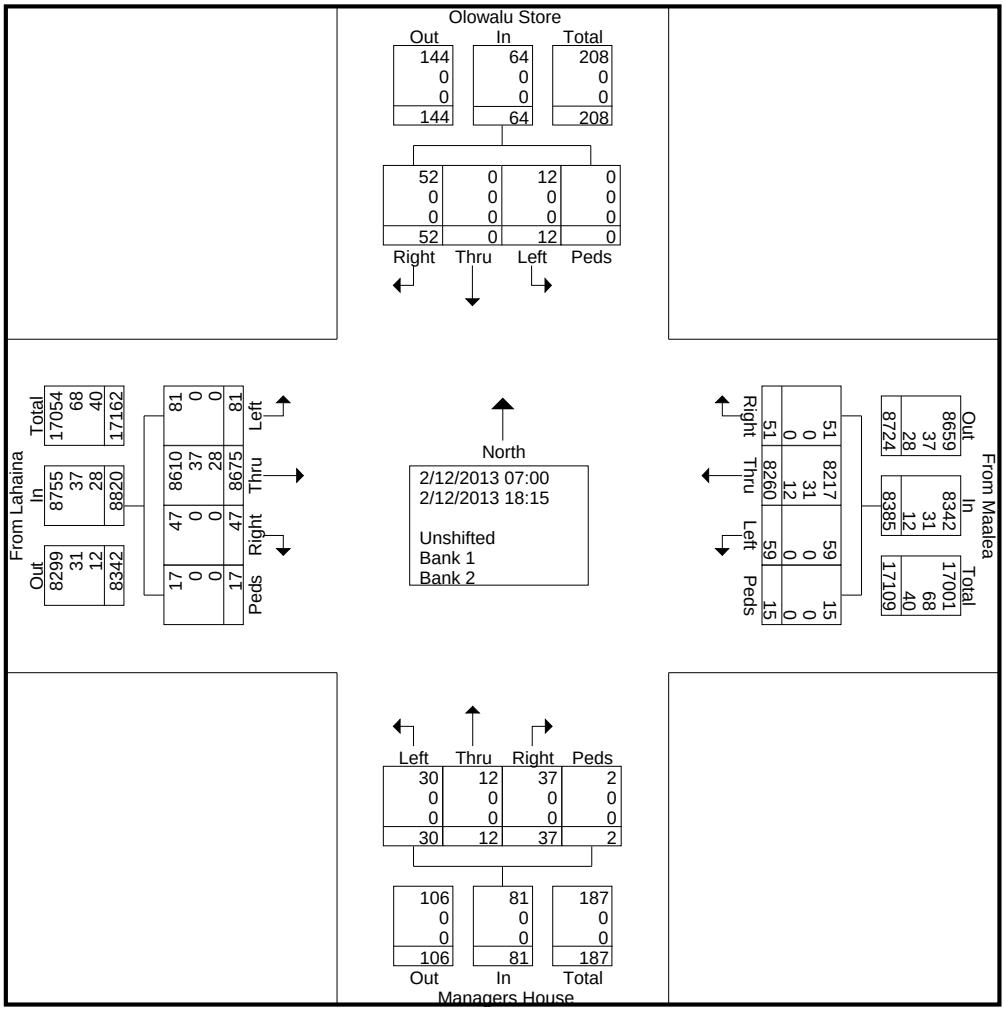
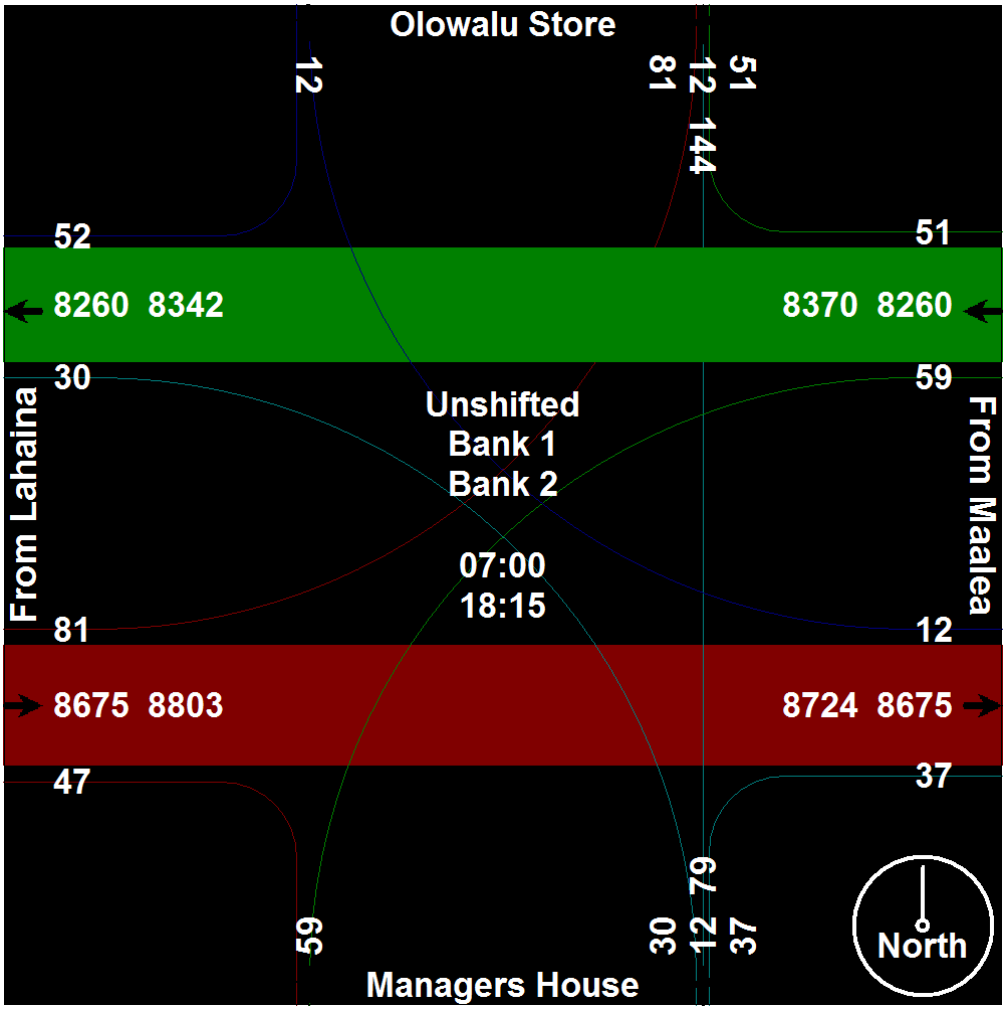
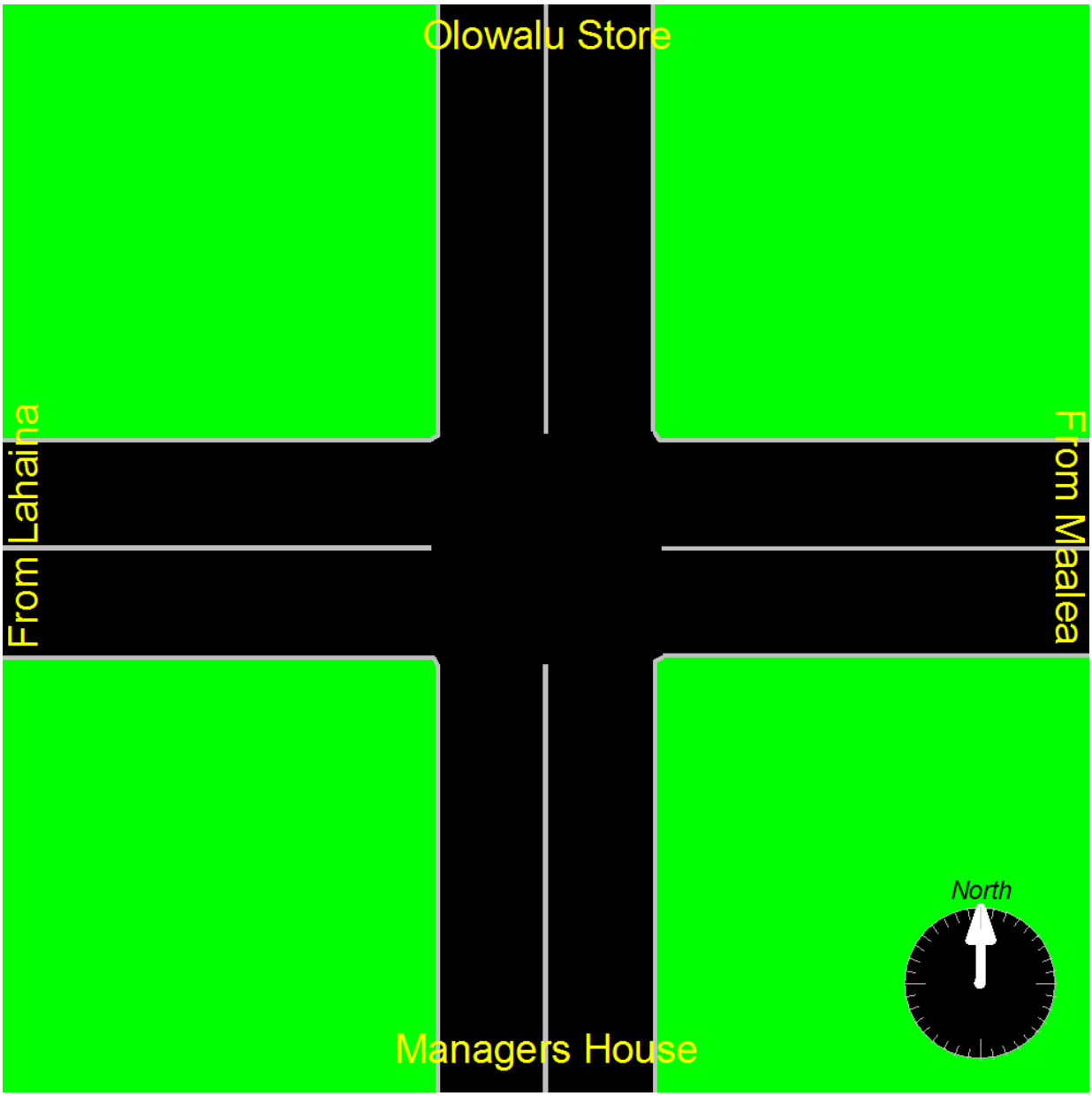


File Name : Not Named 34
Site Code : 77777777
Start Date : 2/12/2013
Page No : 3



File Name : Not Named 34
Site Code : 77777777
Start Date : 2/12/2013
Page No : 4



Palmetto Traffic Group, LLC

File Name : Pohaku St TMC
Site Code :
Start Date : 2/14/2013
Page No : 1

Groups Printed- Unshifted - Bank 1

	Pohaku St From North					HP HWY from Maalea From East					From South					HP WHY from Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:00	0	0	0	0	0	3	119	0	0	122	0	0	0	0	0	0	113	0	0	113	235
06:15	1	0	0	0	1	0	164	0	0	164	0	0	0	0	0	0	102	0	0	102	267
06:30	1	0	0	1	2	0	262	0	0	262	0	0	0	0	0	0	139	0	0	139	403
06:45	1	0	0	0	1	0	223	0	0	223	0	0	0	0	0	0	134	0	0	134	358
Total	3	0	0	1	4	3	768	0	0	771	0	0	0	0	0	0	488	0	0	488	1263
07:00	0	0	0	0	0	0	283	0	0	283	0	0	0	0	0	0	161	0	0	161	444
07:15	1	0	1	0	2	4	284	0	0	288	0	0	0	0	0	0	179	1	1	181	471
07:30	0	0	0	0	0	0	219	0	0	219	0	0	0	0	0	0	197	0	0	197	416
07:45	0	0	1	0	1	1	182	0	0	183	0	0	0	0	0	0	184	0	0	184	368
Total	1	0	2	0	3	5	968	0	0	973	0	0	0	0	0	0	721	1	1	723	1699
08:00	1	0	1	0	2	0	225	0	0	225	0	0	0	0	0	0	179	0	0	179	406
08:15	0	0	0	0	0	1	231	0	0	232	0	0	0	0	0	0	172	0	1	173	405
08:30	0	0	0	0	0	1	219	0	1	221	0	0	0	0	0	0	184	0	1	185	406
08:45	0	0	0	0	0	3	215	0	2	220	0	0	0	0	0	0	163	0	0	163	383
Total	1	0	1	0	2	5	890	0	3	898	0	0	0	0	0	0	698	0	2	700	1600
09:00	0	0	1	0	1	0	179	0	1	180	0	0	0	0	0	0	205	0	0	205	386
09:15	2	0	0	0	2	2	170	0	0	172	0	0	0	0	0	0	226	0	1	227	401
*** BREAK ***																					
Total	2	0	1	0	3	2	349	0	1	352	0	0	0	0	0	0	431	0	1	432	787
*** BREAK ***																					
15:00	2	0	0	0	2	0	247	0	0	247	0	0	0	0	0	0	229	0	0	229	478
15:15	2	0	0	0	2	2	275	0	1	278	0	0	0	0	0	0	248	0	0	248	528
15:30	0	0	0	0	0	1	309	0	0	310	0	0	0	0	0	0	274	0	0	274	584
15:45	0	0	2	0	2	1	312	0	1	314	0	0	0	0	0	0	291	1	0	292	608
Total	4	0	2	0	6	4	1143	0	2	1149	0	0	0	0	0	0	1042	1	0	1043	2198
16:00	0	0	0	0	0	4	251	0	0	255	0	0	0	0	0	0	266	0	0	266	521
16:15	2	0	1	0	3	1	296	0	0	297	0	0	0	0	0	0	272	0	0	272	572
16:30	0	0	0	0	0	1	274	0	0	275	0	0	0	0	0	0	289	0	2	291	566
16:45	0	0	0	0	0	1	243	0	0	244	0	0	0	0	0	0	294	0	0	294	538
Total	2	0	1	0	3	7	1064	0	0	1071	0	0	0	0	0	0	1121	0	2	1123	2197
17:00	0	0	0	0	0	1	262	0	0	263	0	0	0	0	0	0	314	0	0	314	577
17:15	0	0	0	0	0	1	273	0	0	274	0	0	0	0	0	0	270	1	0	271	545
17:30	0	0	1	0	1	2	223	0	0	225	0	0	0	0	0	0	245	1	0	246	472
17:45	1	0	0	0	1	2	181	0	0	183	0	0	0	0	0	0	264	2	1	267	451
Total	1	0	1	0	2	6	939	0	0	945	0	0	0	0	0	0	1093	4	1	1098	2045
18:00	0	0	1	0	1	2	174	0	0	176	0	0	0	0	0	0	186	0	0	186	363
18:15	0	0	0	0	0	0	182	0	0	182	0	0	0	0	0	0	214	4	0	218	400
Grand Total	14	0	9	1	24	34	6477	0	6	6517	0	0	0	0	0	0	5994	10	7	6011	12552
Apprch %	58.3	0	37.5	4.2		0.5	99.4	0	0.1		0	0	0	0		0	99.7	0.2	0.1		
Total %	0.1	0	0.1	0	0.2	0.3	51.6	0	0	51.9	0	0	0	0	0	0	47.8	0.1	0.1	47.9	
Unshifted	14	0	9	1	24	34	6454	0	6	6494	0	0	0	0	0	0	5973	10	7	5990	12508
% Unshifted	100	0	100	100	100	100	99.6	0	100	99.6	0	0	0	0	0	0	99.6	100	100	99.7	99.6
Bank 1	0	0	0	0	0	0	23	0	0	23	0	0	0	0	0	0	21	0	0	21	44
% Bank 1	0	0	0	0	0	0	0.4	0	0	0.4	0	0	0	0	0	0	0.4	0	0	0.3	0.4

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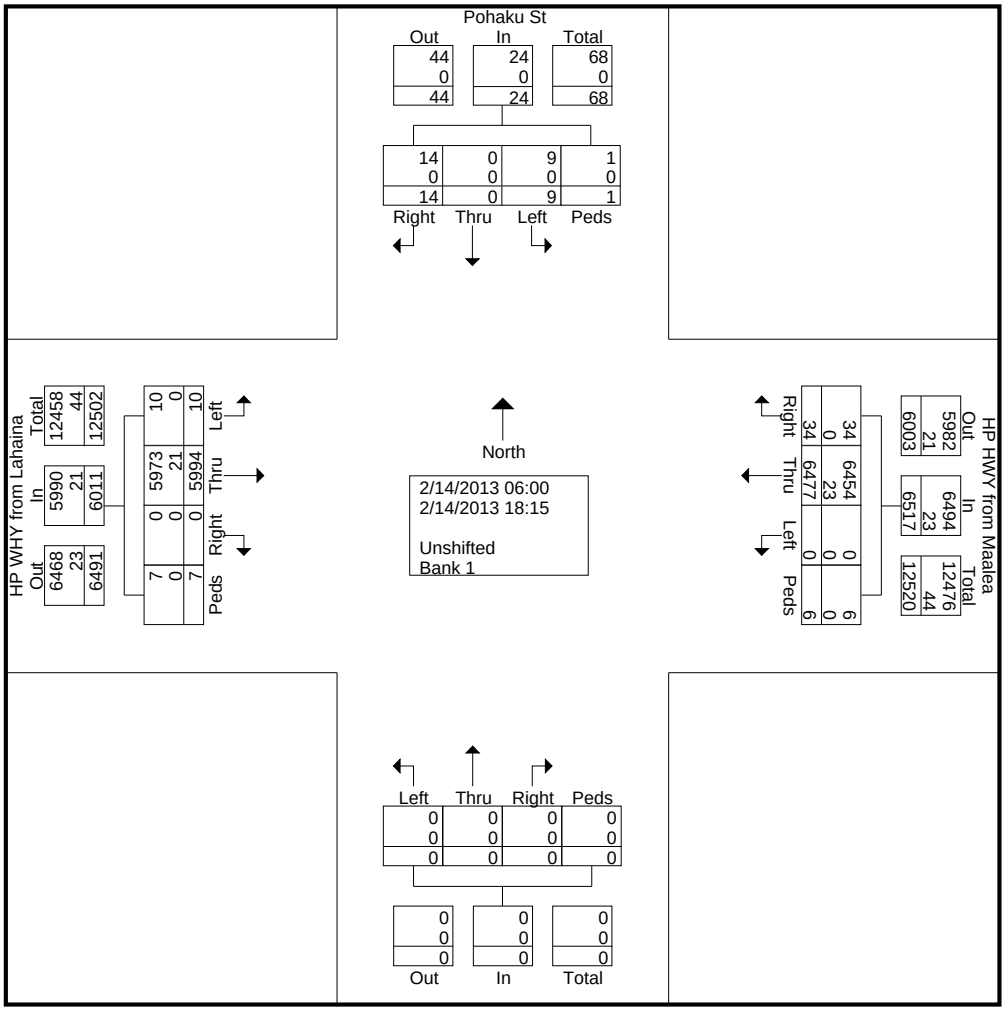

File Name : Pohaku St TMC
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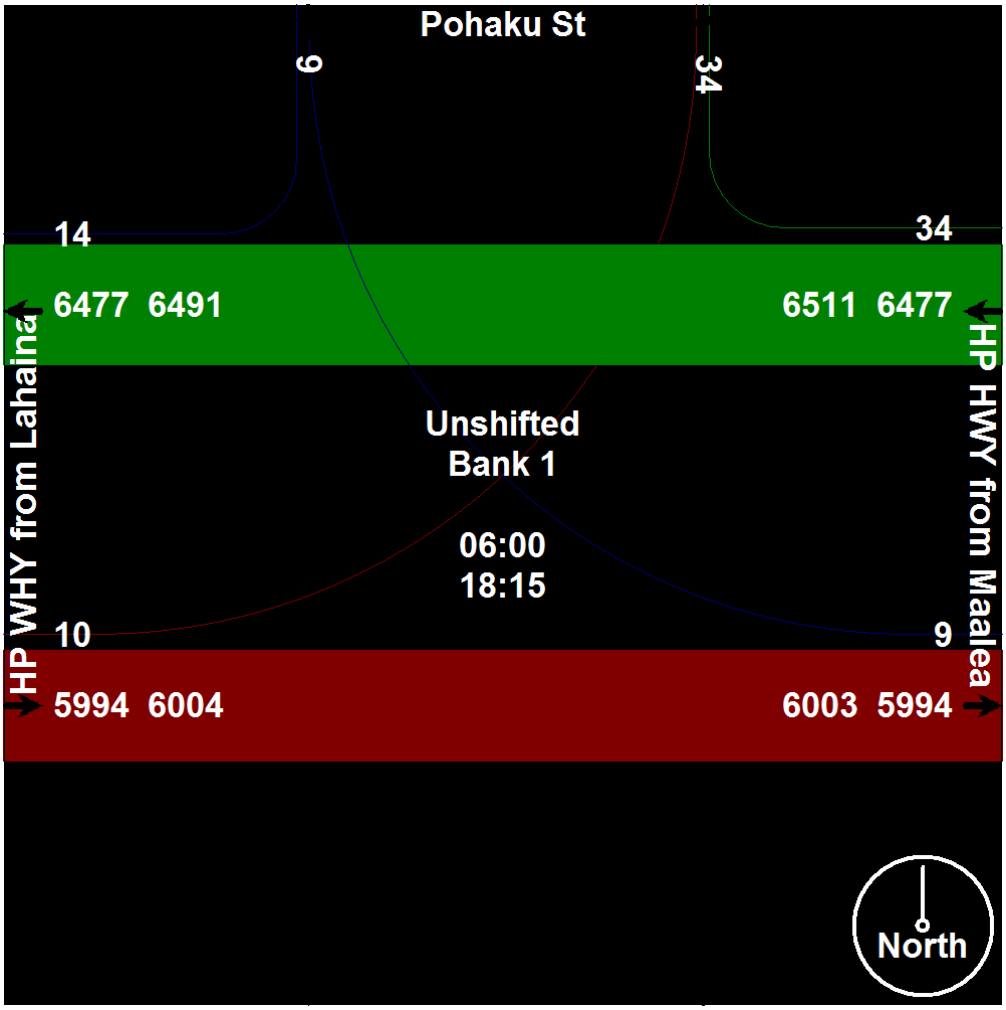

	Pohaku St From North					HP HWY from Maalea From East					From South					HP WHY from Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:00																					
07:00	0	0	0	0	0	0	283	0	0	283	0	0	0	0	0	0	161	0	0	161	444
07:15	**1**	0	**1**	0	**2**	**4**	**284**	0	0	**288**	0	0	0	0	0	0	179	**1**	**1**	181	**471**
07:30	0	0	0	0	0	0	219	0	0	219	0	0	0	0	0	0	**197**	0	0	**197**	416
07:45	0	0	1	0	1	1	182	0	0	183	0	0	0	0	0	0	184	0	0	184	368
Total Volume	1	0	2	0	3	5	968	0	0	973	0	0	0	0	0	0	721	1	1	723	1699
% App. Total	33.3	0	66.7	0		0.5	99.5	0	0		0	0	0	0		0	99.7	0.1	0.1		
PHF	.250	.000	.500	.000	.375	.313	.852	.000	.000	.845	.000	.000	.000	.000	.000	.000	.915	.250	.250	.918	.902

File Name : Pohaku St TMC
Site Code :
Start Date : 2/14/2013
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	Pohaku St From North					HP HWY from Maalea From East					From South					HP WHY from Lahaina From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:00 to 11:45 - Peak 1 of 1																					
Peak Hour for Each Approach Begins at:																					
	06:30					06:30					06:00					08:30					
+0 mins.	**1**	0	0	**1**	**2**	0	262	0	0	262	0	0	0	0	0	0	184	0	**1**	185	
+15 mins.	1	0	0	0	1	0	223	0	0	223	0	0	0	0	0	0	163	0	0	163	
+30 mins.	0	0	0	0	0	0	283	0	0	283	0	0	0	0	0	0	205	0	0	205	
+45 mins.	1	0	**1**	0	2	**4**	**284**	0	0	**288**	0	0	0	0	0	0	**226**	0	1	**227**	
Total Volume	3	0	1	1	5	4	1052	0	0	1056	0	0	0	0	0	0	778	0	2	780	
% App. Total	60	0	20	20		0.4	99.6	0	0		0	0	0	0		0	99.7	0	0.3		
PHF	.750	.000	.250	.250	.625	.250	.926	.000	.000	.917	.000	.000	.000	.000	.000	.000	.861	.000	.500	.859	
Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 15:30																					
15:30	0	0	0	0	0	1	309	0	0	310	0	0	0	0	0	0	274	0	0	274	584
15:45	0	0	2				312		1	314							291	1		292	608
16:00	0	0	0	0	0	4	251	0	0	255	0	0	0	0	0	0	266	0	0	266	521
16:15	2	0	1	0	3	1	296	0	0	297	0	0	0	0	0	0	272	0	0	272	572
Total Volume	2	0	3	0	5	7	1168	0	1	1176	0	0	0	0	0	0	1103	1	0	1104	2285
% App. Total	40	0	60	0		0.6	99.3	0	0.1		0	0	0	0		0	99.9	0.1	0		
PHF	.250	.000	.375	.000	.417	.438	.936	.000	.250	.936	.000	.000	.000	.000	.000	.000	.948	.250	.000	.945	.940

Peak Hour Analysis From 12:00 to 18:15 - Peak 1 of 1
Peak Hour for Each Approach Begins at:

	15:00					15:30					12:00					16:15				
+0 mins.	**2**	0	0	0	**2**	1	309	0	0	310	0	0	0	0	0	0	272	0	0	272
+15 mins.	2	0	0	0	2	1	**312**	0	**1**	**314**	0	0	0	0	0	0	289	0	**2**	291
+30 mins.	0	0	0	0	0	**4**	251	0	0	255	0	0	0	0	0	0	294	0	0	294
+45 mins.	0	0	**2**	0	2	1	296	0	0	297	0	0	0	0	0	0	**314**	0	0	**314**
Total Volume	4	0	2	0	6	7	1168	0	1	1176	0	0	0	0	0	0	1169	0	2	1171
% App. Total	66.7	0	33.3	0		0.6	99.3	0	0.1		0	0	0	0		0	99.8	0	0.2	
PHF	.500	.000	.250	.000	.750	.438	.936	.000	.250	.936	.000	.000	.000	.000	.000	.000	.931	.000	.250	.932

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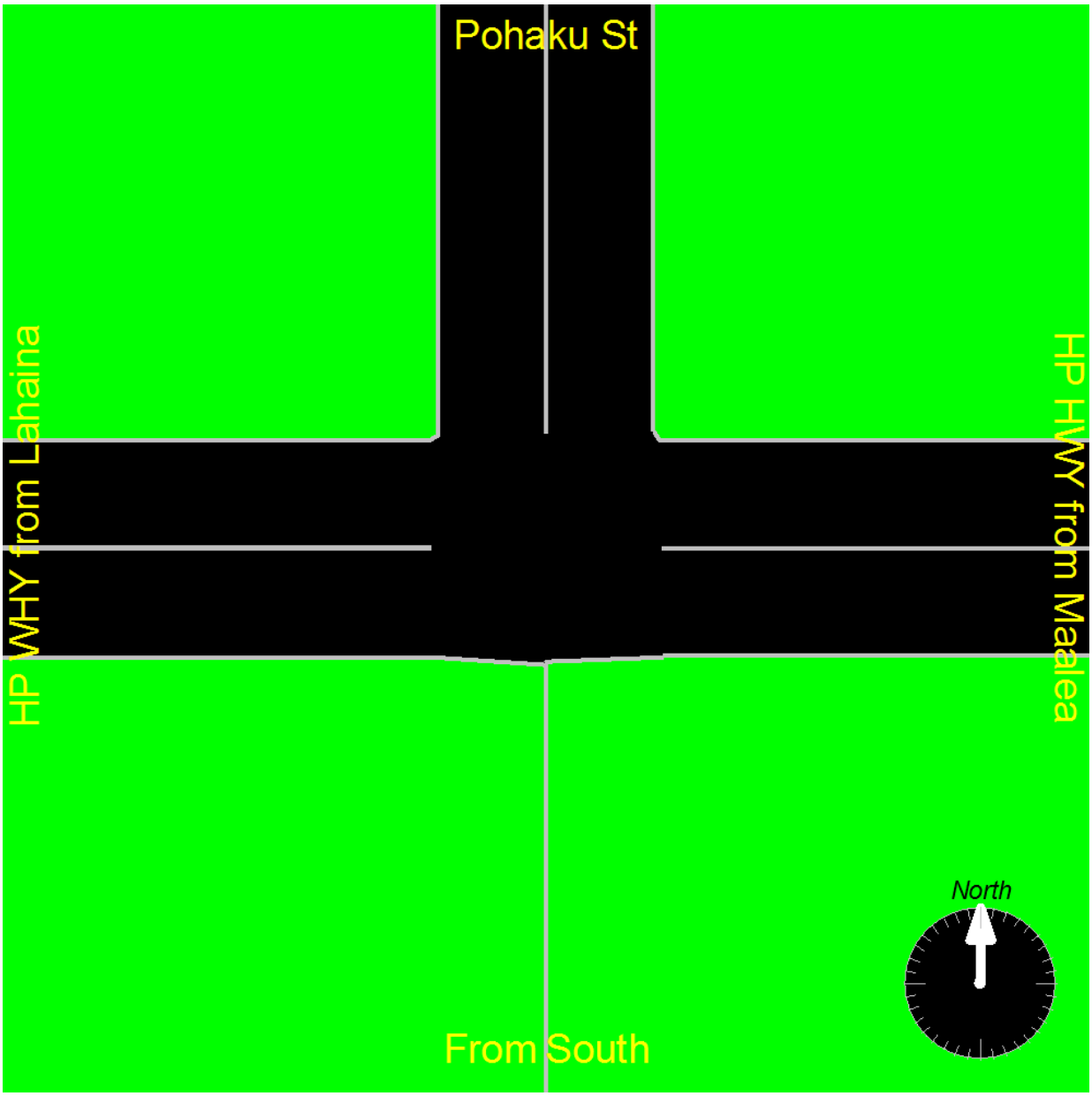

Palmetto Traffic Group, LLC

File Name : Not Named 12
Site Code : TMC
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Groups Printed- Unshifted - Bank 1 - Bank 2

	From North					Honoapiilani Hwy From East					Overlook From South					Honoapiilani Hwy From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
06:45	0	0	0	0	0	0	232	0	2	234	1	0	0	0	1	2	107	0	0	109	344
Total	0	0	0	0	0	0	232	0	2	234	1	0	0	0	1	2	107	0	0	109	344
07:00	0	0	0	0	0	0	247	0	0	247	1	0	0	0	1	1	121	0	0	122	370
07:15	0	0	0	0	0	0	272	0	2	274	0	0	0	0	0	1	154	0	0	155	429
07:30	0	0	0	0	0	0	334	1	0	335	0	0	0	0	0	3	284	0	0	287	622
07:45	0	0	0	0	0	1	177	2	1	181	3	0	1	0	4	2	158	0	0	160	345
Total	0	0	0	0	0	1	1030	3	3	1037	4	0	1	0	5	7	717	0	0	724	1766
08:00	0	0	0	0	0	0	224	2	0	226	5	0	1	0	6	5	157	0	0	162	394
08:15	0	0	0	0	0	0	232	5	1	238	3	0	0	0	3	8	246	0	1	255	496
08:30	0	0	0	0	0	0	213	11	3	227	8	0	6	0	14	11	221	0	0	232	473
08:45	0	0	0	0	0	0	201	4	1	206	3	0	6	0	9	9	261	0	1	271	486
Total	0	0	0	0	0	0	870	22	5	897	19	0	13	0	32	33	885	0	2	920	1849
09:00	0	0	0	0	0	0	180	11	0	191	13	0	3	0	16	11	184	0	9	204	411
09:15	0	0	0	0	0	0	177	6	0	183	7	0	8	0	15	9	149	0	0	158	356
09:30	0	0	0	0	0	0	160	0	0	160	6	0	1	0	7	6	223	0	0	229	396
*** BREAK ***																					
Total	0	0	0	0	0	0	517	17	0	534	26	0	12	0	38	26	556	0	9	591	1163
*** BREAK ***																					
15:30	0	0	0	0	0	17	236	9	0	262	11	0	9	0	20	9	232	0	0	241	523
15:45	0	0	0	0	0	0	239	17	0	256	10	0	6	0	16	8	275	0	0	283	555
Total	0	0	0	0	0	17	475	26	0	518	21	0	15	0	36	17	507	0	0	524	1078
16:00	0	0	0	0	0	0	391	4	0	395	2	0	14	0	16	15	426	0	0	441	852
16:15	0	0	0	0	0	0	382	10	1	393	5	0	4	0	9	14	319	0	0	333	735
16:30	0	0	0	0	0	0	200	9	0	209	4	0	4	0	8	7	246	0	0	253	470
16:45	0	0	0	0	0	0	227	9	0	236	12	0	5	0	17	12	251	0	0	263	516
Total	0	0	0	0	0	0	1200	32	1	1233	23	0	27	0	50	48	1242	0	0	1290	2573
17:00	0	0	0	0	0	0	404	6	0	410	8	0	10	0	18	21	413	0	1	435	863
17:15	0	0	0	0	0	0	338	10	0	348	5	0	5	0	10	12	412	0	0	424	782
17:30	0	0	0	0	0	0	451	13	0	464	3	0	10	0	13	10	392	0	0	402	879
17:45	0	0	0	0	0	0	193	12	0	205	7	0	4	0	11	4	179	0	0	183	399
Total	0	0	0	0	0	0	1386	41	0	1427	23	0	29	0	52	47	1396	0	1	1444	2923
18:00	0	0	0	0	0	3	173	6	0	182	6	0	7	0	13	8	177	0	1	186	381
Grand Total	0	0	0	0	0	21	5883	147	11	6062	123	0	104	0	227	188	5587	0	13	5788	12077
Apprch %	0	0	0	0		0.3	97	2.4	0.2		54.2	0	45.8	0		3.2	96.5	0	0.2		
Total %	0	0	0	0	0	0.2	48.7	1.2	0.1	50.2	1	0	0.9	0	1.9	1.6	46.3	0	0.1	47.9	
Unshifted	0	0	0	0	0	21	5788	147	11	5967	123	0	104	0	227	188	5488	0	13	5689	11883
% Unshifted	0	0	0	0	0	100	98.4	100	100	98.4	100	0	100	0	100	100	98.2	0	100	98.3	98.4
Bank 1	0	0	0	0	0	0	71	0	0	71	0	0	0	0	0	0	41	0	0	41	112
% Bank 1	0	0	0	0	0	0	1.2	0	0	1.2	0	0	0	0	0	0	0.7	0	0	0.7	0.9
Bank 2	0	0	0	0	0	0	24	0	0	24	0	0	0	0	0	0	58	0	0	58	82
% Bank 2	0	0	0	0	0	0	0.4	0	0	0.4	0	0	0	0	0	0	1	0	0	1	0.7

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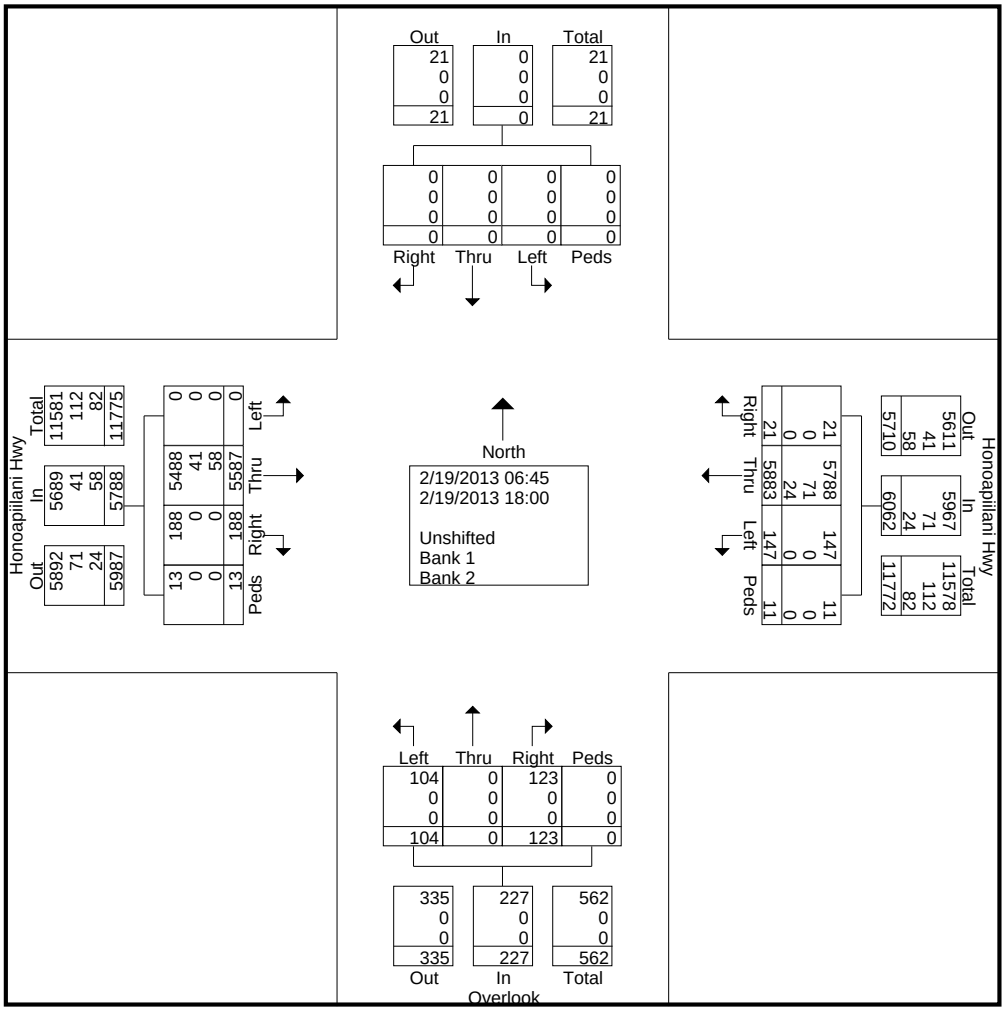

File Name : Not Named 12
Site Code : TMC
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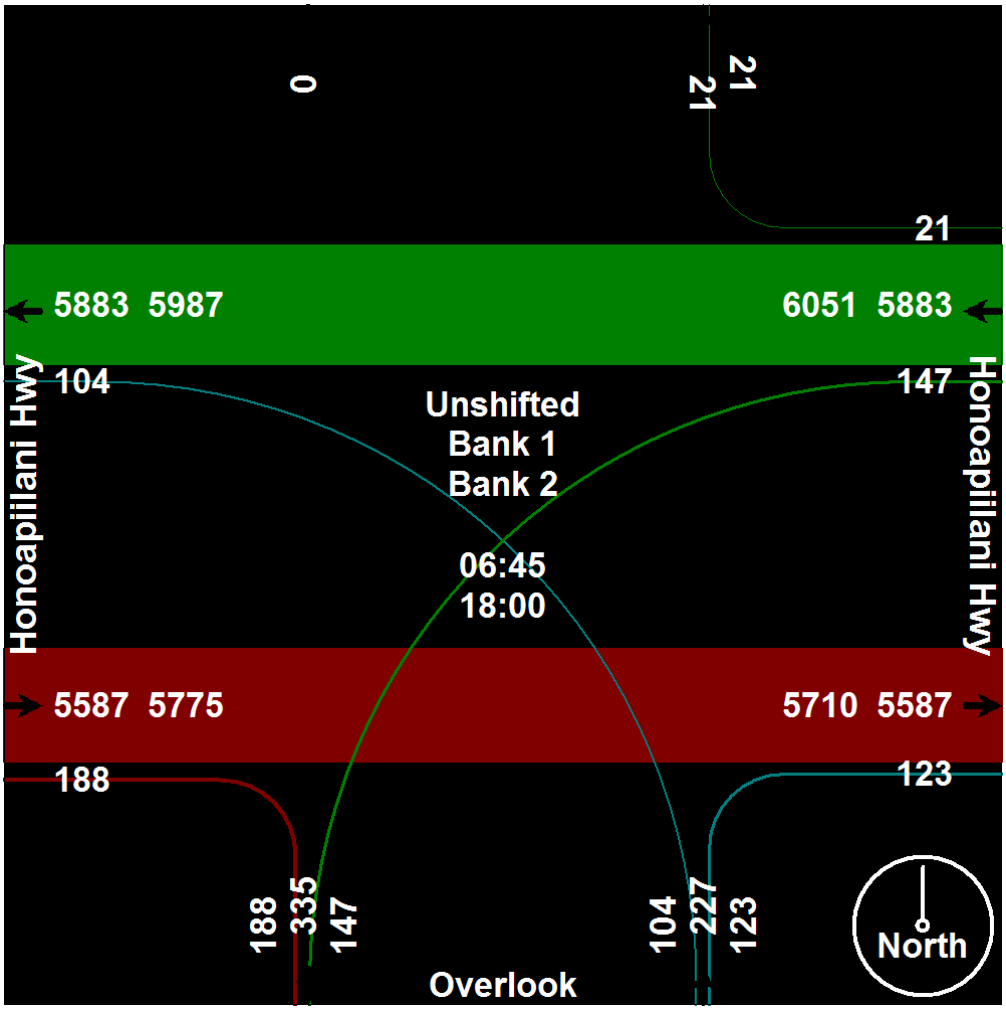

	From North					Honoapiilani Hwy From East					Overlook From South					Honoapiilani Hwy From West					
Start Time	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Right	Thru	Left	Peds	App. Total	Int. Total
Peak Hour Analysis From 06:45 to 11:45 - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 08:15																					
08:15	0	0	0	0	0	0	**232**	5	1	**238**	3	0	0	0	3	8	246	0	1	255	**496**
08:30	0	0	0	0	0	0	213	**11**	**3**	227	8	0	**6**	0	14	**11**	221	0	0	232	473
08:45	0	0	0	0	0	0	201	4	1	206	3	0	6	0	9	9	**261**	0	1	**271**	486
09:00	0	0	0	0	0	0	180	11	0	191	**13**	0	3	0	**16**	11	184	0	**9**	204	411
Total Volume	0	0	0	0	0	0	826	31	5	862	27	0	15	0	42	39	912	0	11	962	1866
% App. Total	0	0	0	0		0	95.8	3.6	0.6		64.3	0	35.7	0		4.1	94.8	0	1.1		
PHF	.000	.000	.000	.000	.000	.000	.890	.705	.417	.905	.519	.000	.625	.000	.656	.886	.874	.000	.306	.887	.941

File Name : Not Named 12
Site Code : TMC
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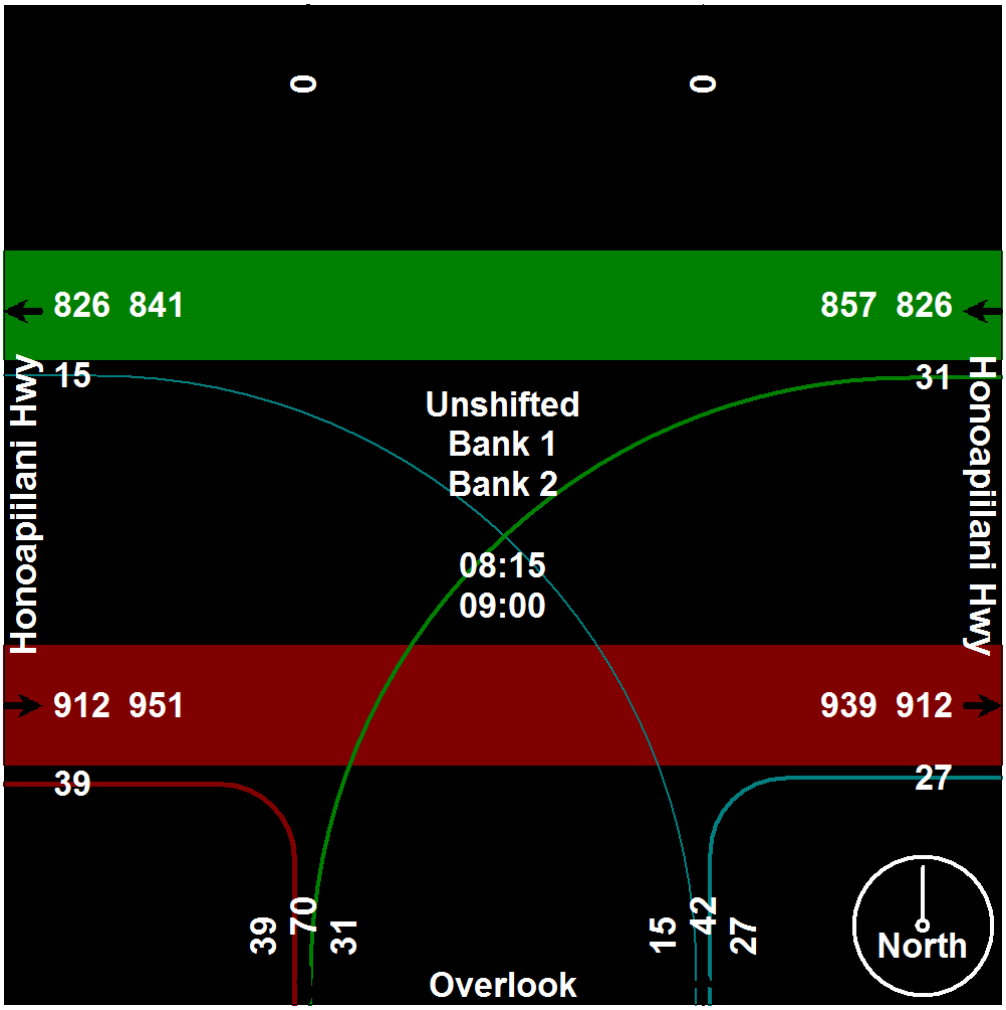

Peak Hour Analysis From 06:45 to 11:45 - Peak 1 of 1

Peak Hour for Each Approach Begins at:

	06:45					06:45					08:30					08:15				
+0 mins.	0	0	0	0	0	0	232	0	**2**	234	8	0	6	0	14	8	246	0	1	255
+15 mins.	0	0	0	0	0	0	247	0	0	247	3	0	6	0	9	**11**	221	0	0	232
+30 mins.	0	0	0	0	0	0	272	0	2	274	**13**	0	3	0	**16**	9	**261**	0	1	**271**
+45 mins.	0	0	0	0	0	0	**334**	**1**	0	**335**	7	0	**8**	0	15	11	184	0	**9**	204
Total Volume	0	0	0	0	0	0	1085	1	4	1090	31	0	23	0	54	39	912	0	11	962
% App. Total	0	0	0	0		0	99.5	0.1	0.4		57.4	0	42.6	0		4.1	94.8	0	1.1	
PHF	.000	.000	.000	.000	.000	.000	.812	.250	.500	.813	.596	.000	.719	.000	.844	.886	.874	.000	.306	.887

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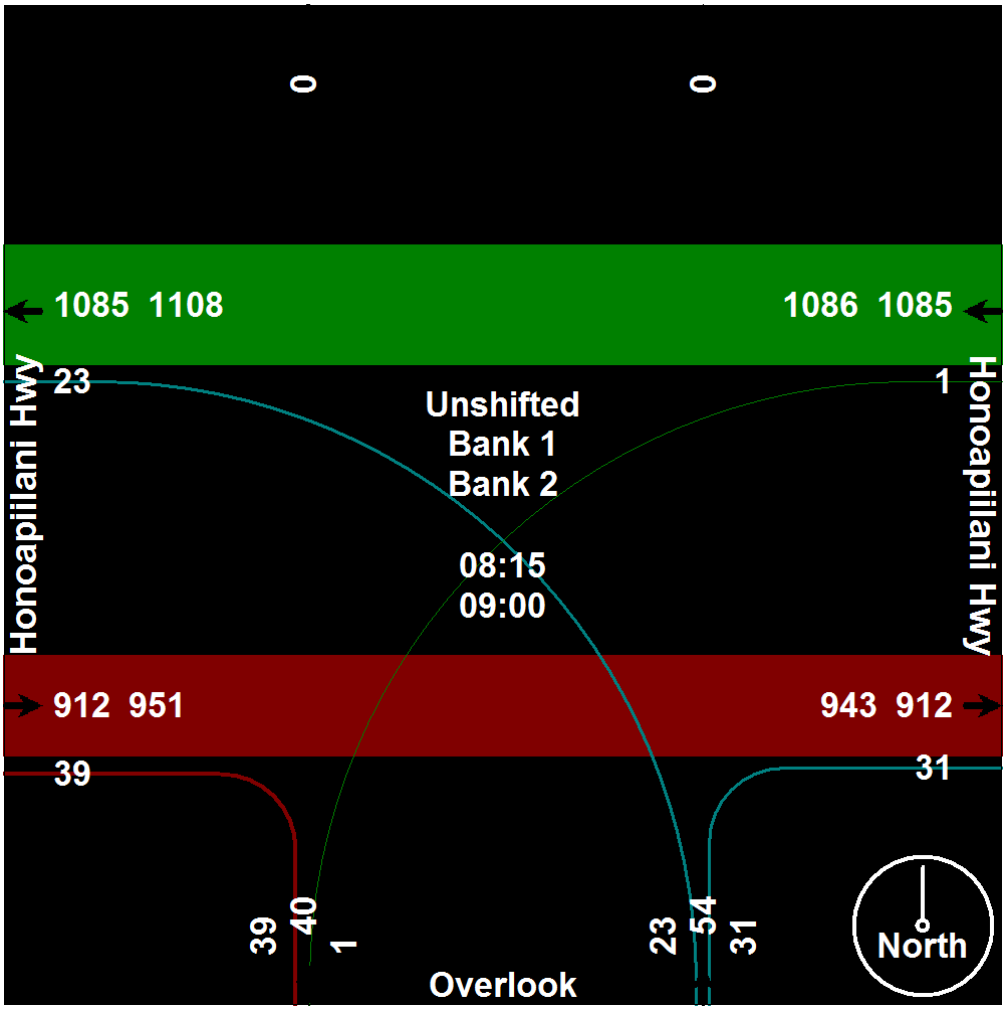
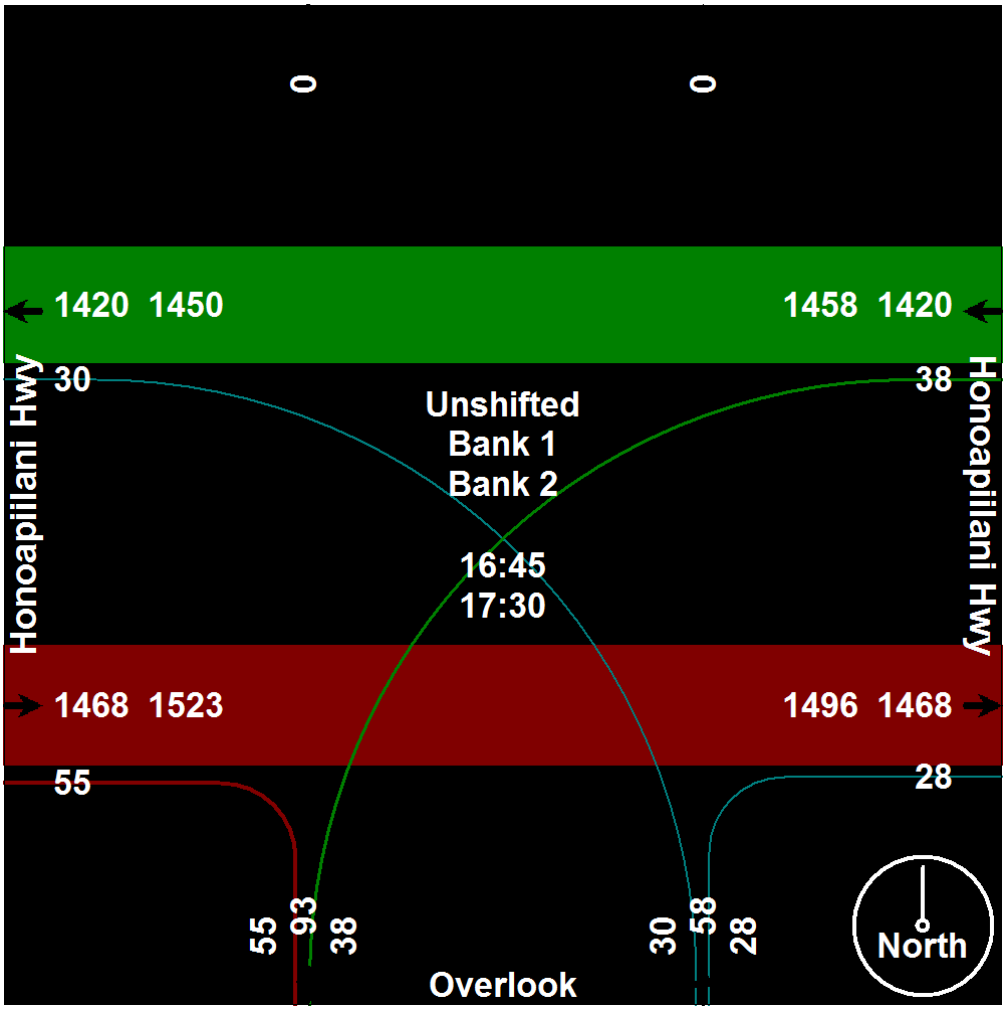


Peak Hour Analysis From 12:00 to 18:00 - Peak 1 of 1
Peak Hour for Entire Intersection Begins at 16:45

16:45	0	0	0	0	0	0	227	9	0	236	**12**	0	5	0	17	12	251	0	0	263	516
17:00	0	0	0	0	0	0	404	6	0	410	8	0	**10**	0	**18**	**21**	**413**	0	**1**	**435**	863
17:15	0	0	0	0	0	0	338	10	0	348	5	0	5	0	10	12	412	0	0	424	782
17:30	0	0	0	0	0	0	**451**	**13**	0	**464**	3	0	10	0	13	10	392	0	0	402	**879**
Total Volume	0	0	0	0	0	0	1420	38	0	1458	28	0	30	0	58	55	1468	0	1	1524	3040
% App. Total	0	0	0	0		0	97.4	2.6	0		48.3	0	51.7	0		3.6	96.3	0	0.1		
PHF	.000	.000	.000	.000	.000	.000	.787	.731	.000	.786	.583	.000	.750	.000	.806	.655	.889	.000	.250	.876	.865

File Name : Not Named 12
Site Code : TMC
Start Date : 2/19/2013
Page No : 6

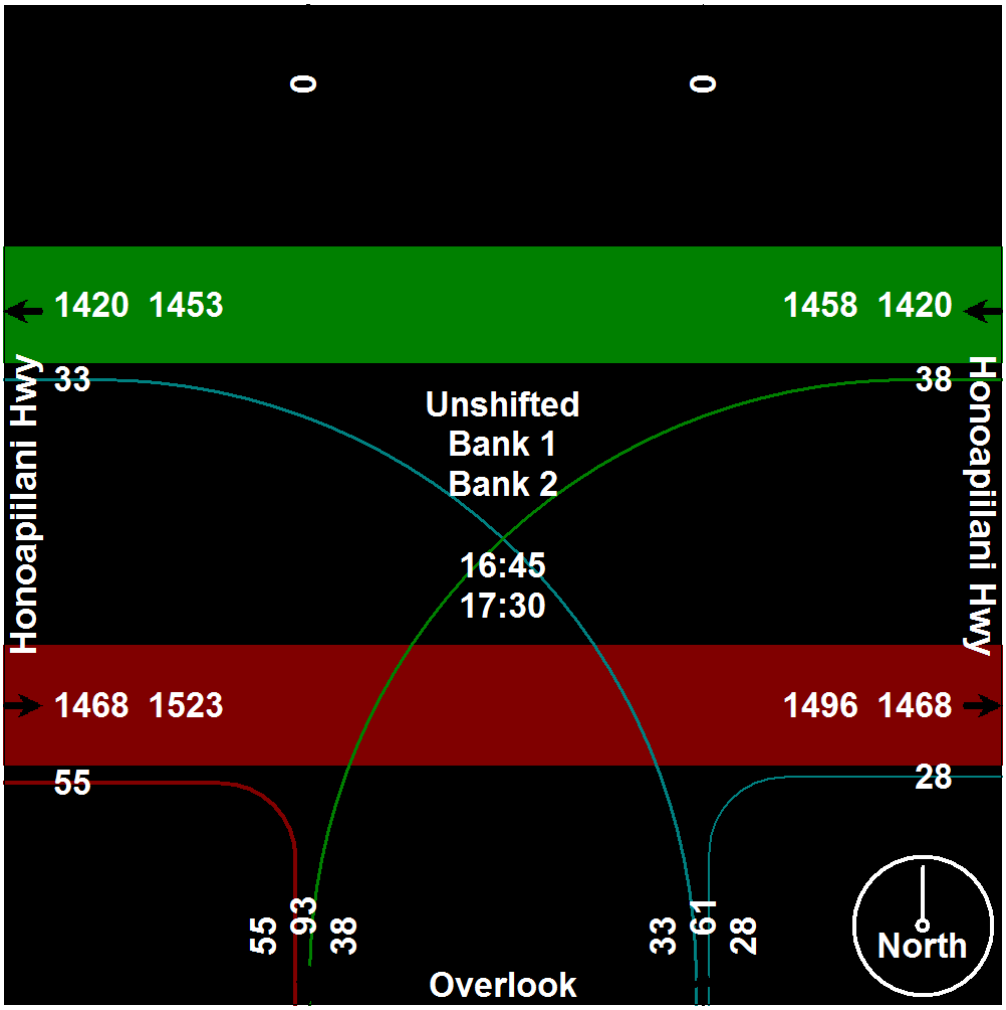


Peak Hour Analysis From 12:00 to 18:00 - Peak 1 of 1

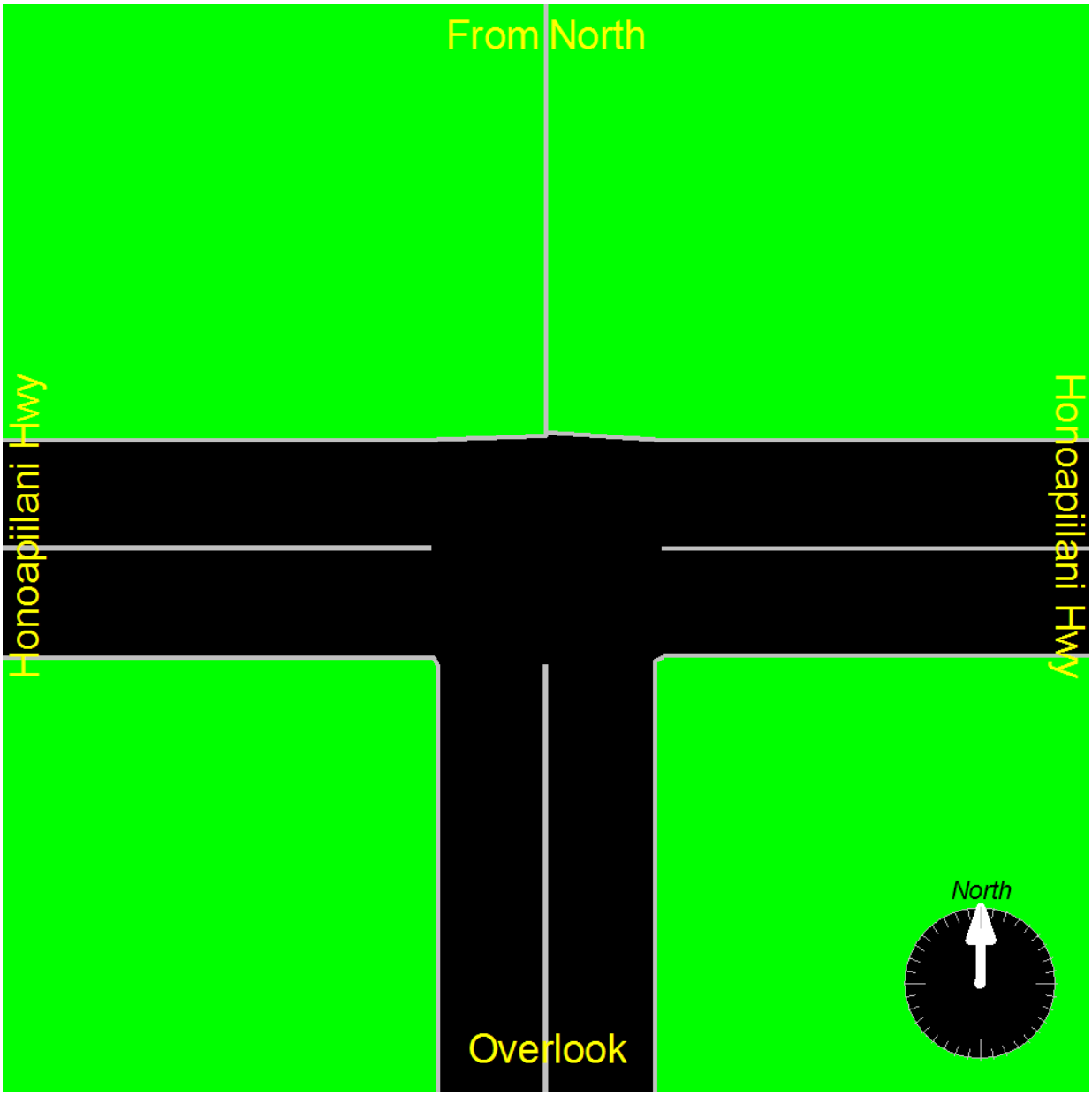
Peak Hour for Each Approach Begins at:

	12:00					16:45					15:30					16:45				
+0 mins.	0	0	0	0	0	0	227	9	0	236	**11**	0	9	0	**20**	12	251	0	0	263
+15 mins.	0	0	0	0	0	0	404	6	0	410	10	0	6	0	16	**21**	**413**	0	**1**	**435**
+30 mins.	0	0	0	0	0	0	338	10	0	348	2	0	**14**	0	16	12	412	0	0	424
+45 mins.	0	0	0	0	0	0	**451**	**13**	0	**464**	5	0	4	0	9	10	392	0	0	402
Total Volume	0	0	0	0	0	0	1420	38	0	1458	28	0	33	0	61	55	1468	0	1	1524
% App. Total	0	0	0	0		0	97.4	2.6	0		45.9	0	54.1	0		3.6	96.3	0	0.1	
PHF	.000	.000	.000	.000	.000	.000	.787	.731	.000	.786	.636	.000	.589	.000	.763	.655	.889	.000	.250	.876

File Name : Not Named 12
Site Code : TMC
Start Date : 2/19/2013
Page No : 7



File Name : Not Named 12
Site Code : TMC
Start Date : 2/19/2013
Page No : 8



Roger D. Dyar, P.E.
231 Tollison Road
Seneca, SC 29672
864-360-7921

HP Hwy Eastbound from 0213A
Site Code:
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 18-Feb-13	Tue 19-Feb-13	Wed 20-Feb-13	Thu 21-Feb-13	Fri 22-Feb-13		Average Day		Sat 23-Feb-13	Sun 24-Feb-13		Week Average		
12:00 AM	*	*	*	**718**	**827**		**772**		0	0		**386**		
01:00	*	*	*	549	472		510		0	0		255		
02:00	*	*	*	544	444		494		0	0		247		
03:00	*	*	*	449	407		428		0	0		214		
04:00	*	*	*	333	290		312		0	0		156		
05:00	*	*	*	190	200		195		0	0		98		
06:00	*	*	*	116	102		109		0	0		54		
07:00	*	*	*	42	38		40		0	0		20		
08:00	*	*	*	34	30		32		0	0		16		
09:00	*	*	*	42	25		34		0	0		17		
10:00	*	*	*	101	55		78		0	0		39		
11:00	*	*	*	114	95		104		0	0		52		
12:00 PM	*	*	*	368	328		348		0	0		174		
01:00	*	*	*	592	520		556		0	0		278		
02:00	*	*	*	695	**620**		658		**1**	0		329		
03:00	*	*	*	890	410		650		0	0		325		
04:00	*	*	986	1008	0		665		0	0		399		
05:00	*	*	1028	1042	0		690		0	0		414		
06:00	*	*	993	992	0		662		0	0		397		
07:00	*	*	812	783	0		532		0	0		319		
08:00	*	*	882	**1104**	0		662		0	0		397		
09:00	*	*	926	1064	0		663		0	0		398		
10:00	*	*	**1128**	948	2		**693**		0	0		**416**		
11:00	*	*	1026	1024	0		683		0	0		410		
Day Total	0	0	7781	13742	4865		10570		1	0		5810		
% Avg. WkDay	0.0%	0.0%	73.6%	130.0%	46.0%									
% Avg. Week	0.0%	0.0%	133.9%	236.5%	83.7%		181.9%		0.0%	0.0%				
AM Peak	-	-	-	00:00	00:00	-	00:00	-	-	-	-	00:00	-	-
Vol.	-	-	-	718	827	-	772	-	-	-	-	386	-	-
PM Peak	-	-	22:00	20:00	14:00	-	22:00	-	14:00	-	-	22:00	-	-
Vol.	-	-	1128	1104	620	-	693	-	1	-	-	416	-	-

Roger D. Dyar, P.E.
231 Tollison Road
Seneca, SC 29672
864-360-7921

HP Hwy Eastbound from 0213A
Site Code:
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 25-Feb-13	Tue 26-Feb-13	Wed 27-Feb-13	Thu 28-Feb-13	Fri 01-Mar-13	Average Day	Sat 02-Mar-13	Sun 03-Mar-13	Week Average
12:00 AM	0	0	**7**	0	0	**1**	0	0	**1**
01:00	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0
05:00	0	0	0	0	0	0	0	0	0
06:00	0	0	0	0	0	0	0	0	0
07:00	0	0	0	0	0	0	0	0	0
08:00	0	0	0	0	0	0	0	0	0
09:00	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0
12:00 PM	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	**3**	0
05:00	0	0	0	0	0	0	0	0	0
06:00	0	0	0	0	0	0	0	0	0
07:00	0	0	0	0	0	0	0	0	0
08:00	0	0	0	0	0	0	0	0	0
09:00	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	0	0	0
11:00	0	0	0	0	0	0	0	0	0
Day Total	0	0	7	0	0	1	0	3	1
% Avg. WkDay	0.0%	0.0%	700.0%	0.0%	0.0%				
% Avg. Week	0.0%	0.0%	700.0%	0.0%	0.0%	100.0%	0.0%	300.0%	
AM Peak	-	-	00:00	-	-	00:00	-	-	-	00:00	-	-
Vol.	-	-	7	-	-	1	-	-	-	1	-	-
PM Peak	-	-	-	-	-	-	-	16:00	-	-	-	-
Vol.	-	-	-	-	-	-	-	3	-	-	-	-

Roger D. Dyar, P.E.
231 Tollison Road
Seneca, SC 29672
864-360-7921

HP Hwy Eastbound from 0213A
Site Code:
Station ID:

Latitude: 0' 0.0000 Undefined

Start Time	Mon 04-Mar-13	Tue 05-Mar-13	Wed 06-Mar-13	Thu 07-Mar-13	Fri 08-Mar-13	Average Day	Sat 09-Mar-13	Sun 10-Mar-13	Week Average		
12:00 AM	0	*	*	*	*	0	*	*	0		
01:00	0	*	*	*	*	0	*	*	0		
02:00	0	*	*	*	*	0	*	*	0		
03:00	0	*	*	*	*	0	*	*	0		
04:00	0	*	*	*	*	0	*	*	0		
05:00	0	*	*	*	*	0	*	*	0		
06:00	**2**	*	*	*	*	**2**	*	*	**2**		
07:00	0	*	*	*	*	0	*	*	0		
08:00	0	*	*	*	*	0	*	*	0		
09:00	0	*	*	*	*	0	*	*	0		
10:00	0	*	*	*	*	0	*	*	0		
11:00	0	*	*	*	*	0	*	*	0		
12:00 PM	0	*	*	*	*	0	*	*	0		
01:00	0	*	*	*	*	0	*	*	0		
02:00	0	*	*	*	*	0	*	*	0		
03:00	0	*	*	*	*	0	*	*	0		
04:00	**2**	*	*	*	*	**2**	*	*	**2**		
05:00	*	*	*	*	*	*	*	*	*		
06:00	*	*	*	*	*	*	*	*	*		
07:00	*	*	*	*	*	*	*	*	*		
08:00	*	*	*	*	*	*	*	*	*		
09:00	*	*	*	*	*	*	*	*	*		
10:00	*	*	*	*	*	*	*	*	*		
11:00	*	*	*	*	*	*	*	*	*		
Day Total	4	0	0	0	0	4	0	0	4		
% Avg. WkDay	100.0%	0.0%	0.0%	0.0%	0.0%						
% Avg. Week	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%			
AM Peak	06:00	-	-	-	-	- 06:00	- -	-	- 06:00	-	-
Vol.	2	-	-	-	-	- 2	- -	-	- 2	-	-
PM Peak	16:00	-	-	-	-	- 16:00	- -	-	- 16:00	-	-
Vol.	2	-	-	-	-	- 2	- -	-	- 2	-	-

Grand Total	4	0	7788	13742	4865	10575	1	3	5815
ADT		ADT 746		AADT 746					

Roger D. Dyar, P.E.
231 Tollison Road
Seneca, SC 29672
864-360-7921

HP Hwy machine 9 Westbound from 0213
Site Code:
Station ID:
HP Hwy Eastbound

Latitude: 0' 0.0000 Undefined

Start Time	Mon 11-Feb-13	Tue 12-Feb-13	Wed 13-Feb-13	Thu 14-Feb-13	Fri 15-Feb-13		Average Day		Sat 16-Feb-13	Sun 17-Feb-13		Week Average		
12:00 AM	*	*	687	672	0		453		0	0		272		
01:00	*	*	748	784	0		511		0	0		306		
02:00	*	*	856	837	0		564		0	0		339		
03:00	*	*	916	997	0		638		0	0		383		
04:00	*	*	986	**1037**	0		**674**		0	0		**405**		
05:00	*	*	1046	916	0		654		0	0		392		
06:00	*	*	**1075**	804	0		626		0	0		376		
07:00	*	*	962	856	0		606		0	0		364		
08:00	*	*	712	864	0		525		0	0		315		
09:00	*	*	558	758	0		439		0	0		263		
10:00	*	*	456	356	0		271		0	0		162		
11:00	*	*	374	403	0		259		0	0		155		
12:00 PM	*	*	275	302	0		192		0	0		115		
01:00	*	*	134	157	0		97		0	0		58		
02:00	*	*	66	79	0		48		0	0		29		
03:00	*	*	36	26	0		21		0	0		12		
04:00	*	*	29	14	0		14		0	0		9		
05:00	*	*	55	26	0		27		0	0		16		
06:00	*	*	87	93	0		60		0	0		36		
07:00	*	*	227	202	0		143		0	0		86		
08:00	*	*	526	490	0		339		0	0		203		
09:00	*	*	**1026**	**978**	0		**668**		0	0		**401**		
10:00	*	*	872	846	0		573		0	0		344		
11:00	*	*	782	568	0		450		0	0		270		
Day Total	0	0	13491	13065	0		8852		0	0		5311		
% Avg. WkDay	0.0%	0.0%	152.4%	147.6%	0.0%									
% Avg. Week	0.0%	0.0%	254.0%	246.0%	0.0%		166.7%		0.0%	0.0%				
AM Peak	-	-	06:00	04:00	-	-	04:00	-	-	-	-	04:00	-	-
Vol.	-	-	1075	1037	-	-	674	-	-	-	-	405	-	-
PM Peak	-	-	21:00	21:00	-	-	21:00	-	-	-	-	21:00	-	-
Vol.	-	-	1026	978	-	-	668	-	-	-	-	401	-	-

Roger D. Dyar, P.E.
231 Tollison Road
Seneca, SC 29672
864-360-7921

HP Hwy machine 9 Westbound from 0213
Site Code:
Station ID:
HP Hwy Eastbound

Latitude: 0' 0.0000 Undefined

Start Time	Mon 18-Feb-13	Tue 19-Feb-13	Wed 20-Feb-13	Thu 21-Feb-13	Fri 22-Feb-13		Average Day		Sat 23-Feb-13	Sun 24-Feb-13		Week Average		
12:00 AM	0	0	0	0	0		0		0	**4**		1		
01:00	0	0	0	0	0		0		0	0		0		
02:00	0	0	0	0	0		0		0	0		0		
03:00	0	0	0	0	0		0		0	0		0		
04:00	0	0	0	0	0		0		0	0		0		
05:00	0	0	0	0	0		0		0	0		0		
06:00	0	0	0	0	0		0		0	0		0		
07:00	**2**	0	0	0	0		0		0	0		0		
08:00	1	**12**	0	0	0		**3**		0	0		**2**		
09:00	2	0	0	0	0		0		0	0		0		
10:00	0	0	0	0	0		0		0	0		0		
11:00	0	0	0	0	0		0		0	0		0		
12:00 PM	0	0	0	0	0		0		0	0		0		
01:00	0	0	0	0	0		0		0	0		0		
02:00	0	0	0	0	0		0		0	0		0		
03:00	0	0	0	0	0		0		0	**2**		0		
04:00	0	0	0	0	0		0		0	0		0		
05:00	0	0	0	0	0		0		0	0		0		
06:00	0	0	0	0	0		0		0	0		0		
07:00	0	0	0	0	0		0		0	0		0		
08:00	0	0	0	0	0		0		0	0		0		
09:00	0	0	0	0	0		0		0	0		0		
10:00	0	0	0	0	0		0		0	0		0		
11:00	0	0	0	0	0		0		0	2		0		
Day Total	5	12	0	0	0		3		0	8		3		
% Avg. WkDay	166.7%	400.0%	0.0%	0.0%	0.0%									
% Avg. Week	166.7%	400.0%	0.0%	0.0%	0.0%		100.0%		0.0%	266.7%				
AM Peak	07:00	08:00	-	-	-	-	08:00	-	-	00:00	-	08:00	-	-
Vol.	2	12	-	-	-	-	3	-	-	4	-	2	-	-
PM Peak	-	-	-	-	-	-	-	-	-	15:00	-	-	-	-
Vol.	-	-	-	-	-	-	-	-	-	2	-	-	-	-

Grand Total	5	12	13491	13065	0	8855	0	8	5314
ADT	ADT 12,746		AADT 12,746						

Traffic Count Data for Vehicle Classification on HP Hwy

Unit Type:	PicoCount 2500 V2.20													
Serial Number:	12032464													
ID:	12032464													
Location:	Pohaku St													
Comments:														
Dwell 1:	55 ms													
Dwell 2:	55 ms													
Measurements:	English													
Start Date:	2/16/2013													
Start Time:	10:00													
Export Version:	Class V1.02													
Scheme:	FHWA													
Scheme ID:	1													
Interval:	15 Min													
Title:	East Bound Classes													
	Motorcycle	PC	2axle trk	buses	su 2 axl	truck 3axl	su4	su4less	du5	du6+	mult5less	mult6	mult7+	
Date/Time	Class #1	Class #2	Class #3	Class #4	Class #5	Class #6	Class #7	Class #8	Class #9	Class #10	Class #11	Class #12	Class #13	Total
02/16/2013 10:00 - 10:14	2	81	12	0	5	0	0	0	0	0	0	0	0	100
02/16/2013 10:15 - 10:29	0	71	13	0	2	1	0	0	0	0	0	0	0	87
02/16/2013 10:30 - 10:44	0	73	16	0	6	2	0	0	0	0	0	0	0	97
02/16/2013 10:45 - 10:59	0	60	10	0	4	1	0	0	0	0	0	0	0	75
02/16/2013 11:00 - 11:14	0	91	13	0	5	1	0	0	0	0	0	0	0	110
02/16/2013 11:15 - 11:29	0	90	14	0	3	0	0	0	0	0	0	1	0	108
02/16/2013 11:30 - 11:44	1	102	19	1	5	0	0	0	0	0	0	1	0	129
02/16/2013 11:45 - 11:59	0	72	13	0	1	0	0	0	0	0	0	0	0	86
02/16/2013 12:00 - 12:14	7	104	14	1	2	0	1	0	0	0	0	0	0	129
02/16/2013 12:15 - 12:29	0	117	13	1	7	1	0	0	1	0	0	0	0	140
02/16/2013 12:30 - 12:44	2	107	9	0	5	0	0	0	0	0	0	0	0	123
02/16/2013 12:45 - 12:59	0	138	16	0	5	2	0	0	0	0	0	1	0	162
02/16/2013 13:00 - 13:14	0	117	14	2	3	0	0	1	0	0	0	0	0	137
02/16/2013 13:15 - 13:29	3	136	20	0	6	0	0	1	0	0	1	0	1	168
02/16/2013 13:30 - 13:44	1	134	22	0	6	1	0	0	0	0	0	0	0	164
02/16/2013 13:45 - 13:59	2	149	17	0	9	1	0	0	0	0	0	0	0	178
02/16/2013 14:00 - 14:14	3	135	18	1	4	1	0	0	0	0	0	0	0	162
02/16/2013 14:15 - 14:29	0	117	12	0	1	0	0	0	0	0	0	0	1	131
02/16/2013 14:30 - 14:44	6	62	3	0	3	0	2	0	0	0	0	0	0	76
02/16/2013 14:45 - 14:59	2	26	2	0	1	0	1	0	0	0	0	0	0	32
02/16/2013 15:00 - 15:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/16/2013 15:15 - 15:29	2	44	7	1	2	0	0	0	0	0	0	0	1	57
02/16/2013 15:30 - 15:44	0	53	7	1	0	0	3	0	0	0	0	0	1	65
02/16/2013 15:45 - 15:59	0	30	5	0	2	0	0	0	0	0	0	1	0	38

Traffic Count Data for Vehicle Classification on HP Hwy

02/16/2013 16:00 - 16:14	1	120	16	0	2	0	3	0	0	0	0	1	0	143
02/16/2013 16:15 - 16:29	2	41	4	0	1	0	2	0	0	0	0	0	0	50
02/16/2013 16:30 - 16:44	7	53	2	0	2	0	0	0	0	0	0	0	1	65
02/16/2013 16:45 - 16:59	1	114	12	2	2	1	0	0	0	0	0	0	0	132
02/16/2013 17:00 - 17:14	1	133	14	1	6	1	1	0	0	0	0	0	0	157
02/16/2013 17:15 - 17:29	0	111	12	1	4	1	1	0	0	0	0	0	0	130
02/16/2013 17:30 - 17:44	3	98	12	1	3	0	0	0	1	0	0	0	1	119
02/16/2013 17:45 - 17:59	6	140	18	0	2	0	1	0	0	0	0	1	0	168
02/16/2013 18:00 - 18:14	4	130	14	0	3	1	2	0	0	0	0	0	0	154
02/16/2013 18:15 - 18:29	2	134	14	0	3	0	0	1	0	0	0	0	0	154
02/16/2013 18:30 - 18:44	0	97	8	0	7	0	0	0	0	0	0	0	0	112
02/16/2013 18:45 - 18:59	1	129	20	1	5	1	2	0	0	0	0	0	0	159
02/16/2013 19:00 - 19:14	2	161	16	2	3	1	1	0	0	0	0	0	0	186
02/16/2013 19:15 - 19:29	2	138	21	0	3	1	0	0	0	0	0	0	0	165
02/16/2013 19:30 - 19:44	0	121	12	0	1	0	0	0	0	0	0	0	0	134
02/16/2013 19:45 - 19:59	0	24	0	0	0	0	0	0	0	0	0	0	0	24
	63	3853	484	16	134	18	20	3	2	0	1	6	6	4606
		3916	4337	500	150	152	38	23	5	2	1	7	12	4612
			Cars	Buses	Trucks	Total								
			4337	16	253	4606								
				0.3%	5.5%									
			94.2%		5.8%		56	0.012158						
								3 axle	240	0.052038	USE 5%			

Traffic Count for Classification Directional

Unit Type:	PicoCount 2500 V2.20													
Serial Number:	12032464													
ID:	12032464													
Location:														
Comments:														
Dwell 1:	55 ms													
Dwell 2:	55 ms													
Measurements:	English													
Start Date:	2/16/2013													
Start Time:	10:00													
Export Version:	Class V1.02													
Scheme:	FHWA													
Scheme ID:	1													
Interval:	15 Min													
Title:	West Bound Classes													
	Motorcycle	PC	2axle trk	buses	su 2 axl	truck 3axl	su4	su4less	du5	du6+	mult5less	mult6	mult7+	
Date/Time	Class #1	Class #2	Class #3	Class #4	Class #5	Class #6	Class #7	Class #8	Class #9	Class #10	Class #11	Class #12	Class #13	Total
02/16/2013 10:00 - 10:14	0	136	29	0	10	1	0	0	0	0	0	0	0	176
02/16/2013 10:15 - 10:29	0	158	31	0	8	3	0	0	1	0	0	0	0	201
02/16/2013 10:30 - 10:44	2	133	42	2	4	1	0	0	0	0	0	0	0	184
02/16/2013 10:45 - 10:59	3	137	42	3	11	1	1	1	0	0	0	0	0	199
02/16/2013 11:00 - 11:14	1	154	44	0	9	0	0	0	0	0	0	0	0	208
02/16/2013 11:15 - 11:29	0	141	33	0	14	1	0	0	0	0	0	0	0	189
02/16/2013 11:30 - 11:44	1	140	18	0	9	3	1	0	0	0	0	0	0	172
02/16/2013 11:45 - 11:59	2	123	43	0	8	0	0	0	0	0	0	0	0	176
02/16/2013 12:00 - 12:14	2	121	33	0	8	1	0	1	0	0	0	0	0	166
02/16/2013 12:15 - 12:29	4	111	24	0	8	2	0	0	0	0	0	0	0	149
02/16/2013 12:30 - 12:44	1	103	25	0	15	0	1	0	0	0	0	0	0	145
02/16/2013 12:45 - 12:59	1	124	21	3	8	0	0	0	0	0	0	0	0	157
02/16/2013 13:00 - 13:14	0	93	28	2	8	0	1	0	0	0	0	0	0	132
02/16/2013 13:15 - 13:29	0	70	18	0	11	2	0	0	0	0	0	1	0	102
02/16/2013 13:30 - 13:44	1	91	25	0	10	2	0	0	0	0	0	0	0	129
02/16/2013 13:45 - 13:59	0	83	12	0	12	0	0	0	0	0	0	0	0	107
02/16/2013 14:00 - 14:14	0	74	24	1	5	2	1	0	0	0	0	0	0	107
02/16/2013 14:15 - 14:29	0	95	21	0	10	1	0	1	0	0	0	0	0	128
02/16/2013 14:30 - 14:44	0	57	17	1	5	0	0	2	0	0	0	0	0	82
02/16/2013 14:45 - 14:59	0	20	4	0	1	0	0	1	0	0	0	0	0	26
02/16/2013 15:00 - 15:14	0	8	2	0	1	0	0	0	0	0	0	0	0	11
02/16/2013 15:15 - 15:29	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/16/2013 15:30 - 15:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/16/2013 15:45 - 15:59	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/16/2013 16:00 - 16:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/16/2013 16:15 - 16:29	0	13	4	0	1	0	0	0	0	0	0	0	0	18

Traffic Count for Classification Directional

02/16/2013 16:30 - 16:44	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02/16/2013 16:45 - 16:59	1	17	5	0	3	0	0	0	0	0	0	0	0	26
02/16/2013 17:00 - 17:14	0	94	28	2	7	0	1	0	0	0	0	0	0	132
02/16/2013 17:15 - 17:29	1	80	25	1	7	1	0	1	0	0	0	0	0	116
02/16/2013 17:30 - 17:44	2	81	21	1	8	0	0	1	0	0	0	0	0	114
02/16/2013 17:45 - 17:59	1	68	26	2	8	0	0	0	0	0	0	0	0	105
02/16/2013 18:00 - 18:14	1	62	10	0	10	0	0	4	0	0	0	0	0	87
02/16/2013 18:15 - 18:29	1	80	26	2	6	1	0	1	0	0	0	0	0	117
02/16/2013 18:30 - 18:44	0	41	8	1	2	0	0	0	0	0	0	0	0	52
02/16/2013 18:45 - 18:59	1	43	15	0	1	0	0	0	0	0	0	0	0	60
02/16/2013 19:00 - 19:14	0	56	16	0	9	0	0	0	0	0	0	0	0	81
02/16/2013 19:15 - 19:29	0	65	22	0	4	0	0	0	0	0	0	0	0	91
02/16/2013 19:30 - 19:44	0	71	18	1	9	0	0	0	0	0	0	0	0	99
02/16/2013 19:45 - 19:59	1	19	1	1	1	0	0	0	0	0	0	0	0	23
	27	2962	761	23	251	22	6	13	1	0	0	1	0	4067
		2989	3723	784	274	273	28	19	14	1	0	1	1	4067
						43								
			Cars	Buses	Trucks	Total								
			3723	23	321	4067								
				0.6%	7.9%									
			91.5%		8.5%									
							Heavy trk	0.010573						
							3 axle	0.010573	2%+ trucks					
							2 axle	0.989427						

Traffic Count HP Hwy Near Old Landfill

Unit Type:	PicoCount 2500 V2.14			
Serial Number:	12032373			
ID:				
Location:				
Comments:				
Dwell:	55 ms			
Measurements:	English			
Start Date:	2/11/2013			
Start Time:	21:00			
Export Version:	Volume V1.03			
Interval:	60 Min			
Title:	Vehicle Volume			
Date/Time	Westbound	Eastbound	Total	
02/11/2013 21:00 - 21:59	0	0	0	
02/11/2013 22:00 - 22:59	973	897	1870	
02/11/2013 23:00 - 23:59	875	872	1747	
02/12/2013 00:00 - 00:59	682	673	1355	
02/12/2013 01:00 - 01:59	438	426	864	
02/12/2013 02:00 - 02:59	486	307	793	
02/12/2013 03:00 - 03:59	346	323	669	
02/12/2013 04:00 - 04:59	258	190	448	
02/12/2013 05:00 - 05:59	162	158	320	
02/12/2013 06:00 - 06:59	92	56	148	
02/12/2013 07:00 - 07:59	50	41	91	
02/12/2013 08:00 - 08:59	39	25	64	
02/12/2013 09:00 - 09:59	48	68	116	
02/12/2013 10:00 - 10:59	91	91	182	
02/12/2013 11:00 - 11:59	144	337	481	
02/12/2013 12:00 - 12:59	433	705	1138	
02/12/2013 13:00 - 13:59	638	881	1519	
02/12/2013 14:00 - 14:59	765	719	1484	
02/12/2013 15:00 - 15:59	934	705	1639	
02/12/2013 16:00 - 16:59	964	642	1606	
02/12/2013 17:00 - 17:59	1098	711	1809	
02/12/2013 18:00 - 18:59	877	799	1676	
02/12/2013 19:00 - 19:59	857	994	1851	
02/12/2013 20:00 - 20:59	994	1042	2036	
02/12/2013 21:00 - 21:59	1096	1026	2122	
02/12/2013 22:00 - 22:59	1085	999	2084	
02/12/2013 23:00 - 23:59	989	890	1879	26374
02/13/2013 00:00 - 00:59	657	617	1274	
02/13/2013 01:00 - 01:59	457	453	910	
02/13/2013 02:00 - 02:59	521	384	905	

Traffic Count HP Hwy Near Old Landfill

02/13/2013 03:00 - 03:59	389	334	723	
02/13/2013 04:00 - 04:59	233	177	410	
02/13/2013 05:00 - 05:59	198	119	317	
02/13/2013 06:00 - 06:59	75	86	161	
02/13/2013 07:00 - 07:59	64	46	110	
02/13/2013 08:00 - 08:59	64	40	104	
02/13/2013 09:00 - 09:59	73	56	129	
02/13/2013 10:00 - 10:59	65	115	180	
02/13/2013 11:00 - 11:59	184	292	476	
02/13/2013 12:00 - 12:59	428	711	1139	
02/13/2013 13:00 - 13:59	594	875	1469	
02/13/2013 14:00 - 14:59	727	810	1537	
02/13/2013 15:00 - 15:59	959	606	1565	
02/13/2013 16:00 - 16:59	1041	646	1687	
02/13/2013 17:00 - 17:59	990	744	1734	
02/13/2013 18:00 - 18:59	947	855	1802	
02/13/2013 19:00 - 19:59	867	991	1858	
02/13/2013 20:00 - 20:59	997	1021	2018	
02/13/2013 21:00 - 21:59	1107	959	2066	
02/13/2013 22:00 - 22:59	1030	944	1974	
02/13/2013 23:00 - 23:59	1010	827	1837	26385
02/14/2013 00:00 - 00:59	732	655	1387	
02/14/2013 01:00 - 01:59	512	471	983	
02/14/2013 02:00 - 02:59	506	389	895	
02/14/2013 03:00 - 03:59	379	374	753	
02/14/2013 04:00 - 04:59	308	191	499	
02/14/2013 05:00 - 05:59	177	254	431	
02/14/2013 06:00 - 06:59	67	79	146	
02/14/2013 07:00 - 07:59	43	29	72	
02/14/2013 08:00 - 08:59	45	43	88	
02/14/2013 09:00 - 09:59	55	59	114	
02/14/2013 10:00 - 10:59	105	109	214	
02/14/2013 11:00 - 11:59	156	287	443	
02/14/2013 12:00 - 12:59	478	698	1176	
02/14/2013 13:00 - 13:59	621	899	1520	
02/14/2013 14:00 - 14:59	701	828	1529	
02/14/2013 15:00 - 15:59	897	592	1489	
02/14/2013 16:00 - 16:59	1038	661	1699	
02/14/2013 17:00 - 17:59	937	712	1649	
02/14/2013 18:00 - 18:59	870	796	1666	
02/14/2013 19:00 - 19:59	824	1034	1858	
02/14/2013 20:00 - 20:59	916	1011	1927	
02/14/2013 21:00 - 21:59	1076	1041	2117	

Traffic Count HP Hwy Near Old Landfill

02/14/2013 22:00 - 22:59	1114	1007	2121	
02/14/2013 23:00 - 23:59	998	834	1832	26608
02/15/2013 00:00 - 00:59	691	641	1332	
02/15/2013 01:00 - 01:59	540	543	1083	
02/15/2013 02:00 - 02:59	608	451	1059	
02/15/2013 03:00 - 03:59	474	351	825	
02/15/2013 04:00 - 04:59	365	269	634	
02/15/2013 05:00 - 05:59	246	177	423	
02/15/2013 06:00 - 06:59	139	84	223	
02/15/2013 07:00 - 07:59	66	38	104	
02/15/2013 08:00 - 08:59	34	30	64	
02/15/2013 09:00 - 09:59	52	43	95	
02/15/2013 10:00 - 10:59	70	118	188	
02/15/2013 11:00 - 11:59	172	314	486	
02/15/2013 12:00 - 12:59	454	681	1135	
02/15/2013 13:00 - 13:59	655	880	1535	

3

2:45 pm

15 minute speed study @ Olowalu Store

# of cars SB	speed
1.	37
2.	39
3.	41
4.	40
5.	39
6.	43
7.	46
8.	42
9.	40
10.	40
11.	51
12.	39
13.	39
14.	38
15.	34
16.	37
17.	40
18.	39
19.	38
20.	40
21.	40
22.	41
23.	44
24.	43
25	36

# of cars	speed
26	39
27	38
28	38
29	37
30	39
31	40
32	44
33	43
34	44
35	37
36	39
37	36
38	41
39	40
40	42
41	42
42	44
43	47
44	46
45	45
46	41
47	40
48	41
49	43
50	41
51	42
52	44

# of cars	speed
53	41
54	44
55	43
56	44
57	46
58	43
59	44
60	40
61	41
62	39
63	42
64	43
65	41
66	41
67	43
68	40
69	40
70	41
71	39
72	44
73	43
74	45
75	46
76	47
77	40
78	43
79	44
80	41
81	40
82	39
83	36
84	40

15 minute speed study Traffic going WB

# of cars	speed
1	43
2	43
3	42
4	41
5	45
6	46
7	40
8	41
9	42
10	43
11	47
12	46
13	44
14	43
15	47
16	49
17	51
18	51
19	50
20	52
21	48
22	48
23	49
24	45
25	47
26	46
27	47
28	47
29	44
30	44
31	45

East Bound	Time EB	West Bound Time	East Bound	WB	EB	WB
Shaw Rd - Lahaina	0	31:57	0	41:09	0	38:10
Launiupoko Beach Park	3:16	28:19	3:42	37:49	3:39	34:04
Landfill	5:37	22:40	6:03	32:35	6:26	28:36
Olowalu General Store	7:26	17:44	7:57	27:47	8:31	24:18
Luawai st.	8:04	16:26	8:36	26:01	9:10	23:17
Olowalu Access Rd	8:07	16:01	8:52	25:31	9:34	23:01
Ehehene st.	9:49	13:28	10:26	19:30	10:55	19:34
Pohaku st	10:43	11:23	11:11	18:07	11:45	16:41
Papalua Beach Park	11:59	10:01	12:13	17:02	12:47	12:49
Scenic overlook	16:31	5:04	16:46	6:14	17:29	5:11
North Kihei Rd	20:21	0	20:25	0	22:14	0
	~~Avg sp 41.7~~	~~Avg sp 27.5~~	~~Avg sp 44.2~~	~~Avg sp 31.7~~ ~~4:35~~ start time 4:35		

Travel Run distance = 14.9 mph

~~Stevens Overlook 12 sec~~

Launiupoko TMC

Green Light Phase Timing

Cycle ~~Phase~~ #	Time
1	11:13
2	5:51
3	8:46
4	3:39
5	3:39
6	3:41
7	7:38
8	3:41
9	7:33
10	3:30
11	7:47
12	3:47
13	3:49
14	3:27
15	3:37
16	3:42
17	3:41
18	4:05
19	3:16
20	3:41
21	3:41

Cycle#	Time
22	3:36
23	3:51
24	3:41
25	3:40
26	7:30
27	3:47
28	3:39
29	4:07
30	2:59
31	5:02
32	4:47
33	4:12
34	[illegible]

car

SB Approach

1 car – 10 sec wait time
1 car – 5 sec wait time
1 car – 1:30 wait time
2 car – 4:09 wait time
1 – 1:13 wait time
2 – 2:22 wait time
2 – 38 sec wait time
1 – 2:34 wait time
2 – 2:57 wait time
1 – 53 sec wait time
2 – 3:32 wait time
1 – 2:21 wait time
2 – 3:30 wait time
1 – 2:58 wait time
2 – 2:47 wait time
2 – 2:42 wait time
1 – 2:21 wait time
1 – 3:37 wait time
1 – 2:51 wait time
1 – 2:36 wait time
2 – 3:45 wait time
2 – 2:36 wait
1 – 2:51 wait
1 – 2:44 wait
1 – 1:04 wait
1 – 2:28 wait
5 – 2:52 wait
2 – 2:58 wait

2 – 4:35 wait
1 – 1:37 wait
1 – 2:26 wait
2 – 3:02 wait

	EB	WB	EB	WB	EB	WB
Shaw Rd Lahaina	0	20:45	0	20:14	0	20:22
Launiupoko Beach Park	3:41	17:17	3:23	16:58	3:39	17:21
Landfill	6:02	14:58	5:44	14:33	5:53	14:59
Olowalu General Store	7:58	13:11	7:33	12:42	7:44	12:53
Luawai St.	8:38	12:28	8:17	12:24	8:22	12:17
Olowalu Access Rd	8:48	12:17	8:30	11:59	8:34	12:01
Ehehene St	10:20	10:49	10:00	10:20	10:11	10:34
Pohaku St.	11:08	9:57	10:44	9:26	10:56	9:45
Papalaua Beach Park	12:31	8:54	11:42	8:18	11:58	8:47
Scenic overlook	16:35	4:44	16:08	3:50	16:23	4:09
North Kihie Rd	21:37	0	21:00	0	21:15	0

distance 24.9 miles

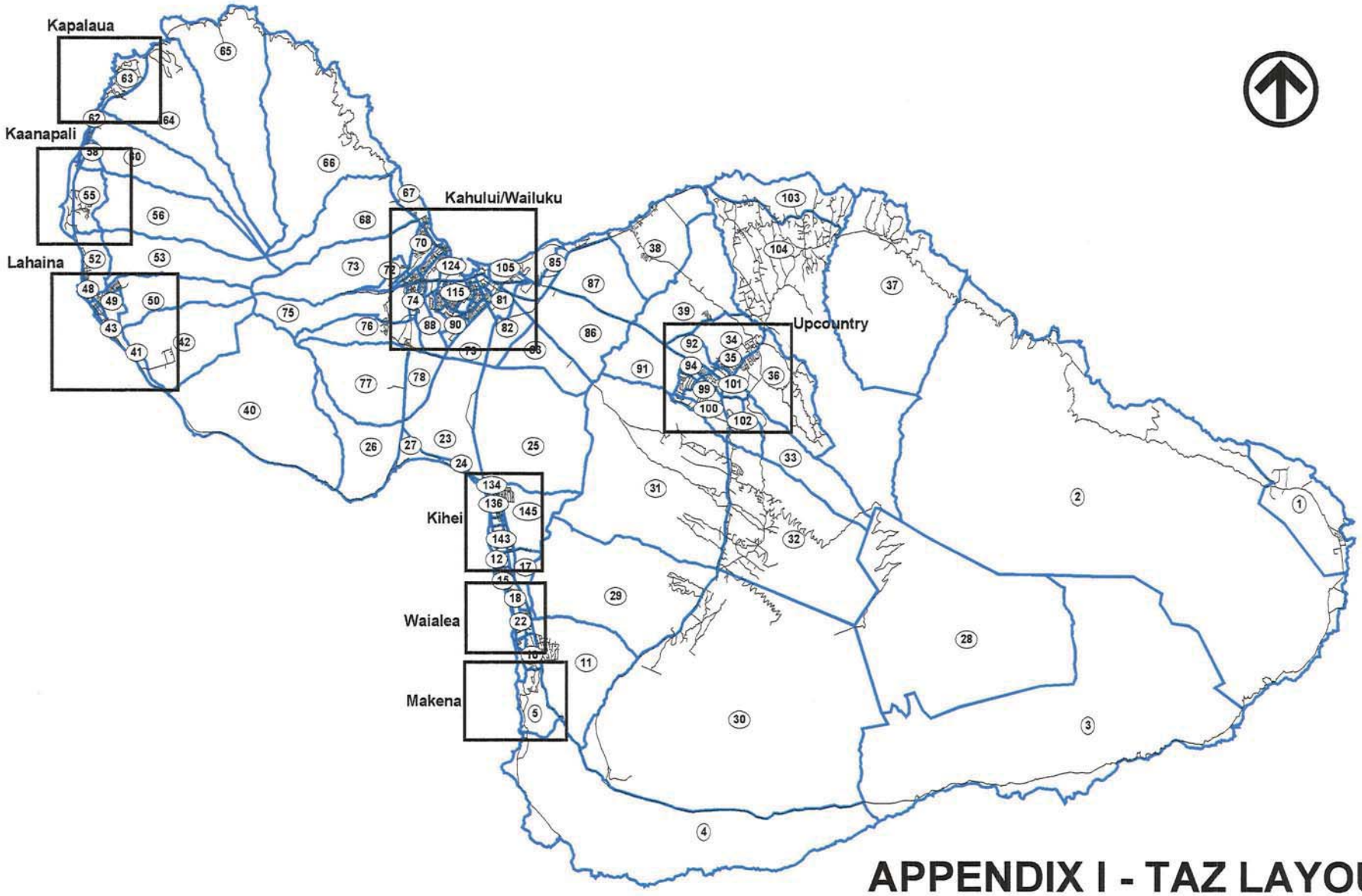
	WB	EB	WB	EB	WB	EB
North Kihei Rd	0	20:37	0	21:11		
Scenic Overlook	4:31	15:58	4:01	16:04		
Papalawa Beach	7:59	12:29	7:31	12:14		
Ukumehame Beach Park	9:14	11:27	8:40	11:02		
mile marker 14	11:40	9:18	11:10	8:58		
Olowalu General Store	13:10	7:57	12:37	7:28		
Landfill	14:58	6:11	14:31	5:40		
Launiupoko Beach Park	17:39	3:45	16:49	3:25		
Shaw St - Lahaina	20:41	0	20:02	0		0

4

Trip Distribution Calcs Sheet

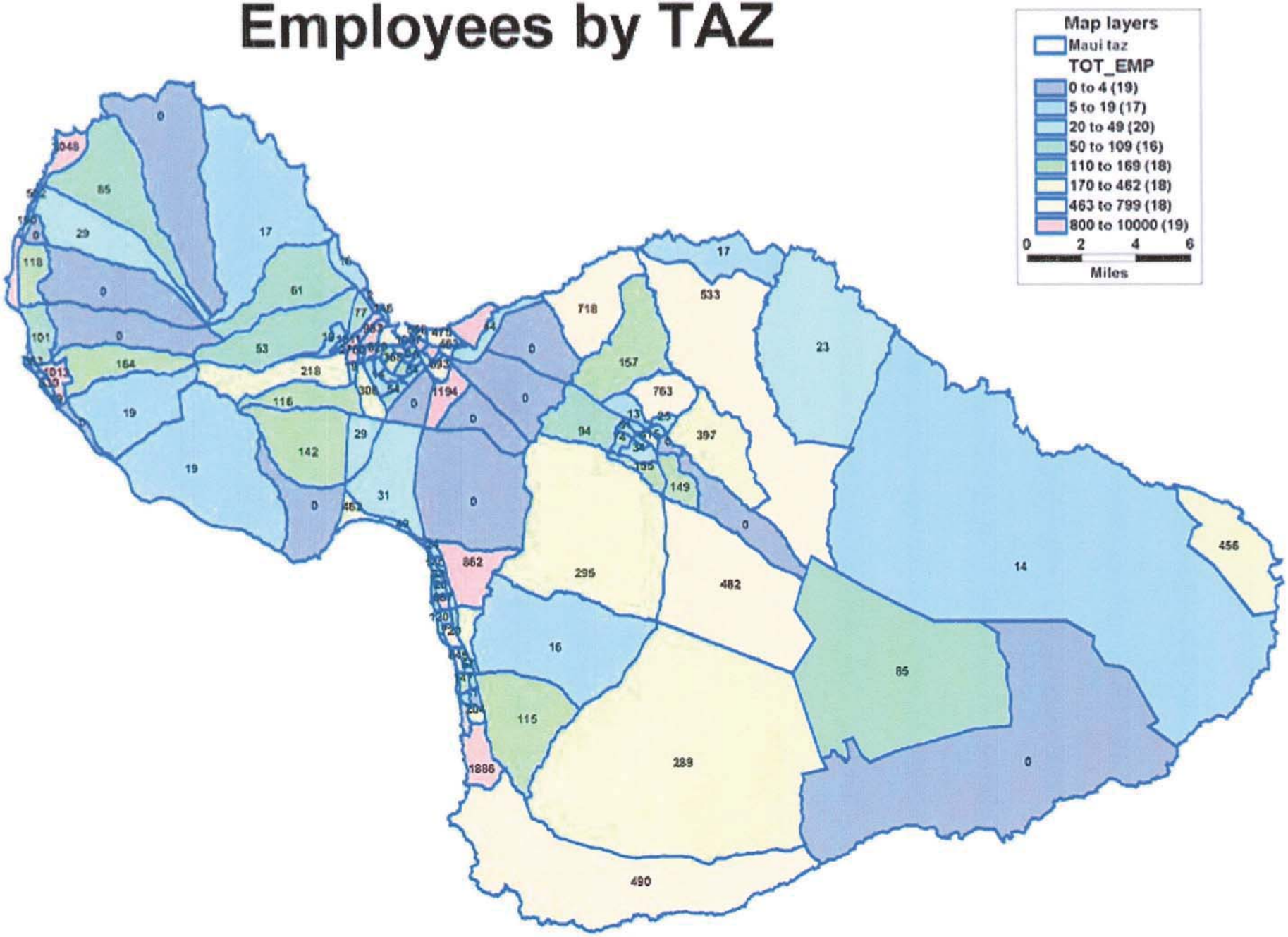
								NEW							PB									
								tot	in	in fm S	in fm N	out	out to S	out to N	tot	in	out	tot	in fm N	in fm S	out to N	out to S	in	out
						0.35	acc1	179	61	25	37	118	47	71	66	28	37	245	14	14	19	19	90	155
						0.58	acc2	296	102	41	61	195	78	117	109	47	62	405	23	23	31	31	148	257
						0.07	riro	36	12	5	7	24	9	14	13	6	7	49	3	3	4	4	18	31
							tot	511	175	70	105	336	134	202	188	81	107	699	41	41	54	54	256	443
									0.342466			0.657534				0.430851	0.569149							
								NEW							PB									
								tot	in			out			tot	in	out	tot					in	out
				from north		0.35	acc1	229	0.20	0.14	0.21	0.15	0.14	0.21	121	0.18	0.17	349					0.00	0.00
						0.58	acc2	379	0.33	0.23	0.35	0.25	0.23	0.35	200	0.30	0.28	579					0.00	0.00
						0.07	riro	46	0.04	0.03	0.04	0.03	0.03	0.04	24	0.04	0.03	70					0.00	0.00
							tot	653	375	0.40	0.60	278	0.40	0.60	345	181	164	998					556	442
									0.574273			0.425727				0.524638	0.475362							
									0.57			0.43				0.52	0.48						0.00	0.00
								NEW							PB									
								tot	in			out			tot	in	out	tot					in	out
						0.35	acc1	229	0.20			0.15			121	0.18	0.17	349					0.00	0.00
				from south	0.4	0.58	acc2	379	0.33			0.25			200	0.30	0.28	579					0.00	0.00
						0.07	riro	46	0.04			0.03			24	0.04	0.03	70					0.00	0.00
							tot	653	375			278			345	181	164	998					556	442
									0.574273			0.425727				0.524638	0.475362							
									0.57			0.43				0.52	0.48						0.00	0.00

5

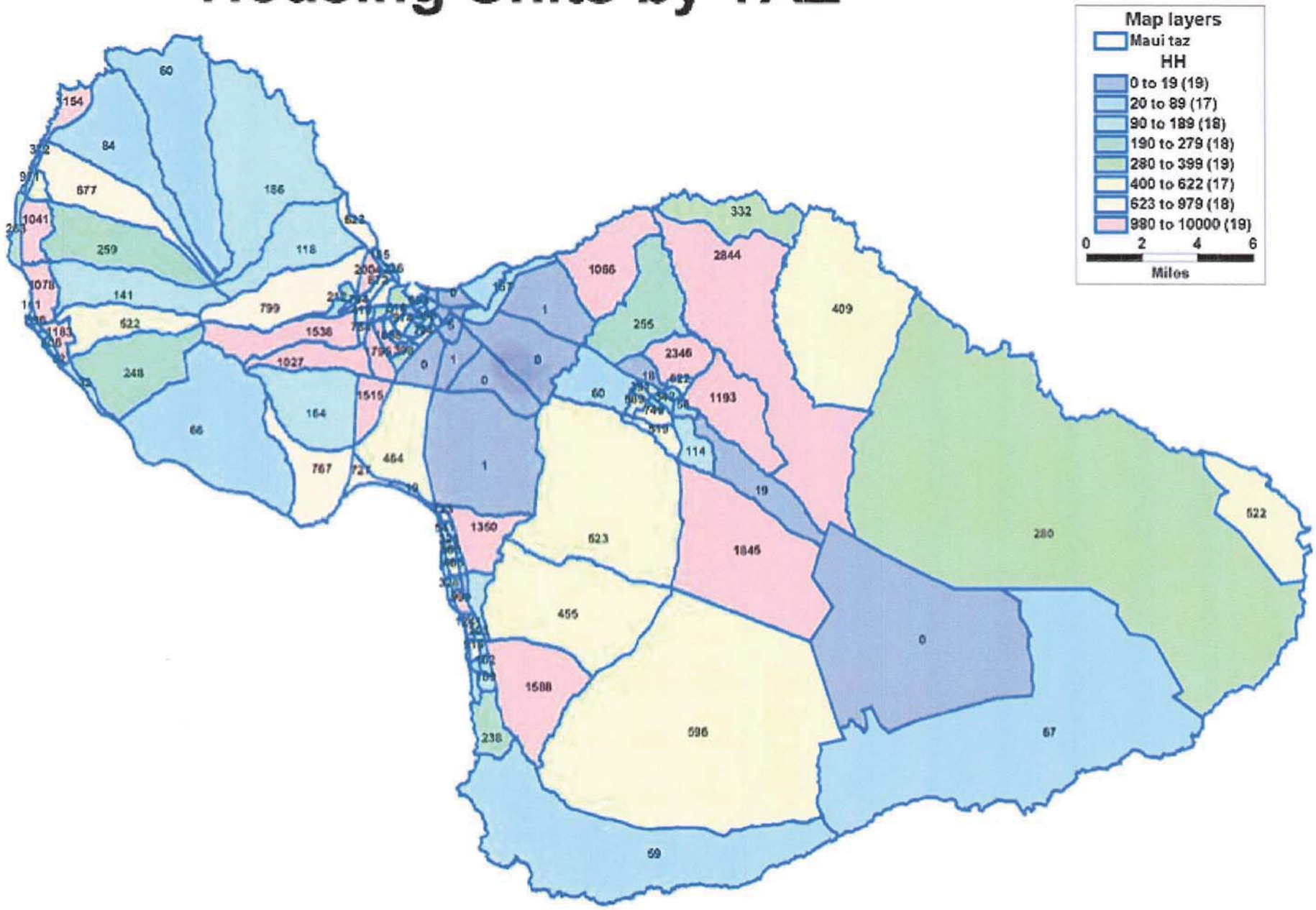


APPENDIX I - TAZ LAYOUT

Employees by TAZ



Housing Units by TAZ



Trips in 1990 and 2020 By Community Name and By Purpose

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2												
3				1990					2020			
4			Home Based Work	Home Based Other	Non-Home Based	Visitors	Total	Home Based Work	Home Based Other	Non-Home Based	Visitors	Total
5	**Community Name**	**aka 1997 LRTP**										
6	West Maui	Lahaina										
7	Kihei-Makena	Kihei-Makena										
8	Wailuku-Kahului	Wailuku-Kahului										
9	Makawao-Pukalani-Kula	Makawao-Pukalani-Kula										
10	Paia-Haiku	Paia-Haiku										
11	Hana	Hana										
12	Total Daily Trips		43,260	89,660	65,590	35,140	233,650	69,050	143,130	114,250	59,850	386,280
13	A.M. Peak Hour		8,980	4,490	1,450	2,600	17,520	14,340	7,170	2,520	4,430	28,460
14	P.M. Peak Hour		9,070	5,050	2,210	4,220	20,550	14,470	8,050	3,840	7,190	33,550
15												
16	**Percentage of Total Trips by Purpose Daily**		**18.5%**	**38.4%**	**28.1%**	**15.0%**		**17.9%**	**37.1%**	**29.6%**	**15.5%**	
17	**Percentage of Total Trips by Purpose AM**		**51.3%**	**25.6%**	**8.3%**	**14.8%**		**50.4%**	**25.2%**	**8.9%**	**15.6%**	
18	**Percentage of Total Trips by Purpose PM**		**44.1%**	**24.6%**	**10.8%**	**20.5%**		**43.1%**	**24.0%**	**11.4%**	**21.4%**	
19												
20												
21			1990 LRTP Daily Trips		2020 LRTP Daily Trips							
22		From	To/from	To/from	To/from	To/from						
23		Site by Purpose	Lahaina	All others	Lahaina	All others						
24		HBW	12,899	30,361	19,426	49,624						
25		HBO	16,431	73,229	20,230	122,900						
26		NHB	10,475	55,115	20,969	93,281						
27		Visitor	21,547	13,593	32,943	26,907						
28		Total	61,352	172,298	93,568	292,712						
29			26.3%	73.7%	26.3%	73.7%						
30	Daily 1990 % by Purpose							2020 % by Purpose				
31	18.5%	HBW	29.8%	70.2%	28.1%	71.9%		17.9%				
32	38.4%	HBO	18.3%	81.7%	14.1%	85.9%		37.1%				
33	28.1%	NHB	16.0%	84.0%	18.4%	81.6%		29.6%				
34	15.0%	Visitor	61.3%	38.7%	55.0%	45.0%		15.5%				
35		Total	26.3%	73.7%	24.2%	75.8%						
36												
37												
38												
39												
40												
41												
42		Example of 5000	To Lahaina (left out)	All others (right out)								
43		5000	276	650								
44		5000	352	1567								
45		5000	224	1179								
46		5000	461	291								
47		Total	1313	3687								

6

[design principles for mobility]

SUSTAINABLE DESIGN PRINCIPLES AND PRACTICES
FOR VEHICLE TRIP REDUCTION AND MOBILITY FEE CREDITS

ACKNOWLEDGMENTS

The study team would like to extend a sincere thanks to the City of Jacksonville Planning and Development Staff whose diligence and desire to create a better system for the City directly contributed to making this effort a reality:

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FOREWORD

"If we can develop and design streets so that they are wonderful, fulfilling places to be — community-building places, attractive for all people — then we will have successfully designed about one-third of the city directly and will have had an immense impact on the rest."—Allan Jacobs, Great Streets

The sweeping, statewide Growth Management changes enacted during the 2011 Legislative session has provided an air of uncertainty with respect to the State's role in future comprehensive planning and oversight. Despite this situation, a proverbial "Let cities be cities" mantra has emerged as the new framework and potentially offers an opportunity for local governments to be progressive and visionary in their approach to planning and development. The City of Jacksonville's adopted 2030 Mobility Plan is ahead of this curve and establishes a new paradigm for infrastructure planning, design, and implementation with a multimodal emphasis. This Plan identifies future transportation infrastructure needs, and uses a simple fee structure based on vehicle miles traveled to fund prioritized improvements throughout designated mobility zones. Unlike the previous concurrency management system, the Mobility Plan is the first effort to truly link the impacts of development to capital expenditures. Perhaps most signficantly, this new approach also creates a system that is supportive of a more predictable, decision-making environment—one of the most significant variables that can make development firms uneasy about investment.

This Guide has been developed by the City of Jacksonville Planning and Development Department with a twofold purpose: (1); to document the various approaches to adjusting trip generation based of design principles, and (2); to provide examples of how the approach chosen by the City can be utilized to maximize trip reduction adjustments for a variety of development typologies. Such trip adjustments are designed to function as an incentive instrument to encourage infill development opportunities and create a built environment supportive of transportation mode choice.

Beyond representing a mere "carrot" to mobility fee reduction, there is tremendous long-term value in encouraging sustainable development opportunities for the City of Jacksonville—development which encompasses real choice in mobility and housing, provides a stronger sense of identity and character, discourages sprawl, and ultimately restores vitality to the places that are important to residents. On behalf of the Planning and Development Department, we hope you find this Guide useful to support and reward desired development outcomes.

Sincerely,

William Killingsworth, Director

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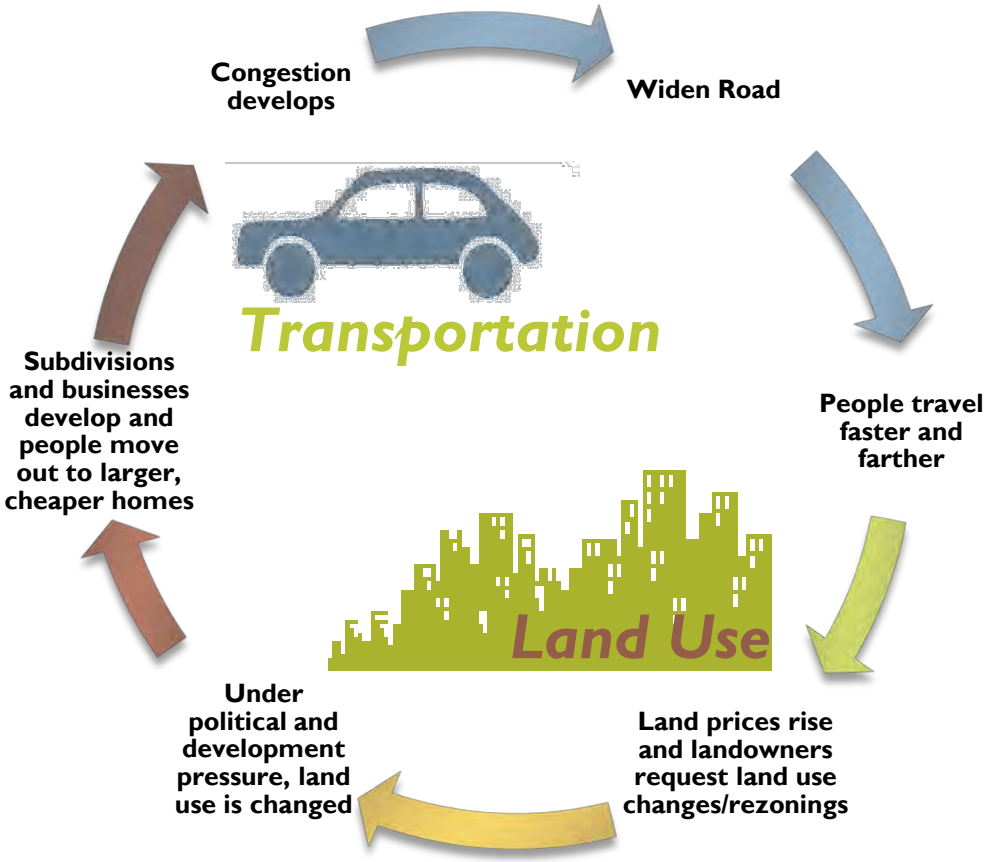
CONTEXT

From Concurrency Management to Mobility Planning
The City of Jacksonville's recent and on-going mobility planning efforts, both in response to Florida's Senate Bill 360 and the many shortcomings of the City's existing Fair Share system, establishes a new, comprehensive framework for transportation planning and concurrency management practices. While transportation concurrency as a policy was designed to ensure that development would ostensibly pay for itself, the system has had the effect of running contrary to many of the goals and objectives of comprehensive planning and growth management principles. Many of these unintended consequences consist of the following:

- → singular focus on PM peak hour level of service for vehicular traffic only
- → disregard to relationship and significance of other modes
- → failure to recognize the fundamental link between supply and demand in travel behavior
- → encouragement of sprawl and unsustainable development patterns
- → disincentive for infill or redevelopment activities
- → unfair and unpredictable mitigation (Fair Share/proportionate share) costs

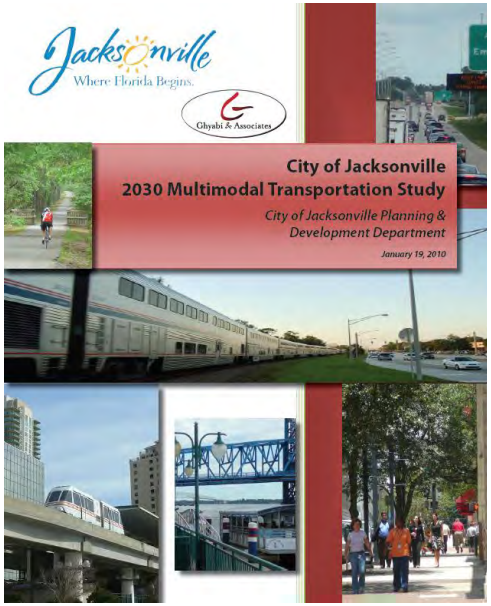


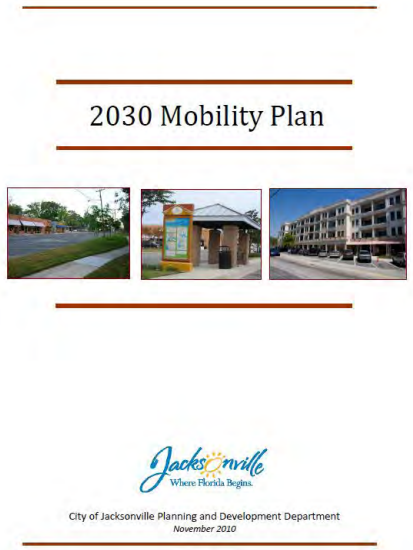
Conventional concurrency practices ignore fundamental supply and demand principles in transportation and travel behavior.

The City's Fair Share procedures for transportation funding have long been reflective of these inefficiences and inequities. Amidst the backdrop of increasingly narrow sources of revenue and antiquated gas tax financing mechanisms, the adopted 2030 Mobility Plan:

- → Provides innovative approaches and long-term solutions to more effectively address the nexus between transportation and land use decisions. This includes the flexibility to support and fund multimodal improvements associated with future travel demand and provide an incentive for quality growth and development.
- → Works in concert with the complementary fee system to reduce leap-frog development, better deal with potential cross-jurisdictional transportation impacts, and provide equity in terms of local stakeholders sharing in the costs, processes, and impacts of transportation decisions—with the ultimate goal being a unified transportation system that promotes **compact, mixed use, and energy-efficient development.**

High density, transit-oriented redevelopment, such as shown above, would generally be financially discouraged under traditional concurrency/Fair Share requirements.





City of Jacksonville 2030 Multimodal Transportation Study and Mobility Plan

While the fee alone won't achieve the goal of funding all of the City's transportation needs, it represents a more equitable and predictable approach addressing the needs of transit users, bicyclists, and pedestrians that have largely been ignored under the existing Fair Share concurrency system, which focuses mainly on the automobile.

The City's Mobility Plan specifically incorporates a number of strategies that are designed to link urban form, transportation and the multimodal environment. The fee system will enable new development to proceed following the payment of a vehicle-miles traveled (VMT)-based assessment that will be collected to fund prioritized multimodal improvements throughout designated "mobility zones" in the City. A key component of the formula includes trip adjustment parameters. These are designed to provide a credit structure to the mobility fee to reward or incentivize quality growth and development. The adjustments directly translate into a percent reduction applied to a project's calculated daily trip generation. This is designed to encourage mixed-use as well as infill and redevelopment opportunities, enhancing the multimodal network by incorporating livable and sustainable design elements.

ITE Trip Generation Limitations

Fundamental to this consideration for a trip reduction mechanism, is the recognition of the shortcomings associated with a universal application of Institute of Transportation Engineers (ITE) trip generation and internal capture procedures for project trip estimation. While a valuable resource for traffic impact assessments, the majority of sites that are surveyed for the purpose of developing the range of per unit rates and linear equations for trip estimation (*Trip Generation, 8th Edition*, 2008) are based primarily on suburban locations. These sites typically reflect individual, segregated uses whose trips are by private vehicle and whose origins and destinations generally lie outside of the development. In addition, most of these sites are characterized by having little or no transit service, nearby pedestrian amenities, or travel demand management (TDM) programs to reduce dependency on private automobile travel. Most of the marketing of these sites is tied to the availability of free and abundant parking.

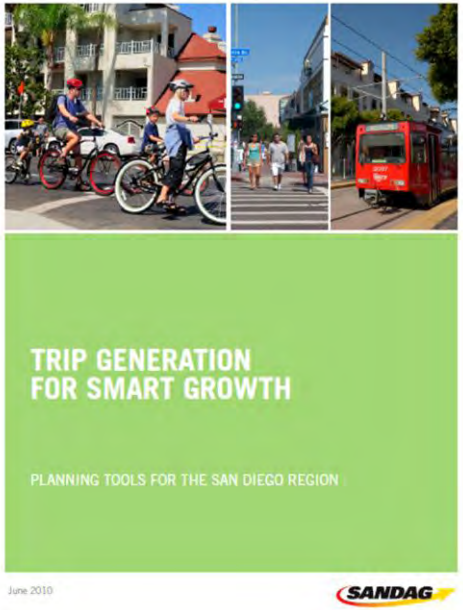
For mixed-use projects, ITE's current procedure for estimating internal capture, or the proportion of trips that remain within the development, provides a downward adjustment to the preliminary estimate of external trip generation. These reductions, however, also have many shortcomings:

- → The method is based upon look-up tables from a "limited number of multi-use sites in Florida" (specifically three sites analyzed by the Florida Department of Transportation, *Trip Generation Handbook*, 2004, p. 130). The accuracy of such a forecast is dependent upon how closely the site being analyzed corresponds to the characteristics of the three sites developed for the look-up tables.
- → The land use types in these tables are also limited to three uses—residential, retail, and office—thus the traffic reducing impacts of other mixed uses cannot be assessed.
- → The scale of development is also overlooked. In other words, a large site with many trip productions and attractions is more likely to produce larger internal capture than a small site, but the look-up tables don't provide higher percentages to account for this distinction.
- → The land use and transportation context of development is also disregarded. This means that a project or site with well- integrated and diverse uses, served by transit, would not be appropriately accounted for in the procedure.

The ITE manual recognizes these limitations, and accordingly, advises that users modify rates at particular sites that do exhibit the above characteristics. The desire, however, for standardization, substantial documented evidence, and general conservativism, results in a widespread reliance on the prescribed, suburban-oriented methodology. Without another mechanism or alternative methodology to appropriately account for use mix, density, location, and multimodal features, trip estimates will continue to be overstated leading to higher exactions and/or negotiated payments than should be the case. This approach will also continue to discourage desirable projects within designated infill areas and other targeted locations.

Current Research

The above shortcomings have represented the foundation of a body of literature and research on travel activity and trip generation associated with mixed use development. In 2010, the US EPA conducted research on 239 mixed-use developments in Seattle, Portland, Sacramento, Houston, Atlanta and Boston. The household surveys revealed statistically meaningful relationships between site characteristics and the amount of vehicle travel generated. These mixed-use sites were found to reduce traffic impacts (above and beyond what is typically estimated using conventional ITE internal capture look up tables) relative to single-use suburban development. This is due to the diverse on-site



activities that capture a large share of trips internally. In addition, the siting of development within walkable areas with good transit access, and central, efficient locations helps reduce trip lengths.

Additionally, other jurisdictions, particularly in California, have begun to implement new trip reduction elements tied to the benefits of density, mix of use, and design in development. Some of these include the URBEMIS model with operational measures specifically developed to address California air quality standards, San Diego Area Government's Smart Growth Toolbox, and a variety of specific vehicle trip reduction and transportation demand management programs implemented around the Country. These efforts represent logical and tested references for Jacksonville in order to provide an incentive system for desired development. The documentation and selection of such practices and principles will, more importantly, help guide decision-makers and planners of mixed use projects on the appropriate package of design features likely to minimize traffic generation, GHG emissions, and produce a standard, replicable analysis technique to quantify the impacts of new mixed use development proposals.

> "Unless developers are rewarded for the trip reducing impacts of well designed and location-efficient mixed-use projects, the market incentive to build such projects with relatively small ecological footprints is substantially removed." *–Mark Feldman, Evidence on Mixed Use Trip Generation—Local Validation of the National Survey*

While it would be naïve to suggest that this credit system would be the sole determining factor in the development decision-making process, Jacksonville can no longer afford a regulatory environment that discourages creating sustainable, mixed use places. This Guide will explore in greater detail principles and best practices associated with reducing vehicular travel demand and enhancing multimodal mobility, ultimately ensuring that mixed use development in desired locations will be rewarded.

Implementing Other Planning Efforts

The City of Jacksonville has a tradition of planning excellence in long-range, district and neighborhood planning initiatives. Many of these great efforts, however, have resulted too often in "plans of intent" with implementation efforts stymied because of little political and/or economic will. The recently adopted 2030 Mobility Plan provides a unique opportunity to implement the collective visions and objectives articulated in the City's Planning District and Neighborhood Action Plans. Over the course of the past decade, the City has developed a series of local plans focused on generating everything from community revitalization and reinvestment to enhancing mobility and housing choices.

The integrated set of Guiding Principles from the most recent Vision Plans establishes a foundation for the development of specific design parameters for a mobility credit system. Major themes reinforce capitalizing on each community's uniqueness, promoting mixed-use and infill development, providing a variety of transportation choices and encouraging economic growth, while enhancing and preserving open space. The principles and example applications will reflect a variety of place types and targeted enhancement areas identified with an eye on linking the potential fees generated by new development to mobility improvements recommended in these plans, in addition to those prioritized in the 2030 Mobility Plan. This approach is intended to create a system that can fund and support mobility throughout the City—especially in the context of long-term community objectives identified in the area Vision Plans.

Design Principles and Best Practices

> "Erosion of cities by automobiles...proceeds as a kind of nibbling, small nibbles at first, but eventually hefty bites...A street is widened here, another is straightened there, a wide avenue is converted to one-way flow...more land goes into parking...No one step in this process is, in itself, crucial. But cumulatively the effect is enormous...City character is blurred until every place becomes more like every other place, all adding up to No place."—*Jane Jacobs, The Death and Life of Great American Cities*

Placemaking

This section will explore in detail the principles and discrete elements that collectively work together to reduce vehicular traffic generation and enhance overall mobility. First consider the following scenarios:

1. There's a new neighborhood store near your home within walking distance. Although a few short blocks away, a long continuous dead-end street prohibits direct access. The alternative solution involves leaving the neighborhood and traversing along the adjacent arterial roadway with no sidewalks en route to make the experience safe and enjoyable. The solution is to drive to the store.
2. You've spent a great portion of your summer day chauffeuring your kids from school to sports practice, and then you're picking up your elderly aunt for her doctor's appointment. Wouldn't it be nice if your children could walk to school by themselves and not worry about speeding motorists? Your aunt would also like to get around by herself, but she walks slowly and wouldn't dare take a chance with impatient drivers on those wide streets.
3. The old train station used to be the real heart of downtown. As it exists today, it's completely deteriorated and lifeless. While there is a place to sit and wait for the local bus, the experience leaves much to be desired. The adjacent storefronts have closed and trains are no more. It's no wonder that people actually prefer to drive.
4. The neighborhood shopping district certainly isn't what it used to be. While the new mall has grown into a bustling place, it lacks the interesting mix of people, walkability, and the commercial and community activities and character that defined your neighborhood main street. On the other hand, the last time you visited the old "main street" it was fairly bleak, especially after being widened to accommodate faster traffic and the main retailer displaced by the larger one at the mall. The intimacy and accessibility that made people like to go there are gone, and so is the sense of place.

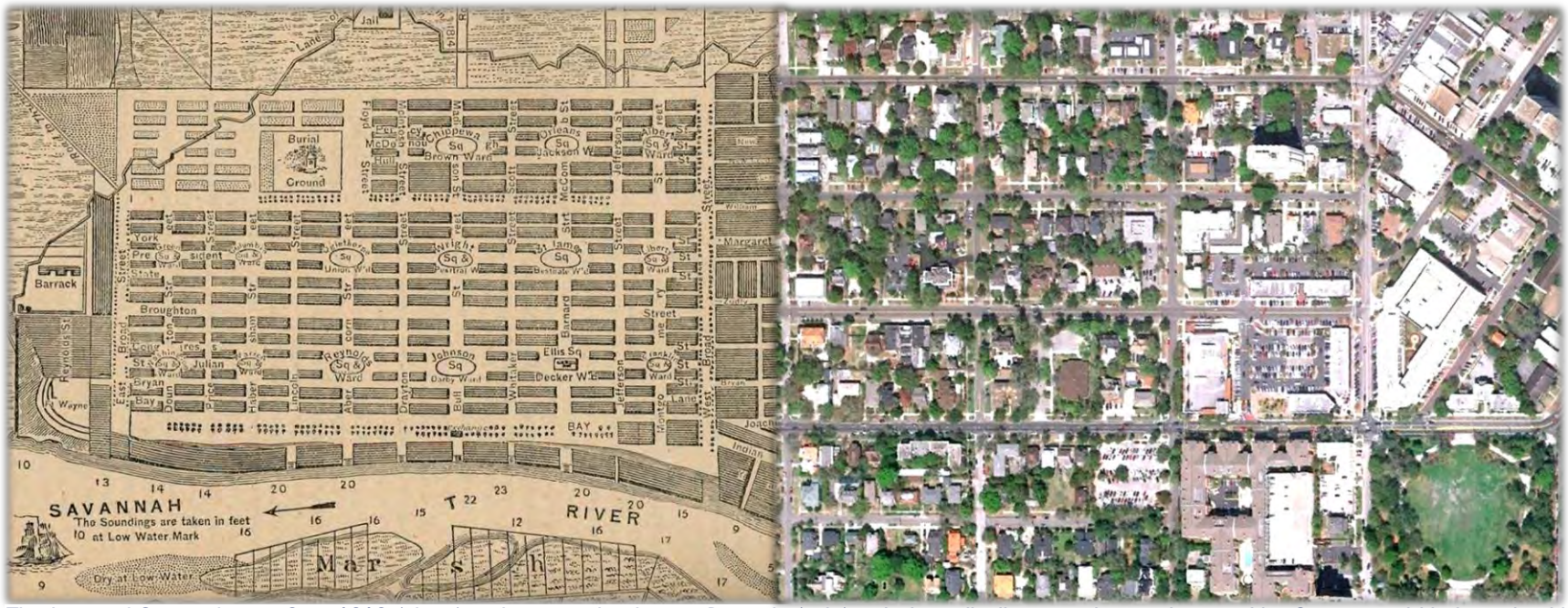
These represent a microcosm of what many of us have become accustomed to experiencing in our everyday lives and commutes, and have come to define much of our City's landscape. The City's adopted Vision Plans clearly indicate a preference for an alternative approach to development and reinvestment, one that preserves and enhances existing neighborhoods and commercial centers, provides multimodal connectivity options, and improves quality of life. Much of this begins with a simple rethinking of our streets as public spaces for the ebb and flow of people and not exclusively automobiles. In many respects, simply looking to our past can provide our City with lessons on how to create lasting and valuable communities that are multimodal by nature. Whether it's Riverside-Avondale, San Marco, and Springfield in our own backyard, or Savannah,

Historic Riverside/Avondale walking experience

Charleston, or Nantucket by design, the collective and integrated elements of all these places has been reinforcing multimodal travel and mobility for over a century.

The previous scenarios also emphasize the importance of *placemaking* as it contributes to enhancing mobility. This concept is both a process and a philosophy. While it generally refers to the act of designing spaces, and in particular public spaces, that attract people because of their interesting qualities, it's also a reflection of a community's needs and desires about places in their lives and the potential experiences and inspiration these places offer. When thinking about what makes such places special, and in particular the important elements that contribute to the sense of place, it often comes down to form and design. In this respect, the pattern and assembly of streets, block sizes and distance, and the configuration and placement of buildings play an essential role in the outcome and quality of the transportation and mobility environment.

While a major emphasis of the City's Mobility planning efforts is to be able to fund multimodal improvements, it is perhaps even more critical to ensure that these improvements are supported by form and design elements that will sustainably support their use. It's quite remarkable to consider the uncomplicated, historical lessons in city-building and urban design of our American Forefathers in terms of offering great insight into how to achieve such results, even in the context of improving contemporary suburban development. Approaching development and redevelopment with a placemaking philosophy will serve to increase the likelihood that projects will be located and designed in a manner which maximizes both long term community planning goals and individual financial incentives.



This historical Savannah map from 1818 (above) and present day, historic Riverside (right) in Jacksonville illustrates the simple assembly of streets and blocks and public squares that fundamentally contribute to pedestrian, bicycle, and transit utilization.

Alternative Methods

Recognizing the importance of placemaking and urban design, additional mixed-use and transit-oriented development, infill and new location-efficient development (collectively referred to as Smart Growth), many jurisdictions and planning agencies across the country have begun to employ new methods to encourage these activities. While traditional tax abatements and subsidies will continue to be utilized as a financial means to attract development to urban centers and other desirable locations, a number of jurisdictions have also begun to adopt alternative methods to more accurately assess the impacts of this type of development. As discussed in the first section, current ITE-based trip generation and parking supply guidelines are based on conventional suburban development, which tend to overestimate the vehicular trip impacts of Smart Growth sites and do not generally account for the distinction between truly urban, walkable, and transit-friendly mixed-use projects and more auto-centric, suburban, development. In many locations that require impact fees or exactions tied to adequate public facilities requirements (such as transportation concurrency in Florida), this would likely impose a larger cost burden on both developers and local governments to provide more roadway and parking capacity associated with these types of projects than is necessary. Recognizing this issue, other jurisdictions are exploring the use of new tools and methods, within the development approval process. These approaches are designed to allow for an adjustment in the number of trips and/or provide additional credits specifically tied to projects that are urban or infill in nature, support complementary mixes of uses, provide safe bicycle and pedestrian access, and present real connections to transit modes. The resulting cost savings also presents a greater opportunity to reduce the impacts to potential homebuyers and renters.

What is Location Efficiency?

While the concept of energy efficiency is a familiar term, locations can be efficient too. Compact neighborhoods with walkable streets, access to transit, and a wide variety of stores and services have high *location efficiency*. They require less time, money, and greenhouse gas emissions for residents to meet their everyday travel requirements.

The savings have been shown to add up for households and communities. Transportation costs can range from 15% of household income in location efficient neighborhoods to over 30% in inefficient locations. Greenhouse gas emissions fluctuate too, depending on household reliance on costly, carbon-intensive automobile travel. *(Center for Neighborhood Technology)*

Supporting Studies and Best Practices

While there is variation in terms of how the trip estimation and/or credits may be calculated or applied, the basis for most of the practices proposed in this document reflect what are known as the "**D**" variables, originally coined by Cervero and Kockelman (1997) as often overlooked indices of travel demand and mode choice. The three original "Ds" are ***density, diversity***, and ***design***. Since then, others have been added as relevant indicators including, ***destinations*** (in terms of accessibility), ***distances*** (such as to transit), ***demographics*** (concentration of employees and households within walking distance), and ***development*** scale. These are representative of the underlying framework for the select variables in the California-based URBEMIS model among other approaches discussed in this section. In the context of urban, mixed-used development projects, travel can generally be conceived as a series of choices dependent upon the extent of these "D" variables—such that a particular site's densities, form, and/or enhanced accessibility will largely influence the probability that a traveler will remain within a development or travel outside or to walk, bike, or use transit. In summary these major characteristics include:

→ ***Density:*** More people and jobs per acre (and/or greater jobs/housing balance) is often a fundamental planning objective of Smart Growth. This is effective at reducing VMT and increasing the mode share, especially when integrated with increased mix of uses, accessibility, and good urban design. Density also promotes infill and redevelopment, minimizing Greenfield, and exurban development.

→ ***Diversity*:** The degree of use mix is often an indicator of the jobs/housing balance, as well as the variety of retail and non-retail employment within

walking/bicycling distance or a short driving distance. The mixing of residential and non-residential uses tends to reduce vehicle trips and VMT, and increases the likelihood of mobility choice.

→ ***Design:*** Development that is designed at the scale of the pedestrian will tend to be more compact and interconnected, including increased street network density and sidewalk completeness, inviting public plazas and spaces, and minimized off-street parking or parking directed to the street or rear of buildings. This increases the safety, convenience, and comfort of the pedestrian environment, yielding a walkable, urban form that is also correlated to reduced vehicle travel and VMT.

→ ***Destination Accessibility:*** Infill and redevelopment is by nature location-efficient development, encouraging the creation of new, vibrant activity centers near existing transportation nodes and support infrastructure, providing greater accessibility to other population and activity centers. This serves to reduce travel time and VMT, and also increases the ability to directly connect via transit.

→ ***Transit Proximity:*** A simple characteristic that considers the number of people and jobs within ½ mile of transit stops. If paired properly with the preceding "D's", this would serve to increase the number of people choosing to walk or bike to the transit service and minimize driving and parking.

CITY OF PORTLAND, OREGON

Collectively and cumulatively, the "D" factors have been shown to play a significant role in both trip reduction and local parking requirements in a number of locations. In the City of Portland Oregon, for example:

→ Trips are reduced an additional 5% at mixed use developments with at least 24 dwelling units per gross acre and 15% or more of the floor area devoted to commercial or light industrial uses

→ Trips are reduced 2% if 41-60% of buildings in a zone are oriented toward the street.

→ Trips are reduced 5% if 60-100% of buildings in a zone are oriented toward the street.

→ Trips are reduced 3% if the Pedestrian Environmental Factor[1] *(an index that indicates the quality of walking conditions in urban areas)* equals 9 to 12.

→ Trips are reduced 1% if it is adjacent to bicycle path and secure bicycle storage is provided.

→ In a central business district, trips are reduced 40%, plus 12% if the Pedestrian Environmental Factor is 9 to 11, and 14% if Pedestrian Environmental Factor is 12.

IMPACTS OF NEW URBANISM AND TOD

A 2003 study by the National Resources Defense Council examined the impacts of Smart Growth principles and "D" variables on two Nashville area New Urbanist neighborhoods. Compared with other nearby neighborhoods, the two communities, with modestly higher density, use mix, and connectivity, yielded 25 percent less per capita VMT. **The results of the study suggested that the combination of better transportation accessibility and a modest increase in land-use density can produce measurable benefits even when both sites are generally automobile-oriented and suburban in character**.

[1] *A component of Portland, OR's "Making the Land Use, Transportation, Air Quality Connection (LUTRAQ)" demonstration project in 1996 to develop methodologies for creating alternative suburban land use patterns and design standards and evaluating their impacts on automobile dependency and mobility, the Pedestrian Environmental Factor (PEF) represents a composite measure of "pedestrian friendliness" scoring parameters such as sidewalk continuity, ease of crossings, local street characteristics, and topography using a range of 4-12 (4 being the lowest and 12 being the highest) in order to improve accuracy of several transportation submodels in Portland.*

A similar 2005 study of a North Carolina neighborhood found that residents generated 22 percent fewer automobile trips and took three times as many walking trips than residents of an otherwise similar neighborhood, even when controlling for demographic factors and travel preferences.

In addition, a 2008 report by the Transit Cooperative Research Program (TCRP) examining actual mixed-use, transit-oriented development (TOD) sites in metropolitan Philadelphia, Washington, Portland, and San Francisco determined that, on average, **car trips were reduced by 49 percent in the morning peak period and 48 percent in the evening peak, compared to what would be expected from the standard ITE estimates typically used by municipalities.**

Much of the supporting research and case studies indicated that neighborhoods with favorable density, mix, street design, and regional accessibility features typically have **20 to 40 percent fewer vehicles and vehicle trips** than otherwise comparable, automobile-dependent communities.

PREVIOUS TRAVEL BEHAVIOR RESEARCH

An extensive body of literature exists on trip generation and the effects of land use and urban form on travel behavior. Much of the current research reflects the growing national interest in building data that expands upon the existing ITE trip generation rates to account for mixed-use and location efficient development within a multi-modal context. Previous research, such as that by Crane (1996), Levinson and Wynn (1963), and Cervero and Kockelman (1996, 1997, and 2002), provides a substantial assessment of the linkage between urban form and density and travel outcomes. The significance, in particular, of population and employment densities as predictors of travel behavior is nearly indisputable and perhaps the strongest predictor compared to all other built environment attributes.

A study of 28 California communities using the 1990 Census information suggested that **doubling neighborhood density resulted in a 25% reduction in the number of cars and VMT per household**. Studies have also found that land use mix and street patterns exert tremendous influence upon travel behavior. One study conducted in 1996 of 44 of the largest metropolitan areas in the U.S. found that having grocery stores and other consumer services within 300 feet of one's residence tended to encourage commuting by mass transit, walking and bicycling. While another series of studies by Kulash, et.al. (1990) and Mcnally and Ryan (1992) strongly suggest that traditional grid circulation patterns with well-connected and continuous sidewalks support less driving and have been shown **to reduce VMT by as much as 57 percent** compared with VMT in looped cul-de-sacs and other similarly-designed street networks.

Trip Reduction Factors, City of Portland, 1995

Minimum FAR	Mixed Use	Commercial Near Bus	Commercial Near LRT Station	Mixed Use Near Bus	Mixed Use Near LRT
No Minimum	----	1.0%	2.0%	----	----
0.5	1.9%	1.9%	2.9%	2.7%	3.9%
0.75	2.4%	2.4%	3.7%	3.4%	4.9%
1.0	3.0%	3.0%	5.0%	4.3%	6.7%
1.25	3.6%	3.6%	6.7%	5.1%	8.9%
1.5	4.2%	4.2%	8.9%	6.0%	11.9%
1.75	5.0%	5.0%	11.6%	7.1%	15.5%
2.0	7.0%	7.0%	15.0%	10.0%	20.0%

FAR=floor area ratio, or ratio of floor space to land area; LRT=light rail transit. "Mixed Use", in this case, means commercial, restaurants, office and light industry with 30 percent or more floor area devoted to residential. "Near Bus" or "Near LRT" means location within one-quarter mile of a bus corridor or LRT station.

Portland State University is currently conducting research in order to specifically "account for how the built environment (both land use and transportation) influences travel behavior including number of trips, trip length, mode choice, and determine trip rates that reflect the entire activity spectrum of different development/place typologies." This important effort is designed to explore the impact of different development types on the transportation system for three primary purposes:
(1) To avoid over supplying the transportation and infrastructure system for the surrounding land uses;
(2) Prioritized strategies and investment options to encourage more compact, mixed-use areas with more transportation choices and
(3) Avoid creating regulatory and/or financial barriers to compact form as envisioned by local, regional and statewide plans.

Parking and Transportation Demand Management (TDM) Considerations

Parking pricing strategies also have an effect upon vehicle trips. Shifting from free to cost-recovery parking (prices that actually reflect the cost of providing parking facilities) typically reduces automobile commuting 10 to 30 percent (Comsis Corporation, 1993). Shifting from free parking to a $6 daily fee in Downtown Portland was shown to reduce automobile commutes 21 percent. The elasticity of vehicle trips with respect to parking price is typically found to be -0.1 to -0.3. This means that a 10 percent parking fee increase reduces vehicle use by 1 to 3 percent (Litman, 2006). In a survey of automobile commuters in 1998 (Kuppam, et. al) nearly 35 percent stated that they would consider shifting to another mode if required to pay daily parking fees of $1 to $3 in suburban locations and $3 to $8 in urban locations. The following tables illustrate the typical reductions in automobile commute trips that result from various parking fees in various geographic locations.

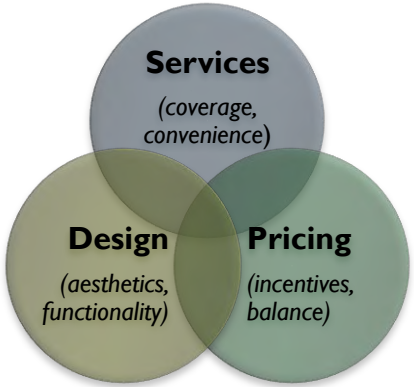
Vehicle Trips Reduced by Daily Parking Fees in Various Locations (2005)

Worksite Setting	$1.35	$2.70	$4.00	$5.40
Low Density Suburb	6.5%	15.1%	25.3%	36.1%
Activity Center	12.3%	25.1%	37.0%	46.8%
Regional central business district/corridor	17.5%	31.8%	42.6%	50.0%

Comsis Corporation, 1993

Of course the effects of pricing on parking and trip reduction are dependent upon the particular situation and context including price structure, quality of parking and alternative modes provided at the location, demographics, and enforcement. Furthermore subsidized or underpriced parking is a market distortion that violates basic principles of economic efficiency, which require that consumers should be able to decide whether or not to purchase a particular good, and that prices reflect full marginal costs. Paying for parking facilities indirectly is unfair and inefficient because it fails to reward consumers who reduce the parking costs they impose.

Transportation Demand Management (TDM) policies and programs, which encourage more efficient travel behavior, can be implemented as an alternative to road and parking facility capacity expansion. Examples of these strategies include, but are not limited to, such measures as: ridesharing, flexible work hours and telecommuting, tolling and congestion pricing, and enhanced bicycle and transit-supportive facilities. TDM affects land use indirectly, by reducing the need to increase road and parking facility capacity, providing incentives to businesses and consumers to favor more accessible, compact development with improved mobility choices. Other management programs, such as *commute trip reduction* programs (*formal programs that give commuters resources and incentives to reduce their automobile trips*), can also reduce affected automobile trips by 10 to 30 percent compared with what would otherwise occur. According to Litman (2006) "Smart Growth, in and of itself, can be considered the land use component of TDM, and TDM can be considered the transportation component of Smart Growth."



The most effective TDM programs combine services, design, and pricing strategies to reduce single-occupancy vehicle trips.

Visualizing TDM—In a July 1999 issue of the Tampa Tribune, entitled "Packing Pavement", the left graphic illustrates how to get more out of the existing system and potentially reduce single-occupancy auto commute trips. While road capacity cannot (for the most part) be increased in a traditional urban center, there are alternative opportunities to increase the capacity and efficiency of the transit and transportation system. 40 people are shown in each image.

Residents of Tampa Bay in their cars..

... then sitting where their cars had been

Now the same number of people are sitting in an invisible bus...

...and now they are walking or biking.

While most TDM programs are aimed primarily at reducing peak hour congestion, the cumulative benefits of these programs, particularly telecommuting and transit improvements, tend to decrease the overall daily traffic generated on the system, thereby supporting the basis of Jacksonville's 2030 Mobility Plan. Numerous jurisdictions across the country have implemented TDM and commute trip reduction programs over the last two decades:

To encourage better transportation planning considerations in large scale and planned unit development projects along high growth corridors, the **City of Atlanta** adopted a program which provides trip reduction measures, such as vanpool subsidies, ridesharing, and public transit incentives, during development agreement processes as a condition for rezoning approvals in such areas.

Parking Management Options

Parking "**cash out**" programs provide commuters who would typically be offered subsidized parking at their workplace the cash equivalent of the "free" parking space, encouraging employees to use alternative transportation or transit. The program was enacted as law in California (§ 43845), applicable only to employers with 50 or more employees in non- attainment air quality basins, after studies showed that cash allowances in lieu of parking subsidies increased alternative means of travel improving air quality and reducing congestion.

"**Unbundling**" is another tool that allows the price of a parking space, typically included as part of the monthly lease of an apartment or condominium purchase, to be separated from the cost of the unit. This allows the developer to construct fewer parking spaces associated with residential units and increases affordability. Moreover, the option provides potential buyers or renters the economic choice of purchasing a parking space or not, especially if they do not own a car and use alternative transportation.

In **North Brunswick, NJ**, in an effort to reduce commute traffic along congested routes during peak hours, the town adopted a mandatory program whereby businesses with more than 50 employees would be required to promote ridesharing, park and ride usage, and offer preferential parking for participants. The program is annually monitored through employer-sponsored travel surveys and includes a $500 per month fine for non-compliance.

King County, WA, through its "Commute Partnerships Program", enacted as state law in 1996, developed partnerships with nearly 425 employers in the area to reduce single occupancy vehicle trips. The County shares employers' initial contribution to fund such measures as subsidies for transit, vanpooling, carpooling, and bicycling and walking. The program has resulted in a 40 percent reduction in drive-alone commuting at the participating work locations.

The following matrix provides a useful summary of the most effective principles and methods that influence both mobility outcomes and population health, in terms of promotion of walking and/or bicycling.

Design and Programmatic Factors Influencing Travel Outcomes

Factor	Definition	Travel Impacts
Density	People or jobs per unit of land area (acre or hectare).	Increased density tends to reduce per capita vehicle travel. Each 10% increase in urban densities typically reduces per capita VMT by 2-3%.
Diversity or Mix	Degree that related land uses (housing, commercial, institutional) are truly mixed. Not to be confused with "multi-use", this would refer to the extent that complimentary land uses are contained in the same building.	Increased land use mix tends to reduce per capita vehicle travel, and increases use of alternative modes, particularly walking for errands. Neighborhoods with good land use mix typically have 5-15% lower vehicle-miles.
Regional Accessibility ("Destinations")	Location of development relative to regional urban center.	Improved accessibility reduces per capita vehicle mileage. Residents of more central neighborhoods typically drive 10-30% fewer vehicle-miles than residents of more dispersed, urban fringe locations.
Centeredness	Portion of commercial, employment and other activities in major activity centers.	Increased centeredness increases use of alternative commute modes. Typically 20-50% of commuters to major commercial centers drive alone, compared with 80-90% of commuters to dispersed locations.
Connectivity	Degree that walkways and roads are connected and allow direct travel between destinations.	Improved roadway connectivity can reduce vehicle mileage, and improved walkway connectivity tends to increase walking and cycling.
Roadway design and management	Scale, design and management of streets.	More multi-modal street design and management increases use of alternative modes. Traffic calming tends to reduce vehicle travel and increase walking and cycling.
Walking and Cycling environment	Quantity and quality of sidewalks, crosswalks, paths and bike lanes, and the level of pedestrian security.	Improved walking and cycling conditions increases non-motorized travel and can reduce automobile travel, particularly if implemented with land use mix, transit improvements, and incentives to reduce driving.
Transit quality and accessibility	Quality of transit service and degree to which destinations are transit accessible.	Improved transit service quality increases transit ridership and can reduce automobile trips, particularly for urban commuting.
Parking supply and management	Number of parking spaces per building unit or acre, and how parking is managed.	Reduced parking supply, increased parking pricing and increased application of other parking management strategies can significantly reduce per capita vehicle travel. Cost-recovery parking pricing (charging motorists directly for the cost of providing parking) typically reduces automobile trips by 10-30%.
Site design	The layout and design of buildings and parking facilities.	More multi-modal site design can reduce automobile trips, particularly if implemented with improved transit services.
Mobility Management	Various programs and strategies that encourage more efficient travel patterns.	Mobility management policies and programs can significantly reduce vehicle travel by affected trips. Vehicle travel reductions of 10-30% are common.

Litman, 2006

CALTRANS TRIP GENERATION RATE STUDY

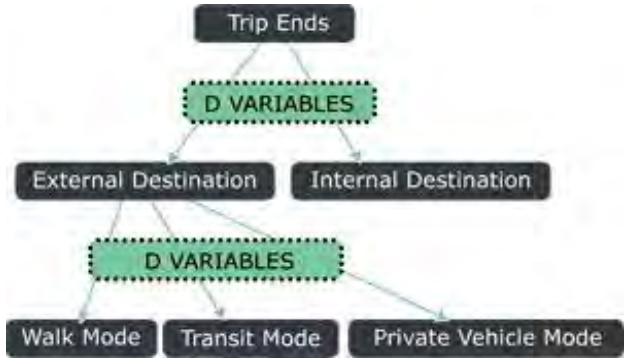
In 2009, the California Department of Transportation (CALTRANS) conducted a two-phase research project to establish a database of empirical trip generation studies for various types of infill development, to standardize data collection and analysis methodology, and to coordinate the findings with the Institute of Transportation Engineers (ITE) for a future publication. Field surveys were conducted at a number of urban infill sites in California in order to develop rates and a database for common infill land use categories to supplement the existing ITE trip generation data.

The preliminary data collected from 27 sites; including those in San Francisco, Berkeley, Oakland, Los Angeles, Santa Monica, Pasadena, and San Diego, indicate that the observed trip rates were generally lower when compared to established ITE rates. Although some individual buildings were equal or higher than the established ITE rates, the weighted average observed rates of the residential sites was **27 to 28 percent lower than the ITE rates**. For the non-residential sites, the weighted average of the observed rates was **26 to 50 percent less.**

While the data collection efforts were postponed in early 2009 as a result of the impacts of the economic downturn on the validity of the trip generation data, the study does begin to formally establish the beginnings of an urban infill trip generation database that could be used in lieu of conventional, suburban rates. More research will be needed to test additional locations in order to confirm and establish potential rates for wider use.

US EPA STUDY & MIXED-USE METHOD (MXD)

A recent national study conducted by the US Environment Protection Agency, in response to the limited offerings of the current ITE *Trip Generation Handbook*, developed a new methodology to more accurately predict the traffic impact of mixed-use developments. This study evaluated household travel surveys from 239 mixed-use developments in Seattle, Portland, Sacramento, Houston, Atlanta, and Boston. Each of the sites varied in population and employment densities, land use mix, presence or absence of transit, and location within a particular region.



The MXD method, as developed by Fehr and Peers, improves vehicle trip generation estimates for mixed-use developments by measuring the degree to which site characteristics such as density, mix of uses, transit frequency, and walkability reduce vehicle trips.

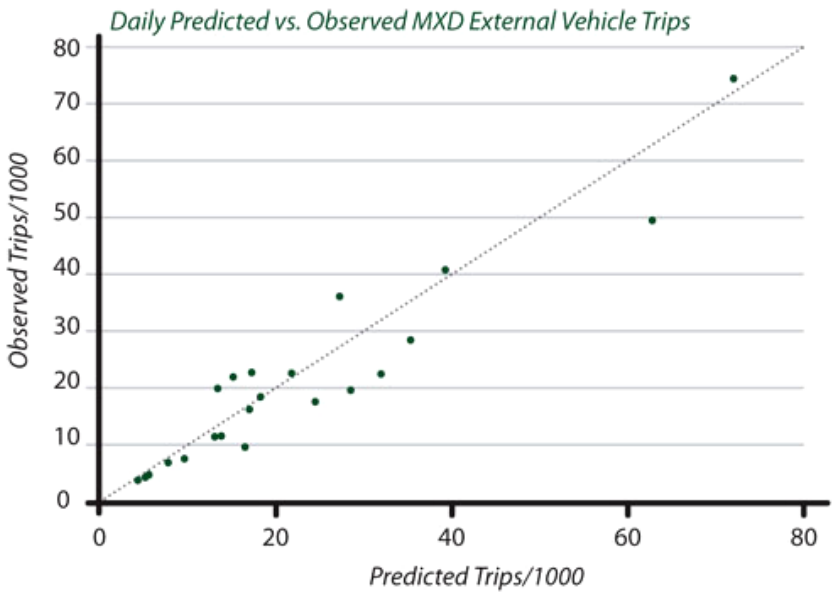
The study found statistical relationships between site development characteristics and the amount of vehicle travel generated based on the use of Hierarchical Linear Modeling (HLM). More importantly, the model produces an equation that more accurately predicts the amount of driving that a development will create and corrects the deficiencies of outmoded, suburban-based equations.

This model, called MXD (for "mixed-use development"), is specifically designed to predict the probabilities of travel choices which can result in the reduction of external vehicle trips to and from a mixed-use development. In this study, each of the seven "D" variables (as described previously) was tested for their ability to predict the travel characteristics of mixed use sites, including models for the choice of internal destinations, choice of walking or bicycling, and choice of transit. The model-generated probabilities were combined with the "raw" ITE rates to predict a "net" number of trips made to and from the particular mixed-use site by private vehicle. **The results indicate a very strong correlation between the impacts of the "D" variables and the reduction in private vehicle trips**. More importantly, the results were also validated in 22 additional sites in Florida and California by comparing with field traffic counts.

SAN DIEGO ASSOCIATION OF GOVERNMENTS (SANDAG)

In 2010, the metropolitan planning organization for the surrounding San Diego region (SANDAG) adopted the MXD methodology and guidelines as an update to the previous *San Diego Traffic Generators Manual*. Its report *Trip Generation for Smart Growth: Planning Tools for the San Diego Region* provided guidelines to local jurisdictions regarding the adjustments of trip generation rates and parking demand associated with Smart Growth developments. The method is also under review by the Institute of Transportation Engineers for wider adoption, and is undergoing evaluation by panels of experts and practitioners in California as part of a study to assess its acceptability for use in development reviews required under state law. The SANDAG Smart Growth Concept Map provides place type thresholds (including specific sites known as Smart Growth Opportunity Areas, or SGOAs) with minimum residential, employment, and transit service targets, and applies the MXD method to 57 specific SGOAs as a means to ground-truth the model in the San Diego region. Based on the results of the analysis, **it was shown that the method estimated and observed an average vehicle trip reduction of 24 percent relative to the standard approach and ranged as high as 47 percent in Downtown San Diego.**

The study is also accompanied by an interactive spreadsheet tool applying the MXD method to assist users in calculating trip reduction rates at specific sites or larger planning areas in California. It is made available to local jurisdictions if they choose to utilize it as part of the development approval process. The spreadsheet can be fully completed by the user inputting their own data, or data can be provided by the SANDAG Service Bureau for a fee. The data needed to perform the trip adjustments are all examples of one or more of the "Ds" that are known to influence travel behavior. This data includes:



The scatter plot above compares the predicted trips of the MXD model to actual observed trips of 22 sites in California and Florida, with the dashed line representing a perfect prediction. The relatively small scatter indicates that the model does an accurate job of predicting net external trips, accounting for the "D" characteristics.

Site-Specific Information:

- → Land Area (of project site in acres)
- → Number of Intersections
- → Is Transit (Bus or Rail) Present Within the Site?
- → Number of Dwelling Units or Population (separated by single family, multi-family)
- → Retail KSF or Employment (separated as specifically as possible)
- → Office KSF or Employment (non-medical and medical if possible)
- → Industrial KSF or Employment (light industrial, manufacturing, or warehouse if possible)
- → Hotel, Motel, Movie Theater (rooms, rooms, and screens)
- → School (by number of students for University, High School, Middle School, or Elementary)
- → Miscellaneous Trips (any special generators or anticipated trips not captured above)

Surrounding Area Variables (assumptions can be developed via a GIS database or travel demand model if necessary):

- → Is the site in a CBD or TOD? (Central Business District or Transit-Oriented Development)
- → Employment: Local (within one mile of the project, but not including the project)
- → Employment: Regional (within a 30 minute transit trip including the project)

Information Attainable From Census or Other National Data Sources (but site-specific is always better if available):

- → Average Vehicles Owned Per Dwelling Unit
- → Average Household Size (by dwelling type is best)
- → Jobs per KSF (retail, office, light industrial, manufacturing, warehousing, misc. uses)
- → Jobs per Unit (hotel room, movie screen, student)
- → Trip Purpose Splits (home-based and non-home-based splits per land use type and time period)
- → Average Trip Lengths (external trips from home-based and non-home-based trips. Not needed to compute vehicle trip reduction, but can be used to estimate VMT as a secondary result.)

URBEMIS MODEL

In 2005, Nelson/Nygaard Consulting Associates developed a mitigation component of a model developed for California air quality control districts to calculate the expected air quality impact of development proposals. Recognizing the limitations of relying solely on the published ITE trip generation rates for estimating traffic associated with higher density, mixed-use development, the URBEMIS tool enables trip adjustments to the standard ITE rates—functioning as a 'plug-in' to standard traffic study methodology.

Through a joint effort between the state's air quality control districts and Department of Transportation examining all of the data influencing trip generation, a series of formulas were adopted which provide vehicle trip reductions and related emissions outputs based on key locational, design, and programmatic factors (the majority of which represent the universal "D" variables). **Most importantly, this model provides an opportunity for jurisdictions to "reward" those developments that are located close to transit service, incorporate higher density and use mix, walking and bicycling features, affordable housing, parking management and pricing, transit service discounts, and other TDM programs.** The inclusion of such measures, collectively, can provide significant reductions relative to the base ITE trip generation estimates.

URBEMIS Trip Reduction Components

	Residential (1)	Non-Residential
Physical Measures		
Net Residential Density	Up to 55%	N/A
Mix of Uses	Up to 9%	Up to 9%
Local-Serving Retail	2%	2%
Transit Service	Up to 15%	Up to 15%
Pedestrian/Bicycle Friendliness	Up to 9%	Up to 9%
Physical Measures subtotal	*Up to 90%*	*Up to 35%*
Demand Management and Similar Measures (require specific commitments through development agreement)		
Affordable Housing	Up to 4%	N/A
Parking Supply (2)	N/A	No limit
Parking Pricing/Cash Out	N/A	Up to 25%
Free Transit Passes	25% * reduction for transit service	25% * reduction for transit service
Telecommuting (3)	N/A	No limit
Other TDM Programs	N/A	Up to 2%, plus 10% of the credit for transit and ped/bike friendliness
Demand Management subtotal (4)	*Up to 7.75%*	*Up to 31.65%*

Notes:
(1) For residential uses, the percentage reductions shown apply to the ITE average trip generation rate for single-family detached housing. For other residential land use types, some level of these mitigation measures is implicit in ITE average trip generation rates, and the percentage reduction will be lower.
(2) Only if greater than sum of other trip reduction measures.
(3) Not additive with other trip reduction measures.
(4) Excluding credits for parking supply and telecommuting, which have no limits.

The trip reduction measures represent operational mitigation components of the larger URBEMIS model, which can be used to calculate expected air quality impacts nationwide. The model is currently in widespread use by air quality districts and other planning agencies in California and other states. While the URBEMIS software package includes the ability to also provide construction and area source emissions data, the operational mitigation components and related equations can be included as a separate worksheet directly linked with a jurisdiction's standard trip generation and internal capture spreadsheet. The key factors for trip reduction capture the environmental setting, or the character of the surrounding neighborhood, and those measures added by the proposed development.

The recommended area of analysis includes a ½ mile radius surrounding the project or the entire project area, whichever is larger. The analysis is suitable for a variety of locations and development typologies ranging from smaller, infill projects to larger, multi-use projects. The following table summarizes the available URBEMIS mitigation measures and possible trip reduction percentages for both residential and non-residential sites. The key "D" characteristics include net residential density, diversity or mix of uses, level of transit service and bicycle and pedestrian friendliness. In addition, the presence of local serving retail ("destinations") is also important as it represents a determining factor in the choice to drive off site or walk or bike or use transit for services and accounts for the overall jobs-population balance.

Physical Measures

As mentioned, high net residential density provides one of the strongest correlations with reduced automobile use. **The density formula provides the greatest weight among each of the physical variables** in terms of trip reduction. Projects with higher household densities are provided a greater trip reduction percentage than those with lower densities.

The mix of uses/local serving retail components are designed to capture the possible availability of services within a ½ mile walking distance of the site, based upon an ideal jobs-housing balance of 1.5 jobs per household.

An index of transit service is also calculated via a formula that is designed to capture the amount (frequency and service span) and quality of transit service (speed) factors which generally predict the degree of ridership. While a greater weight is given to rail or dedicated shuttle service modes within ½ mile of a site, the frequency of bus service within ¼ mile of the site is also included.

"Ideal" Land Use Mixing

Conventional zoning practices and the dependency on automobile travel have contributed to the largely segregated activities within the urban realm. The blend of non-residential and residential uses locates trip attractions within a more comfortable walking distance of homes and is an almost necessary precondition for walkability and active, pedestrian streets. "People are also more likely to walk when there are specific and nearby places to go," as Christopher Alexander puts it in his seminal work, "A Pattern Language".

There are many views on what makes an "ideal" land use mix. As a general rule the following breakdown is a good starting point and has been shown to be particularly supportive of transit and TOD development:

Housing: 20-60%
Commercial/Offices: 30-70%
Public/Open Space: 5-15%

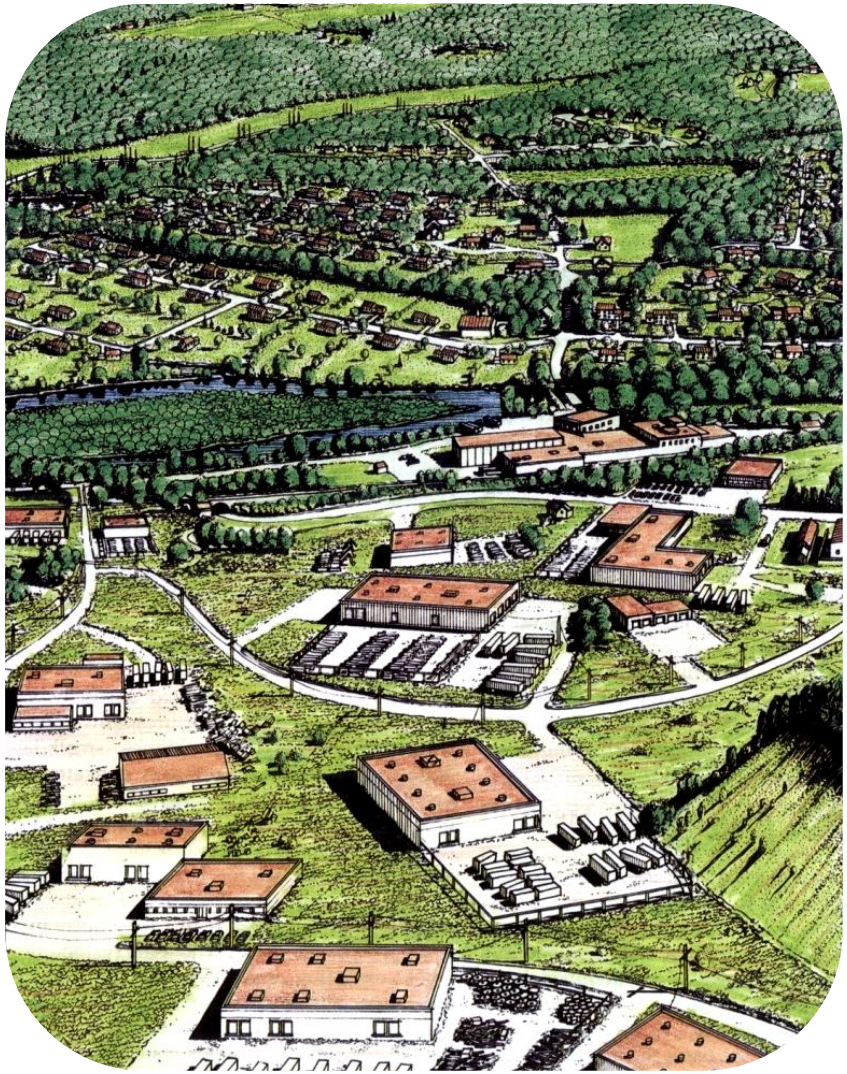
Finally, the bicycle/pedestrian service index is based upon three important variables including: intersection density (a measure of street connectivity), sidewalk completeness, and bicycle network completeness. Trip deductions of up to 9 percent are available with this measure assuming an intersection density of 1,300 legs per square mile (roughly a dense grid network with four way intersections every 300 feet). While other factors such as motor vehicle volumes and speed, roadway widths, urban design, and the extent of separation between pedestrians and vehicles are also significant factors, the inputs required for such would overcomplicate data collection and may dramatically change following development or occupancy.

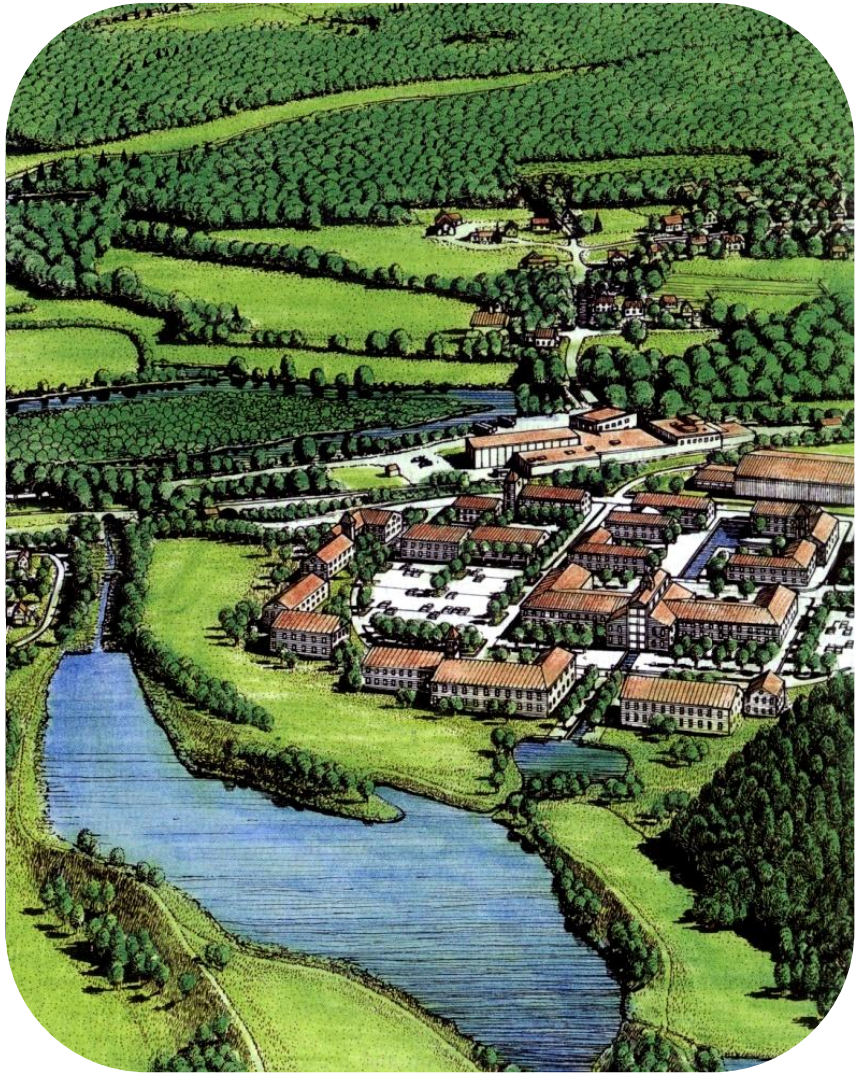
The URBEMIS tool provides maximum possible values for each of the physical design measures. To achieve the maximum reduction, for example, a development would typically need to be constructed at 160 units per acre, include the maximum level of transit service, the best possible use mix and local-serving retail, and have a bicycle/pedestrian factor equivalent to complete sidewalk and bicycle lane coverage within a compact grid of blocks no longer than 300 feet per side. This would result in an 81 percent reduction from the average single-family home trip rate. While the spreadsheet formulas associated with the design and density variables enable a possible 90 percent reduction, such an outcome would only be possible with densities nearing 380 units per acre, three times the average density of San Francisco's Chinatown, for example.

Density Considerations

In some cases, the residential densities of particular projects being evaluated may be so low that the URBEMIS-based spreadsheet model will result in a negative trip reduction percentage. In such instances, it is advisable to adjust the trip adjustment calculation to zero out the result if negative so that trips are not added to a project's net daily external trip estimation. The customary internal capture, pass-by, and/or diverted link adjustments may still be applied to such projects, but would not receive any of the trip credits as a result of the physical design and density measures.

Recognizing the impact of density on trip reduction outcomes, proposed residential projects in suburban and rural areas that typically represent low density, single-family subdivisions with segregated outparcels of commercial/retail are likely to receive little if any credits. In such scenarios, projects should consider clustering their development plans around neighborhood commercial centers and providing additional open space or conservation easements. This could enable projects on large tracts of land which are preserving vast portions of property to open space to have this acreage removed from the density calculation. This would greatly increase the opportunity for design credits. For example if a project that consists of 5,000 acres proposes to incorporate higher density, mixed use villages over only 2,500 acres, with the remaining as dedicated open space, this amount should be removed from the units/acre denominator.





The above left concept illustrates conventional suburban design on a large, greenfield site. By contrast, the use of creative development and clustering of the same number of units and non-residential square footage on the same site can result in greater internal trip capture while also preserving community character and valuable open space. (Courtesy of Randall Arendt's "Rural By Design—Maintaining Small Town Character")

Other Demand Management or Similar Measures

The tool also permits additional, discretionary trip reduction measures such as the inclusion of affordable housing, the amount of free/priced parking, availability of transit passes, or other transportation demand management programs. As discussed previously, parking pricing can exert a tremendous influence on vehicle trips (in many cases yielding 10 to 30 percent reductions) depending on the amount charged. Parking cash out and "unbundled" parking programs are other effective tools that can encourage transit use and expand mobility options. These can also minimize the amount of land area that would otherwise be devoted to parking based on typical ratio requirements. The only valid and measurable way, however, for these to be included as variables within the scope of a trip reduction program would be to adopt some sort of legally-binding development agreement with a jurisdiction at least prior to issuance of Certificate of Occupancy (COA). Since TDM is fundamentally programmatic and relies largely on voluntary participation, a binding agreement would serve to guarantee that such measures would be implemented by the developer.

Selected Approach

The City of Jacksonville's 2030 Mobility Plan references the use of a "trip reduction adjustment procedure" as a means to reduce a development's mobility fee, provided the development meets specific design and location criteria to support both alternative transportation use and reduced vehicle miles traveled. The transportation element of the City's Comprehensive Plan also includes specific policies that support trip reduction assessments, particularly the establishment of non-motorized transportation and transit-based networks throughout the City as well as pedestrian-oriented design elements as per the Downtown Master Plan.

The basic principles of the mobility fee and supporting credit/adjustment system are designed to support a variety of transportation modes; reduce VMT and generated vehicle emissions; promote compact and interconnected land development form; and improve the health and quality of life for the City's residents.

As discussed, the fee system also provides a unique opportunity for the City to implement the mobility-related Guiding Principles established by the adopted Vision Plans, while encouraging developers to capitalize on the benefits of infill and redevelopment at specific locations identified in the Plans.

The URBEMIS model captures the most effective design principles which have been shown to influence mobility choices, but is also flexible enough so as to not circumvent the City's established trip generation and internal capture methodologies. Rather the tool adds depth to the City's procedures, providing a "super internal capture" element to the final trip estimation that would more objectively account for the effects of the surrounding neighborhood and proposed development characteristics.

The City's mobility fee approach is designed to capture the relationship between location and VMT. Part of this framework includes the establishment of Development Areas (as shown in the following "Mobility Fee Development Areas" Map) with corresponding average trip lengths. There are five Development Areas which represent the general spectrum of the built environment of the City from higher densities in the Downtown core to the lower density outer suburban and rural areas towards the edge of the City's limits. The average VMT of each development area is shown on the following:

Development Area	Average Trip Lengths (VMT)
1) Downtown Development Area	9.09
2) Urban Priority Area	9.24
3) Urban Development Area	9.46
4) Suburban Development Area	10.28
5) Rural Development Area	12.27

A fixed, City-wide cost per VMT has been established as a part of the fee formula. This cost was determined based upon the calculated growth of VMT between 2010 and 2030 as a denominator of the estimated City-wide transportation and mobility infrastructure project needs identified in the Mobility Plan. Based upon the current estimate of transportation projects, this cost is $24.31.

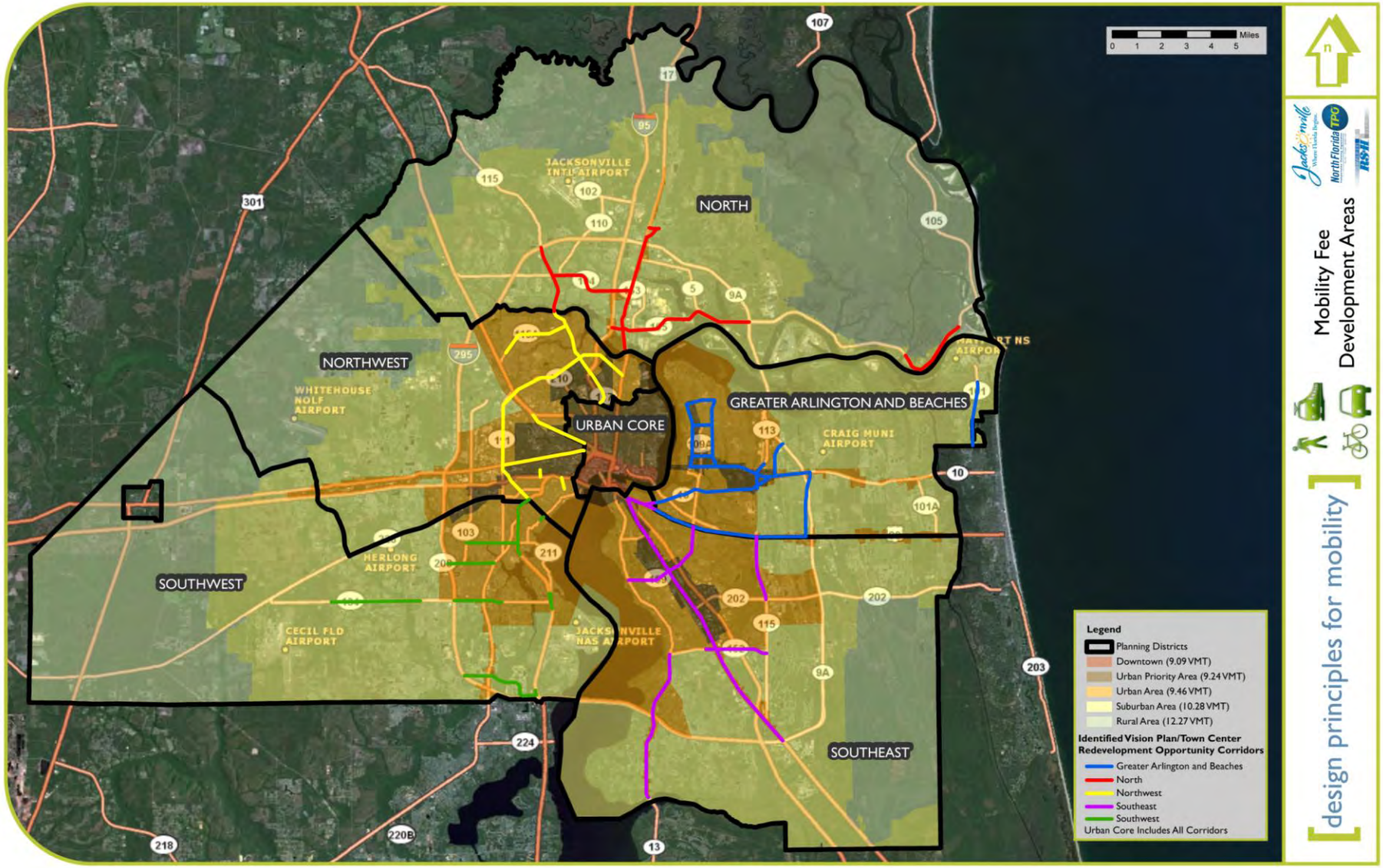
It is expected that every five years the Plan and component cost per VMT will be adjusted to reflect updated transportation improvement needs and costs and/or changes in VMT.

The base, quantitative formula, for the purposes of estimating a developer's mobility fee for the transportation impacts generated by a proposed development, equals:

→ the cost per vehicle miles traveled (A); multiplied by the average trip lengths (VMT) per development area (B); multiplied by the daily trips generated by the proposed development (C); subtracted by the trip reduction adjustments (as calculated by the URBEMIS-based spreadsheet tool, for example) assessed to the proposed development, such that:

Mobility Fee Formula=A x B x (C – *trip reduction adjustments*)

The following section "Application of Principles to Development Typologies" provides sample calculations for a number of development typologies.


Mobility Fee
Development Areas
design principles for mobility
NORTH
NORTHWEST
SOUTHWEST
SOUTHEAST
URBAN CORE
GREATER ARLINGTON AND BEACHES
JACKSONVILLE INTL AIRPORT
WHITEHOUSE NOLF AIRPORT
HERLONG AIRPORT
CECIL FLD AIRPORT
JACKSONVILLE NAS AIRPORT
CRAIG MUNI AIRPORT
Miles
0 1 2 3 4 5
Legend
Planning Districts
Downtown (9.09 VMT)
Urban Priority Area (9.24 VMT)
Urban Area (9.46 VMT)
Suburban Area (10.28 VMT)
Rural Area (12.27 VMT)
Identified Vision Plan/Town Center Redevelopment Opportunity Corridors
Greater Arlington and Beaches
North
Northwest
Southeast
Southwest
Urban Core Includes All Corridors

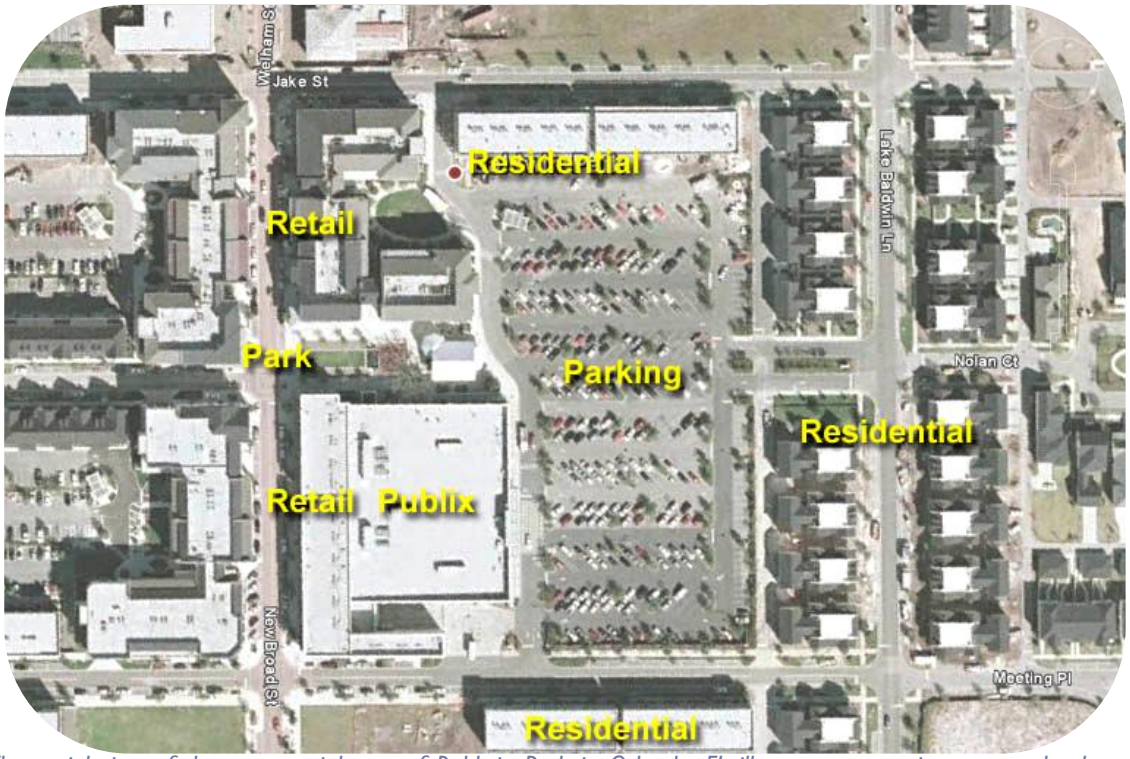
The Credit Framework

In addition to the standard internal capture, pass-by, and/or diverted trips that are subtracted from a development's gross daily trip estimation, the design-based variables of the URBEMIS model serve as the additional layer of possible trip reduction adjustments. An adjustment may also be credited to the gross daily trip estimation in order to account for the number of trips associated with an existing use. The City presently provides credit for the number of trips associated with existing or historic uses (such as previous uses located on vacant or abandoned sites) in the context of redevelopment.

In addition, a TDM credit can also be applied at the discretion of the City. This percentage reduction is contingent upon the proposed demand management program to be implemented by the developer.

Based upon the case study review provided in this section, a range of 5 to 30 percent is recommended, with the higher reductions based upon the combination of features such as priced parking, employee cash out options, and/or formal commute trip reduction programs established through a development agreement.

For example, if a developer proposed a new mixed-use project on an existing commercial strip or office location, the developer would be credited the amount of daily trips associated with the existing use. The developer would thereby only be subject to paying a fee associated with the trips that are above and beyond what the existing use generated. If the developer also proposes a formal commute trip reduction or other approved TDM option, a credit associated with such program will also be applied. In terms of the entitlement benefits of redevelopment, the combination of these credits along with the URBEMIS-based trip adjustments could result in a scenario under which no mobility fees are imposed to the developer. Section 3 tests a number of scenarios using these procedures to illustrate the potential costs associated with different development typologies and locations.



The aerial view of the commercial core of Baldwin Park in Orlando, FL illustrates a creative way to develop a mixed use site and potentially maximize trip reduction credits. While free parking is present, it is hidden behind building liners that are oriented against the street to create enclosure and foster walkablility. The uses are directly and safely accessible, by foot or bicycle, to a variety of residential types and densities.

Notably, the average VMT of each development area within the fee formula represents a type of credit or incentive in and of itself. As such, proposed development that is within or in proximity to Urban and Downtown Areas that generates less VMT would potentially be assessed a reduced mobility fee

(depending on the use) comparable to what might be assessed if located in the Suburban or Rural Areas (with higher VMT). This approach captures the intent of location efficiency, serving to reward development that is located in desirable locations with existing infrastructure.

As is the case with ensuring that potential TDM measures are fully implemented to receive trip reduction credits, a development agreement may also need to be drafted to provide surety with respect to adjustments associated with density and/or employment, for example. Such an agreement may include provisions for periodic site plan review or employment verification after issuance of Certificate of Occupancy (COA) to make certain that credits were applied appropriately.

Mobility Credit Banking System

In particular cases of redevelopment, the combination of the number of vehicle trips associated with an existing or historical use, high internal capture, and the URBEMIS-based trip reduction and/or TDM credits may result in a net surplus of daily external trips. Such instances are more likely to occur with high density, mixed-use redevelopment proposed on sites that are currently generating an equal or higher number of vehicle trips, such as shopping centers or other auto-oriented uses. These results illustrate how the "D" variables of the URBEMIS model work to provide a greater amount of credits to such projects. The advantage in these cases is twofold:

One, it clearly provides a fiscal incentive to explore the right location for infill and redevelopment and two, it reinforces the City's Vision Plan Guiding Principles and overall sound planning objectives. As such, the real potential for a market-based incentive to redevelopment could result.

It is clear that certain locations and development typologies will likely have greater opportunities than others for surplus outcomes. In this respect, development areas and mobility zones that are benefiting from catalyst redevelopment as a result surplus trip opportunities should not be able to transfer potential surplus trips to other zones for financial benefit. For example, this would avoid projects in remote Suburban or Rural Development areas which do not incorporate the appropriate design and density elements to benefit from surplus trips associated with projects and locations in other zones which do demonstrate recommended design practices in order to offset their mobility fee costs. This procedure will also better ensure that mobility fees generated in the area can be spent on capital improvement projects that are directly related to the impacts of the corresponding development activity and continue to further redevelopment incentives.

Chapter 655 of the City's Ordinance Code, "Concurrency and Mobility Management System", outlines the procedure for credits associated with trip reduction adjustments. For capital improvement project consistency and rational nexus purposes, any surplus trips shall be transferred only between projects within the same development area and same mobility zone. The potential transfer of these surplus trips to another project within the same development area and mobility zone will occur at the time a potential recipient project enters into a new Mobility Fee Contract. This contract memorializes an agreement between the City and landowner regarding the arrangement of credits and/or payment schedule for a phased development pattern.

Marketing and Monitoring Vehicle Trip Reduction

The City's mobility fee and credit framework, as a replacement for the complex and often "unfair" fair-share concurrency system, offers a more transparent and easily understood methodology in the context of the entitlement process. More importantly, it provides a means to fund and support multimodal travel.

While it exists as one component of the overall concurrency system, (i.e. parks and recreation/water/sewer/schools, etc.) it presents the Planning and Development Department with a unique opportunity to begin to develop and market an overall Vehicle/Commute Trip Reduction Program. Such an initiative would work to encourage more efficient commute travel throughout the City, providing commuters resources and incentives to use alternative modes. The program would also directly support the mobility fee credit system, by encouraging awareness of walking, bicycling, transit use, and other TDM strategies that may indirectly encourage redevelopment activities.

In addition, recognizing that impact fees are often viewed negatively by the market as a regulatory barrier to development, actively promoting the benefits of such a program and the incentives available in a collaborative manner may reduce such negative perceptions and/or eliminate the adversarial environment that can characterize development approval processes. An important part of this strategy includes the development of partnerships, with public and private entities, to develop a range of tools and demonstrate leadership to foster buy-in.

The development of such programs that can be feasibly adopted by private businesses, such as telecommuting or parking management, will also provide the opportunity to establish additional mobility fee credits (i.e., Demand Management Measures). Specific strategies that warrant consideration through partnering with agencies and businesses include:

- → Dissemination and periodic updating of information on all available transit services to and from the worksite
- → Advertising, promoting and making available for purchase on the worksite any programs offered by transit authorities
- → Use of social media such as Facebook to promote and create awareness of program
- → Employer sponsored shuttle service to transit stops
- → Recommendations to individual employees of employee-specific travel options to reduce VMT
- → Incentives and assistance for bicycle commuting including secure parking facilities, shower/changing facilities, and education and training programs
- → Coordinating, facilitating and providing subsidies for employer-sponsored rideshare programs
- → Preferential parking for carpools and vanpools
- → Employer-paid transit/vanpool programs where the employer provides at least $30 per month, for example, in benefits or the full value of commuting costs
- → Expanding opportunities for alternative work schedules including telecommuting, compressed work weeks and/or flexible schedules to facilitate ridesharing
- → Elimination or reduction of parking subsidies for single-occupant vehicles
- → Parking "Cash Outs"

While formal adoption of such a program is not required, implementation of such would positively contribute to the City's goals and objectives supporting a reduction in VMT and related emissions through the use of alternative transportation mobility options.

In recent years there has been an emphasis in performance-based planning for the purpose of demonstrating measurable outcomes of policy initiatives. The monitoring and evaluation of the mobility fee program represents a valuable and necessary step to ensure effective performance.

According to the adopted Mobility Plan, the Planning and Development Department will conduct review and analysis of the Plan every five years, assessing the impact of mobility-related strategies and multimodal improvements to ensure positive Plan outcomes. This includes, but is not limited to, reduced VMT, increased accessibility, the mitigation of multiple transportation deficiencies, and the promotion of sustainable development. Such review will assist in the establishment of priorities and ranking of projects while also supporting future land use element goals and objectives. The mobility fee credit system and related components provides the City with additional tools to effectively monitor the short and long-term influence of design and programmatic impacts on mobility, as well as the placemaking and the quality of life elements that are most important to a community.

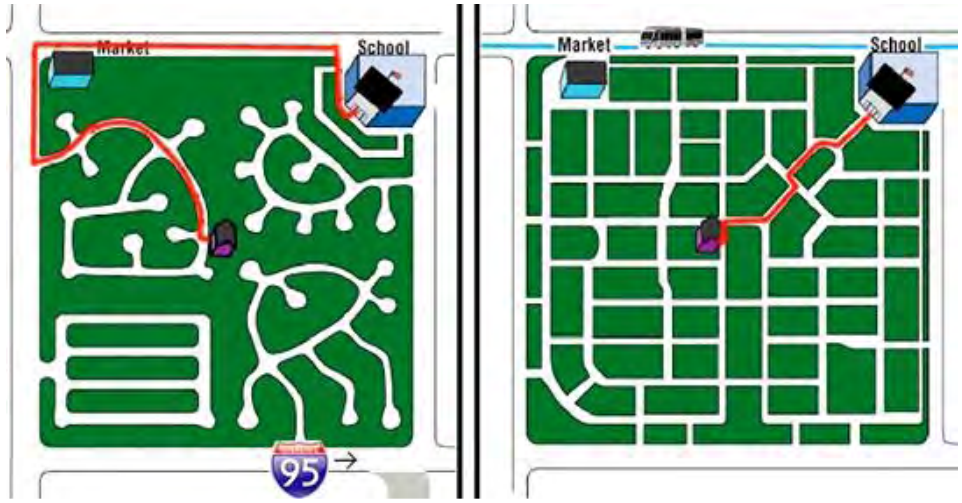
Streets, Blocks and Buildings

While the previous practices and case studies provide substantial evidence linking design and density to reduced vehicle travel, it can really be simplified into those historic lessons of the past and starting with the streets! Central to placemaking, and particularly walkability, is the simple assembly of streets, blocks, and buildings. These elements of the urban environment are perhaps the most deterministic of real choice and experience of mobility—namely providing a safe and comfortable option to travel via foot, bicycle, and/or transit. In other words, how each of these are collectively scaled and configured will also determine the extent of both mobility support and credit maximization that results in a substantial mobility fee reduction.

The following section outlines many of the general principles of streets, blocks, and buildings (reinforcing the relationship between public and private spaces) that can work to increase development incentives and most importantly, the sense of place and quality of the built environment.

STREETS

Streets, in recent decades, have been designed as spaces to ***move through***, rather than places to purposefully ***come to***. The street should not be seen as a dividing line among communities, but rather places and passageways facilitating economic and social interactions, along with providing a means to travel. In this sense, the street can provide a better balance among users of all modes. As the "bones" of our communities, streets have the tremendous capacity to support development activity that is mixed, interconnected, and likewise supportive of enhanced mobility: Simple elements such as the ***patterns, hierarchy, configuration, and detail*** of streets often determine how walkable or bicycle-friendly a given place may be. A single street should be part of a larger street network



The above graphic illustrates contrasting approaches to connectivity and mobility support. The left scenario is generally not conducive to walking or bicycling, as one is forced to use the higher speed arterial to access school or shopping opportunities. The left also increases vehicular congestion on the arterial network as there are minimal access and egress points.

that is well-connected and supports continuity of movement within the overall network to encourage concentrated activity centers and mixing of uses.

Streets are also generally classified according to the volumes of vehicles. This approach works against the creation of transit-supportive, walkable places because the resulting design of such facilities favors larger rights-of-way and higher speed limits. In this sense, the land use context should be determined first followed by street design in order to better accommodate all forms of mobility. Vertical elements, including buildings and landscaping and other elements influence the character and scale of streets, including the speed of traffic. Right-of-way widths should be proportionally related to the adjacent building heights and the numbers of lanes balance vehicle flow and pedestrian crossing considerations.

Ultimately, to ensure that streets encourage multimodal use, some of the major guiding principles in design include:

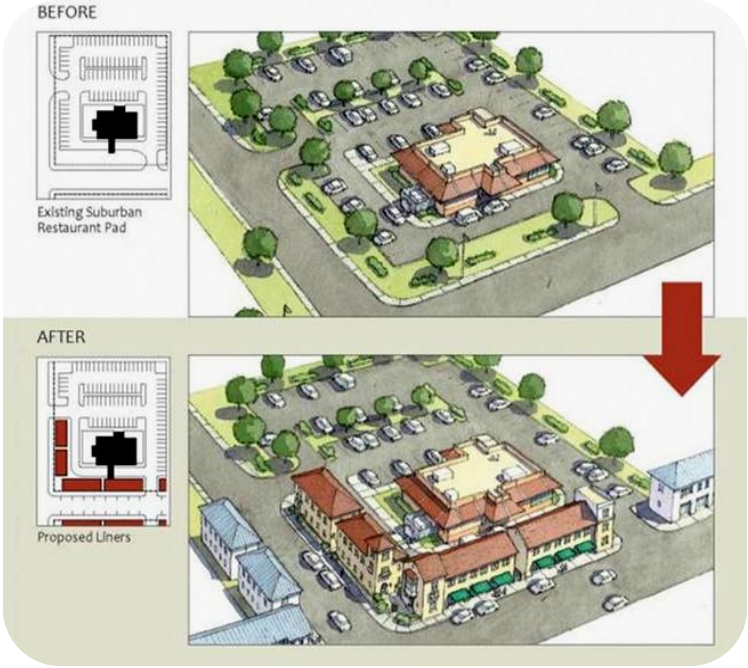
- → Minimized block radii to slow cars down at intersections and allow pedestrians to cross streets relatively quickly;
- → Landscaped medians to reduce the apparent width of streets; (allow for pedestrian refuge)
- → Two-way (versus one-way) streets that improve pedestrian crossing safety;
- → Reduced lane widths to, for example, 10 or 11 feet;
- → Street vehicle speeds that are compatible with adjacent uses, such as 25 to 30 mph (or better yet, establish design speeds equal to posted speeds);
- → Removal of "free" right-turn lane slips, unless a refuge island is available;
- → Properly designed curbs and sidewalks at intersections that accommodate the impaired;
- → On-street parking to protect pedestrians from the actual and perceived danger of moving traffic;
- → Conceiving the street corridor as a center of activity rather than a barrier to activities on either side
- → Adoption of a Complete Streets or Context-Sensitive Design Policy

BLOCKS

The traditional block provides the nexus between the building fabric and the public realm of cities. Block size and configuration also plays a tremendous role in facilitating walkability and when designed at the appropriate scale, provides for a mutually beneficial relationship between people and vehicles within an urban space. The shorter the length of a block, (ideally 250 to 500 feet) the more pedestrian-friendly a place is generally. A grid of relatively short blocks also allows single buildings to easily reach the edges of blocks at a variety of densities and directs parking to be located away from the sidewalk to the street. City blocks also define the community's fabric and character. A rectangular or square block can accommodate a variety of lot widths and depths, which influences the range of building types and densities. The longer and more irregular the block, the less likely that the building envelope will be close enough to the setback line to define any sense of enclosure which would serve to calm traffic and increase pedestrian and bicycle mobility. Finally, regularly planted trees along blocks establish the overall rhythm and scale of the street as well as that of the sidewalk. Landscaping attributes along blocks affect light, temperature, and views, which ultimately contribute to an individual's experience of place—and whether walking is a comfortable and safe option.

BUILDINGS

Buildings fundamentally express the importance of our public shared institutions and improving the daily working and home life of a community. For all practical and symbolic purposes, they represent the permanent fixtures in the landscape and the city. A building's configuration and placement on a lot and its relationship to other buildings and the street not only determines the character of a particular site or settlement, but also greatly influences the degree of balanced, safe, and comfortable mobility. While *use*, to a minor degree, plays a role in determining the nature of access and whether it is safe for walking or bicycling (i.e. a large, truck-dependent warehousing facility with direct connection to a major highway), this element has regrettably outweighed the importance of design and form. It has also been the driving force

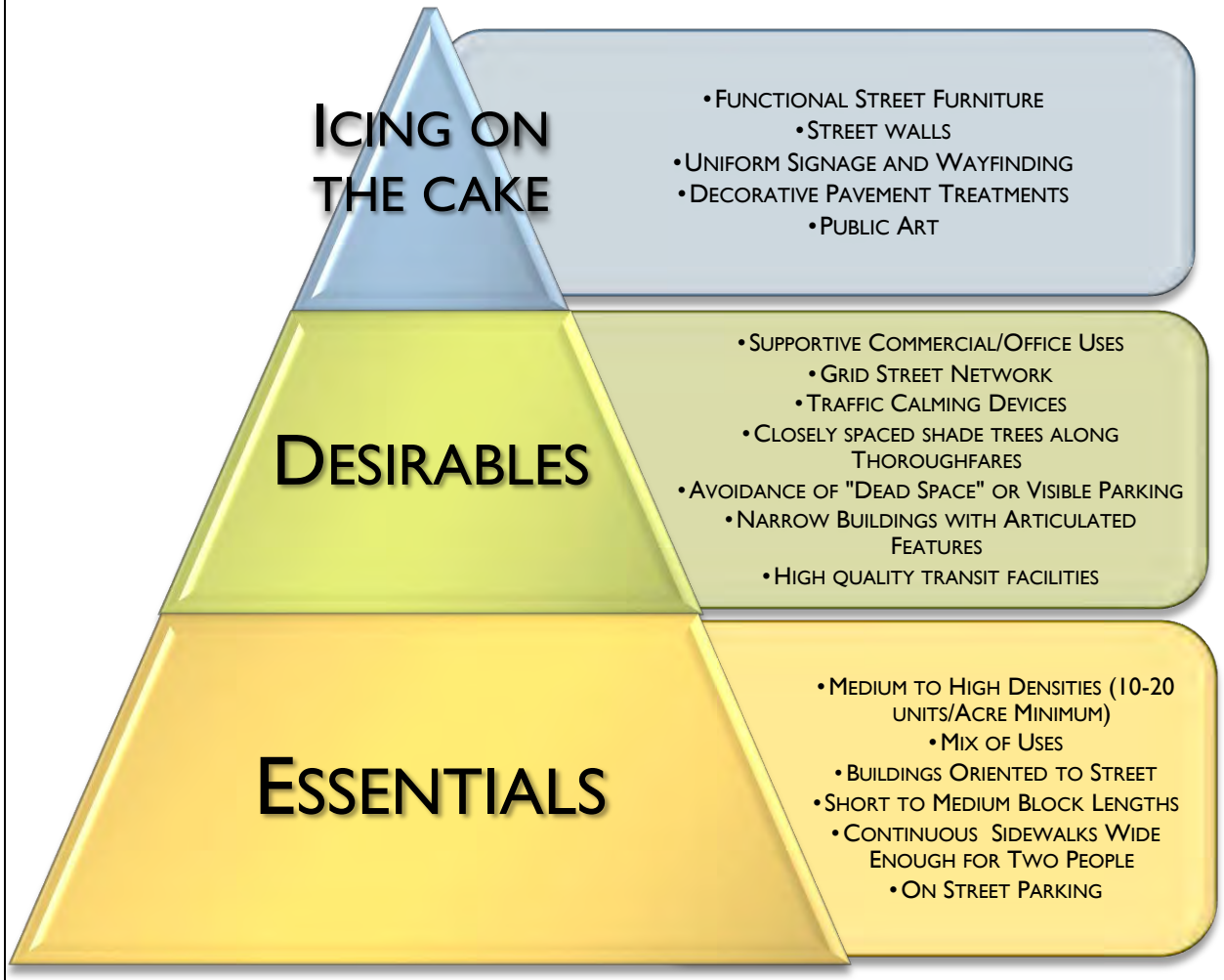


Adding proposed building liners to the existing, parking-dominated outparcel functions to create a more pedestrian-oriented environment and provides valuable character and sense of place to a community.

behind most zoning and land development regulations. This has resulted in fragmentation and disconnection of parts of a city or community from each other. By contrast, buildings designed and organized by reference to their type and not solely their function, employing common architectural features, will enable adaptive changes in use over time without compromising form and making them obsolete. ***Density*** and ***form*** of buildings should prioritize neighborhood and/or district context, emphasizing predictable and physical outcomes versus abstract standards and floor area ratios (FAR) which favor buildings as exclusive and singular objects.

There is also a mutual dependence between the built form and the landscape form. The relationship of buildings to the street and public realm is reciprocal. The extent of building frontage to the public realm emphasizes the character of streets and open spaces within a block and greatly influences the mode and volume of travel.

In the context of the City's Mobility Plan and Fee system, how a developer approaches a particular site in light of these considerations can greatly influence both mobility and entitlement outcomes. For example, a developer may decide to redevelop an existing, underutilized, strip shopping center in an area of established neighborhoods served by well-connected sidewalks and transit service. A site plan proposal could replace much of the vacant existing parking lot with new street and block interventions to accommodate higher density, mixed-use buildings. The plan could also incorporate greater connectivity to adjacent centers and the neighborhood via multi-use paths; the numerous existing curb cuts along the adjacent arterial may be replaced by safer and efficient shared access points; the buildings may be designed to front the newly constructed blocks establishing a greater sense of arrival and enclosure. Each of these new design attributes can work to increase mobility, achieving desired community planning goals, and may substantially reduce transportation-related exactions.



Within the appropriate assembly of buildings, blocks, and streets, this pyramid illustrates a hierarchy of mobility-friendly urban design features from the most basic elements fostering walkability and transit use, to those that represent nice additions.

The following series (Courtesy of Steve Price) shows the transition of an arterial roadway "tamed" by traffic calming techniques, including a "road diet," (reduction or conversion of traffic lanes for safety and aesthetics) as well as other urban design strategies embodying the "Streets, Blocks, and Buildings" principles creating a more walkable, livable, mobility-friendly environment.

The existing automobile- driven "Main Street" is improved with public investments in sidewalk and access management improvements, raised medians, landscaping and lighting to calm traffic and begin to create enclosure and a sense of place.

*Private buildings and investment follow the public improvements with increased densities and diversity of uses oriented to the street. The improved street and block elements create a "**come to**" versus "**move through**" environment. This better supports a balanced mobility system that accommodates bicyclists, pedestrians, and vehicle traffic.*

1. Existing Conditions

This example of before and after photos illustrates the transformation of an existing, underperforming shopping center, or "greyfield" location into a new, walkable, main street.

The existing auto-oriented shopping center is improved with a combination of mixed-use, multi-story redevelopment and landscaping, lighting, and on-street parking. The proposed "street intervention" within the existing parking lot establishes the framework from which to create the mobility-supportive environment.

2. New Infill Mixed-Use Development and Streetscaping on Existing Parking Lot

3. Further Infill Development

The initial improvements catalyze additional infill development along the adjacent blocks, with increased densities and diversity of uses oriented to the street. The replacement of the existing big box stores on the right with sidewalk-oriented mixed use development provides a great example of how a developer can also achieve additional density-based mobility fee credits

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Application of Principles to Development Typologies

Development Place Types and Locations

The previous section offered a range of approaches that have been shown to provide vehicle trip reductions. The physical design measures and corresponding equations within the URBEMIS model provides a user-friendly trip reduction framework that can easily be linked to the City of Jacksonville's current trip generation and internal capture methodologies. To illustrate the value of the system to the development community and local planning agencies, this section will explore a number of locations and place typologies throughout the City to determine the effects of the design variables and location-efficiencies (as measured by the average trip lengths per Development Areas) on vehicle trips and resulting mobility fees. Place typologies are a useful way to describe the scale and character of different development patterns, be they various forms of residential neighborhoods or shopping centers. Typologies

The urban-to-rural transect provides an alternative means to organize and develop land according to context and generally emphasizes the importance of form and connectivity over use

can also be used to describe the scale and type of development at an even higher level such as the corridor or district. As it relates to mixed use development, typologies can provide a common language for decision-making in the context of development outcomes. This approach enables a wider audience to understand key development decision points related to idealized scenarios and real-life places within their community at the same time. The urban-to-rural transect has become a practical tool to illustrate planning and street design, recognizing that there may be a range of development scales, uses, and forms depending on the local and regional land use context and the transportation modes, service and accessibility.

In the context of the City's Development Areas, a basic range of place types that describe the general scale and character of the variety of development patterns within the City can be best categorized according to the following categories beginning on page 34. Recognizing that there is no "one size fits all" approach to Smart Growth that can be uniformly applied to all areas, these categories are broad enough to capture the numerous forms and assembly of commercial, office, residential, industrial and/or mixed-use development that may be suitable within each:

Portland's TOD Station Area Typologies

Not all markets in a region, no matter how many cool looking plans have been created, are ready for more urban types of development. Portland's approach shows what types of investments are suitable for the different types of places that exist in their region. Every place is ready for some type of investment, but doing a specific plan for each one could be time consuming and result in lot of money spent needlessly. By mapping urban form and transit orientation against the market strength of a transit district, a typology of place and investment types emerges. The value of this plan is to show where investments should be targeted that will actually move the market in the right direction.
Courtesy of Reconnecting America: People, Places, Possibility.

→ ***Metropolitan Centers (Downtown Development Area)***: The Central Business District (CBD), or the region's primary business, civic, commercial, and cultural centers, such as Downtown Jacksonville. These areas usually consist of mid to high-rise residential, office, and commercial buildings, with high levels of concentrated employment and numerous transportation services and/or hubs. The areas also draw heavily from throughout and beyond a particular region's borders.

→ ***Urban/Town Centers (Urban Priority/Urban Development Areas)***: Characterized as a major, sub-regional business, civic, commercial, and cultural centers, such as Southpoint or the St. Johns Town Center, for example. Other potential, transit-oriented sites, such as large, older, underutilized shopping centers (i.e., Town and Country/Regency Square Shopping Malls) that could be redeveloped at a scale to accommodate greater intensities and regional demand may also be included. Building types represented often include low to mid-rise residential, office, and commercial. The areas typically have medium to high levels of professional and service employment that draws from both the immediate area and throughout the region. Like Metropolitan centers, such areas could support high frequency corridor and transit lines (such as Bus Rapid Transit or Commuter Rail Service) and related TOD development, but are typically served by high frequency local bus and shuttle service.

→ ***Community/Neighborhood Centers (Urban/Suburban Development Areas)***: Such areas are generally inclusive of low-rise residential, office, and commercial buildings. Housing and neighborhoods are generally within walking or biking distance to transit stops, typically served by local bus service. In Jacksonville, such areas are typically auto-oriented and include strip shopping centers with outparcels and/or smaller office and commercial employment that draws from nearby communities and neighborhoods. However, mixed-use sites such as Tapestry Park, which exhibit transit-supportive design features for new development, are also represented.

→ ***Rural Villages (Rural Development Area):*** These are communities typically located in the outer suburban or rural areas that consist of largely residential (single-family) and limited low-rise employment buildings that draw from nearby rural/suburban areas. They may have a concentrated local road network that supports a "main street" village, with increased density and mix of building types that could support local transit service. Such areas in Jacksonville may include the Dinsmore or Bayard areas or the ICI Rural Village Planned Unit Development.

→ ***Special Use Centers (All Development Areas)***: Generally consist of dedicated employment areas consisting of medical, educational, or industrial-based facilities, including a variety of low, mid, or high rise buildings. They are typically characterized by one type of non-residential land use that draws from throughout a region or sub-region. The Jacksonville International Airport and nearby distribution centers, University of North Florida, and Baptist Medical Center Complex, represent such place types.

Other typologies can be used to describe the range of development patterns at a smaller scale. This is designed to illustrate the assembly and form of particular uses such as single family neighborhoods or shopping centers within a particular area or district. Depending on the development area context there may be a variety of shopping types potentially represented where the design and user experience is reflective of the mobility context. For example, most of the conventional shopping centers in suburban areas are typically single-use, commercial strips with or without outparcels dominated by free and abundant parking. The design and accessibility of such uses mutually support the automobile as the main mode of transportation. Other modes such as walking or transit are possible, but not generally supported, given the lack of density, distances to other uses, and the infrastructure designed to support vehicle traffic.

Shopping place types such as the more urbanist **Tapestry Park** or **Riverside Market Square Publix Plaza** still support vehicle accessibility and parking but are designed at a more "human scale" with walkable and transit-oriented densities and greater mix of uses to create a balanced mobility environment. The graphics beginning on page 36 illustrates a range of shopping center typologies within Jacksonville from single-use, auto-oriented sites to more walkable locations and designs.

While *placemaking* is a vital part of enhancing mobility, keep in mind that not every place is a "Place". In many districts and neighborhoods within the City it may be quite obvious to tell what building types and forms are appropriate, but there are other areas where it's less clear what "form" is evident. Such areas may include large acreages of parcels in non-prime suburban locations, low density industrial zones, as well as environmentally-constrained redevelopment sites. Within many of these locations there is little or no surrounding context where an existing fabric is discernable and where a spectrum of future possible forms exists.

Key elements of city-building and placemaking, including a focus on streets, blocks, paths, edges, nodes, and districts, are quite valuable and also serve as a reminder that not every place within the City deserves equal attention. While the City could decide on and establish a preferred cafeteria of suitable building and place types for these fringe and or non-prime locations, it is not clear that it should. The best strategy may be to apply place type and form standards on those areas with the greatest potential for density, walkability, and transit-oriented development patterns.

Large big box retail and grocery stores can also be redesigned to fit a variety of place types to infuse local or neighborhood context elements and also support balanced mobility outcomes. The Congaree Vista District Publix in Columbia, SC (left), the Riverside Market Square Publix (middle) and the Downtown Orlando Publix (right) show that successful grocery stores can be designed uniquely to fit neighborhoods, with mix of uses, limited surface parking and buildings oriented to the street.

Beach Blvd. Strip center

Conventional, single-use suburban strip center with parking oriented to front and vehicle access generally provided by one or two driveway openings off high speed arterial.

Target Plaza

Larger community or subregional shopping "power center" with outparcels, dominated by free and abundant parking. While such sites are often within walking or biking distance to residential uses, the transportation environment and design speeds do not support the safe access of these modes.

Tapestry Park

Urbanist, mixed-use retail center newly constructed in suburban with angled on-street parking and directly adjacent to multi-family residential units in rear. Directly accessible, by walking or biking to regional employment center.

5 Points

Older, commercial district within comfortable and direct walking distance to established, single and multi-family residential neighborhood

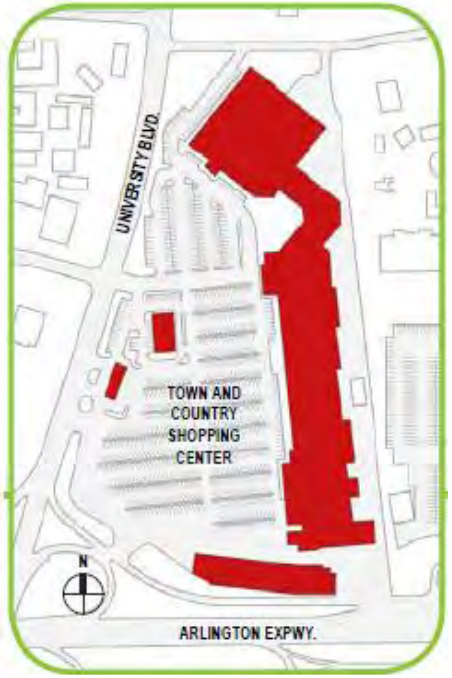
Riverside Market Square

Creative approach to conventional grocery store-anchored shopping center, employing variety of commercial uses adjacent to street and directly accessible to high density residential and transit options.

Downtown (Laura Street)

Downtown retail shopping place type, generally employing greatest amount of density and use mix.

With respect to maximizing potential trip reduction credits, it is expected that the lower-density, single-use sites would receive the lowest percentage reduction in external vehicle trips. The proposed density of a particular site accounts for the greatest impact on the trip reduction outcome, followed by the use mix and the corresponding transit and bicycle and pedestrian environment. The individual test sites in this section represent both hypothetical locations and development pro formas in addition to actual sites that are in various stages of development. This exercise will illustrate the credit differences and corresponding mobility fees that could be expected in light of the influence of the "D" variables.



Town and Country Shopping Center existing footprint (Source: Zyscovich Architects, 2009)

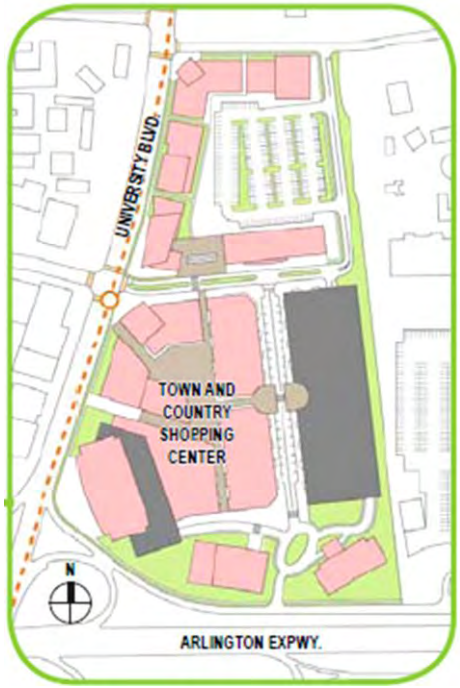
Test Site 1:
Town and Country Shopping Center (Hypothetical Mixed-Use Redevelopment)

Located in the Arlington area at 903 University Boulevard North, the Town and Country Shopping Center was constructed in 1953 as a multi-tenant shopping center. This shopping center currently has over 203,658 square feet of existing retail space on a 19.21 acre parcel. Currently there are three outparcels including a McDonald's restaurant, a BP Gas Station and a Vystar ATM facility.

The property has direct frontage along University Boulevard, and access from the Arlington Expressway to the immediate south. According to available real estate information published in August of 2009, the shopping center is "located with easy access to more than 200,000 residents within 5 miles and has over 106,000 square feet of vacant space ready to lease with occupancy of 48%."

The City of Jacksonville's Vision Plan for Greater Arlington and Beaches prepared by Zyscovich Architects in 2009 has identified the Town and Country Shopping Center as a prime location for redevelopment. The Vision Plan identified the site as ideal for mixed use development, especially given the site's proximity to established neighborhoods and Downtown. The site can provide convenient retail as well as entertaintment for the residents as well as adjacent neighborhoods. The Vision for the redevelopment plan calls for a pedestrian-friendly environment that is connected to adjacent schools and neighborhoods. Along the back edge of the site a parking structure is envisioned to accommodate residents and visitors. A major transit hub serving the development along University Boulevard is also contemplated in the Vision Plan. The images to the left and right illustrate the existing footprint and how the site could be potentially redeveloped transforming an underutilized shopping center into a true urban gateway into the District.

The redevelopment plan illustrated for the existing Town and Country Shopping Center also strongly supports the the City's Vision Plan Guiding Principles as specifically referenced in the *Greater Arlington/Beaches Vision Plan*.



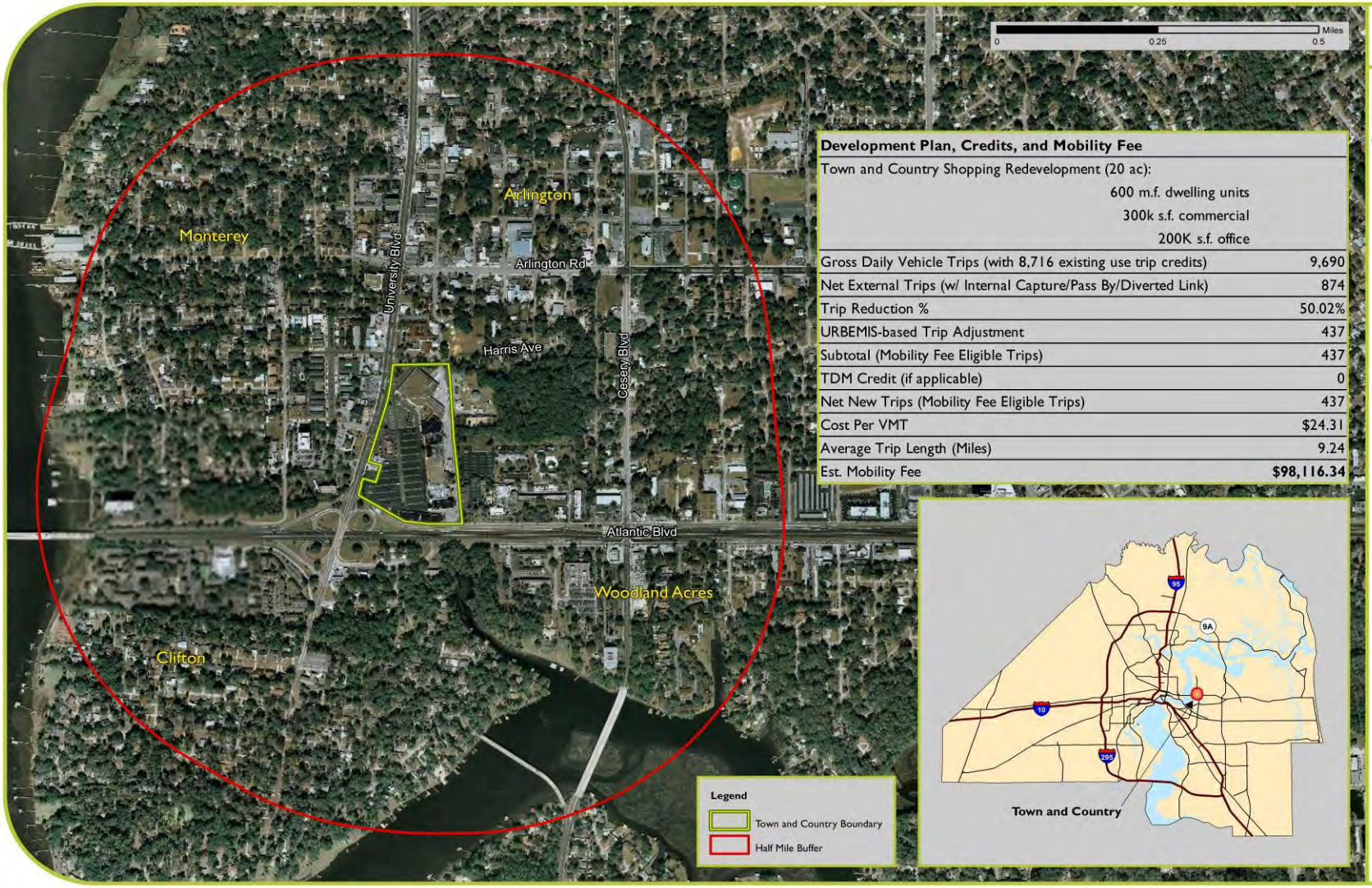
Town and Country Shopping Center proposed plan (Source: Zyscovich Architects, 2009)

Under the mobility fee scenario, the hypothetical redevelopment plan for Town and Country consists of 600 mid rise apartment units, 300,000 square feet of commercial retail, and 200,000 square feet of office park. (For all projects, this information is input into the City's trip generation model which is then linked to the corresponding URBEMIS worksheet model). Based on the analysis, the proposed household density is approximately 30 units per acre. As discussed, this variable yields the greatest influence on trip reduction and as such provides a 36.9% trip adjustment.

As shown in the following mobility fee table, the combination of project use mix and the multimodal features within ½ mile of the Town and Country Shopping Center boundary provides an additional 13% credit, yielding a total design-based trip reduction adjustment of 50%. This percentage is applied to the 874 net external trips, inclusive of the existing trips associated with the existing 203K shopping center, and the internal capture, pass-by, and diverted link trips deductions. This results in 437 trips that would be eligible for the mobility fee. In addition, the site may be eligible for a TDM credit, implemented through a development agreement, which would provide an additional trip reduction.

Looking west towards the Mathews Bridge, the Town and Country Shopping Center's strategic location relative to Downtown provides opportunity to establish a revitalized urban gateway into the Arlington district.

Applying the $24.31 cost per VMT and the average trip length of 9.24 miles due to the project's urban priority development area location, the estimated fee is $98,116. For the scale of the development, this is a marked decrease in what would have been paid under the City's current Fair Share scenario. Even after applying the existing use trip credit, the estimated gross Fair Share assessment is $1,385,661 as a result of the need to mitigate the two failing links of University Boulevard (from the Arlington Expressway north to Arlington Road) and the Mathews Bridge Expressway (from University Boulevard to the Haines Street Expressway). This example highlights the strong influence of the design based principles and the local area land use and transportation context on reducing trips at a high density development. More importantly, it illustrates the added community value of transforming an older, underutilized suburban shopping center into a vibrant destination supporting a variety of mobility choices.



Development Plan, Credits, and Mobility Fee	
Town and Country Shopping Redevelopment (20 ac):	
600 m.f. dwelling units	
300k s.f. commercial	
200K s.f. office	
Gross Daily Vehicle Trips (with 8,716 existing use trip credits)	9,690
Net External Trips (w/ Internal Capture/Pass By/Diverted Link)	874
Trip Reduction %	50.02%
URBEMIS-based Trip Adjustment	437
Subtotal (Mobility Fee Eligible Trips)	437
TDM Credit (if applicable)	0
Net New Trips (Mobility Fee Eligible Trips)	437
Cost Per VMT	$24.31
Average Trip Length (Miles)	9.24
Est. Mobility Fee	**$98,116.34**

Test Site 1:
Town and Country
Shopping Redevelopment

design principles for mobility

Test Site 2: Pecan Park/I-95 Multiuse Development (Hypothetical Greenfield Development)

As a hypothetical comparison to the Town and Country redevelopment site, the same development pro forma was applied to the currently vacant northwest quadrant of I-95 and Pecan Park Road. This location, on the Northside of Jacksonville north of JIA, consists of three parcels totaling 127 acres held in separate ownership. The two smaller parcels directly adjacent to the interchange are currently zoned commercial (CCG-1), while the larger, adjoining parcel to the immediate west is zoned planned unit development (PUD) with a business park (BP) land use. The site is directly between the I-95 corridor to the east and the adjacent, 527-unit Bainebridge Estates single family development to the immediate west. In addition, its general proximity to the International Airport and the River City Marketplace regional shopping center to the south, make the site well-suited for a variety of potential development

Vacant PUD parcel looking east toward I-95 interchange along Pecan Park Road

Bainebridge Estates single family development immediately west of the Pecan Park site

types including, residential, office and retail. Entitlement history indicates that the area was largely programmed for industrial park use with a mix of retail/commercial.

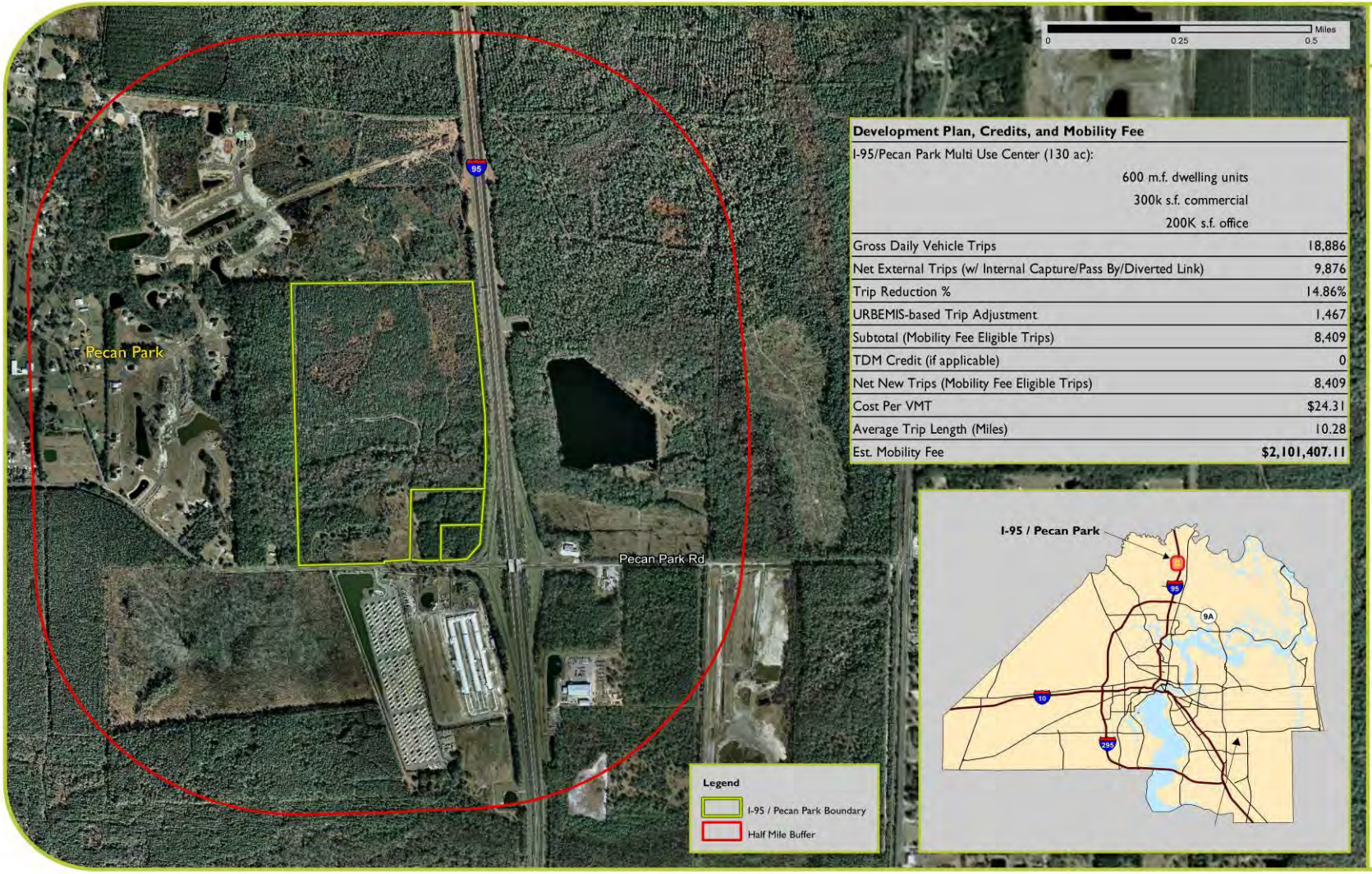
Whether attributed to current, industrial market realities or other economic factors, the site currently has no development activity outside of timber production. Regardless of the intended use or current entitlement status, the purpose of this exercise is to illustrate the difference in mobility fee outcome relative to the potential Town and Country redevelopment use. Under this illustration, it is assumed that the hypothetical, multi-use development plan is spread over the three parcels as a single PUD.

Notably, the most recent Fair Share associated with the larger, PUD parcel was estimated at $998,073 for 1.2 million square feet of warehousing use only. While this assessment was reduced following the enactment of the City's industrial incentive ordinance (relaxing transportation concurrency standards for such uses) it is assumed that a

much higher Fair Share would result under the hypothetical development plan.

From a trip generation perspective, a minor difference in daily external trips occurs as a result of the conversion of the 600 mid rise apartment units at the Town and Country location to 300 low rise apartments and 300 condominium units. This change was to account for the relatively low density characteristics of the area, recognizing that urban-scale, mid to high-rise apartments would likely not be suited to this context. However, the 200,000 square feet of office park, and 300,000 square feet of commercial remain the same. A major advantage provided to Town and Country is the existing use trip credit.

When applying the URBEMIS-based mitigation factors, a comparatively modest reduction in vehicle trips occurs with the Pecan Park site. This is largely attributed to the substantial difference in densities among the two locations, with Pecan Park yielding 4.62 units per acre (compared with 30 units per acre at Town and Country). This provides a 6.79% density-based reduction in external vehicle trips. In addition, given the lack of transit service, virtually no measurable bicycle/pedestrian connectivity, or any local serving retail, the site receives no credits for such variables. This case assumes that no TDM credits have been applied to the site, recognizing that transit service to the area is non-existent. The combined trip reduction adjustment is 14.86% based on the planned use mix and modest densities. Factoring in the location's average trip length of 10.28 miles applied to the fixed cost per VMT, the estimated mobility fee is calculated at $2,101,407 under the proposed scenario. While it remains to be seen how the PUD or the adjacent commercial parcels will develop, incorporating additional densities, interconnectivity and multimodal provisions may contribute to additional design-based or TDM trip adjustments.



Development Plan, Credits, and Mobility Fee

I-95/Pecan Park Multi Use Center (130 ac):

600 m.f. dwelling units
300k s.f. commercial
200K s.f. office

Gross Daily Vehicle Trips	18,886
Net External Trips (w/ Internal Capture/Pass By/Diverted Link)	9,876
Trip Reduction %	14.86%
URBEMIS-based Trip Adjustment	1,467
Subtotal (Mobility Fee Eligible Trips)	8,409
TDM Credit (if applicable)	0
Net New Trips (Mobility Fee Eligible Trips)	8,409
Cost Per VMT	$24.31
Average Trip Length (Miles)	10.28
Est. Mobility Fee	**$2,101,407.11**

Test Site 2:
I-95/Pecan Park
Multi Use Center

design principles for mobility

Test Site 3: St. Johns Town Center (Existing "Power Center" Retail Development)

To highlight the application of the trip reduction factors to a recently developed suburban retail location, the St. Johns Town Center DRI was selected. This 207-acre open-air lifestyle center, owned by the Simon Property Group, opened in March 2005. Located at the northwest corner of J. Turner Butler Boulevard and State Road 9A project construction is estimated at $158 million and includes more than 100 retailers, many of whom used the development as an entry into the Jacksonville market. The second phase of retail may include upscale stores such as Nieman-Marcus and/or Nordstrom. As such, the project development plan at build-out will consist of approximately 2 million square feet of retail, 330,000 square feet of office, 450 multifamily units, 250 hotel rooms, and a 500 seat movie theatre.

Northern section of the St. Johns Town Center, characterized by conventional suburban design and abundant parking

Southern portion of the St. Johns Town Center, with open-air shops and more walkable, urban design features

From a transportation concurrency standpoint, the DRI is part of an established transportation management area (TMA) under the auspices of a private landowner. Under this arrangement, any transportation-related impact fees are paid by the prospective developer through a private agreement between the developer and the landholder. The City draws the resulting trips down following the execution of the development agreement and reserves these trips under its concurrency management system. Based upon the DRI development agreement in 2001, the proportionate share was calculated at $13,339,378 in cash payments and funded transportation improvements to offset the transportation impacts of the DRI, including those to J. Turner Butler Boulevard, State Road 9A, and Southside Boulevard.

When applying the URBEMIS-based mitigation factors under the mobility fee scenario, a negligible reduction in vehicle trips occurs with this site. This is also largely related to the low density characteristics of the area. The 450 multifamily units over the 207 acre parcel yields a net negative density-based credit because of this. While the site receives nominal credits for mix of uses, the presence of local serving retail, and bicycle and pedestrian accommodations, the overall lack of

residential density and use mix reduces the overall trip reduction. This case assumes that no TDM credits have been applied to the site recognizing that current frequency of transit service is very low. As proposed, the combined trip reduction adjustment is 3.48%. Under the proposed mobility scenario, the estimated payment is a comparable $13,815,804 based upon the 55,284 net, daily mobility fee-eligible trips.

While the southern portion of the St. Johns Town Center provides, to some extent, an urban and pedestrian orientation, the overall project design could be further modified to capitalize upon the three "D's" and receive additional trip reduction credits. The lack of housing within a safe and comfortable walking distance to available employment combined with the domination of free and abundant parking particularly at the northern shopping area, promotes an autocentric quality to the site. Examples such as **CityPlace** in West Palm Beach and **Mizner Park** in Boca Raton, offer

Mizner Park in Boca Raton embodies traditional neighborhood development (TND) characteristics enabling residents and workers to realistically choose to walk or bike to work, school, or shop.

CityPlace development in West Palm Beach provides a design contrast to the St. Johns Town Center. This project would receive additional trip reduction credits based upon the incorporation of higher residential densities and mix of uses within walking distance.

alternative design and programmatic approaches that could be incorporated into future phases of the Town Center. Such truly mixed-use design and density elements within these projects have resulted in the creation of new, vibrant, walkable places offering a "live/work/play" environment that continues to be in high demand among growing demographic segments—particularly Millenials and downsizing Baby Boomers. These projects have also substantially increased adjacent real property values.

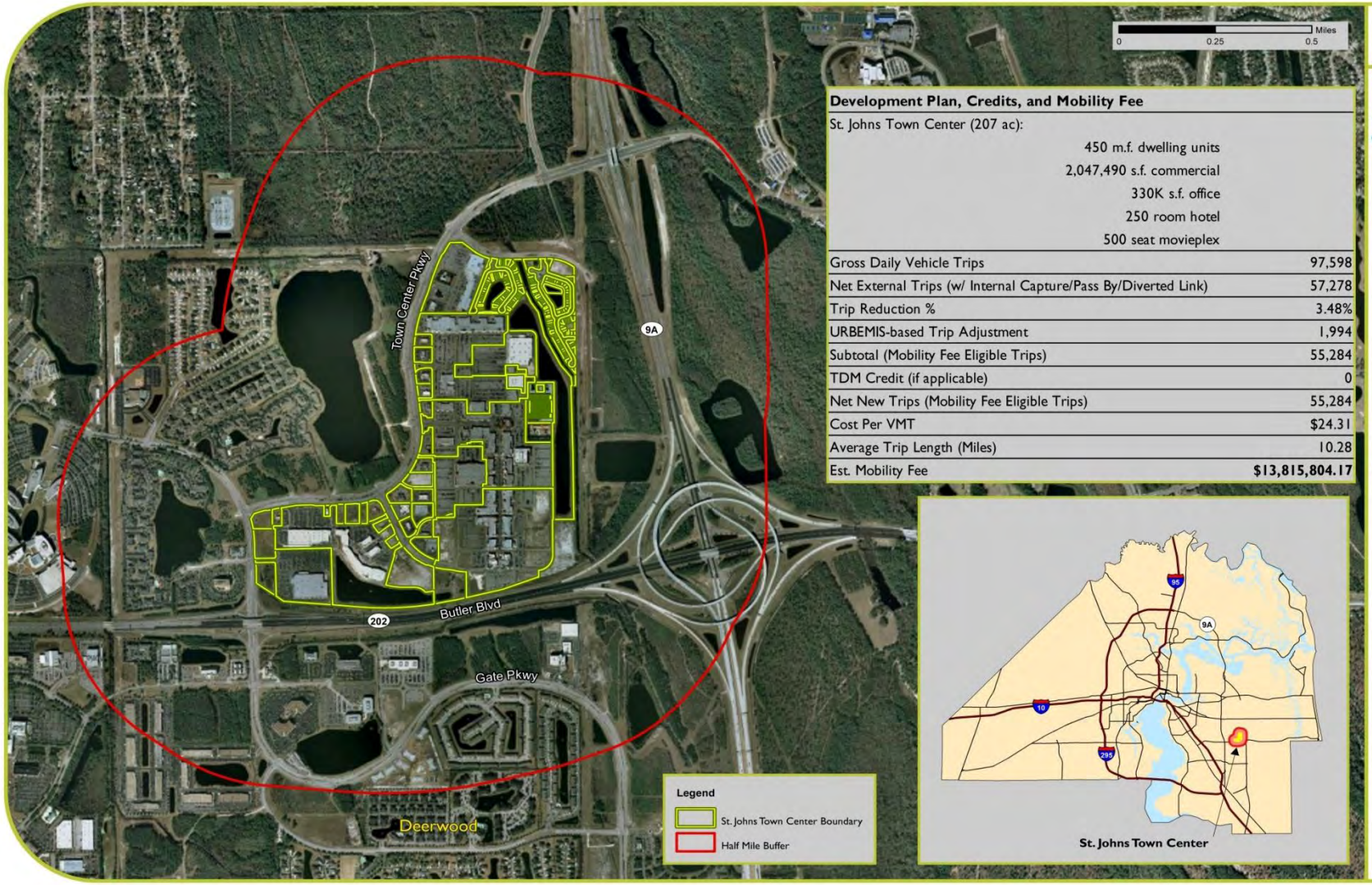
The residential component of Cityplace includes over 2,300 residential units built since 1994. Additionally, over 10,000 new residential units have been built within a one mile radius of the site within the last 12 years. Cityplace includes a wide variety of housing types ranging from affordable three-story garden apartments on the east side of Central Expressway to luxury high rise units and townhouses on the west. Over 1,400 apartments have been built on the west side of the site in buildings ranging from four stories to twenty stories. Roughly 60% of the

apartments are within mixed-use buildings and 40% are in stand-alone apartment buildings.

The mixed-use, Mizner Park town center clearly demonstrates how suburban communities can create vital downtowns by redeveloping abandoned shopping centers. Crocker and Company worked with Boca Raton's Community Development Agency to replace the failed shopping mall with a 28.7-acre mixed-use project that includes 272 homes, a public promenade and park, retail shops and restaurants, 262,000 square feet of office space, a movie theater, and a museum.

The success of Mizner Park has sparked other cities in Florida to convert their under-performing shopping malls into new town centers. Mizner Park would likely receive substantial trip reduction credits under this mobility fee credit system based upon redevelopment and the ability to capitalize upon a dense residential context. In addition, this project provides a great reference for the potential redevelopment of the Town and Country Shopping Center, converting the underused shopping mall into a new mixed use center, removing a blighted property and helping to revitalize the surrounding community.

Mizner Park in Boca Raton provides a successful example of "Dead Mall" redevelopment. From the short-lived Boca Raton Mall (above) to its immensely popular transformation (below), this illustrates a typology that would receive substantial trip reduction benefits under the proposed mobility credit system. (Courtesy of Ellen Dunham Jones' "Retrofitting Suburbia")



Development Plan, Credits, and Mobility Fee

St. Johns Town Center (207 ac):

450 m.f. dwelling units
2,047,490 s.f. commercial
330K s.f. office
250 room hotel
500 seat movieplex

Gross Daily Vehicle Trips	97,598
Net External Trips (w/ Internal Capture/Pass By/Diverted Link)	57,278
Trip Reduction %	3.48%
URBEMIS-based Trip Adjustment	1,994
Subtotal (Mobility Fee Eligible Trips)	55,284
TDM Credit (if applicable)	0
Net New Trips (Mobility Fee Eligible Trips)	55,284
Cost Per VMT	$24.31
Average Trip Length (Miles)	10.28
Est. Mobility Fee	**$13,815,804.17**

Test Site 3:
St. Johns Town Center

[design principles for mobility]

Test Site 4: ICI Rural Villages (Approved Planned Unit Development)

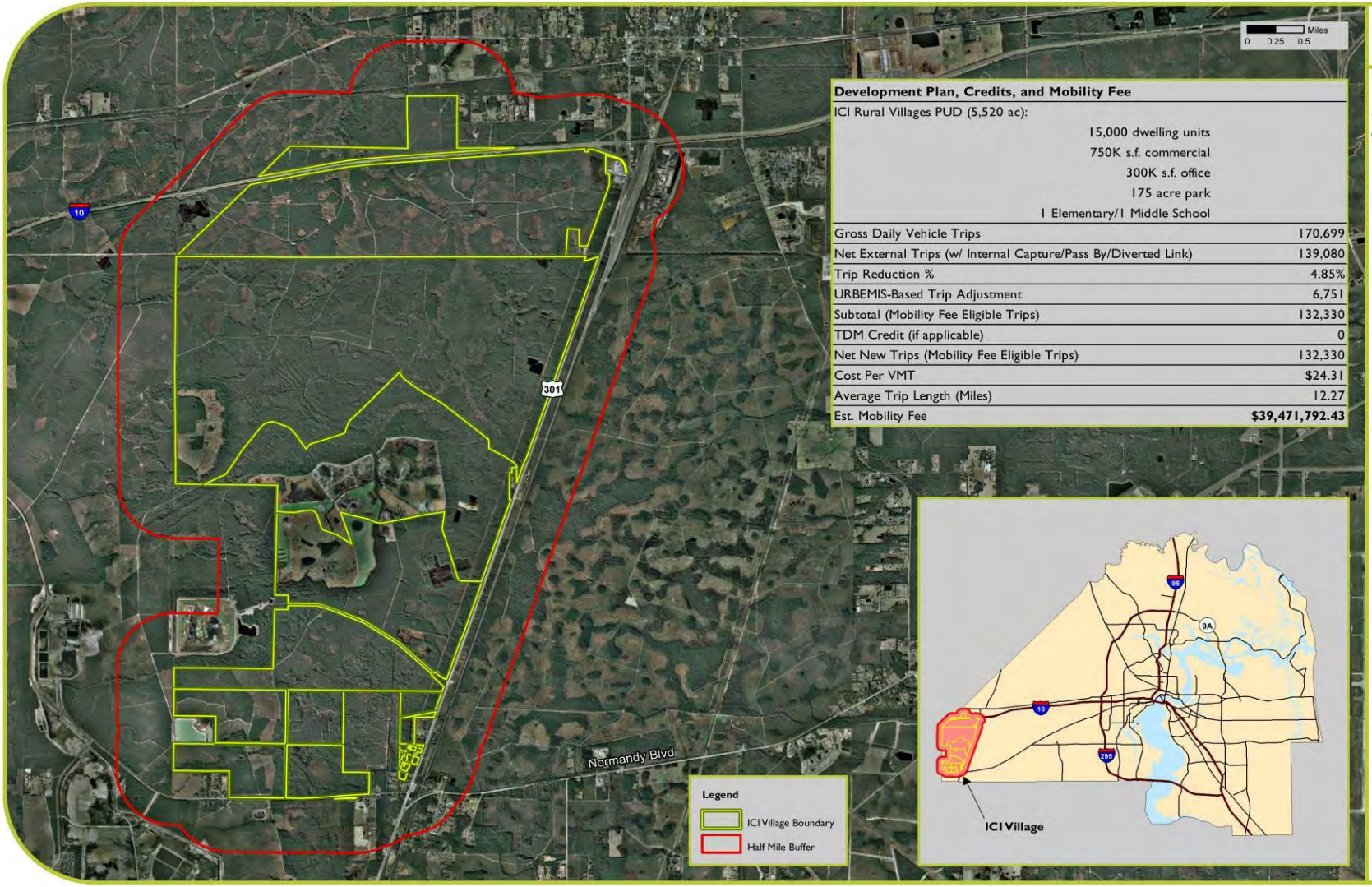
ICI Rural Villages property west and adjacent to U.S. 301 in southwest Duval County.

To test a proposed, master planned community in the designated Rural Development area of the City of Jacksonville under the mobility fee scenario, the ICI Rural Villages PUD was selected. The site is located on 5,520 acres in the southwest portion of the City of Jacksonville approximately 1.7 miles south of I-10 with direct frontage on U.S. 301. This large, vacant tract has been rezoned and reclassified from a predominant agricultural and silvicultural district to a planned unit development-satellite community between 2006 and 2010. The project master plan was based on both the criteria for a "Rural Village" as documented the Southwest Vision Plan and "a combination of conventional and traditional master planning principles." The development plan, as proposed, consists of approximately 15,000 dwelling units, 750,000 square feet of regional retail/shopping, 300,000 square feet of office park, as well as two school sites and other community support amenities.

The site is intended to consist of multiple residential villages connected directly to one or more neighborhood centers with a mix of civic and commercial uses. Over 1,500 acres of the site has been set aside for conservation and open space purposes, which provides a negligible density credit of 3.84%. However, it does not benefit substantially under the overall package of available design and transit-based credits of the URBEMIS model. The site's remote location, low density, and lack of adjacent development and multimodal context results in an overall trip reduction of 4.85%

Under the Fair Share scenario, the gross assessment was estimated at $5,843,668 in 2007. This is reflective of minimal roadway capacity improvements warranted given the lack of congestion and/or constrained facilities within the specified traffic impact area. Using the revised mobility fee methodology and credit system, the development would be assessed $39,471,792. This number is substantially higher based on the amount of daily external trips generated and minimal internal capture as a result of the amount of proposed residential development. While in this case it is also assumed that no TDM component is included, even if such a credit of 5 to 10 percent maximum was applied through a development agreement, the fee would be minimally reduced.

This example continues to illustrate the importance of high density, jobs/housing balance, and the frequency and characteristics of the transit and pedestrian environment in order to maximize the URBEMIS-based trip reduction credits. In order to increase credit opportunities under this example, clustering the proposed villages over a smaller area and providing a greater mix of use within proposed neighborhood centers would result in additional open space preservation and increase the density variable by excluding such lands from the calculation.



Development Plan, Credits, and Mobility Fee

ICI Rural Villages PUD (5,520 ac):

15,000 dwelling units
750K s.f. commercial
300K s.f. office
175 acre park
1 Elementary/1 Middle School

Gross Daily Vehicle Trips	170,699
Net External Trips (w/ Internal Capture/Pass By/Diverted Link)	139,080
Trip Reduction %	4.85%
URBEMIS-Based Trip Adjustment	6,751
Subtotal (Mobility Fee Eligible Trips)	132,330
TDM Credit (if applicable)	0
Net New Trips (Mobility Fee Eligible Trips)	132,330
Cost Per VMT	$24.31
Average Trip Length (Miles)	12.27
Est. Mobility Fee	**$39,471,792.43**

Test Site 4:
ICI Rural Villages (PUD)

[design principles for mobility]

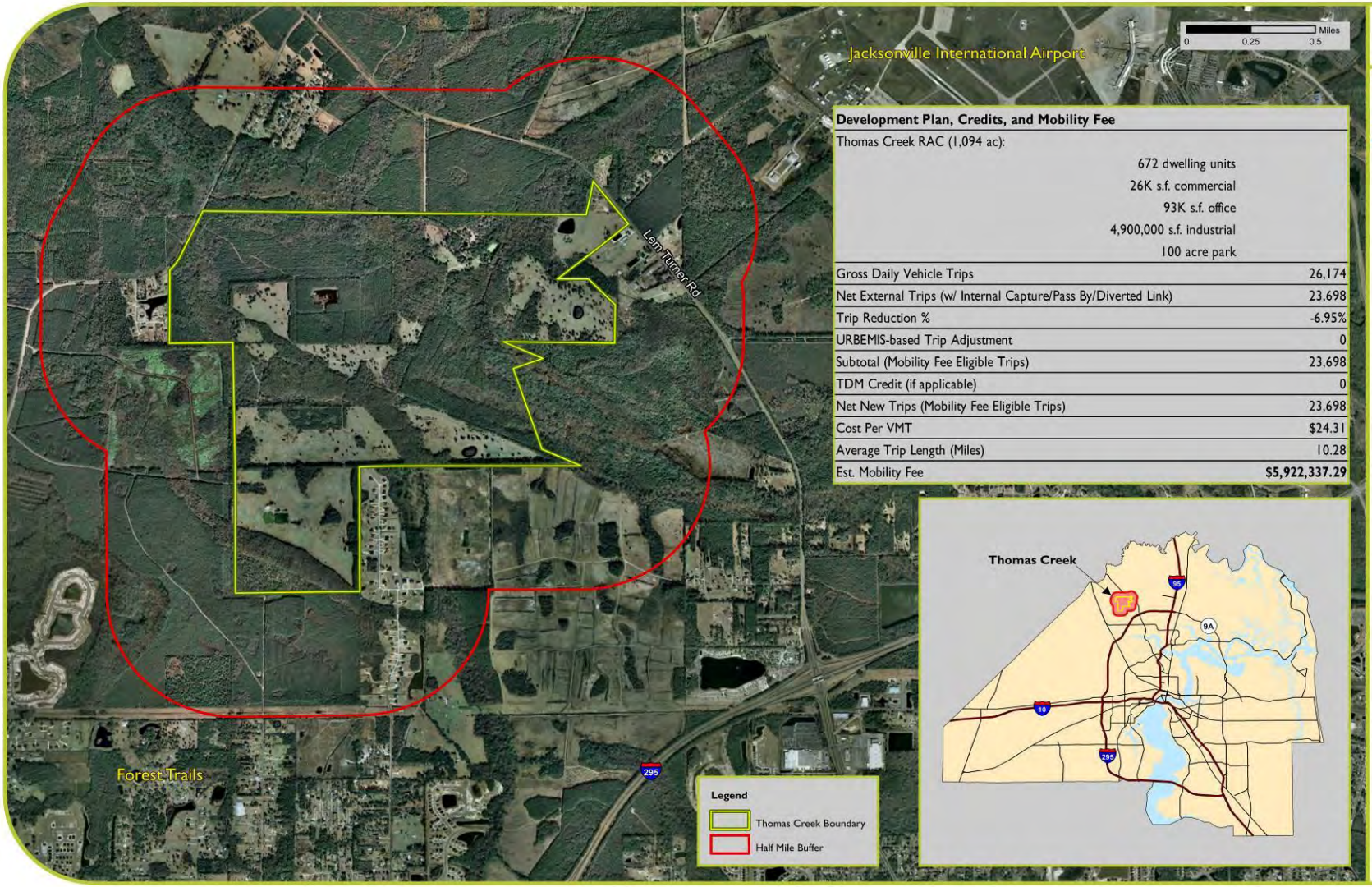
Test Site 5: Thomas Creek (Approved Regional Activity Center)

Thomas Creek Village is a 1,093 acre parcel located on Lem Turner Road approximately two miles north of I-295 in Jacksonville, Florida. The property is currently owned by Transworld Investment Corporation and was originally entitled for approximately 2,600 residential units. The original development plan has been adjusted to reflect the current residential market downturn to include the following uses: 319 acres of warehouse distribution uses or approximately 4.9 million square feet; 180 acres or approximately 672 units of single family residential; and 33 acres of general office/commercial uses, including 93,000 square feet of office and 26,000 square feet of retail.

Thomas Creek Industrial Park information sign and entrance to property along Lem Turner Road

The warehouse, office and commercial parcels will be accessed from Lem Turner Road on the east side of the property. This access point is adjacent to lands with industrial and commercial land uses that are within ½ mile of the cargo entrance to Jacksonville International Airport. The residential development is buffered from the other uses by large wetland areas and would be accessed from Braddock Road on the west side of the property. The area surrounding this access point is largely low-density residential in nature.

Based upon the latest information provided by the City, this project was assessed a Fair Share contribution of $4,047,697 for adjacent roadway improvements. This amount is slightly less than what would be assessed under the mobility fee system. As can be shown in the following table, the resulting mobility fee is estimated at $5,922,337 and includes no trip adjustment credits. While the project receives a notable 6.51% reduction in trips associated with the proposed use mix, the gains are offset by the substantial reduction in single family homes over the same acreage. This has resulted in a density of less than one unit per acre and a net negative reduction. Combined with the vicinity's lack of meaningful transit service and bicycle/pedestrian provisions and connectivity, no trip reduction adjustments are provided. If the project were to remove the residential component, thereby eliminating the density parameter from the model, a combined trip reduction percentage of 8.77% would result and the fee would drop to approximately $5.4 million.



Development Plan, Credits, and Mobility Fee

Thomas Creek RAC (1,094 ac):	
672 dwelling units	
26K s.f. commercial	
93K s.f. office	
4,900,000 s.f. industrial	
100 acre park	
Gross Daily Vehicle Trips	26,174
Net External Trips (w/ Internal Capture/Pass By/Diverted Link)	23,698
Trip Reduction %	-6.95%
URBEMIS-based Trip Adjustment	0
Subtotal (Mobility Fee Eligible Trips)	23,698
TDM Credit (if applicable)	0
Net New Trips (Mobility Fee Eligible Trips)	23,698
Cost Per VMT	$24.31
Average Trip Length (Miles)	10.28
Est. Mobility Fee	**$5,922,337.29**

Test Site 5:
Thomas Creek RAC

[design principles for mobility]

Test Site 6: Jackson Square TOD (Proposed Transit Oriented Development)

View north along Philips Highway from the Jackson Square property entrance

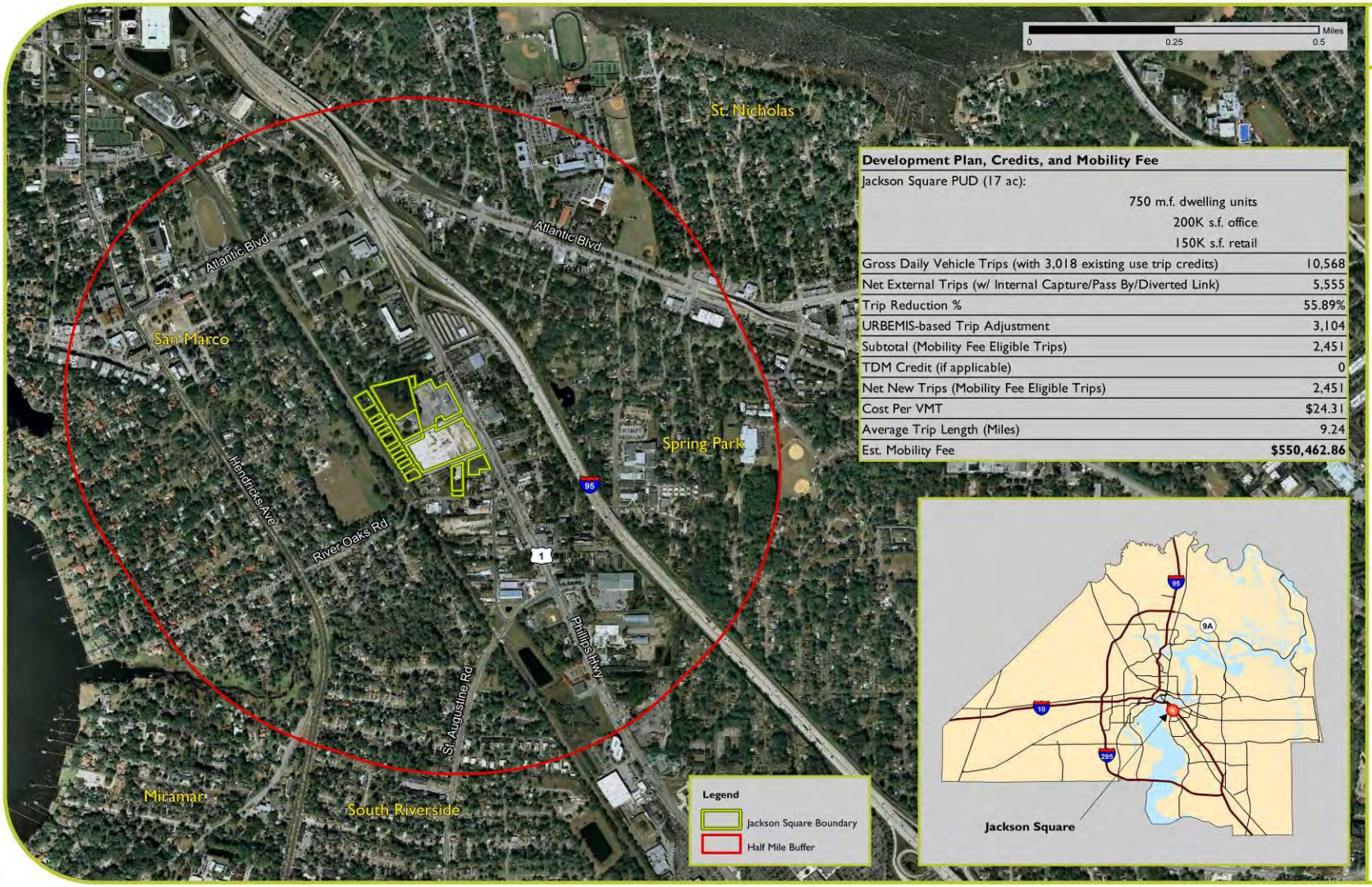
The proposed Jackson Square project occupies the former site of an automotive dealership and repair facility on approximately 17.3 acres along the west side of Philips Highway, south of Atlantic Boulevard between Mitchell Avenue and River Oaks Road. The project is also adjacent to the existing Florida East Coast rail line, well positioning the site for potential commuter rail service along JTA's proposed Southeast Commuter Rail Corridor. The property was rezoned and reclassified from largely commercial and light industrial uses to planned unit development in 2008. The project provides a unique opportunity to demonstrate to the City and the region the implementation of transit oriented development at an infill site strategically located near Downtown.

The development plan consists of 750 multifamily units, 150,000 square feet of commercial/retail and 200,000 square feet of general office use. Under the latest adopted ordinance, the project, prior to any development beyond 30 residential units per acre, must incorporate an enhanced mass transit station and amenities. These features are designed to be consistent with long-range transit development options including potential BRT, commuter rail, and/or other modes identified or implemented by the Jacksonville Transportation Authority. The following conceptual master plan, prepared by Basham and Lucas, illustrates the placement and orientation of the proposed mix of uses, including multimodal features such as the required transit amenities, roundabouts, landscaping, signage and wayfinding, as well as traffic calming and internal circulation elements.

Western perimeter of Jackson Square site adjacent to Florida East Coast Rail line and FEC Park

As tested under a preliminary Fair Share calculation, the site would be responsible for $1,243,311 in transportation-related improvement costs associated with project traffic impacts to I-95 near Downtown. Applying the alternative mobility fee and credit methodology, the costs are approximately 60% less. Based upon the existing use credit, the site receives a deduction of 3,018 daily trips from the gross daily vehicle trips. The average density of 44 units per acre alone provides an additional 41.4% reduction in trips. The project nearly achieves the 9% maximum possible reduction associated with use mix. The combination of the design and density credits provides an approximate 56% reduction in daily external vehicle trips. Based upon the location, density, and transit-supportive characteristics, the site would also likely be eligible for substantial TDM credits. This, of course, assumes a revised development agreement that would ensure such provisions are included and monitored. The project's urban priority location also reduces the average VMT in the calculation and as a result the estimated mobility fee is $550,462.

The proposed Jackson Square Conceptual Master Site Plan (above), courtesy of Basham and Lucas, illustrates desired use and design features, such as office space above retail and a new transit hub, within the dense urban fabric of the vicinity (below). Such projects amplify the significance of the 3Ds in promoting mobility and maximizing the available trip reduction credits.



Development Plan, Credits, and Mobility Fee

Jackson Square PUD (17 ac):

750 m.f. dwelling units
200K s.f. office
150K s.f. retail

Gross Daily Vehicle Trips (with 3,018 existing use trip credits)	10,568
Net External Trips (w/ Internal Capture/Pass By/Diverted Link)	5,555
Trip Reduction %	55.89%
URBEMIS-based Trip Adjustment	3,104
Subtotal (Mobility Fee Eligible Trips)	2,451
TDM Credit (if applicable)	0
Net New Trips (Mobility Fee Eligible Trips)	2,451
Cost Per VMT	$24.31
Average Trip Length (Miles)	9.24
Est. Mobility Fee	**$550,462.86**

Test Site 6:
Jackson Square TOD

[design principles for mobility]

Jacksonville Smart Growth Concept Development Opportunities

As a next step, or concurrent to the development of an automated system (to be discussed in the next section), it is recommended that the City create a Smart Growth Development Opportunities manual linked to the implementation of the mobility fee and design-based credit system. As a further extension of this section, which tests a number of existing and proposed locations and projects, the purpose of this value-added document would be to explore and showcase particular development sites in Jacksonville where trip reduction credits could be maximized.

Actual locations would be surveyed in terms of accommodating mixed use opportunities and multimodal design features. Within the manual, realistic pro-formas, photo and place type documentation, as well as conceptual site plans and renderings would be included with each of the identified locations. The selected examples will illustrate both development potential and the corresponding discounted mobility fees or even credits that result from a net surplus of trips that could be banked and transferred to other sites. More importantly, such a manual could serve as a potential real estate development marketing guide to be used by the Planning Department and the Chamber of Commerce in order to attract investment to strategic locations which optimize such incentives.

This effort is also strongly supportive of the City's Comprehensive Plan Future Land Use Element Policies 6.3.1 and 6.3.2, which encourage new investment and multimodal design elements in targeted infill and redevelopment areas.

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Framework for Prototype Automated Software

An interactive, web-based application is proposed as a means to automate the trip generation, credit, and mobility fee estimation process. Combining the City's established trip generation and internal capture/pass-by procedures with the URBEMIS-based mitigation measures, this proposed application (preliminarily referred to as "**MOBILJax**") will enable the City, developers and other parties of interest to test various site locations, compare preliminary fee estimates, and potentially determine optimal location(s) for development "on the fly".

The web application will require minimal user input with calculations for trip generation, internal capture, credit reduction and estimated fee processing automatically in the background on a hosted server. The adjacent table lists the data variables needed to calculate the trip reduction credits along with which items represent user inputs and which calculations would be performed by the application on a remote server.

"MOBILJax" Variables		Source	Update Frequency
Project Location			
	Development Area	*City of Jacksonville*	*5 Years*
Land Use (Residential / Non-Residential)			
	Project Acreage/Units/Sq Ft (entered in trip generation section)	*User Input*	*N/A*
Housing Units			
	Proposed Units (automatically populated from trip generation section)	*Census or NERPM TAZ*	*10 years or As Available*
	Households Per Acre	*Census or NERPM TAZ*	*10 years or As Available*
	Total Housing Units	*Census or NERPM TAZ*	*10 years or As Available*
Employment			
	Proposed Employees (automatically populated from trip generation section)	*User Input*	*N/A*
	Total Employees	*InfoUSA*	*As Available*
Local Serving Retail			
	Yes/No	*User Input*	*N/A*
Transit			
	Number Weekday Buses Stops	*Jacksonville Transportation Authority (JTA)*	*6 months*
	Number of Daily Rapid Transit Buses Stops	*Jacksonville Transportation Authority (JTA)*	*6 months*
	Number Daily Shuttles	*Jacksonville Transportation Authority (JTA)*	*6 months*
Intersection Density		*City of Jacksonville*	*Continually maintain file and update as needed*
Sidewalk Coverage		*City of Jacksonville*	*Continually maintain file and update as needed*
Bike Lane Coverage		*City of Jacksonville*	*Continually maintain file and update as needed*
Existing Use Trip Credit		*City of Jacksonville*	*N/A*
Transportation Demand Management (TDM) Credit		*City of Jacksonville*	*N/A*

The following datasets will be required to perform the automated processes listed above: Based on accurate trip reduction calculations, it is anticipated that particular datasets will need to be updated on a minimum annual or semi-annual basis to account for changes in both JTA's transit service and/or property appraiser (parcel) information.

1. Development Area Boundaries
2. NERPM TAZ Information, updated as 2010 Census becomes available
3. Info USA
4. Daily Weekday Bus Schedule and Stops
5. Daily Rapid Transit Bus Schedule and Stops
6. Dedicated Daily Shuttles
7. Scored Intersections
8. Sidewalk Inventory
9. Bike Lane Inventory

Project Location

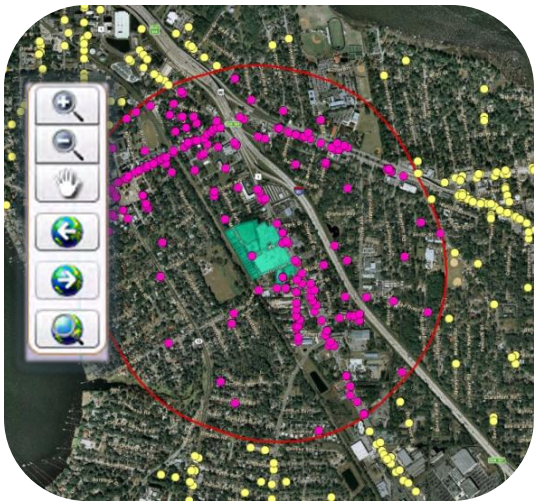
The system will consist of a GIS-based graphical interface enabling the user to select the project location. Parcel boundaries and road names will be visible to assist the user in finding the desired location. The project area can also be selected based on the real estate (RE #) number. Once the project location is selected, the application will automatically determine the appropriate Development Area from which to populate the average trip length (VMT) into the fee calculation parameter—including Downtown Development, Urban Priority, Urban Development,

Potential graphical user interface illustrating buffered project location and population by TAZ.

Suburban Development, or Rural Development Area. The Development Area category boundaries are predefined and the web application performs a spatial selection of the category that contains the project location. The Development Area category dictates the average VMT that is used in the mobility fee formula calculation.

Land Use (Residential Household Density)

A simple, pull down menu or radio button will be provided in the Land Use section of the web interface to allow the user to choose if the development is residential or exclusively non-residential. This component is directly linked to the density calculation model to determine the extent of trip reduction credits associated with residential density. Under exclusively non-residential developments, the density calculation would be eliminated from the sum of credit percentages.



Potential graphical user interface illustrating buffered project location and employment by TAZ.

Housing Units (Mix of Uses)

The use mix credit model is a function of the total number of housing units relative to employees within ½ mile of a project boundary. The total number of housing units reflects both existing units within the immediate area and the proposed number of units associated with a project. The user will input the number of proposed housing units in the trip generation interface as planned for the development. The number of households per acre will be calculated based on the number of proposed housing units divided by the total acreage of the project. The application will also calculate the number of existing housing units within ½ mile of the project boundary. Until the 2010 Census Data is readily available by block group or traffic analysis zone (TAZ), it is recommended to obtain the existing housing units from the Northeast Regional Planning Model (NERPM). The NERPM model provides number of total housing units as of 2008 for each TAZ. The application will automatically create a ½ mile buffer of the project boundary and clip the TAZ data layer. The total housing units will be extracted from the TAZ data based on the coverage of the project location buffer. The proposed and existing housing units will be added together for the total number of Housing Units that is used to calculate any potential trip adjustments associated with mix of uses.

Employment (Mix of Uses)

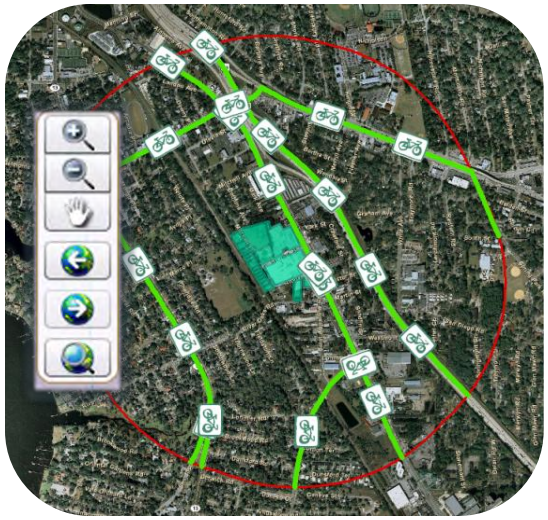
The number of proposed employees as planned for the development will be derived from the trip generation component. This is based upon an established rate of employees per 1,000 square feet associated with the specific, non-residential square footage as input by the user. The web application will estimate the existing ("other") employees utilizing the most current InfoUSA point data. InfoUSA is a comprehensive database that provides total number of employees for each point representing businesses. By spatially selecting the InfoUSA data points that fall within the ½ mile buffer of the project location, the total number of existing employees is determined. The proposed project and existing employees are then automatically added together to yield a total number of employees that is incorporated into the mix of uses trip reduction equation.

Local Serving Retail

A 2% maximum credit is incorporated relative to the presence of local serving retail within the ½ mile buffer radius. A simple, pull down menu or radio button will be provided for the user to choose if there is or is not retail property within ½ mile of the project boundary.

Transit Service

Comprehensive data files of weekday buses, rapid transit buses, and daily shuttles are required for the web application to calculate transit use within the project area. Currently, the user would be required to manually check the posted schedule from JTA's website to confirm the number of weekday stops within the ½ mile buffer of the project. It is recommended that the City coordinate with the JTA to link the schedule database to the stop point files so that the information is geo-referenced and can be automatically selected out of the buffer and incorporated into the server-based calculations.



Potential graphical user interface illustrating buffered project location and bike lane coverage.

The URBEMIS guidance provides a ¼ mile radius for buses and ½ mile radius for high capacity shuttles or rail service.

However, for ease of analysis and to be able to capture all potential modes of high capacity transit service within a 10 minute walk distance, it is recommended to use ½ mile radius in order to capture all available services. Upon receipt of the appropriate data, the web application will spatially select the bus stops within ½ mile of the project's center and multiply by the bus frequency schedule to obtain the number of weekday buses, rapid transit buses, and daily shuttles stopping within the project area.

Intersection Density (Bicycle/Pedestrian Friendliness)
As an excellent measure of the walkability characteristics within the project influence area, intersection network density per square mile is built-in to the trip reduction credit component.

The City of Jacksonville Planning and Development Department has developed a point file of all intersections in Duval County, to which each point is provided a score. The scoring process is based on the number of legs at a given intersection. A three-legged intersection receives a score of "3" with four and five-legged intersections receiving scores of "4" and "5" respectively. The web application will automatically select the points within the ½ mile buffer of the project location and sum these scores. The total score is then divided by 0.79 to obtain the number of intersections per square mile.

Sidewalk Coverage (Bicycle/Pedestrian Friendliness)
The total sidewalk coverage is based on the City's sidewalk inventory file provided by the City of Jacksonville Planning and Development Department. This file provides the percentage of sidewalks on one side or both sides of the street. The web application will clip the sidewalk inventory file to contain only those segments which fall in the ½ mile buffer of the project location. The percentage of sidewalk coverage on one side and both sides will be calculated relative to the total roadway length and the sidewalk percentage.

Bike Lane Coverage (Bicycle/Pedestrian Friendliness)
The total bike lane coverage is based on the 2009 City of Jacksonville Bike and Pedestrian Network file. This file contains attributes describing the type of bike path as developed by the City: Bike Lane, Limited Access, Multi-Use Path, Nonstandard Path, Parking Lane, Paved Shoulder and None. The application will spatially select the features that are within ½ mile of the project's center. The lengths of the features that are attributed as Bike Path, Limited Access, Multi-Use Path, and Non-standard Path are summed and divided by the total roadway length. This calculation results in the percentage of arterials/collectors with bike lanes that is incorporated into the bicycle/pedestrian trip reduction measures.

The following summary tables illustrate how the preceding information is populated via the discrete variables inputs, as well as the resulting trip reduction credits and estimated mobility fee for the Town and Country example:

Project Name:	**Sample Project - Town and Country Redevelopment Mixed Use Town Center**
Mobility Zone:	
Date:	**August 26, 2011**

Required Data

Data Provided by JPDD

Project Location (Development Area)		Choose From Below	Average Trip Length	2
	1	Downtown Development Area	9.09	
	2	Urban Priority Area	9.24	
	3	Urban Development Area	9.46	
	4	Suburban Development Area	10.28	
	5	Rural Development Area	12.27	

Land Use ("R" Residential or "N" Non-Residential)	R
Number of Housing Units within 1/2 Mile of project center or project boundary whichever is greater	2,840
This Project's Housing Units (From Trip Generation Worksheet)	600
Other Housing Units Within 1/2 Mile of project center or project boundary whichever is greater	2,240
Study Area Employment (No. of employees within 1/2 mi. of project center or project boundary whichever is greater)	5,484
This Project's Employment (From Trip Generation Worksheet)	1,076
Other employees within 1/2 mile of project center or project boundary whichever is greater	4,408
Households per Acre (From trip Generation worksheet)	30.00
Local Serving Retail (Yes/No) (Yes if any retail land uses within 1/2 mile of project's center.)	Yes
Number of Daily Weekday Buses Stopping Within 1/4 Mile of Site	150
Number of Daily Rapid Transit Buses Stopping Within 1/2 Mile	0
Number of Dedicated Daily Shuttles	0
Number of Intersections Per Square Mile (½ Mile R =.79 Square Mile)	591.14
Intersections Within .5 Mile R	467
Percent of Streets with Sidewalk on One Side (%)	12.00%
Percent of Streets with Sidewalk on Both Sides (%)	14.00%
Percent of Arterials/Collectors with Bike Lanes	4.00%
Transit Service Index Transit service Index =	0.166666667
Number of average daily weekday buses stopping within 1/4 mile of the site	150
Plus twice the number of daily rail or bus rapid transit trips stopping within 1/2 mile of the site	0
Plus twice the number of dedicated daily shuttle trips	0
Divided by 900, the point at which the maximum benefits are assumed.	900

All estimates for bike an pedestrian data should be based on estimates within a 1/2 mile radius from the project's center or the entire project, whichever is larger.

Trip Adjustment Calculations Sample Project - Town and Country Redevelopment Mixed Use Town Center

A. Mix of Uses **Trip Reduction =**	**7.49%**
Trip reduction =(1– (ABS(1.5 * h – e) / (1.5 * h + e)) – 0.25) / 0.25 *0.03	
Where: h = study area households (or housing units)	
e = study area employment	
(Negative reductions of up to 3% can result, and should be included.)	
The maximum possible reduction using this formula is 9%.	
B. Household Density	**36.91%**
Trip reduction = 0.6*(1-(19749*((4.814+ households per residential acre)/(4.814+7.14))-0.639)/25914)	
The maximum allowable reduction is 55% (equivalent to a 380 unit per acre development)	
C. Local Serving Retail **Trip Reduction =**	**2.00%**
The presence of local serving retail can be expected to bring further trip reduction benefits, and an additional reduction of 2% is recommended.	
D. Transit Service **Trip Reduction =**	**1.54%**
Trip reduction = t * 0.075+ t * ped/bike score * 0.075	
Where t = transit service index	
E. Bicycle and Pedestrian Measures **Trip Reduction = 9% of ped/bike factor =**	**2.08%**
Ped/bike factor = (network density + sidewalk completeness + bike lane completeness) / 3	
Ped/bike factor =	0.23
Network density = intersections per square mile / 1300 (or 1.0, whichever is less)	
Network density =	0.4547
Sidewalk completeness = % streets with sidewalks on both sides + 0.5 * % streets with sidewalk on one side	
Sidewalk completeness =	0.2
Bike lane completeness = % arterials and collectors with bicycle lanes.	
Bike lane completeness =	0.04
F. Trip Reduction = A+B+C+D+E (For Non-residential, A+C+D+E)	**50.02%**

Mobility Fee Eligible Trip Calculation

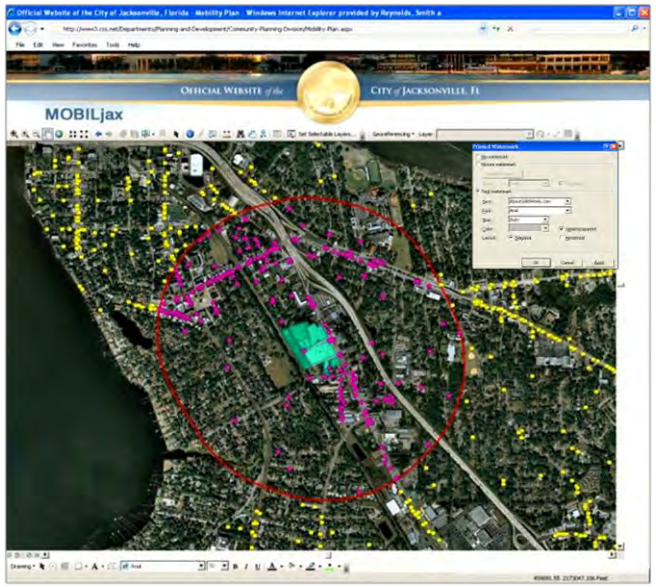
G. Gross Vehicle Trips (Average daily trips from trip generation worksheet)	18,406
H. Existing Trip Credit (Average daily trips from current use)	8,716
I. Adjusted Gross Vehicle Trips (G - H)	9,690
J. Internal Trips (from internal capture worksheet)	3,142
K. Gross External Trips = (I – J)	6,548
L. Pass-By Trips (from trip generation worksheet)	4,656
M. 25% of Diverted Linked Trips (from trip generation worksheet)	1,018
N. Net External Trips = (K - L - M)	874
O. Trip Adjustment = F * N	437
P. Subtotal Mobility Fee Eligible Trips = (N - O)	437
Q. TDM Credit = P * x% (as determined through City review)	0
R. Net New Trips (Mobility Fee Eligible trips) = (P - Q)	**437**

Mobility Fee Calculation

S. Cost per VMT (County Wide)	$24.31
T. Average Trip Length in Project Development Area	9.24
U. Mobility Fee = R * S * T	**$98,116.34**

Source: URBEMIS2007 for Windows Users' Guide Appendix D – URBEMIS2007 Mobile Source Mitigation Component,

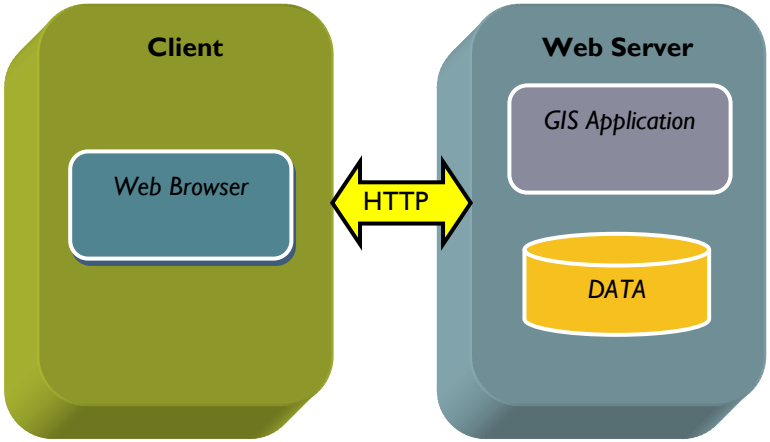
Interactive Web Mapping Application Features ("MOBILJax")



The customizable, web mapping application, or "**MOBILJax**", will consist of a user-friendly platform designed for non-technical users. Inputs will be kept to a minimum and the tools and map navigation will be designed to be very intuitive. As much automation as possible will be built into the application in order to minimize the amount of user inputs and enable "on-the-fly" testing.

Support/maintenance of the website will also be very flexible. Depending on the select variables, the web based application can be maintained and hosted internally at the City or externally on a web server. The latest technologies will be used to deploy the system and the application will be written using industry standard web authoring tools.

Typical of many mapping applications accessible on a web server, the users send a request to a server (i.e. an address) and the server processes the request and sends the results back as an image embedded in an HTML page via standard HTTP. The response is a standard web page that most browsers can view. In server-side internet GIS applications, all the complex and/or proprietary software, in addition to the spatial and tabular data remain on the server. This architecture has several advantages because the application and data are centralized on a server. These advantages include simplified development, deployment, and maintenance. As such, the basic framework of the application will consist of the following:



- Windows server-based
- 100% browser-based using Adobe Flash
- Accessible to users via password protected, encrypted (SSL) log in page
- All data would reside on server – no cross domain/server queries necessary
- Trip Generation and Trip Reduction Credits sections would be selectable via a sequential "tabbed" section that guides users in steps, such as *"I. Trip Generation and Internal Capture"; "II. Trip Adjustment Credits"; "III. Mobility Fee Calculation"*
- User-friendly, graphical "tools" and/or "icons" selectable from toolbar for zoom, pan, and calculate commands
- Users would be guided via overlaid instructions/tips
- Users would have clearly labeled fields to enter necessary input data (both the user's project information and JPDD provided data) for the server-based calculations
- All data manually entered by the user would be validated client-side in order to correct invalid data quickly. Before form results are submitted land use and trip reduction inputs would be presented via copy/paste/downloadable window

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Urban Core Vision Plan
Southeast Vision Plan
Southwest Vision Plan
Northwest Vision Plan
North Vision Plan

Adopted Town Center Program (Phase I) Plans (2004-2006)

RS&H TEAM

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Department of Civil, Construction,
& Environmental Engineering

Carolina Transportation Program

Final Report

Traditional Neighborhood Development Trip Generation Study

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16. Abstract

Since the beginning of the new urbanist movement, alternately referred to as Traditional Neighborhood Developments (TNDs), planners and architects have touted their neighborhood and community designs for reducing residents' reliance on the automobile by creating compact, mixed use, and pedestrian-friendly developments. However, researchers have not explicitly examined how travel behavior and traffic impacts differ in a tightly controlled comparison of conventional and traditional developments. Additionally, current forecasting models and trip generation procedures need to be tested for their applicability to these new developments. This report aims to fill that void by studying a matched-pair of neighborhoods: One conventional and one traditional. The neighborhoods are located in the Chapel Hill/Carrboro area of North Carolina. Traffic counts were taken at all entrances and exits to the developments and a detailed behavioral survey of the residents was conducted in the two neighborhoods during 2003. The results show that households in Southern Village, the TND, make about the same amount of total trips, but significantly fewer automobile trips, fewer external trips and they travel fewer miles, when compared to households in the conventional neighborhoods. However, this reduction of trips in a suburban environment does little to decrease delay at "over-designed" intersections along major highways. Finally, ITE trip generation methods and rates are acceptable for predicting the trip generation of the study neighborhoods. The implications of these results are discussed in the report.

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Executive Summary

Introduction

Traditional Neighborhood Developments (TNDs) are characterized by human-scale, walkable, and transit friendly communities with moderate to high densities and a mixed-use core. TNDs are becoming increasingly popular in the United States and North Carolina, and they are expected to encourage walking and bicycling and increase the percentage of trips performed inside the development, due to the mixture of land uses.

Over the past decade, a number of Traditional Neighborhood Developments were completed in the Triangle Area. Examples include Southern Village and Meadowmont in Chapel Hill, and Carpenter Village in Cary. As these types of neighborhoods become increasingly popular, a closer assessment of the traffic impacts of TND designs becomes warranted. Conceptually, TND design encourages walking by decreasing distances to shops and businesses and creating a pleasant and safe neighborhood environment. Even without an increase in walking, TND designs intend to capture vehicular trips within neighborhood boundaries by providing amenities in the village centers, as well as, cause a mode shift towards public transportation, the implementation of which becomes more viable in a more denser development style.

However, the differences in traveler behavior and the resulting effects on traffic of these developments are yet to be determined and scientific analyses are required to assess whether proclaimed benefits of the design are indeed occurring. Current forecasting models and trip generation procedures need to be tested for their applicability to these new developments. This research report assesses the impacts of a TND neighborhood by comparing trip generation and traffic impact analysis results to actual traffic counts taken at the neighborhood boundaries and by investigating the results of resident and business surveys taken in the Southern Village (TND neighborhood) and Northern Carrboro developments (conventional neighborhoods) near Chapel Hill North, Carolina.

Project Scope and Objectives

Traditional Neighborhood Developments (TNDs) are planned in a relatively high-density design and combine a mix of land uses within the boundaries of the development. Chapter 7 of the Institute of Transportation Engineers (ITE) Trip Generation Handbook defines Multi-Use Developments as “typically a single real-estate project that consists of two of more ITE land use classifications between which trips can be made without using the off-site road system”. Southern Village, a development south of Chapel Hill, NC was designed in the style of TNDs and fits the ITE definition of multi-use development because it contains houses, shops, restaurants, a grocery store, a movie theatre, offices, a day care center, and a an elementary school within its boundaries.

For comparative purposes, a second residential area was chosen, which was not designed in the style of TNDs. The Northern Carrboro neighborhoods, also near Chapel Hill, NC, were selected because they were determined to best represent the opposite side of the spectrum in relation to Southern Village with respect to factors that might influence the number of trips people make

and how likely people are to use walking, biking or transit for trips. These factors include: mix of uses, density or "compactness" of development, availability/quality of pedestrian and bike features (sidewalks, bike lanes, etc.), availability/quality of transit service, street connectivity, site design/layout features, and proximity to destinations. By choosing the Northern Carrboro neighborhoods, we get to see two ends of the spectrum on these related factors for what are expected to be similar demographic groups, thus any differences in travel behavior should represent two endpoints.

By comparing Southern Village with Lake Hogan Farms (a conventional development within the Northern Carrboro neighborhoods), we can compare differences in trip generation and actual traffic volumes for one example of each development form. In this study, only these two neighborhoods were assessed and all results are only proven to be applicable for these two examples. Generalizations for other TNDs in North Carolina or nationwide, therefore have to be treated with care.

TNDs are expected to encourage the use of alternative modes, and increase internal trip capture rates ultimately reducing congestion, vehicle miles traveled and to improve air quality. The behavioral trip generation portion of this study assesses if indeed trip generation rates and alternative mode use are any different in Southern Village compared with more conventional developments in Northern Carrboro. The study conducted a resident survey of Southern Village TND and Northern Carrboro conventional neighborhoods (N=453 households) and also collected spatial data on the developments. In addition, data regarding trips to on-site commercial and retail offices in the Southern Village TND was collected to understand the travel characteristics of office and retail users. The study survey attempts to distinguish between trip types, such as home-based-work or home-based-other, and to estimate the effects of TND design such as trip chaining, mode choice, internal capture, and pass-by trips.

For the two neighborhoods, typical traffic impact analysis (TIA) methods were also utilized to explore TND trip generation. Traffic generation was performed using the methods developed by ITE, as well as, spreadsheet implementations of these methods developed by a consultant. As an additional method to explore trip generation the study used the Triangle Regional Travel Demand Model to obtain further trip estimates. It was not the objective of this study to develop new methods for traffic forecasting, but rather to apply, verify and validate existing ones. In that regard all traffic generation estimates were compared to traffic counts taken on streets entering/exiting the neighborhood.

The focus of the traffic generation portion of this study is on the total site traffic generated and overall volumes counted at the entrances and exits to the developments. The study did not look at internal distribution and did not distinguish between trip types, such as home-based-work or home-based-other. Other proclaimed features and effects of TND design such as trip chaining, mode choice, internal capture, and pass-by trips are discussed in the literature review, and are analyzed in the traffic generation portion of the document to the extent that they affect the total traffic volumes entering and exiting the neighborhood. The traffic generation estimates and methods reflect and validate current practice of consultants and public agencies.

Conclusions

In terms of traveler behavior this study finds no statistically significant difference between the *total* trips made by households in the Southern Village TND and the comparable conventional developments. However, TND households substituted driving trips with alternative modes, i.e., the *automobile* trip generation rate for the TND was significantly lower (by 1.25 trips per day per household) than conventional neighborhoods. In addition, empirical evidence suggests that TND households have:

- Lower vehicle miles traveled—on average, the TND single-family households travel 18 miles less per day.
- Higher share of alternative modes—in the TND, 78.4 percent of the trips were by personal vehicle compared with 89.9 percent in the conventional neighborhoods.
- Lower external trips—on average, the TND households made 1.53 fewer external trips per day.

The TND examined in this study internally captured a substantial share of the total trips produced (20.2 percent). By comparison, the conventional neighborhoods internally captured a much smaller share of the total trips (5.5 percent). Therefore the difference between the internal trip capture rates for the two development types is 14.7 percent.

The Southern Village TND business survey asked business managers about their employees and customers/visitors. It revealed that only 5.2 percent of the 432 employees reside in Southern Village and a large majority of the employees (92.4 percent) use personal vehicles to commute to work. This is not surprising given the free employee parking in Southern Village and relatively high levels of automobile ownership by people who work. A significant percentage of customers/visitors (39.2 percent) reside in Southern Village; about 18.1 percent of the total trips attracted to Southern Village businesses are reportedly by walking. The results show that Southern Village employees use passenger cars as often as employees in conventional facilities, but that customers/visitors are more likely to walk. Off-site employees and customers/visitors make up a majority of trips attracted to the TND businesses.

Examination of the ITE methods for trip generation, and comparison of trip generation results to counts taken at both Southern Village and Lake Hogan Farms, verify the ITE methods for trip generation for mixed-use and conventional neighborhoods. The Triangle Regional Model was too aggregate to study single neighborhoods. A study of the micro-simulation VISSIM and other simulation models shows that such simulations hold promise for single neighborhood analysis, particularly with respect to internal vehicle and pedestrian circulation.

A sensitivity analysis of the affect of internal capture on access traffic indicated that the reduction in vehicle trips due to the internal capture of Southern Village does not significantly improve the level of service of the intersections adjacent to the development, even during the peak hour. A development located in a more urban area may have larger internal capture effects due to the greater interconnectivity of surface streets and an increase in the number of shopping and work opportunities available to the residents of the area.

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Chapter 1: Introduction

This report presents the findings of a study on travel behavior and trip generation associated with a traditional neighborhood development (TND) and how TND travel characteristics are different from those in a nearby conventional suburban development. The Department of City and Regional Planning of the University of North Carolina at Chapel Hill and the Department of Civil, Construction, and Environmental Engineering at North Carolina State University completed the research for the North Carolina Department of Transportation (NCDOT). While the UNC-Chapel Hill team focused on resident and business surveys and the travel behavior of the residents of the neighborhoods, the N.C. State team concentrated on trip generation procedures, vehicle counts leaving the development, and traffic impacts on adjacent streets.

Problem

The number of neighborhood-scale new urbanist projects completed or under construction rose 37 percent between 2000 and 2001 and has risen by 20 percent or more per year over the past five years.[1] An estimated 1.4 million people reside in new urbanist communities (Berke *et al*. 2003). More than half of these projects were built on Greenfield sites. Such neighborhoods are emerging in North Carolina, and in fact, North Carolina Department of Transportation (NCDOT) has issued guidelines for designing Traditional Neighborhood Developments (TNDs). Over the past decade, a number of TNDs have been completed in the Research Triangle Area. Examples include Southern Village and Meadowmont in Chapel Hill, Carpenter Village in Cary, and North Hills in Raleigh. Unlike the conventional development practices of the 1970s and 1980s, typified by single-use, large lot residential developments with strip commercial centers located on the periphery and businesses located in separate business parks, new urbanist/traditional community design stresses a mix of uses compactly arranged in a single development. Planning theorists believe that individuals rely on automobiles to travel from place to place in conventional communities because each land use, such as residential, commercial, and business, is separated and spread out. When pedestrian-oriented design features such as continuous sidewalks and street trees are combined with the mixed land uses typically found in traditional communities, individuals should theoretically drive less and walk more. To investigate this hypothesis, the following report explores the impacts of a TND on trip production and attraction, mode choice, and trip chaining by comparing and analyzing the differences in travel behavior between a conventional neighborhood, a TND, and the Triangle region (Raleigh-Durham-Chapel Hill). One fundamental research question that we will attempt to answer is: Do residents of TNDs in North Carolina have lower trip generation rates, automobile use and vehicle miles traveled compared with more conventional, auto-oriented neighborhoods?

Additionally, as these types of neighborhoods become increasingly popular, a closer assessment of traffic impacts caused by TND designs becomes warranted. The TND development form is a fairly new design concept, and there are few existing TNDs in North Carolina upon which to base trip generation and traffic forecasts. Trip generation and traffic impact analysis methods that are commonly used for new suburban neighborhoods may or may not be appropriate for TND traffic impact analyses. It is essential, however, for traffic forecasting and trip generation

[1] These projects are greater than 15 acres. Source: New Urban News, 2001, "New urbanist project construction starts soar." http://www.newurbannews.com/annualsurvey.html

professionals to obtain reliable estimates of traffic volumes resulting from a new TND plan in order to develop street access and have the plan approved by local officials.

Without reliable forecasting techniques, disputes may arise for a new TND. Developers may claim reduced TND traffic impacts while city officials seek mitigation for the TND traffic generated. Furthermore, if the TND access uses state roads, NCDOT must review and approve the TND plan. Thus, it is essential for NCDOT to have a reliable method to substantiate TND traffic impact analyses.

This research report assesses impacts of a TND neighborhood by comparing trip generation and traffic impact analysis results to actual traffic counts taken at the neighborhood boundaries. The study includes one neighborhood that meets TND standards and one neighborhood that is designed in a conventional single-use suburban design.

Scope and Definition of Terms for Travel Behavior

Before proceeding further, we will define and discuss a number of key terms. A trip is defined as the movement of a person in space (at least 300 feet) and time. In this study we focus on daily trips, which are mostly done within a city/region, i.e., the trips studied are less than 100 miles. The two neighborhood types that were surveyed in the study had distinctly different land use characteristics and their boundaries were clearly defined, e.g., Southern Village is a TND, with residents having a fairly clear idea of the shape and size of the development. We will refer to new urbanist, neotraditional neighborhoods as traditional neighborhood developments.

Trip generation is composed of both trip productions and trip attractions. We analyze residential trip productions and the trips analyzed include bicycling and walking modes. The trip purposes analyzed included: Home-based work, home-based shop, home-based school, home-based other, and non-home-based. While trip production is expressed as a function of socio-economic data and/or population at the household level, such as household size, number of cars present, and household income, trip attraction is expressed as function of land use, employment, and/or other economic activities such as shopping and entertainment destinations. As part of our study, we will estimate trip generation models to quantify and compare trip generation rates across traditional and conventional neighborhoods and also compare them with the larger Triangle region trip generation rates. This study also explores trip attractions in the TND by surveying the businesses.

Mode choice is an individual's selection from a variety of transportation options, including private vehicle, bus, walking, and bicycling. It is most often a function of time, cost and socioeconomic variables; and of course it depends on the availability of alternatives. For instance, an individual may choose to drive because their destination is far away, they need to transport people or goods, and/or there are no alternatives, such as public transportation. Conversely, a person may choose to walk when their destination is nearby, they are not transporting other people or goods, and/or there is a network of sidewalks and trails connecting them to their destination. More intangible, however, is the appeal of using various modes of transportation. For instance, some people may prefer driving because of the freedom this choice permits, while other people prefer riding the bus so they can work while they commute. This

study will examine mode choice within the framework trip generation, i.e., number of automobile trips that are generated.

Trip chaining is another component of trip generation and is defined as the process of making a series of non-home based trips in a row. Trip chaining is composed of stops and each chain of stops is known as a tour. An example of trip chaining is running errands, which is more convenient for single occupant automobile users than for carpoolers or transit users. Trip chaining is generally considered more efficient than returning home after each destination is reached. However, the distribution and distance of the destinations should be considered before such conclusions can accurately be made. For instance, it may be more efficient to chain trips when the origination is located far from destinations and/or when the destinations are clustered in one or a few areas, away from the origination of the trip. However, it may not necessarily be efficient to chain trips when alternative modes, such as transit or walking, are available, the origination is close to the destinations and the destinations are spread out around the origination. Regardless, many people may choose to chain trips once they have begun running errands despite what may be most efficient. Because trip chaining has not been thoroughly studied, this study attempts to understand trip chaining in the traditional versus conventional context.

Scope and Objectives for Trip Generation

The objective of this portion of the study is to determine the reliability of currently accepted traffic forecasting methods, not to develop new methods. The focus of this report is on the total site traffic generated and the traffic volumes at the entrances and exits to Southern Village (TND) and Lake Hogan Farms (conventional suburban development, or CSD) in Chapel Hill, NC. The specific objectives of the study are:

- To estimate, count, and compare site traffic at a TND and a CSD using conventional traffic impact analysis (TIA) and travel demand model (TDM) methods
- To compare TND and CSD trip rates implied from travel diaries to published trip rates, including internal capture rates
- To recommend changes (if any) in NCDOT traffic impact analysis methods and TDM methods to address the specific travel impacts of TNDs

Chapter 7 of the ITE Trip Generation Handbook defines multi-use developments as “typically a single real-estate project that consists of two or more ITE land use classifications between which trips can be made without using the off-site road system” (ITE, 2001). Southern Village was designed as a TND and fits the ITE definition of a multi-use development. The Southern Village area contains houses, shops, restaurants, a grocery store, a movie theatre, offices, a day care center, and an elementary school within its boundaries.

For comparative purposes, a conventional suburban development (CSD) was studied. Lake Hogan Farms was selected as the comparison neighborhood because it is similar to the size, location, and demographics of Southern Village. However, such factors as mix of land uses, density or “compactness” of development, availability/quality of pedestrian and bike features (sidewalks, bike lanes, etc.), availability/quality of transit service, street connectivity, site design/layout features, and proximity to destinations are quite different from Southern Village.

By comparing these two neighborhoods that share similar demographic groups but have different design elements, it is possible to compare trip generation and actual traffic volumes for each type of development. This study should yield significant insight into the trip generation characteristics of TNDs but generalizations for other TNDs in North Carolina or nationwide must be treated with care, due to the location and relative youth of the Southern Village development in comparison to older developments that may have the same retail and commercial opportunities but are more integrated into the urban fabric.

Typical traffic impact analysis (TIA) methods were utilized for both neighborhoods. Trip generation was performed using the methods developed by ITE and implemented in spreadsheets. The study used the travel demand model (TDM) "Triangle Regional Model" to obtain additional trip estimates for further comparison

Chapter Summary

This chapter gave an overview of the project. Various problems related to TNDs were highlighted and the cope and objectives of this study were determined. Various terms related to trip making were also defined.

Chapter 2: Literature Review
Traffic Impacts and Assessment Methods For Traditional Neighborhood Developments

Introduction

In the 1990's, a planning movement known as "The New Urbanism" led to the design and construction of a new category of neighborhoods across the nation. These "*Neotraditional Neighborhood Developments*" create more livable mixed land-use communities that promote walking and bicycle use, thereby reducing traffic congestion and related impacts. They feature compact residential development combined with additional land-uses like retail, office, and recreational facilities in a grid-pattern street design. The term "neotraditional" refers to the revitalized idea of the pre-World War II "traditional" design of closely connected, higher density urban neighborhoods, that preceded the 1950's trend of "suburban" neighborhood developments. In this review, the term "traditional neighborhood development" (TND) will be used. TND examples in North Carolina include Falls River in Raleigh, Carpenter Village in Cary, and Meadowmont and Southern Village in Chapel Hill. Street and land-use design concepts for such TNDs are available to planners, engineers and architects. Relatively few U.S. researchers have attempted to determine how effective the neotraditional street and land-use designs really are in reducing traffic impacts compared to conventional suburban developments. Studies for North Carolina TNDs do not exist. This literature review examines TND features, particularly related to resident travel behavior and traffic issues, and evaluates alternative methods to estimate traffic impacts caused by these types of neighborhoods.

TND Design Issues and Resident Travel Behavior

This section provides a summary of the literature and identifies gaps in the literature. While the relationship between design and travel behavior has been studied broadly for large areas, it has not been studied specifically on the neighborhood scale for actual traditional neighborhoods. As the following literature shows, not only have the study areas been much larger and more difficult to define than actual neighborhoods, but studies have used traditional neighborhoods as a proxy for traditional neighborhoods primarily because few "mature" traditional neighborhoods exist (Crane, 1996; Cervero, 1995). However, this substitution is often not justifiable because (neo)traditional neighborhoods are often constructed on undeveloped areas on the fringe of city limits, whereas traditional neighborhoods, usually defined as neighborhoods built prior to World War II, are well-integrated into the urban fabric of the city as subsequent development has occurred around these neighborhoods. Additionally, some studies have found that income levels in traditional neighborhoods are lower than in more auto-oriented areas (Cervero, 1996), while this is not always the case for residents of (neo)traditional neighborhoods. Finally, many of the findings of the studies that examine the relationship between travel behavior and urban form may be applicable for the area where the studies were conducted, mainly in highly-urbanized regions of California, but are not applicable to other areas of the country. For these reasons and in the context of the current breadth of literature, we feel that the findings of our study will help broaden the understanding of the relationship between travel behavior and urban form and will be more useful in considering future traditional developments in North Carolina.

First, it is necessary to look at the existing literature on the topic. A number of studies have broadly examined the impact of community form on travel behavior (Appendix A).[2] Using factor analysis, Cervero and Kockelman (1997) found that density, diverse land-uses, and pedestrian-oriented design dimensions of the built environment encourage non-auto travel in marginally statistically significant ways that differed between trip purposes and modal choice: compact development had the strongest influence on personal business trips, within-neighborhood retail shops had the strongest influence on mode choice for work trips, and people living in neighborhoods with grid street designs and restricted commercial parking averaged significantly fewer vehicle miles of travel and relied less on single-occupant vehicles for non-work trips.

Because urban form has the potential to increase walking and therefore physical activity rates, a number of public health related studies have been undertaken on the topic. Two such studies illustrate the type of work being done in the public health field. Craig *et al.* (2002) studied the effect of the physical environment on physical activity by rating eighteen neighborhood characteristics and correlating the scores with walking to work, as reported by households in the Canadian census. Though some of the characteristics could have been rated subjectively, they found that characteristics associated with traditional design, including density and the presence of mixed land uses, were correlated with walking to work. In a national study of the relationship between walking and urban form, Berrigan and Troiano (2002) found that people who lived in urbanized areas in homes built prior to 1946 and between 1946 and 1973 were significantly more likely to walk than people living in homes built after 1973. They argue that home age is a useful proxy for neighborhood design; however the designs of neighborhoods built between 1946 and 1973 vary greatly and are not always consistent with neighborhoods built before 1946.

On the transportation and city planning side of the neighborhood design, Ewing and Cervero (2001) recently conducted a seminal literature review of the topic. With respect to neighborhood/activity center design impacts on travel behavior, many of the cases they reviewed used traditional neighborhoods as a proxy for neotraditional neighborhoods and were mainly set in California. Additionally, the conventional neighborhoods used in those studies were built anytime between the end of World War II and present day. The authors found that trip frequencies depend mainly on household socioeconomic characteristics and that travel demand is inelastic with respect to accessibility. Trip frequencies are therefore a secondary function of the built environment.

Ewing and Cervero (2001) also found that walking is more prevalent and that trip lengths are generally shorter in traditional urban settings. While trip lengths are primarily a function of the built environment and secondarily a factor of socioeconomic characteristics, mode choices depend on both, though perhaps less so on the built environment. With respect to the prevalence of walking, Ewing and Cervero (2001) make two important points. First, the prevalence of walking may be due to a self-selecting process, that is to say that people who like to walk choose to live in neighborhoods with a supportive walking environment. Second, it is unclear as to whether walking trips in traditional neighborhoods substitute or supplement longer automobile trips. However, the findings of at least two studies (Cervero and Radisch, 1996; Handy 1996) support the substitution possibility.

[2] Handy *et al* (2002) recently identified over 70 such studies in just the 1990s.

In most instances, these studies involve the use of travel behavior data over large urban areas or multiple neighborhood sites. While travel behavior data usually come from metropolitan travel surveys, neighborhood data are extracted from census tract information or local land use inventory databases and are sometimes supplemented with neighborhood surveys created by the authors of the study. These approaches are fraught with difficulties. Travel behavior data from metropolitan surveys rarely yield enough observations per census tract; therefore, tracts are often combined. These methods may not adequately represent neighborhoods, as single or multiple census tracts rarely follow or capture neighborhood boundaries (Crane and Crepeau, 1998).

Additionally, neighborhood environmental data is usually separated into multiple attributes, such as sidewalk width, social dynamics, four-way intersection frequency, street layout (grid vs. curvilinear), mix of uses, population density, job density, the presence of other people, and visual interest. In line with Cervero (1993), design elements, such as sidewalk width or presence of street trees "are too 'micro' to exert any fundamental influences on travel behavior." Additionally, not only are some of these attributes, such as "visual interest" or "ease of street crossing", difficult to measure objectively and/or consistently (Handy *et al.*, 2002; Ewing and Cervero, 2001), but the multicolinearity and statistical interaction between the attributes render many of the built environment variables statistically insignificant.[3]

Each of the attributes mentioned above can be grouped into what Cervero refers to as the '3-Ds': density, diversity, and design. While density may be relatively easy to measure, diversity and design elements typically are not. Cervero and Kockelman (1997) correctly note that it is the synergy of the 3-Ds in combination that is more likely to yield appreciable impacts with regard to travel behavior. Instead of attempting to determine the impact of each neighborhood attribute or to use complicated factor analysis that results in multiple, difficult to interpret variables (Ewing and Cervero, 2001), neighborhood qualities are best identified as a whole. In this manner, we can best capture the interaction between the 3-Ds.

As in the design of this study, Cervero and Radisch (1996) use a matched-pair comparison of two neighborhood types in the San Francisco Bay Area to measure the impact of the synergy of the 3-Ds. They found that the compact, mixed-use, and pedestrian-oriented nature of a traditional neighborhood resulted in a significantly lower share of automobile trips. These trips were replaced by a higher share of walking and transit trips compared to the trips made in a conventional neighborhood.

While Cervero and Radisch's (1996) study is rightly criticized for failing to isolate the effects of different elements of urban design on travel behavior and their magnitudes (Ewing and Cervero, 2001; Crane and Crepeau, 1998; Handy, 1996), we believe it is a simple and effective way to gauge the overall impact of such developments on travel behavior. Past studies have attempted to tease out the individual effects of various design elements with limited success. Unfortunately, few elements are found to be statistically significant influences in multiple studies (Boarnet and Crane, 2001) and some are regarded as spurious (Ewing and Cervero, 2001). Hypothetically, even if such elements were consistently identified, the utility of such findings would be debatable, as planners and developers who then incorporated statistically significant elements

[3] Cervero and Kockelman (1997)

into their designs (such as street trees) and ignored statistically insignificant elements (such as having continuous sidewalks) may yield little change in travel behavior (in this case, walking).

Though their methodology is similar to our study, significant differences exist. Whereas Cervero and Radisch used two neighborhoods built before and after World War II in their study – Lafayette as a conventional suburban neighborhood and Rockbridge as a proxy for a neo-traditional neighborhood – we use new neighborhoods built in the last decade – the northern Carrboro neighborhoods (Lake Hogan Farms, Wexford, Fairoaks, Sunset Creek, and the Highlands) as conventional suburban neighborhoods and Southern Village as an actual neo-traditional neighborhood. A number of other studies have used traditional neighborhoods as a proxy for neotraditional neighborhoods.[4] By using an actual neotraditional neighborhood in our study, we are able to control for the age of the development with respect to its more conventional counterpart and we are better able to represent the travel behavior impacts of proposed and existing traditional neighborhoods.

Though the neighborhoods Cervero and Radisch used contain a similar mix of elements to those of our neighborhoods (Lafayette and the northern Carrboro neighborhoods are primarily single use neighborhoods with homes placed on large lots and Rockbridge and Southern Village are denser, mixed-use neighborhoods), noticeable differences exist. First, Lafayette and Rockbridge are larger than the northern Carrboro neighborhoods and Southern Village. Additionally, because these neighborhoods are older, they are also surrounded by development, while the northern Carrboro neighborhoods and Southern Village are located on the fringe of the city limits. Additionally, Lafayette has a commercial corridor while the northern Carrboro neighborhoods do not. Both Bay Area neighborhoods have rail (BART) stations near their commercial districts while only Southern Village is served by bus transit. Finally, Handy (1996) correctly notes that, "the findings of the numerous West Coast studies, especially those in the Bay area, may not prove to be fully generalizable to other parts of the U.S." due to such differences as urban form, culture, and topography. Our study is the first of its kind in this area of the country and will broaden our understanding of how travel patterns may differ in various geographic regions. Overall, while Lafayette and Rockbridge best capture the differences in travel behavior between older, larger, transit-served neighborhoods that are more integrated into urban areas, the northern Carrboro neighborhoods and Southern Village best capture the differences in travel behavior between new, smaller, less transit-oriented developments that are less integrated into urban areas. While not typical of all new development, the northern Carrboro neighborhoods and Southern Village do represent the types of neighborhoods being proposed and built in many areas of North Carolina (e.g., Afton Village, Vermillion and Cheshire) and the rest of the country.

TND Issues Related to Traffic Impact Analyses

In the early 1990's, around the time when the first neotraditional neighborhoods were being constructed, several studies attempted to predict the effect of the new land-use design on vehicular traffic by comparing hypothetical models of traditional neighborhood developments (TND) to conventional suburban developments (CSD). Cevero and Landis (1995) concluded in their study that land-use could be an important contributor to transportation trends and vice

[4] Dozens of such studies exist; see Ewing and Cervero (2001) for a listing.

versa. Stone, Foster and Johnson (1992) examined two hypothetical street designs and found that TND land-use strategies would lead to a significant reduction in vehicle miles traveled (VMT) for a 5%-15% transit/pedestrian modal split compared to a suburban neighborhood; even with 100% automobile travel, the TND would still reduce VMT, though marginally. Additional infrastructure savings accrue to efficient TND design.

Similarly, McNally and Ryan (1993) used transportation planning models to evaluate and compare the performance of two hypothetical TND and CSD street systems and found relative benefits in VMT and average trip length, as well as congestion on links, in the neotraditional design. They determined trip rates by trip generation and then used a gravity model for trip distribution. The proportions of internal and external trips as well as the production/attraction split were based on assumptions, since it was a hypothetical study with no actual traffic counts available. In an earlier study, Ryan (1991) performed a quantitative analysis of two hypothetical street networks and obtained similar results of reduced VMT and average trip length. But again, the researchers had to make assumptions and generalizations about travel behavior as no actual counts or surveys were taken. The study focused on the internal operation of the street network and neglected external street effects of the development. In yet another study Kulash, Anglin and Marks (1990) found the TND design to have lower vehicle miles traveled on arterials and collectors, a lower volume-to-capacity ratio and higher level of service (LOS) on arterials compared to suburban neighborhoods.

In his 1998 dissertation study, Fatih Rifki (1998) concluded, after applying a series of multiple regression models to data from metropolitan Washington, DC, that aspects of urban spatial structure such as land-use, density, and accessibility do indeed have an effect on travel patterns of city dwellers. Stephen P. Gordon (1991), whose study predicted a reduction in VMT, listed three reasons for the benefits of TNDs: a large internalization of trips, a reduction in auto mode split, and a high capture of jobs within the development. In 1992 Gordon participated in a second study together with Friedman and Peers (1992) in which the researchers also concluded that TNDs have characteristics that result in fewer automobile trips than do current suburban developments. Bookout (1992) pointed to another potential benefit of traditional neighborhoods when he argued that congestion at individual links in the street network would be reduced because the drivers have alternate routes between points. Supporting the notion that traditional neighborhood development reduces traffic impacts, a recent study by Rajamani, Bhat, Handy, Knaap and Song (2002), found that "higher residential densities and mixed-uses promote walking behavior for non-work activities." Together with their claim that only one quarter of urban trips are actually work related, it seems likely that a traditional street system that promotes pedestrian walking to nearby destinations on pleasant walkways does indeed result in a reduction of vehicular traffic within as well as out of the development.

One of the authors who question the actual transportation benefits of TND design is Randall Crane (1996), who claimed that analyses of a potential change in demand of the new street pattern had to be made. He stated in explanation that the grid design results in an increase in access, which reduces the cost of travel and thus may encourage people to take more trips. In contradiction to the hypothetical studies mentioned in the previous paragraph, Crane's (1998) statistical regression analysis of actual travel data showed "no evidence that the neighborhood street pattern affects either car-trip generation or mode choice." In another study, Ewing and

DeAnna (1996) also found "no significant, independent effects of residential density, mixed land-use, and accessibility on household trip rates." As an explanation, Kitamura, Mokhtarian, and Laidet (1994) argue that "attitudes were more strongly correlated to travel behavior than neighborhood characteristics," and TND design would therefore have at best indirect effects on traffic. For example, TNDs may attract people who inherently prefer walking rather than to actually cause a reduction in automobile trips of all residents through design. Another important issue related to neotraditional neighborhood design in this context is externally attracted traffic. This phenomenon that Pryne (2003) referred to in a *Seattle Times* article as "induced travel," describes an increase in traffic volume that is not generated by growth or other demographic forces but by the expansion of the road system, or in this case, the neighborhood development itself. In other words, it is unclear how much additional traffic is generated by a neotraditional development due to the attraction of its nature of mixed land-use, which would not be an issue in a conventional single land-use residential development. According to Stephen Littman (2001), "generated traffic reduces the congestion-reduction benefit that can result from increased road capacity." The improved road network of a TND may therefore induce additional traffic as residents and possibly shoppers from outside the development wish to take advantage of the lower delay times and convenient on-street parking as compared to shopping in a strip mall, for example.

These results from the literature suggest that despite the compact, mixed-use development and the new grid pattern, traditional neighborhood developments do not inherently reduce travel. If so, conventional trip generation models for single use sites as outlined in Institute of Transportation Engineer's (ITE) "Trip Generation Manual" (1997) may be applicable to traditional, mixed-use developments, with little or no trip rate reductions for "internal capture." However, as a result of its own research, ITE has recently published the "Trip Generation Handbook" (2001) as a supplement to its current manual to account for assumed internal capture and pass-by trips in multi-use developments. In several studies conducted by the Florida DOT (Tindale et. al 1994 and Keller 1995) that form the empirical justification for the new ITE handbook, internal capture rates, which reduce site traffic impacts, were as great as 30-40% and reductions in trip rates from pass-by trips approached 30%. The FDOT studies utilized large-scale mixed-use developments and are not necessarily representative of the traffic impacts of smaller neotraditional neighborhoods such as those in North Carolina. They do suggest, however, that further research on trip generation methods and their applicability to local TNDs is necessary.

Research on traditional neighborhood street and land-use design using hypothetical models suggests reductions in vehicle miles traveled within, as well as external to, the development. This conclusion is supported by traffic studies on large-scale multi-use developments by FDOT. ITE applies these findings to modify conventional trip generation methods in its "Trip Generation Handbook." However, no work has been accomplished for actual traditional neighborhoods of a scale typical in North Carolina. Other studies show no statistically significant traffic reductions. Thus, the premise of reduced traffic impacts of TNDs may not be fulfilled.

In summary, the conflicting views regarding traffic impacts at traditional neighborhood developments are as follows:

1. Internal TND automobile traffic decreases if walking trips to internal attractions increase.
2. Exiting TND traffic decreases if internal attractions capture trips and increase trip chaining
3. Congestion at TND intersections decreases if an increased number of intersections distribute traffic more evenly.

On the other hand …

4. TNDs with shopping, employment and entertainment opportunities may attract traffic from external origins, which increases internal and external traffic.
5. Relatively uncongested TND streets may induce additional internal automobile travel due to efficient street network and convenient on-street parking.

Traffic Impact Analysis Methods Applicable to TNDs

Due to the relative "youth" of the "New Urbanism" planning movement, research on neotraditional neighborhood developments is relatively scarce. The majority of the studies mentioned in this review either utilized hypothetical computer models of TND and CSD street designs for comparison or used older traditional developments as a proxy for neo-traditional design (Ewing and Cervero 2001). Considering the relative scarcity of applicable studies, the question for adequate models and means of analyzing TND traffic behavior is difficult to approach. Even after extensively searching online databases, scientific journals, and engineering libraries, no reference to published results of research evaluating methods of traffic impact analysis in their applicability and validity for TND street systems could be found. A likely explanation for the lack of studies is that traffic impact analyses are typically completed by consultants for specific project sites and, therefore, have very practical applications, rather than publishable extensions of theory. Consequently, the following review concentrates on traffic impact analyses (TIA) by consultants. Furthermore, it will evaluate which method will be most appropriate for the case of a traditional neighborhood development.

The Oberlin case is a recent example of a traffic impact analysis of a proposed mixed-use development that caused significant public controversy in Raleigh, NC. According to Geary (2001), the traffic consultants found that the proposed mixed-use development would not push the adjacent Oberlin Road and Wade Avenue over capacity. Interestingly, citizen groups from the surrounding traditional neighborhoods of modest homes strongly opposed this construction of several six to eight story buildings. Ultimately, the citizens convinced City Council and the developer to withdraw plans for the development after completing their own local traffic counts and producing an independent estimate of unacceptable traffic impacts. This case highlights the issues of using appropriate methods of TIA analysis, local or national trip generation rates, and professional judgment or guidelines to adjust trip rates for internal capture, pass-by traffic and transit. Other available TIA studies for proposed developments in North Carolina show that the typical method for trip generation uses ITE trip generation rates and adjustments combined with professional estimates of the reductions for pass-by trips and internal capture. The ITE trip generation method was also utilized in the original traffic impact study for the Southern Village TND. As the ITE trip generation handbook had not been published at that time, adjustments for internal capture were made based on estimates derived from a local transportation study and a

total of 33% of trips were predicted to remain within the development. Furthermore, a 5% reduction of trips related to the use of public transportation and non-motorized transportation modes was assumed. Traffic distribution and assignment at entrances to the development were estimated from existing traffic counts and turning volumes.

The critical issues related to TIA studies and trip generation are the "professional estimates" of trip rates and their adjustments to account for local travel preferences and behavior. It therefore seems necessary to choose or possibly generate a TIA methodology or a combination of acceptable methods that can predict the impacts of mixed-use TNDs in North Carolina accurately and with confidence. Clear guidelines on how traveler preferences and attitudes are best modeled need to be developed. A systematic review of different categories of TIA methods will help accomplish this goal. Then testing one method against the other for actual North Carolina TND and CSD sites will demonstrate the need for modifications to the TIA methods.

Synopsis of Methods for Traffic Impact Analysis

Consultants use TIA methods to predict internal and external traffic impacts of proposed neotraditional neighborhood design as well as conventional suburban developments, commercial developments, etc. City and State agencies require TIAs from developers as part of the site review process. Before agencies issue building permits, developers must agree to pay for any needed traffic mitigation measures such as signals and turn lanes on roadways adjacent to the site. In addition, the agencies may constrain locations for driveways and access to roads to the proposed sites, all depending on the results of the TIA.

Methods for traffic impact analysis include four broad categories:

I. Site-specific deterministic methods
II. Site-specific traffic simulations
III. Regional travel demand models
IV. Travel demand models integrated with simulation

Some of these methods represent complete traffic impact analyses; others rely on additional techniques to estimate site generated traffic and its distribution and assignment to streets and highways. Most methods generate traffic using ITE trip rates and adjustments or professional judgment. Subsequent trip distribution and assignment may result from integrates and automated computer programs or from manual methods based on professional judgment and assumptions. The resulting internal and external site traffic, plus "background" traffic are evaluated using Highway Capacity Manual (2000) methods to estimate traffic congestion and to test geometric and signal mitigation options.

Planners and engineers usually make the following assumptions for TIAs of typical developments and TNDs:

1. Study Area: (scope/area, land-use, network) The extent of the traffic impact study area may be as close as bordering streets and intersections or as far as all facilities having 10%-15% traffic increase or level of service decrement. Proposed total build-out land-uses must be

known for the development, as well as existing and proposed roadways and transit services for the built-out (design) year.

2. Build-out year and phasing: Construction phasing and intended built-out year give the annual and future year traffic impacts that are added to forecast background traffic.

3. Background traffic growth: Background traffic represents the traffic that would be on the roadways adjacent to the site whether it is built or not. Initial (base year) estimates result from detailed traffic counts in the study area. Usually background traffic increases at rates of 2% to 5% per year depending on the local economy and the capacity of the network to absorb additional traffic.

4. Trip generation: ITE trip generation rates reflect site traffic demand. They are the usual default values most professionals use unless better local data are available. Analysts reduce the rates depending on demonstrated or assumed pass-by traffic, transit use, internal capture of site traffic and trip chaining, which all tend to reduce the site's traffic impacts. Increases in site traffic impacts occur if the site attracts external trips.

5. Trip distribution: Trip distribution mathematically describes how the site's trips disperse throughout the surrounding study area. Larger activity areas with employment and shopping opportunities attract the most trips, however, precise estimates using gravity model approaches are rarely used. Instead, professionals often assume that site traffic distributes proportionally to current year traffic counts on study area streets.

6. Mode choice: Reductions to site automobile traffic usually occur in the trip generation step. Among the possibilities for alternate transportation use are public transit and walking trips, which are especially important in the consideration of mixed use developments like TNDs.

7. Traffic assignment: How the network is loaded depends on the traffic assignment method. Manual methods typically assume all-or-nothing loading with no adjustments for street capacity constraints. Such assignment highlights street, driveways and intersections needing mitigation. Computerized methods recognize street capacities and divert traffic to less traveled links in the network.

8. Traffic impacts: The usual measurements of a site's external traffic impacts on adjacent streets and intersections are levels of service based on traffic volume, speeds, and delays. Highway Capacity Manual (HCM 2000) methods estimate the levels of service for the study area network with and without the proposed site in the future year or during critical phased built-out years. Depending on local and agency requirements and the estimated future traffic congestion, the developer may have to pay for roadway and signal improvements before building permits are issued. Internal traffic impacts in the development are not usually of concern to the agency.

Depending on the extent of the study area, the available data and the resources available for the TIA, more or less constraining assumptions will be made and appropriate TIA methods applied. The following review will compare TIA methods on the basis of several factors regarding their

practicality and feasibility for application to neotraditional neighborhoods and conventional neighborhoods. In particular the factors that are important in this context are:

a. Type of method
- site-specific deterministic method
- site-specific traffic simulations
- regional travel demand model
- travel demand model with simulation

b. Functionality of method
- breadth of study area
- characteristics of land-use and transportation network
- build-out year and project phasing
- background traffic growth
- trip generation and adjustments for internal capture, pass-bys, etc.
- mode choice
- traffic assignment
- traffic impacts

c. Practical Issues
- availability and cost
- amount of data required for input
- user friendliness, training required and model development time

d. Applicability to TND-specific issues
- internal capture and trip chaining
- multi-use design features versus single use CSD
- pass-by trips and externally attracted traffic
- generated or induced traffic
- pedestrian friendliness and walkability of development

e. Inclusion of regional features
- accessibility to transit
- residential and retail employment zones
- demographics of residents' work sites

Site-Specific Deterministic Methods

In this most basic type of traffic impact analysis, trip generation is performed using mathematical equations and graphs derived from site-specific studies in the ITE Trip Generation Manual (ITE 1997). In most practical applications and consulting work for small-scale projects, the resulting vehicle trips are distributed and assigned to the exits and entrances of the site by expert judgment. Usually the trip distribution and assignments are proportional to non-site traffic counts at the site entrances and exits. It is also possible to use more analytical methods like the "gravity model" to distribute trips. The recently published ITE Trip Generation Handbook (ITE 2001) adjusts trip generation values for multi-use developments to account for internal capture and trip

chaining. A variety of commercial, public domain and "ad hoc" spreadsheets are available and commonly used by consultants. The methods have quick, user-friendly input of study area and development features, they provide quick results, and the spreadsheet programming can be easily customized. Internal capture rates that underlie the adjustments for multi-use TND trip generation may be standard ITE adjustments or may be adaptable for various site designs. The site-specific deterministic method neither allows for considerations of street design and other TND features nor makes differentiations between urban and rural location of development or adjustments for other regional features. Finally, the ITE based methods output daily or hourly estimates of traffic volumes for intersections. Traffic distributions and assignments are usually accomplished manually by ad hoc methods. NCDOT utilizes such methods for limited site, intersection and corridor analyses. They are not appropriate for large site developments with regional traffic impacts.

Site-Specific Time-Dependent Simulations

A more sophisticated and time-consuming approach for traffic impact analysis is microscopic traffic simulation using software such as "Vissim" (2002), "Corsim" (2002), and "Traffix" (1999) and others. "Traffix" is a spreadsheet-like program designed for modeling and quantifying turning movements for smaller sites in smaller study areas. It does not feature real-time graphical simulation like the other examples do. Vissim and Corsim are software products that simulate short-term (15-60 minutes) operational models that allow a probabilistic analysis of a specific corridor or street system. The models give TIA output including traffic as a function of time, delay travel time, headway gaps, etc. Animations may be developed, as well as LOS and capacity analyses. Typically, trip generation has to be performed using the ITE method, or local trip rates of similar developments can be used in the model. The simulations are capable of modeling impacts on the network LOS from adding lanes or changes intersection timing plans.

"Corsim" is the model most currently used in the U.S. It is a flow-based simulation model that obtains performance of links from inputting entry and turn volumes. "Vissim" on the other hand is path-based and is recommended practice in most European countries. Path-based simulations reproduce network trip-making behavior and use origin-destination matrices as input. All of the simulation models do, however, require significant user input in the form of traffic counts and trip generation rates and, with the exception of Vissim, trip distribution and network assignments have to be performed manually as well. Simulations, therefore, are particularly useful to evaluate LOS of existing street systems. Similarly, they can estimate performance and impacts of new TND designs, and they are gaining broad acceptance for predicting traffic impacts and testing mitigation measures. However, none of these models reflects demographic factors and socioeconomic data that may be important for TND traffic impact analyses in order to model mixed land-uses and related travel behavior. Also, the simulation programs require significant financial and time investments, which make their application for small-scale projects inefficient. The clear advantage compared to the spreadsheet methods is that simulation models consider and display the actual physical layout of the street network and animate resulting traffic flows. This can be done at the subarea scale of a single neighborhood development, which may permit integration with a regional travel demand model.

Regional Travel Demand Models

Travel Demand Models like "Tranplan" (2002) or "TransCAD" (2002) use socioeconomic census data and survey results to estimate trip generation based on household sizes and income groups, while accounting for area type (urban and rural) and employment features of retail and office locations in the development. In contrast to the simulation models discussed earlier, regional models lead the user through the entire four-step forecasting procedure before the user conducts the actual traffic impact analysis. TransCAD and similar models based on geographic data commonly support regional planning, and thus require significant input as well as specifically trained users. It is also a very time consuming process to develop and calibrate a travel demand model for the particular area of interest. A local North Carolina application of TransCAD is the Triangle Regional Model (TRM) (2002), which divides trip generation into five categories: home-based work, home-based shopping, home-based school, home-based other, and non-home-based. Socioeconomic data of the study area are entered in a regression model in combination with a cross-classification model to give deterministic estimate of traffic volumes throughout the region. The TRM clearly accounts for a number of TND design issues and, therefore, would appear to be a good choice for traffic impact analyses of traditional neighborhood developments. However, the travel demand models do not give time-dependent representations of traffic behavior, as the site-specific simulations are capable of doing. It is also essential that up-to-date data are available; otherwise, the travel demand model will give incorrect traffic estimates. In summary, the use of a regional model is very time consuming, costly, and out of scale for most site development analyses.

Travel Demand Model Integrated with Simulation

Recent research has addressed the question whether it is possible to integrate travel demand models into time-dependent operational simulations of traffic behavior. This would allow for a visual and dynamic modeling of TND street networks, while accounting for their socioeconomic characteristics as well as regional features. In his master's thesis, Greg Saur (2003) addressed this question by successfully combining TransCAD and Vissim to accomplish sub-area analysis for transportation projects, specifically two north-south bypass alternatives around Pittsboro, NC. Another program that will feature simulation methods integrated in a TransCAD regional model is Transmodeler, which is expected to be available from Caliper, Inc. It may be feasible to transfer a similar approach to traditional neighborhood developments and use similar combinations of tools in the assessment of the Southern Village development; however, more research on this issue as well as development of user-friendly software is required.

Chapter Summary

As Table 2-1 indicates, this chapter reviewed the applicability of various models to perform TND traffic impact analyses. The four models discussed are site-specific deterministic, site-specific simulation, travel demand model and travel demand model integrated with simulation. The features for each category include scale, functionality and cost/resource requirements. The table shows that while the ITE trip generation method with adjustments from the "Trip Generation Handbook" considers mixed land-uses, the specific layout of the street system cannot be modeled explicitly. Yet it is a cost and time efficient way to obtain trip generation rates and

traffic, which professionals can then distribute, assign and interpret using engineering judgment. To take the specific street pattern into consideration, a simulation model of the projected traffic volumes can be used. This requires much user input and still has to deal with the issue of traffic assignment and distribution, which in a program like Corsim has to be performed manually. Since a simulation model still fails to take regional land-use characteristics and effects into consideration, a regional travel demand model may be the most appropriate. Yet again, a lot of user input and extensive knowledge of the respective software are prerequisites and even then, the focus on a small area like a single development remains difficult and perhaps inappropriate. In the future, programs that feature simulation integrated into a regional model may transform some of the currently required input into routine and automated operations and become a powerful alternative even for smaller study areas like TNDs.

Table 2-1: TND Modeling Capabilities of TIA Methods

Does this specific model have the capability to mathematically assess the following? (rather than to rely on professional judgment)	Site-specific deterministic model	Site-specific simulation	Travel Demand Model (TDM)	TDM + Simulation
Regional land use and street network	NO	NO	**YES**	**YES**
TND scale street network	NO	**YES**	NO	**YES**
Trip generation	**YES**	NO	**YES**	**YES**
Adjustments to TND trip generation for …				
… pass-by trips	**YES**	NO	**YES**	**YES**
… internal capture	**YES**	NO	**YES**	**YES**
… externally attracted traffic	**YES**	NO	**YES**	**YES**
… transit trips	**YES**	NO	**YES**	**YES**
… induced travel (internal)	NO	NO	NO	NO
TND internal trip distribution (intra-zonal trips)	NO	**YES**	NO	**YES**
TND external trip distribution (inter-zonal trips)	NO	NO	**YES**	**YES**
Capacity, travel time or delay analysis	NO	**YES**	**YES**	**YES**
TND traffic assignment (trip chaining)	NO	NO	NO	NO
Model refinement to fit small scale of TNDs	**GOOD**	**GOOD**	POOR	**GOOD**
Training Requirements	**LOW**	HIGH	HIGH	HIGH
Cost Requirements	**LOW**	MED-HIGH	HIGH	HIGH
Data Requirements	**LOW**	HIGH	HIGH	HIGH

As a result, this review suggests that conventional TIA methods using ITE methods and professional judgment are appropriate and cost effective with relatively low data requirements. Simulation and TDMs are out-of-scale for most TND analyses; however, consultants are beginning to use simulations more frequently. Regional transportation planning agencies are also becoming more interested in testing alternative land-use strategies, like TNDs, yet their travel demand models for regional studies do not have the proper refinement for small-scale TNDs. Hence, a need exists for integrating site-specific methods, including simulations, with TDM methods.

This project, as the following section on the methods illustrates, will apply and compare the conventional ITE site-specific deterministic method to both TND and CSD sites. Traffic forecasts will be compared to actual traffic counts taken at the entrances/exits of the developments. Furthermore, the project will test the feasibility of directly using the Triangle Regional Model for TND and CSD trip generation and traffic impact analyses. The results of

this comparison, the accuracy of the TDM forecasts, will then lead to the decision of whether additional analyses using simulations, either alone or in combination with TDM analysis, will be performed.

Chapter 3: Methods for Traveler Behavior

This chapter discusses the methodology for the traveler behavior portion of the study. Specifically, we begin by hypothesizing the relationships that might influence household trip generation. Then the neighborhoods where the survey was implemented are described. The sampling and survey design are discussed next. Then the data files generated from the survey and socioeconomics of the respondents are discussed.

Hypotheses

Based on NCDOT needs and the findings of past studies, we will formulate and test four fundamental hypotheses (Table 3-1). First, with respect to trip frequencies, we hypothesize that households in the TND will make more trips than households in the conventional neighborhoods, owing to the proximity of mixed land uses. We also believe that households in study will make more trips than other households in the region, largely due to their higher incomes. This hypothesis is partly based on our analysis of the regional model, which found that households with higher incomes make more trips than households with lower incomes.[5] This finding may be due to the likelihood that households with higher incomes have more finances available to fund activities such as shopping and recreation that induce travel. Therefore, we expect that households in the study will generally make more trips partly because they have higher incomes than the regional average. Second, following from the findings in the literature review, we also hypothesize that households in the traditional neighborhood will make fewer auto trips than households in the conventional neighborhood (of course, we do not know how much fewer). This may be because more trips will be made by alternative modes of transportation in the traditional neighborhood than in the conventional neighborhoods, as distances between origins and destinations are shorter in traditional neighborhoods and are therefore more conducive for walking or bicycling. Third, we hypothesize that trip lengths will be shorter for households in the traditional neighborhood than for households in the conventional neighborhoods since destinations are closer in mixed use neighborhoods than in single use neighborhoods. Finally, and in line with a number of studies from the public health field, we hypothesize that people in the traditional neighborhood will make more trips using active forms of transportation (walking and bicycling) than people in the conventional neighborhoods.

In light of the multicolinearity and statistical interaction observed in studies where each attribute is analyzed independently, an indicator variable representing neighborhood type will be used when testing these hypotheses to capture the collective effects of density, diversity, and design. Additionally, we will control for the traditional predictors of trip generation models – household size and number of cars – by including these variables in our models.

[5] This is also consistent with that of McNally and Kulkarni (1997).

Table 3-1: Hypotheses Tested

	Trip Generation
Hypothesis	Households (HHs) in a TND neighborhood make more trips than HHs in a conventional neighborhood
Alternative Hypothesis	HHs in a TND neighborhood make fewer trips than HHs in a conventional neighborhood
Null Hypothesis	HHs in a TND neighborhood make the same amount of trips as HHs in a conventional neighborhood
	Automobile Trips
Hypothesis	HHs in a TND neighborhood make fewer automobile trips than HHs in a conventional neighborhood
Alternative Hypothesis	HHs in a TND neighborhood make more automobile trips than HHs in a convetional neighborhood
Null Hypothesis	HHs in a TND neighborhood make the same amount of automobile trips as HHs in a conventional neighborhood
	Trip Distances
Hypothesis	HHs in a TND neighborhood make shorter trips (and travel less) than HHs in a conventional neighborhood
Alternative Hypothesis	HHs in a TND neighborhood make longer trips than HHs in a conventional neighborhood
Null Hypothesis	HHs in a TND neighborhood make the same length of trips as HHS in a convetional neighborhood
	Physical Activity Trips
Hypothesis	People in a TND neighborhood make more walking and bicycling trips than people in a conventional neighborhoc
Alternative Hypothesis	People in a TND neighborhood make fewer walking and bicycling trips than people in a conventional neighborhoc
Null Hypothesis	People in a TND neighborhood make the same amount of walking and bicycling trips as people in a conventional

Description of Neighborhoods

To best understand how the study is framed, it is important to compare the two neighborhoods selected for our study. In order to control for a number of confounding variables, many of studies suggest normalization between neighborhoods when the goal is to compare travel behavior and accessibility (Handy and Clifton, 2001; Ewing and Cervero, 2001). Accordingly, we selected (see Appendix B) Southern Village and the northern Carrboro neighborhoods (Figure 3-1) because they share many common characteristics, but differ in aspects relevant to our study, as outlined in Tables 3-2 and 3-3. They are between 7 to 8 miles apart and we had initially intended to survey Lake Hogan Farms only, but due to a relatively small development size (438 home sites) and hence sample size, we expanded the study to include other conventional neighborhoods nearby. Appendix I contains the site plans for the two developments.

Southern Village is a traditional neighborhood and was developed and annexed to southern Chapel Hill, North Carolina. Market Street, which is located in the southern sector of the development, serves as the neighborhood's "Main Street". A number of businesses (Appendix E) are located along Market Street with open space and parking spaces situated in the center. The area is situated on a small hill. Most of the buildings are two or three story brick structures, and several are mixed use—the first floor is used for office space while the second floor is residential. There are a few vacant lots and commercial spaces available for future growth (as of 2003). Surrounding this ring of businesses are apartments and condominiums.

Figure 3-1: Location of Northern Carrboro and Southern Village

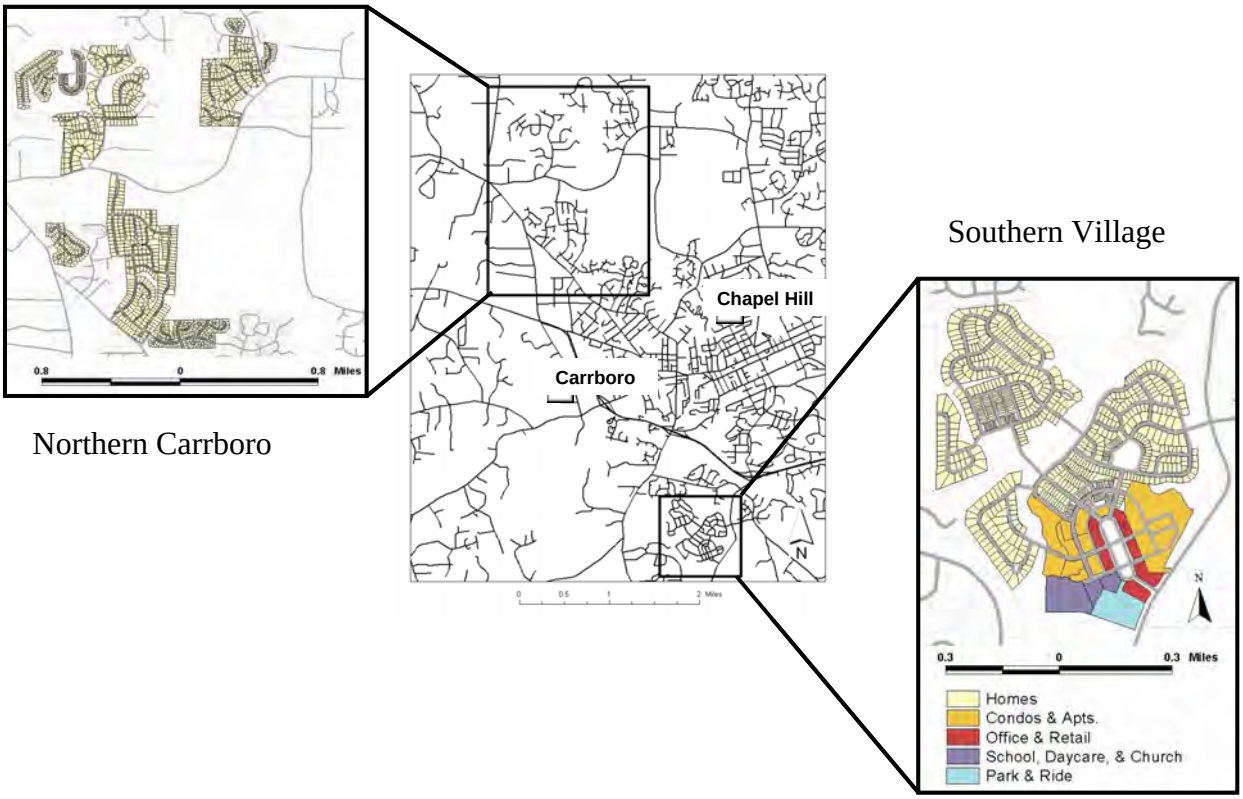


Table 3-2: Density, Diversity and Design Characteristics of Our Study Sites

	Southern Village	Northern Carrboro
Density		
Number of households	9201	891
Average lot size[2]	6,969 sq. ft.	16,812 sq. ft.
Employees	Approx. 432	0
Diversity of land uses		
Uses present	Retail, Office, School, Residential	Residential
Commercial sq. ft.	Approx. 200,000[3,4]	0
Design		
Street design	Modified Grid	Curvilinear
Pedestrian provisions	Sidewalks on both sides of the street, parks, street trees	Sidewalk on one side of the street, parks, street trees

[1] 611 single family homes, 197 apartments, and 112 occupied condominiums
[2] Calculation does not include lot size approximations for apartments or condominiums
[3] Calculation does not include the school (90,000 sq. ft.), daycare center (6,000 sq. ft.), or church (27,000 sq. ft.)
[4] Retail sq. ft. = 50,000 sq. ft., 30,000 sq. ft. of which is built; office sq. ft. = 145,000 sq. ft., 95,000 sq. ft. of which is built.

Row houses, alleyways, pocket parks and sidewalks on both sides of the street are found throughout Southern Village. A paved greenway trail and the neighborhood's recreational facility divide the northwest portion of the development from the rest of the neighborhood.

Homes are situated in relatively close to the streets and have wide front porches facing the sidewalk and street. Garages are accessed from the alleyways and sidewalks are separated from the street by a strip of grass planted consistently with young trees. Existing vegetation prior to the development of the neighborhood remains in areas through the neighborhood.

Table 3-3: Additional Characteristics of Our Study Sites

	Southern Village	Northern Carrboro
Age of Development	Late 1990s	Late 1980s – 1990s
Average Housing Value	$301,787	$303,357
Distance to Downtown	2.5 miles	3.5 miles
Average Resident Age	33	31
# of People per Household	2.28	3.26
# of Cars per Household	1.65	2.11
T- Intersections	35	19
Four-way Intersections	16	8
Cul-de-sacs and Dead Ends	2	56
# of Buslines Serving Area	2	0

The northern Carrboro neighborhoods – Lake Hogan Farms, Wexford, Fairoaks, Sunset Creek, and the Highlands – are located west of Chapel Hill, in northern Carrboro. While manicured open space with young trees and ponds occupy the land between the various developed areas of Lake Hogan Farms, more mature trees and stands of trees exist in the older northern Carrboro neighborhoods. Two recreational facilities exist in the area, one in the geographic center of Lake Hogan Farms and the other in the northern portion of Wexford. Farmland and forests separate the northern Carrboro neighborhoods and similar single-use neighborhoods are slated for development on this land. Throughout all of the northern Carrboro neighborhoods, homes are deeply setback from the streets, sidewalks are on one side of the roads, cul-de-sacs and dead ends are common and two- or three-car garages face and are accessed from the street. Small parks are scattered through each neighborhood.

It is important to note that neither Southern Village nor Lake Hogan Farms are fully "mature." Most notably, commercial space in Southern Village is still under construction and some remains vacant, some homes in Lake Hogan Farms have yet to be built and occupied, and landscaping features such as street trees in both developments are not mature. It would be worthwhile to undertake a follow-up study in ten or more years after the areas have matured to further examine people's travel behaviors.

Because it is best to compare like cohorts, our analysis compares single-family homes in Southern Village to single-family homes in northern Carrboro. As will become apparent in the descriptive analysis section, socioeconomic measures in the condominium and apartment households in Southern Village vary greatly from the single-family homes in Southern Village and the northern Carrboro neighborhoods. Accordingly, we control for or omit the condominiums and apartments of Southern Village as often as possible from our analyses and models.

Sampling

Like most mixed-use neighborhoods, different types of housing exist within Southern Village (Figure 3-1). Since the travel behavior of apartment and condominium dwellers may differ from single-family households (in large part due to differences in socioeconomic factors, such as income), we divided the population of Southern Village accordingly.

$$SE = \sigma\sqrt{\frac{1}{n} - \frac{1}{N}}$$

Using the equation above, we determined the Standard Error (SE), measured in trips, for each neighborhood division based on the division's response rate (Table 3-4). The standard deviation (σ) we used in our equation, 6.25, comes from the Triangle Transit Authority's 1995 travel behavior survey discussed below. It was selected because it best approximates the standard deviation of the variable in which we are most interested: trips per household per day. According to our sampling equation, the results for trips per household per day can be estimated for the various populations in bold, which are the divisions that will be used in our analyses, with a standard error of about ± 0.5 trips.

The results show a relatively good response rate of 25 percent. The sample sizes are as follows: Households = 453; Trips for persons above 16 years of age = 723; Persons of all ages in the data = 1261; Total trips reported = 3736.

Table 3-4: Response Rates

	Neighborhood Division	Population (N)	Responses (n)	Response Rate	Standard Error
Southern Village	Apts.	197	44	22.3%	0.83
	Condos.	112	31	27.7%	0.95
	Condos & Apts.	309	75	24.3%	0.63
	Single-Family Homes	**611**	**168**	**27.5%**	**0.41**
	Total So. Vill. HHs	920	243	26.4%	0.34
Conventional Neighborhoods	Lake Hogan Farms	244	61	25.0%	0.69
	The Highlands	179	37	20.7%	0.92
	Sunset Creek	65	23	35.4%	1.05
	Wexford	248	51	20.6%	0.78
	Fairoaks	155	38	24.5%	0.88
	Total No. Carr. HHs	**891**	**210**	**23.6%**	**0.38**

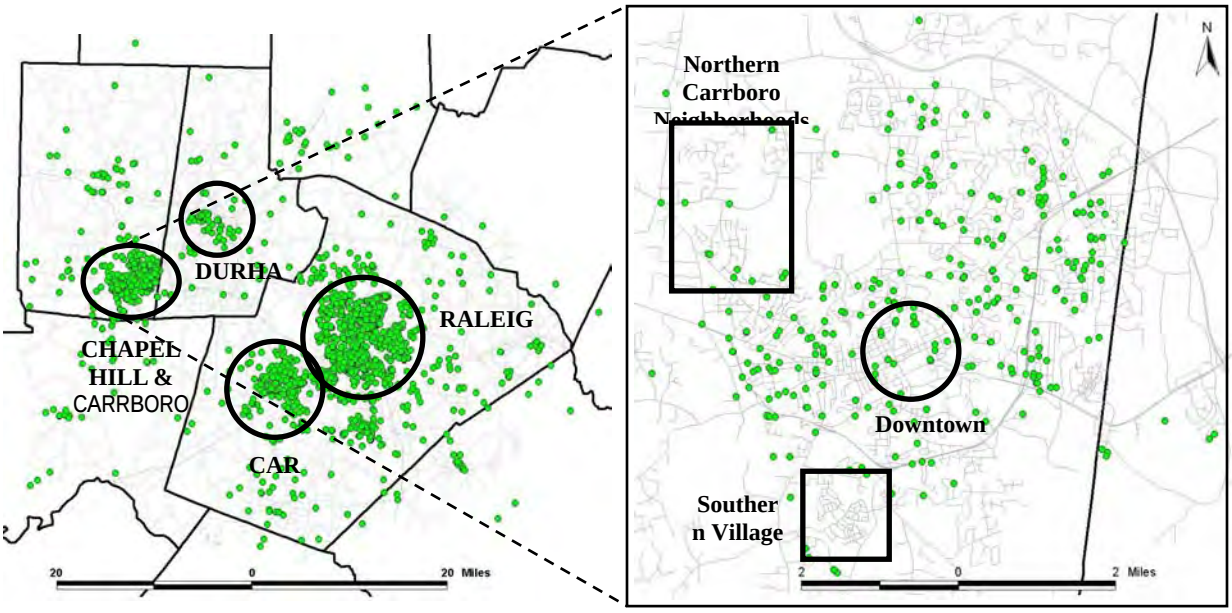
Survey Design

A handful of travel surveys have been administered in the Triangle region of North Carolina. In 1995, the Triangle Transit Agency (TTA) administered a household travel survey. These data are being used in the Triangle Regional Model (TRM). The distributions of households sampled for this survey in the Triangle region and in Chapel Hill/Carrboro are shown in Figure 3-2. The database that resulted from this survey has been useful to TTA in estimating people's travel behavior within the Triangle region and is compared to the travel behavior of residents of the northern Carrboro neighborhoods and Southern Village later in this report. However, the survey

yielded no observations in a traditional neighborhood, since no traditional neighborhood existed in the Triangle at that time.

In the late 1990s and early 2000s, the three major universities in the area – the University of North Carolina, North Carolina State University, and Duke University – administered surveys to their employees and students. Though these surveys were helpful in investigating the travel behavior of people affiliated with the universities, the studies failed to examine the travel behavior of individuals not affiliated with the university. Therefore, in order to collect primary travel data, this study utilized mailback surveys (Appendix F) sent to the residents of the northern Carrboro neighborhoods and Southern Village.

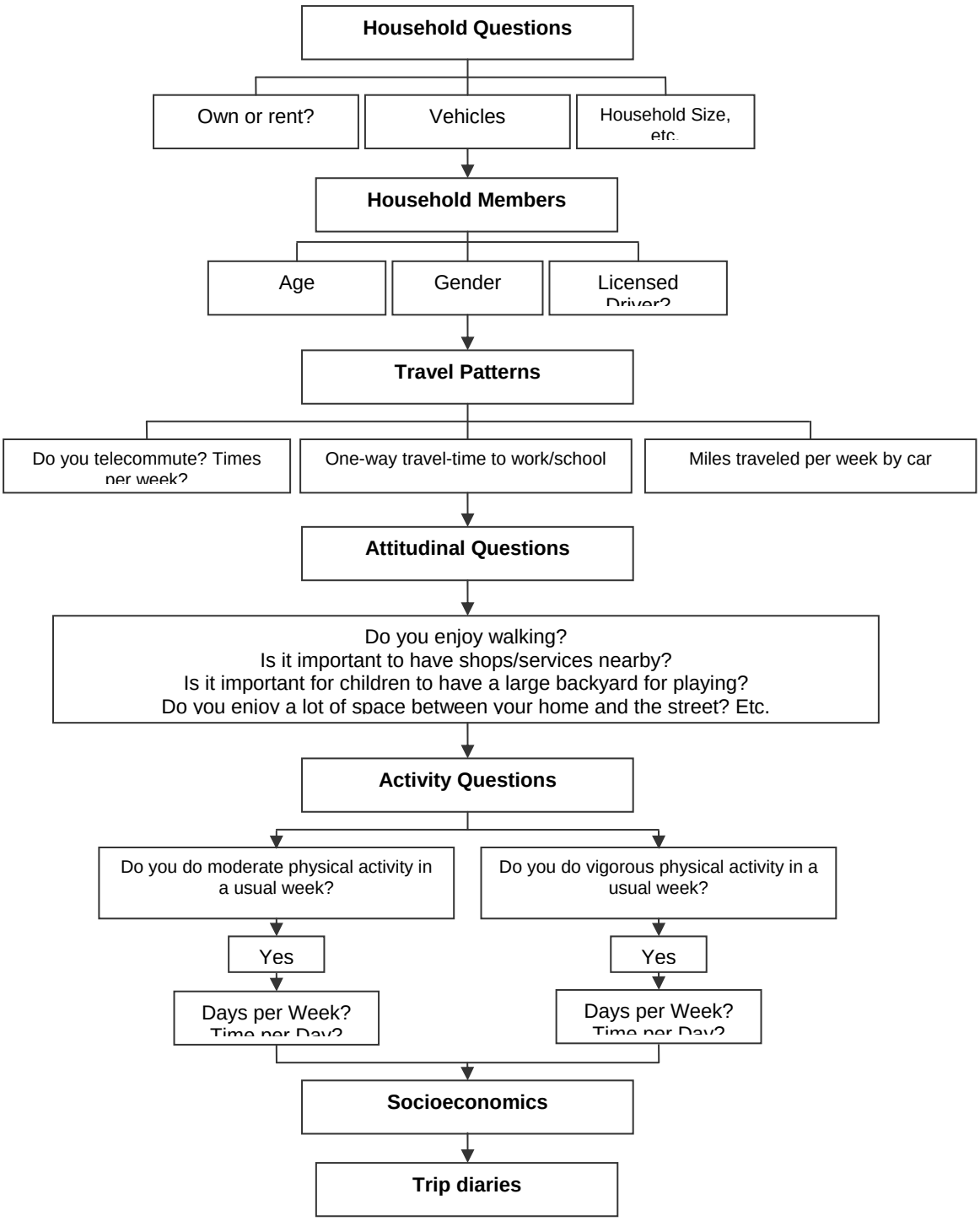
Figure 3-2: Distribution of Households Sampled in the Triangle (left) and the Chapel Hill-Carrboro Area (right)



The survey was divided into two sections (Appendix G). Section one was to be filled out be the head of household and section two was to be filled out by all members of the household 16 years or older. Section one was divided into four parts. Part one asked questions related to the respondent's household such as whether they own or rent their home, how many vehicles they own, and the number and ages of people in their homes. Part two asked questions about the respondent's travel patterns, such as the number and type of trips made in a typical week, employment status and job type. Part three asked questions related to the respondent's attitudes and part four asked questions about the respondent's activities, such as how much exercise they do in and away from their neighborhood, their education and household income level. A conceptual structure is provided in Figure 3-3. Section two was composed of a travel diary with detailed instructions for completion. Many of the questions were based on questions asked in other surveys, primarily from TTA's 1995 survey, the National Household Travel Survey, and physical activity surveys. Though every member of the household regardless of age should

ideally complete both sections of the survey, we decided this would be too laborious and felt additional requests would negatively impact our response rate.

Figure 3-3: Household Survey Conceptual Structure (selected questions asked of respondents)



The attitudinal questions were included in part to investigate the issue of self-selection. As mentioned by a number of studies[6], people may choose their residential location based at least in part on their desired travel patterns. Accordingly, certain urban designs might not draw would-be motorists out of their cars so much as they would provide homes for people who already prefer to drive less (Boarnet and Crane, 2001). Therefore, simply having the option to walk without also having the desire may not be enough to encourage people to walk instead of drive (Handy and Clifton, 2001). One study (Krizek, 2000) that does address self-selection with respect to mode choice and urban form took a longitudinal approach to the issue and found small increases in the use of non-automobile transportation when people moved from more to less auto-dependent neighborhoods and small decreases associated with moves to more auto-dependent neighborhoods. Though this study did not attempt to account for life-changing occurrences, such as the birth of a child, this finding lends credence to the possibility that people's mode choice varies depending on the transportation orientation of their neighborhood.

To investigate this issue, we ask twenty attitudinal questions based on a five-point Likert scale to identify any relationships that may exist between certain attitudes, travel behavior, and the decision to move into a neighborhood with particular urban design features. If certain relationships exist, then it is likely that a person may be predisposed to move into a certain neighborhood type (Appendix D). If no relationships exist, then it is likely that no such predisposition exists. Kitamura *et al.* (1997) took a similar approach and found that attitudes were a more significant predictor of travel behavior than either characteristics of the built environment or socioeconomic attributes. Much like our study, however, Kitamura *et al.* (1997) were not able to establish causality, only association. Accordingly, it is debatable as to whether people's attitudes are independent of urban form or whether they may be affected by urban form. If the latter is true, attitudinal questions may not be useful in investigating self-selection.

The time of year and the specific days of travel that we chose to administer our survey also impact people's travel behavior. March, April, and May were chosen as the appropriate months since they best approximate the average local conditions. However, some attributes of the pedestrian environment may not be present; for instance, the value of street trees in providing shade along the walking corridor is limited during the early spring and on overcast days.[7] Though we specified that the travel diaries should be filled-out on a Tuesday, Wednesday, or Thursday, some diaries were filled out for Mondays or Fridays and a small portion were filled out on weekends. While these later diaries were included in our study, they only accounted for 36 of 3736 trips.

Data Files

Four data files are provided with this report. The Household File codes responses to the household survey while the Trip File codes travel information from the travel diaries. The Person File provides information on all of the members of households that completed the household survey. The Trips per Household File links travel diary information to the household level. Appendix H provides a 'data dictionary' that describes the variables in the four data files.

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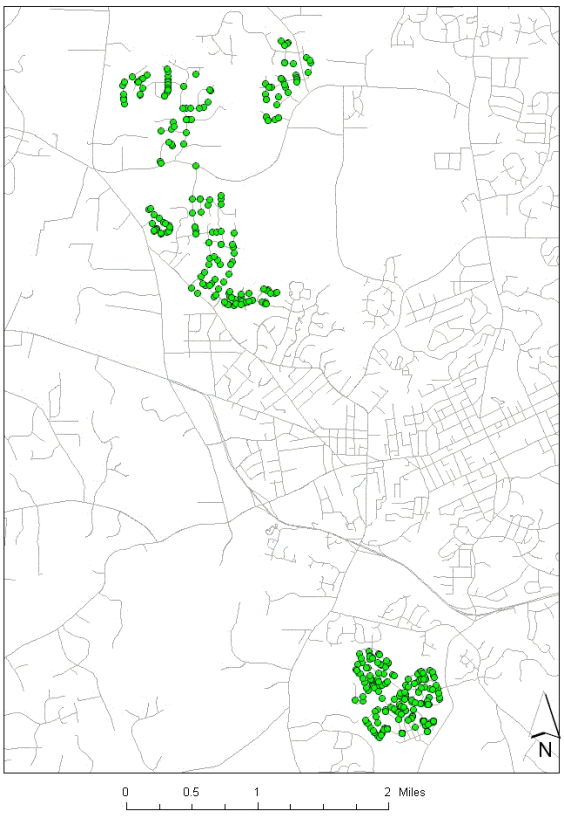
[6] These studies include Boarnet and Crane (2001), Craig *et al* (2002), Handy (2002), Handy (1993), Handy and Clifton (2001), Kockelman (1997), Crane (2000), Boarnet and Sarmiento (1998), Boarnet and Crane (2001 – Book)
[7] Cervero and Kockelman (1997)

Socioeconomics

In this section socioeconomic data are presented at both the household head level and at the person level for Southern Village single-family homes, Southern Village multi-family homes, and northern Carrboro. Figure 3-4 shows the location of households that completed the survey. As expected there was missing data on income (29 percent of the households did not report their income). The median income of the reporting households varies considerably. Residents of Southern Village multi-family homes report the lowest median incomes, between $40,001 and $50,000. However, when Southern Village single-family homes are compared to Carrboro single-family homes, less variation is apparent. Both categories report median incomes between $100,001 and $150,000. The median head of household has attained a graduate or professional school degree. The variation among gender at the household level is considerable. In Southern Village single-family homes, 51.8 percent of household heads are male, compared with 60.6 percent in northern Carrboro and 28.0 percent in Southern Village multi-family homes. Median age for household heads displays moderate variation, with the most obvious disparities between single-family homes and apartments/condominiums. The median age of household heads in Southern Village multi-family homes is 38.04 years. For single-family homes, the average in Southern Village is 46.44 years and in northern Carrboro is 47.17 years. The average tenure at Southern Village is 2.98 years (N=214) and in northern Carrboro is 5.21 years (N=187).

Figure 3-4: Location of Households that Completed TND Survey



At the person level, which includes all adult members of the household above 16, the average age is 34.2 years in Southern Village multi-family homes, 33.0 years in Southern Village single-

family homes, and 31.2 years in Carrboro single-family homes. The gender distribution is similar in both single-family study areas, with 46.9 percent male in Southern Village and 47.8 percent male in Carrboro. However, only 31.6 percent of the household members in Southern Village multi-family homes are male. The percentage of licensed drivers in Southern Village single-family homes and Carrboro single-family homes are 69 percent and 62.5 percent respectively. For Southern Village multi-family homes the percentage of licensed drivers is 90.4 percent. The household heads reported traveling, on average, 162 miles per week.

Although 26.5 percent of the cases were missing, among the household heads that responded, 51 percent did not telecommute. In addition, 84 percent had used the Internet almost everyday, while 6 percent reported never using it during the past 6 months. Overall, the respondents represent higher socioeconomic status and the neighborhoods are fairly comparable in terms of socioeconomic attributes.

Chapter 4: Analysis and Findings for Traveler Behavior

In this Chapter, we analyze the traveler behavior results in three broad ways. First, we will look at the descriptive statistics for each of the neighborhoods and how the households in our study compare to households surveyed in TTA's study. Next, we will estimate trip generation models for the neighborhood types and see how they compare to the trip generation model created from TTA's data. Finally, we will estimate other travel behavior models for each neighborhood. This chapter concludes with an analysis of the trip generation rates of the businesses located within Southern Village and how they compare to ITE trip generation rates.

Descriptive Analysis

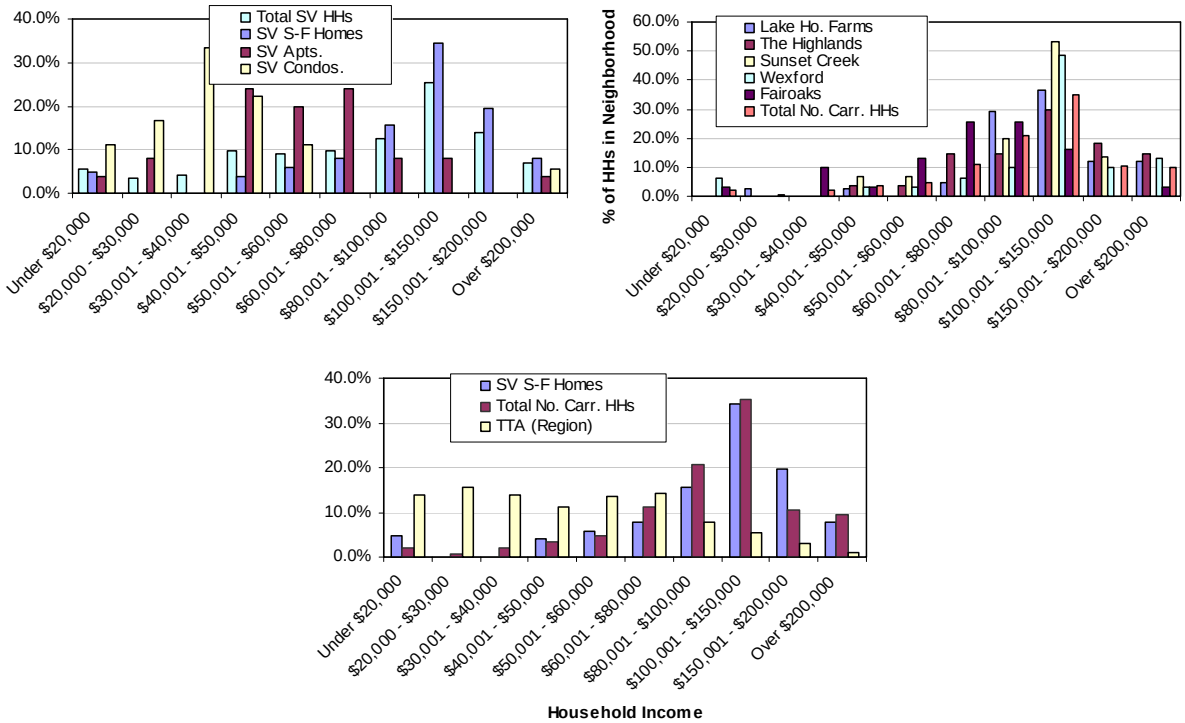
The following descriptive analysis will illustrate how the neighborhoods compare to one another and to the regional baseline. This analysis will show how travel behavior differs among the neighborhoods and the region as a whole and will help us identify what variables should be controlled for in our trip generation models. Unless noted otherwise, the analyses below discuss differences between households in the northern Carrboro neighborhood *taken in sum* and the *single-family* households in Southern Village so that we are comparing like cohorts. The variables in which we are most interested include income, housing values, the number of cars and people per households, the number of overall trips and chained trips, trip distances and times, and trip purposes, trip modes, and physical activity trips. For this and our subsequent trip generation analyses, we filtered out people under the age of 16 and the transit-enhanced cohort within the TTA dataset so that our and TTA's datasets and our subsequent analyses would be consistent and not over represent any one group.

Several of the analyses in this section contain two tables. The first is the trip data reported in by respondents in the surveys. The second accounts for 'missing' trip data, where one or more eligible people did not complete a travel diary. This occurred in 63 households. If these individuals were left unaccounted for, our analysis at the household level might misrepresent travel behavior. The 'missing' people were assigned the mean of each travel behavior attribute and then were linked at the household level. No new households were created in instances where every eligible person in that household failed to complete a travel diary. The inclusion of this missing data provides a more accurate picture of household travel behavior that can be compared to the TTA regional data.

Though only 64 percent (Southern Village apartments) to 94 percent (Wexford) of the households in each neighborhood reported their incomes (Appendix C), this is sufficient to determine how comparable our neighborhoods are to one another. Figure 4-1a shows that condominium dwellers in Southern Village have lower household incomes than apartment dwellers. Typically, condominium households contained fewer people, and therefore wage earners, than apartment dwellers. Household sizes are discussed later. Figure 4-1b shows that while households in most of the northern Carrboro neighborhoods have comparable incomes, households in Fairoaks have lower household incomes and Sunset Creek and Wexford have higher household incomes when compared to the average of the neighborhoods. Finally, Figure 4-1c shows that while the single-family homes of Southern Village have comparable household incomes to the homes in the northern Carrboro neighborhood, the households in the region have

significantly smaller incomes than the households in our study. This difference is intuitive, however, since we purposefully selected neighborhoods that we feel are indicative of new and forthcoming developments in the area and because housing prices in Chapel Hill and Carrboro are notably higher than elsewhere in the region. In sum, the incomes of the neighborhoods that we will be analyzing in our study are comparable. Although they are higher than the region as a whole; accordingly, we will include income as an influencing variable across neighborhood types.

Figure 4-1: Comparative Household Income in a) Southern Village (66.5 percent reporting—145/218), b) Northern Carrboro (77 percent reporting—145/189) and c) the Triangle region



An analysis of housing values is important because housing values can be a more accurate indicator of income when compared to the self-reported household incomes analyzed above. This is because housing values represent what the household can afford based on all incomes, including non-occupational incomes such as retirement benefits, interest from saving accounts, payouts from trusts and stocks, and social security checks. Table 4-1 shows that the assessed value of homes is quite high (relative to the rest of the region). However, respondents to our survey live in slightly less highly valued homes on average when compared to the actual average household values in their neighborhood. Additionally, while there are differences between the neighborhoods of northern Carrboro, the mean housing values of Southern Village and the northern Carrboro neighborhoods are similar. However, the standard deviation and range of the housing values for the northern Carrboro neighborhoods are greater than the standard deviation and range of the housing values for Southern Village. This difference is largely due to the inclusion of the less expensive homes of the Fairoaks neighborhood. Yet, without the inclusion of these homes, the overall mean housing values for the northern Carrboro neighborhoods would be higher than the mean for the Southern Village homes (which, by definition, do not include

apartment or condominium households). In sum, the housing values are comparable between our paired cohorts, i.e., the single-family homes of Southern Village and the homes in the northern Carrboro neighborhoods. Therefore our subsequent analyses will not have to take difference in housing prices into account.

Table 4-1: Assessed Housing Values of the Population

		Population				*Sample*		
	Pop.	Mean	Standard Deviation	Range	Sample	Mean	Standard Deviation	Range
Southern Village	**611**	**$301,787**	**$77,288**	**$559,528**	**167**	**$296,645**	**$69,575**	**$462,278**
Lake Hogan Farms	244	$346,765	$103,976	$537,387	58	$334,686	$100,456	$445,154
The Highlands	179	$327,484	$67,041	$339,666	37	$340,002	$72,264	$284,900
Sunset Creek	65	$315,153	$22,526	$108,310	23	$314,068	$19,676	$63,471
Wexford	248	$315,085	$74,921	$546,591	50	$307,971	$75,642	$374,293
Fairoaks	155	$182,905	$24,559	$131,755	38	$178,406	$25,120	$131,755
Total No. Carr. HHs	**891**	**$303,357**	**$93,720**	**$612,558**	**206**	**$298,026**	**$93,004**	**$520,823**

Note: Southern Village values are for single-family homes only.

Table 4-2 shows that, on average, households in Southern Village single-family homes are smaller than households in the northern Carrboro neighborhoods (2.72 versus 3.31 persons per household respectively) but larger than households in the greater Triangle region (2.32). Southern Village has 17.8 percent less people than households in the northern Carrboro and 17.2 percent more people than households in the region. While the apartment and condominium households in Southern Village have fewer people on average and smaller standard deviations than households elsewhere in the region, the single-family households in Southern Village have more people on average.

Additionally, Table 4-2 shows that households in Southern Village have fewer vehicles than households in the northern Carrboro neighborhoods and in the region. Specifically, in Southern Village, households have 11.3 percent less vehicles than households in the northern Carrboro neighborhoods ($p < 0.05$) and 2.6 percent less vehicles than households in the region. The greater number of vehicles per household in the northern Carrboro neighborhoods is most likely a result of several socioeconomic factors. We found that statistically controlling for the effects of income, household size and number of licensed drivers, the households in Southern Village own about 0.24 less vehicles per household. This issue of automobile ownership is critically important, partly because it is a major determinant of trip generation, and it needs further investigation. We will use these two variables in the trip generation model specification.

The results are largely consistent with NHTS (2003), which shows that the mean number of vehicles owned or available to U.S. households is 1.9. These data provides a useful national perspective and a reality check when used as a basis for comparison. Nationally, a majority of daily trips, 87 percent, were taken by personal vehicle. In addition, U.S. residents averaged 4 trips per day, totaling on average 40 miles of travel—most of it (35 miles) in a personal vehicle. For all adults nationally, including non-drivers and those who may not have driven on a given day, 55 minutes are spent behind the wheel driving 29 miles a day.

Table 4-2: Number of People and Cars in Household

			Number of People per HH			*Number of Cars per HH*		
		N	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**152**	**2.72**	**1.22**	**5**	**1.89**	**0.61**	**4**
	Apts.	39	1.77	0.96	3	1.31	0.57	3
	Condos.	26	1.23	0.43	1	1.15	0.37	1
	Total So. Vill. HHs	217	2.37	1.24	5	1.70	0.65	4
Conventional Neighborhoods	Lake Hogan Farms	54	3.09	1.17	4	2.13	0.62	4
	The Highlands	36	3.61	1.32	5	2.25	0.69	3
	Sunset Creek	19	3.68	0.95	4	2.16	0.37	1
	Wexford	47	3.49	1.28	6	2.15	0.59	3
	Fairoaks	33	2.88	1.08	4	1.97	0.64	2
	Total No. Carr. HHs	**189**	**3.31**	**1.22**	**6**	**2.13**	**0.61**	**4**
	Region (TTA)	1732	2.32	1.21	6	1.94	0.95	7

Note: The sample size reflects the households that completed the trip diaries.

An analysis of travel behavior shows that households in Southern Village make fewer trips than households in the northern Carrboro neighborhoods but more trips than households in the region (Table 4-3b). In the Southern Village, households make 12.1 percent fewer trips than households in the northern Carrboro neighborhoods (although this difference is not statistically significant—see later) and 29.6 percent more trips than households in the region. Also, the difference between Southern Village and the northern Carrboro neighborhoods does not hold at the person level. It is logical that households in Carrboro and Southern Village make more trips than households in the Triangle since households with higher income levels make more trips than households with lower income levels. There might be differences in reporting pedestrian/bicycle trips, as our survey stressed the importance of reporting such trips. Also, households in northern Carrboro have more people than households in Southern Village and elsewhere in the region.[8] As previously mentioned, household size will be included in the trip generation models.

Table 4-3: Number of Total Trips and Car Trips per Household

a. Descriptive Analysis (not accounting for missing data)

			Trips			*Auto Trips*		
		N	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**153**	**9.1**	**4.21**	**23**	**7.1**	**3.84**	**21**
	Apts.	39	7.2	4.59	21	5.0	3.27	15
	Condos.	26	5.6	2.28	10	3.3	1.72	8
	Total So. Vill. HHs	218	8.3	4.26	23	6.3	3.79	21
Conventional Neighborhoods	Lake Hogan Farms	54	9.4	4.27	19	8.9	4.18	19
	The Highlands	36	11.3	4.21	15	10.2	3.60	14
	Sunset Creek	19	9.5	5.03	18	8.7	4.53	17
	Wexford	47	10.6	4.01	17	9.3	3.56	16
	Fairoaks	33	10.1	5.63	23	8.5	5.17	21
	Total No. Carr. HHs	**189**	**10.2**	**4.55**	**24**	**9.2**	**4.16**	**22**
	TTA (Region)	1692	7.6	4.698	27	7	4.58	26

[8] See Targa's study in Appendix F.

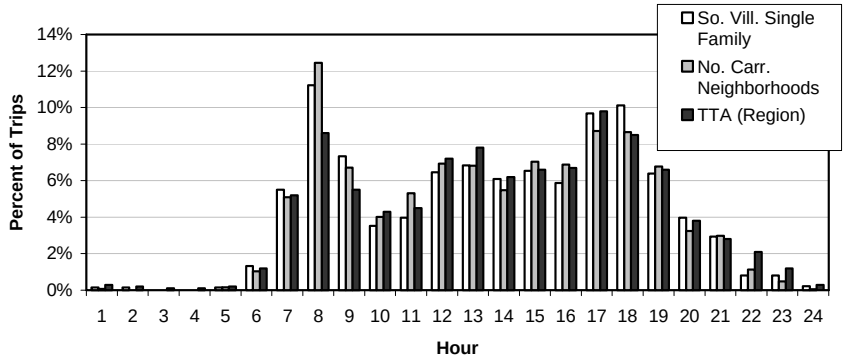
b. Descriptive Analysis (accounting for missing data)

			Trips			*Auto Trips*		
		N	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**153**	**9.8**	**4.33**	**26**	**7.7**	**3.99**	**25**
	Apts.	39	7.7	4.89	21	5.3	3.47	15
	Condos.	26	5.8	2.51	10	3.4	1.58	8
	Total So. Vill. HHs	218	9.0	4.48	25	6.8	3.99	26
Conventional Neighborhoods	Lake Hogan Farms	54	10.4	4.27	22	9.8	4.21	22
	The Highlands	36	12.3	4.10	15	11.1	3.59	13
	Sunset Creek	19	11.2	3.81	14	10.2	3.35	13
	Wexford	47	11.6	4.08	17	10.2	3.62	16
	Fairoaks	33	10.7	5.40	23	9.0	5.04	21
	Total No. Carr. HHs	**189**	**11.2**	**4.38**	**23**	**10.1**	**4.06**	**24**
	TTA (Region)	1692	7.6	4.698	27	7	4.58	26

Table 4-3b also shows that households in Southern Village make substantially less automobile trips than households in the northern Carrboro neighborhoods. Specifically, households in Southern Village make 23.4 percent fewer auto trips than households in the northern Carrboro neighborhoods. This observation is theoretically logical, because households in the traditional neighborhood are located within walking and bicycling distance of the village retail center, and because two bus routes serve the community. Households in the traditional neighborhood, on the other hand, make only 10.1 percent more auto trips than households in the region, which probably reflects differences in socioeconomic status. The standard deviation for auto trips per household in the northern Carrboro neighborhoods is slightly higher than the standard deviation for car trips per household in Southern Village but not as high as the standard deviation for auto trips per household in the region, meaning there is greater variability in car trips in the region than in northern Carrboro neighborhoods and Southern Village.

Figure 4-2 shows the start time of trips for households in Southern Village, in the northern Carrboro neighborhoods, and in the region. This figure provides us with an idea of when traffic volumes on area roads are highest. The distributions are quite similar and bimodal, reflecting the two peak periods in a typical weekday. While households in Southern Village and the northern Carrboro neighborhoods begin more trips during the morning rush hour, households in the region make slightly more trips during the middle of the day.

Figure 4-2: Start Time of Trips



Note: Sample size for Southern Village = 1363 trips; Northern Carrboro = 1847 and Triangle region = 12,087.

As mentioned earlier, trip chaining is another component of trip generation and is defined as the process of making a series of non-home based trips in a row. Trip chaining is composed of stops and each chain of stops is known as a tour, i.e., a tour starts and ends at home. Therefore,

No. of TRIPS = No. of TOURS + No. of STOPS

That is, number of trips equals the number of tours and stops.[9] Greater chaining of trips (i.e., fewer tours and more stops) is more convenient for single occupant automobile users than for carpoolers or transit users. Trip chaining is generally considered more efficient, from a transportation network perspective, than people returning home after accessing a non-home destination. Table 4-4b shows that households in Southern Village single family households make 11.9 percent fewer tours than households in the northern Carrboro neighborhoods (3.7 versus 4.2 tours respectively). However, tours made by households in the Southern Village single family households have fewer stops than households in the northern Carrboro neighborhoods (6.1 stops versus 6.9 stops). Specifically, households in the Southern Village make 11.6 percent fewer stops than the northern Carrboro neighborhoods. These findings do not show a clear trend on way or another and owning to the large standard deviation, the differences are not statistically significant (p = 0.05).

Table 4-4: Tours and Stops per Household

a. Descriptive Analysis (not accounting for missing data)

			Tours			*Stops*		
		N	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**153**	**3.1**	**2.0**	**11.0**	**5.7**	**2.9**	**16.0**
	Apts.	38	2.9	2.1	9.0	4.1	2.7	12.0
	Condos.	27	2.6	1.4	5.0	3.2	1.8	9.0
	Total So. Vill. HHs	218	3.2	1.9	10.0	5.1	2.9	16.0
Conventional Neighborhoods	Lake Hogan Farms	54	3.6	1.6	6.0	5.8	3.2	13.0
	The Highlands	36	4.2	1.7	6.0	7.1	3.1	12.0
	Sunset Creek	19	3.6	2.0	7.0	5.9	3.4	12.0
	Wexford	47	4.0	1.9	7.0	6.5	2.5	10.0
	Fairoaks	33	3.7	2.3	10.0	6.3	3.9	15.0
	Total No. Carr. HHs	**189**	**3.9**	**1.8**	**10.0**	**6.3**	**3.2**	**16.0**

[9] Except in instances where a trip's origin and destination are home, such as a leisure walk, jog or bicycle ride. These trips are considered as a tour without a stop.

b. Descriptive Analysis (accounting for missing data)

			Tours			*Stops*		
		N	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**153**	**3.7**	**1.9**	**11.7**	**6.1**	**3.0**	**16.0**
	Apts.	38	3.1	2.1	9.0	4.4	3.1	12.0
	Condos.	27	2.7	1.5	5.0	3.3	1.9	9.0
	Total So. Vill. HHs	218	3.4	1.9	11.7	5.5	3.1	16.0
Conventional Neighborhoods	Lake Hogan Farms	54	4.0	1.5	6.8	6.4	3.2	15.3
	The Highlands	36	4.6	1.6	6.0	7.7	3.0	11.0
	Sunset Creek	19	4.2	1.7	6.0	7.0	2.6	9.0
	Wexford	47	4.4	1.8	7.0	7.1	2.6	10.5
	Fairoaks	33	3.9	2.2	10.0	6.7	3.8	15.0
	Total No. Carr. HHs	**189**	**4.2**	**1.7**	**10.0**	**6.9**	**3.1**	**15.3**

Households in the Southern Village on average travel shorter distances (52 miles per day) than households in the northern Carrboro neighborhoods (80 miles a day) (Table 4-5b). Indeed, average daily miles traveled are over 28 miles less for households in Southern Village than households in the northern Carrboro neighborhoods. The standard deviation for trip distance per household in the northern Carrboro neighborhood is higher than the standard deviation for trip distance per household in Southern Village, meaning there is greater variability in trip distance per household in the northern Carrboro neighborhood than in Southern Village. Trip distances from the regional dataset are unavailable. Because it has been postulated that households in the northern Carrboro neighborhoods make more regional trips than households in Southern Village due to their proximities to the Interstates (40 and 85) and to the University of North Carolina respectively, we tested trips that are greater than 10 miles in order to more closely examine these regional trips.

Households in Southern Village single family homes spend 2.8 hours and northern Carrboro households spend 3.1 hours making their daily trips. This is in line with the national average of nearly 55 minutes per resident—the average for Southern Village *resident* is approximately 62 minutes ([2.8*60]/2.72) and for northern Carrboro, it is 56 minutes ([3.1*60/3.31]). Clearly, households in Southern Village spend 20 minutes less making trips than household in the northern Carrboro neighborhoods but on a per person basis, this difference does not hold. Also note that compared to the region, the households spend more time on their travel (Table 4-5b). The standard deviations for trip length in terms of daily travel time per household are notably smaller for the two study areas than for the region, which may be a result of greater homogeneity in households in the study areas than in the region with respect to socioeconomic characteristics, such as income.

Table 4-5: Daily Length of Trips per Household in Time and Distance

a. Descriptive Analysis (not accounting for missing data)

			Distance (miles)			*Duration (hours)*		
		N	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**153**	**52**	**33.1**	**160**	**2.6**	**1.13**	**4.8**
	Apts.	39	39	35.5	122	1.9	1.31	5.6
	Condos.	26	39	39.2	136	1.7	1.00	3.9
	Total So. Vill. HHs	218	48	34.6	160	2.3	1.20	5.6
Conventional Neighborhoods	Lake Hogan Farms	54	75	37.5	166	2.8	1.02	3.9
	The Highlands	36	75	36.3	144	3.0	1.23	5.1
	Sunset Creek	19	52	36.9	156	2.3	1.36	4.6
	Wexford	47	71	47.5	227	2.9	1.27	5.8
	Fairoaks	33	81	64.4	311	3.1	1.49	5.7
	Total No. Carr. HHs	**189**	**73**	**45.7**	**317**	**2.9**	**1.25**	**6.5**
	TTA (Region)	1692	n/a	n/a	n/a	2.2	1.68	15.4

b. Descriptive Analysis (accounting for missing data)

			Distance (miles)			*Duration (hours)*		
		N	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**153**	**56**	**33.1**	**160**	**2.8**	**1.15**	**5.8**
	Apts.	39	43	38.9	151	2.0	1.40	5.6
	Condos.	26	40	38.6	136	1.8	1.02	3.9
	Total So. Vill. HHs	218	52	35.4	160	2.5	1.25	6.2
Conventional Neighborhoods	Lake Hogan Farms	54	82	35.1	190	3.1	0.98	4.6
	The Highlands	36	82	37.1	144	3.3	1.28	5.1
	Sunset Creek	19	64	33.9	156	2.8	1.02	3.6
	Wexford	47	78	47.5	227	3.2	1.25	5.7
	Fairoaks	33	85	67.1	344	3.3	1.52	6.8
	Total No. Carr. HHs	**189**	**80**	**45.4**	**355**	**3.1**	**1.21**	**6.9**
	TTA (Region)	1692	n/a	n/a	n/a	2.2	1.68	15.4

Note: N = 407 due to missing data

Households in Southern Village make 30.3 percent fewer regional trips (defined as greater than 10 miles) per day than households in the northern Carrboro neighborhoods (Table 4-6b). Due to the northern Carrboro neighborhoods proximity to major Interstates and State roads, it is likely that the regional trips are work related. Accordingly, we will attempt to account for these regional trips in our statistical analyses. The standard deviation for regional trips per household in the northern Carrboro neighborhood is higher than the standard deviation for regional trips per household in Southern Village, meaning there is greater variability in regional trips per household in the northern Carrboro neighborhood than in Southern Village.

Table 4-6: Regional Trips (> 10 miles) per Household per Day

a. Descriptive Analysis (not accounting for missing data)

			Regional Trips		
		N	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**153**	**1.4**	**1.39**	**6**
	Apts.	39	1.0	1.46	5
	Condos.	26	0.7	1.09	4
	Total So. Vill. HHs	218	1.2	1.39	6
Conventional Neighborhoods	Lake Hogan Farms	54	2.1	1.91	7
	The Highlands	36	2.1	1.19	4
	Sunset Creek	19	1.2	1.17	4
	Wexford	47	1.7	1.43	4
	Fairoaks	33	2.2	1.79	7
	Total No. Carr. HHs	**189**	**1.9**	**1.60**	**7**
	TTA (Region)	1692	n/a	n/a	n/a

b. Descriptive Analysis (accounting for missing data)

			Regional Trips		
		N	Mean	Standard Deviation	Range
Southern Village	**Single-Family Homes**	**153**	**1.5**	**1.37**	**6**
	Apts.	39	1.1	1.54	6
	Condos.	26	0.7	1.09	4
	Total So. Vill. HHs	218	1.3	1.40	6
Conventional Neighborhoods	Lake Hogan Farms	54	2.3	1.85	8
	The Highlands	36	2.3	1.24	5
	Sunset Creek	19	1.5	1.12	4
	Wexford	47	1.9	1.46	5
	Fairoaks	33	2.3	1.78	7
	Total No. Carr. HHs	**189**	**2.1**	**1.58**	**8**
	TTA (Region)	1692	n/a	n/a	n/a

As Table 4-2 showed, northern Carrboro has more people and cars per household than the single-family homes in Southern Village. While a number of the observations and discussions mentioned above, such as the higher number of auto trips and the longer trips for households in northern Carrboro, can be largely attributed simply to the fact that those households have more people and more cars than the single-family households in Southern Village, some of the observations still hold true at the person level (Table 4-7). In particular, people in Northern Carrboro make 15.2 percent more auto trips and travel over 8 miles more than people in Southern Village. However, some of the observations discussed above, such as the differences in trip chaining across neighborhoods, do not appear to hold at the person level. These and other observations will be further analyzed by statistically controlling for such factors as household size and number of vehicles in the following section.

Table 4-7: Variable Means at the Person Level – Residents of Single Family Homes

	Southern Village Single-Family			Northern Carrboro		
Variable	N	Mean	Std Dev	N	Mean	Std Dev
Trips	271	5.12	2.48	366	5.26	2.89
Auto Trips*	271	4.01	2.37	366	4.73	2.64
Tours	271	1.92	1.06	366	1.99	1.15
Stops	271	3.20	1.90	366	3.27	2.05
Trip Distance (miles)*	270	29.35	21.88	364	37.70	30.99
Trip Time (hours)	271	1.45	0.66	366	1.48	0.79

* Means are statistically different at the 95% confidence level

External automobile trips are of interest because they are contributors to traffic congestion and related environmental impacts. Households in Southern Village make fewer external trips that are shorter in both distance and time (Table 4-8b). Households in Southern Village make on average 25.8 percent fewer external trips, defined as trips outside the neighborhood, when compared to households in the northern Carrboro neighborhoods. This observation is not surprising since there are more non-residential destinations in the traditional neighborhood than within the conventional neighborhoods. Additionally, households in Southern Village make shorter external trips than households in the northern Carrboro neighborhoods, measured both in hours and in miles. External trips in Southern Village are about 37 minutes shorter and 24.6 miles less (per household per day) than in the conventional neighborhoods. This observation may be due to the fact that more people in Southern Village work in the Chapel Hill area than do people in northern Carrboro. This possibility will be investigated in more depth later. For each variable, the smaller standard deviations for households in Southern Village mean that there is less variation (greater uniformity) in external trips than there is for households in northern Carrboro.

Table 4-8: External Trips and External Trip Duration and Distance per Household per Day

a. Descriptive Analysis (not accounting for missing data)

			Trips			*Duration*			*Distance*		
		N	Mean	Stan. Dev.	Range	Mean	Stan. Dev.	Range	Mean	Stan. Dev.	Range
Southern Village	**Single-Family Homes**	**153**	**7.24**	**3.77**	**22**	**2.10**	**1.05**	**5.10**	**50.13**	**32.98**	**163**
	Apts.	39	5.90	3.48	15	1.57	1.08	4.98	37.58	35.03	122
	Condos.	26	4.15	2.13	10	1.34	0.82	2.75	37.63	37.64	137
	Total So. Vill. HHs	218	6.63	3.70	22	1.91	1.07	5.10	46.40	34.48	163
Conventional Neighborhoods	Lake Hogan Farms	54	8.87	4.15	19	2.57	1.03	4.25	74.02	37.72	174
	The Highlands	36	10.47	3.98	15	2.71	1.18	4.26	74.07	38.54	144
	Sunset Creek	19	9.37	5.02	18	2.28	1.34	4.58	51.89	36.76	156
	Wexford	47	10.13	3.79	16	2.67	1.14	5.42	70.32	47.55	225
	Fairoaks	33	9.39	5.29	21	2.80	1.49	5.66	79.92	64.72	311
	Total No. Carr. HHs	**189**	**9.63**	**4.35**	**22**	**2.63**	**1.20**	**6.03**	**71.91**	**45.82**	**317**

b. Descriptive Analysis (accounting for missing data)

			Trips			*Duration*			*Distance*		
		N	Mean	Stan. Dev.	Range	Mean	Stan. Dev.	Range	Mean	Stan. Dev.	Range
Southern Village	**Single-Family Homes**	**153**	**7.85**	**3.95**	**25.08**	**2.28**	**1.08**	**6.03**	**54.40**	**33.07**	**162**
	Apts.	39	6.30	3.75	15	1.68	1.17	4.98	40.50	38.36	148
	Condos.	26	4.31	2.11	10	1.38	0.83	2.75	38.73	38.85	137
	Total So. Vill. HHs	218	7.15	3.92	25.08	2.06	1.12	6.03	50.05	35.25	162
Conventional Neighborhoods	Lake Hogan Farms	54	9.79	4.21	21.97	2.82	0.98	4.69	80.93	35.28	189
	The Highlands	36	11.44	3.97	15	2.98	1.23	4.87	81.33	37.32	144
	Sunset Creek	19	10.94	3.84	14	2.71	1.01	3.58	63.68	33.75	156
	Wexford	47	11.08	3.82	16	2.93	1.10	5.17	77.47	47.54	225
	Fairoaks	33	10.00	5.12	21	2.96	1.54	6.73	84.45	67.50	346
	Total No. Carr. HHs	**189**	**10.58**	**4.22**	**22.97**	**2.89**	**1.16**	**6.91**	**79.03**	**45.60**	**354**

Table 4-9 and Figure 4-3 show the percent of trips by mode by neighborhood and housing type. Compared to households in the northern Carrboro neighborhoods and households in the region, households in Southern Village make more walking and bus trips and fewer auto trips. In particular, in Southern Village, 78.4 percent of trips are by car, compared with 89.9 percent in the northern Carrboro neighborhoods and 92.4 percent in the region and 87 percent nationally. Additionally, 17.2 percent of all trips in Southern Village are walking, compared with 7.3 percent in the northern Carrboro neighborhoods and 5.1 percent in the region. The significant mode choice differences in the traditional neighborhood are likely attributable to three factors: The walkable distance between residences and the commercial center, the pedestrian-oriented design of the neighborhood and its network of trails and sidewalks, and the availability of direct bus routes from the neighborhood to the university and downtown areas. The lower bicycle mode share in the traditional neighborhood is probably related to the hilly condition of the neighborhood and because it is connected to the rest of Chapel Hill via a local highway that makes bicycling outside of the neighborhood rather unsafe.

Table 4-9: Trips by Mode by Neighborhood

		N	Car	Bus	Walk	Bike	Other
Southern Village	***Single-Family Homes***	152	78.4%	3.5%	17.2%	0.5%	0.4%
	Apts.	39	69.2%	10.8%	19.7%	0.4%	0.0%
	Condos.	26	58.9%	13.7%	27.4%	0.0%	0.0%
	Total SV HHs	217	75.4%	5.5%	18.4%	0.4%	0.3%
Conventional Neighborhoods	Lake Hogan Farms	54	94.9%	0.0%	4.7%	0.4%	0.0%
	The Highlands	36	90.4%	0.5%	8.1%	0.7%	0.2%
	Sunset Creek	19	91.7%	1.1%	3.9%	3.3%	0.0%
	Wexford	47	87.7%	1.0%	8.7%	2.4%	0.2%
	Fairoaks	33	84.0%	1.2%	10.3%	4.5%	0.0%
	Total Conv HHs	189	89.9%	0.8%	7.3%	2.0%	0.1%
	TTA (Region)	1692	92.4%	1.4%	5.1%	0.6%	0.6%

Figure 4-3: Trips by Mode by Neighborhood

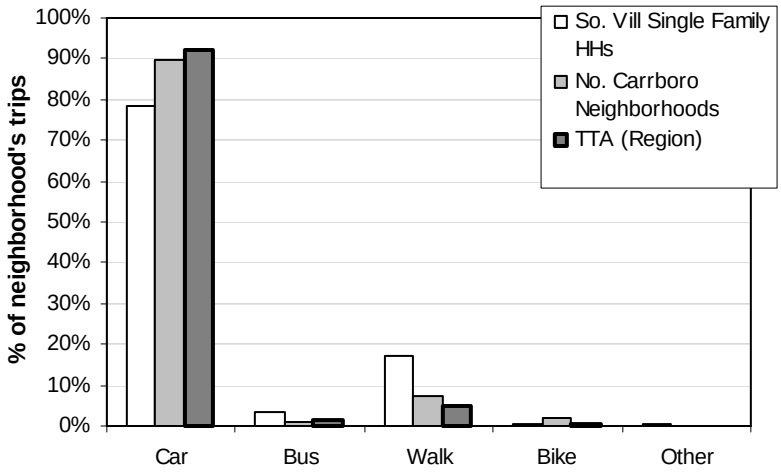


Figure 4-4 shows the mode share of internal and external trips in Southern Village and northern Carrboro single-family homes. It provides additional insights by comparing modal choices by the type of trip (internal or external). Trips that do not begin and end in the neighborhood are classified as external trips. Even though the conventional neighborhood has very few internal trips (5.5 percent), the vast majority of those trips are by pedestrian mode (84 percent). By contrast, Southern Village has much more internal trips (20.2 percent), though fewer of the internal trips were by pedestrian mode (63 percent). Thus, 1) the internal trip capture rate of Southern Village is substantially higher (14.7 percent) and 2) the percentage of internal auto trips is higher in Southern Village. This probably indicates that a greater percentage of internal trips in the northern Carrboro neighborhoods are for recreational purposes, such as jogging or walking a dog, while in Southern Village, internal trips represent both recreational trips as well as utilitarian trips, such as to the retail/office center or to the elementary school, which can be made by several modes. The differences are less pronounced for external trips. In both neighborhood types, more than 90 percent of external trips were made by auto and less than 10 percent were made by other modes.

Figure 4-4: External and Internal Trips by Mode Share

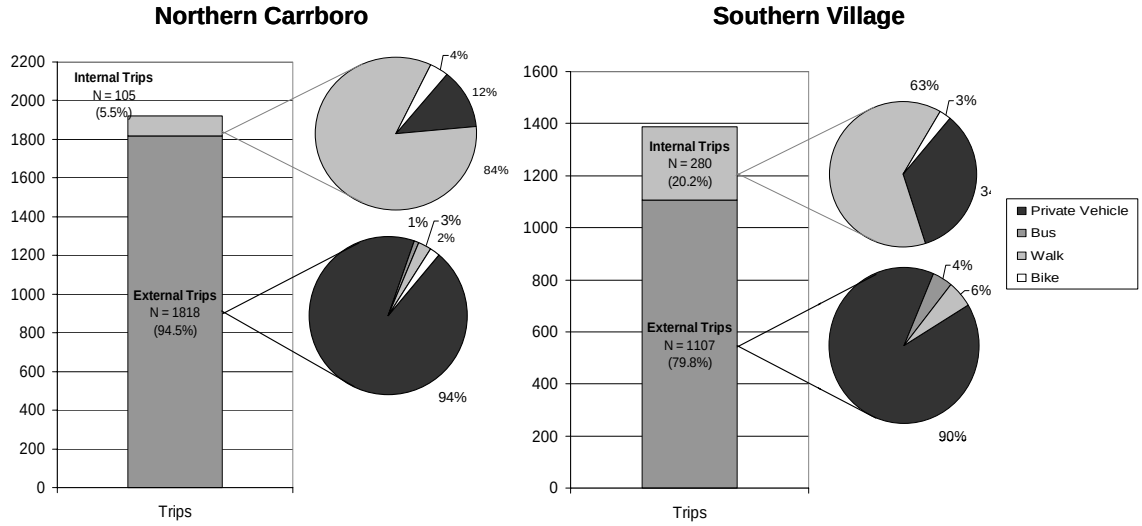
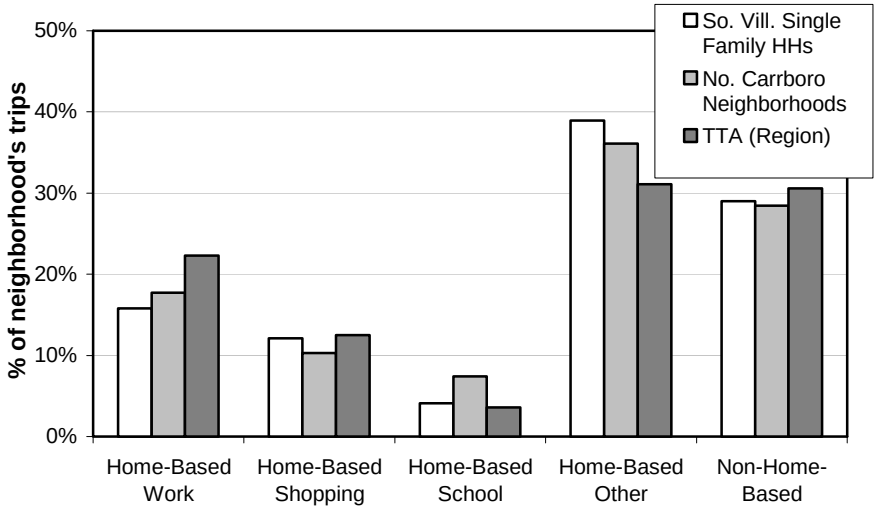


Table 4-10 and Figure 4-5 show the percent of trips by purpose by neighborhood or housing type. The breakdown is quite similar across the two neighborhoods. Compared to the regional baseline, households in Southern Village and the northern Carrboro neighborhoods make fewer home-based work trips per day. Conversely, both neighborhoods make more home-based other and home-based school trips per day. Home-based other trips are composed of trips with a home end made to and/or from services such as doctor's appointments, restaurants, and dry cleaners, and trips made to transport people to places such as school and work. These differences may be attributable to the presence of the University of North Carolina in Chapel Hill, older couples with high school-aged children, and the presence of college-aged and furthering education students living in both of these neighborhoods.

Table 4-10: Trip Type per Neighborhood

		N	Home-Based Work	Home-Based Shopping	Home-Based School	Home-Based Other	Non-Home-Based
Southern Village	***Single-Family Homes***	**152**	15.8%	12.1%	4.1%	39.0%	29.0%
	Apts.	39	24.0%	14.0%	9.3%	31.2%	21.5%
	Condos.	26	20.5%	10.3%	12.3%	41.8%	15.1%
	Total SV HHs	217	17.4%	12.3%	5.6%	38.0%	26.7%
Conventional Neighborhoods	Lake Hogan Farms	54	15.3%	15.9%	5.3%	35.4%	28.1%
	The Highlands	36	18.4%	9.1%	7.6%	35.4%	29.5%
	Sunset Creek	19	14.4%	6.6%	12.7%	40.3%	26.0%
	Wexford	47	18.5%	7.7%	8.1%	39.9%	25.8%
	Fairoaks	33	21.7%	9.6%	6.9%	30.4%	31.3%
	Total Conv HHs	**189**	17.7%	10.3%	7.4%	36.1%	28.4%
	TTA (Region)	1692	22.3%	12.5%	3.6%	31.1%	30.6%

Figure 4-5: Trip Type by Neighborhood



Figures 4-6 and 4-7 show the mode choice of Southern Village and northern Carrboro residents by trip type. In each of the five trip types below, home-based work, home-based shop, home-based school, home-based other and non-home based, single-family households in Southern Village report significantly less automobile usage. In northern Carrboro, about 98 percent of

home-based work trips and 83 percent of home-based school trips are by auto compared with 84 percent 70 percent respectively in Southern Village. This makes sense, due to the direct bus routes from Southern Village to the university and the proximity of Scroggs Elementary School. Interestingly, in northern Carrboro 99 percent of home-based shopping trips are made by auto compared with 80 percent in Southern Village (a 19 percent difference). Again, this is logical, due to the presence of a grocery store and other services in the Southern Village commercial area. Walking trips are made for shopping (usually to the grocery store located in the commercial area of the neighborhood) as well as to other locations in the neighborhood, including trips to neighbor's homes, to escort children to school, and trips to the service-related businesses in the commercial area, such as the cleaners, the restaurant, and the movie theater. Finally, 94 percent of non-home-based trips are by auto in northern Carrboro, compared with 81 percent in Southern Village. Non-home-based walking trips represent the chaining of trips. Walking accounts for 16.1 percent of non-home-based trips in Southern Village (4.4 percent in northern Carrboro), which were usually from one destination in the commercial area to another or trips from escorting children to school and then going to the commercial area.

Figure 4-6: Trips by Mode by Type (Southern Village)

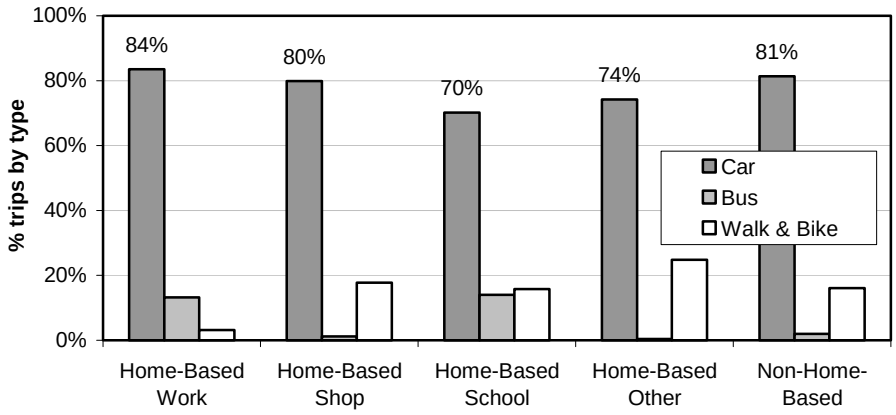
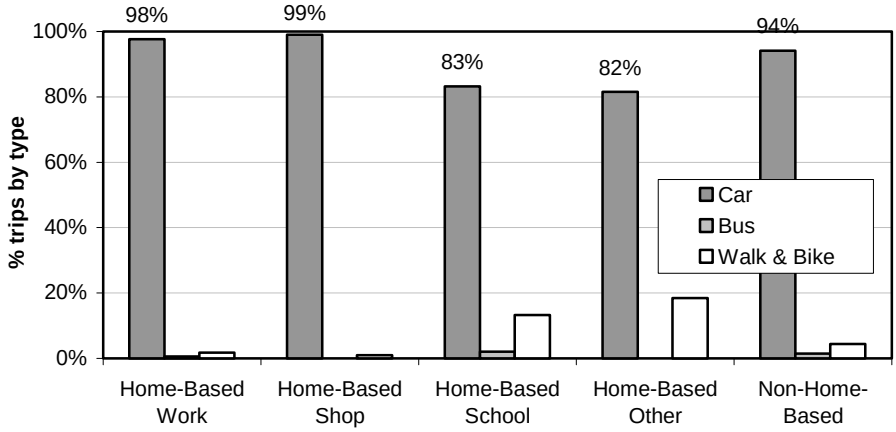


Figure 4-7: Trips by Mode by Type (northern Carrboro)



The distance of trips per person by mode for the residents of Southern Village is shown in Figure 4-8. These distances correspond with the trip purposes discussed above, namely, that walking trips represent shorter trips within the neighborhood and car and bus trips represent trips outside of the neighborhood to school and to work.

Figure 4-8: Trip Distance by Mode (Southern Village)

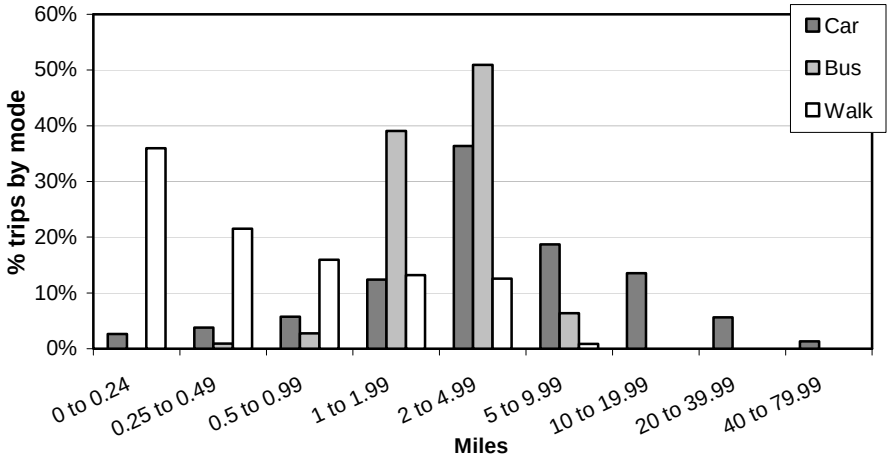
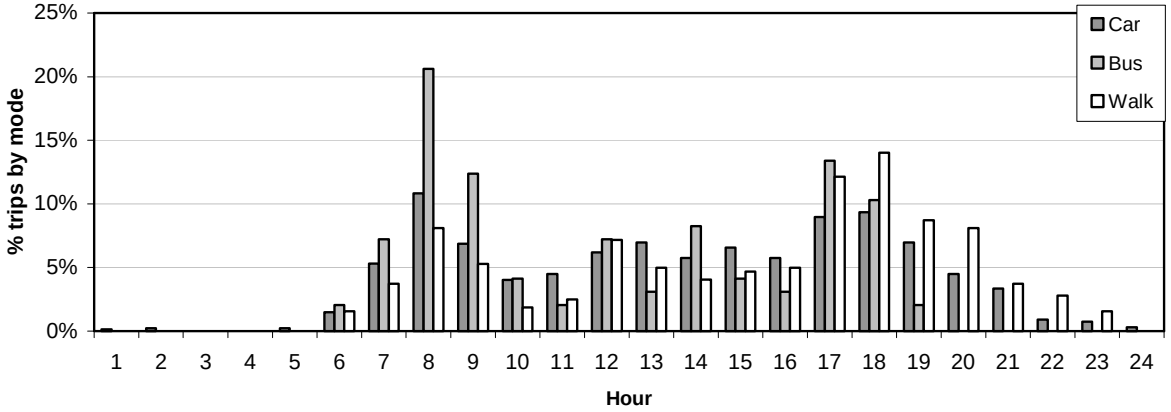


Figure 4-9 shows the start time of trips per person by mode for the residents of Southern Village. These start times also correspond with the types of trips discussed above. Specifically, most walking trips are made in the morning to escort children to school and in the evening to go to the commercial area. Likewise, but to a greater extent in the morning, most bus trips occur in the morning and in the evening with some trips around the lunch hour as well, perhaps for students and employees of the university attending classes and going to their work shifts, respectively. Unsurprisingly, most car trips are made equally in the morning and evening as people travel to work and in between these times as people shop, run errands, and go to lunch.

Figure 4-9: Trip Start Times by Mode -- Southern Village (N=1,337)



Physical activity is becoming increasingly important as people and the government becomes more aware of the overweight and obesity problem in the U.S. population. People might also be moving to traditional neighborhoods, based on their physical activity needs. Table 4-11 shows the mean number of physical activity trips, duration, and distance for the *people* living in single-family homes in Southern Village and the conventional neighborhoods. This analysis is done at the person level because the choice to be physically active is made by the person, whereas a decision to drive somewhere can be a choice of the household. A base set of data for northern Carrboro is presented, along with corrected data that removed four long recreational bicycle trips. The analysis is conducted between Southern Village and the corrected northern Carrboro data.

In Southern Village, residents make 89.1 percent more physical activity trips for 60.2 percent longer durations and 27.2 percent longer distances (Table 4-11a). However, subdividing physical activity into recreational physical activity and utilitarian physical activity reveals that this difference is largely driven by utilitarian physical activity trips. For recreational physical activity trips, Southern Village residents make 29.1 percent more trips that are 28.6 percent longer in duration and 10.6 percent longer in distance (Table 4-11b). For utilitarian physical activity trips, Southern Village residents make nearly 2.6 times more trips, for 2.2 times longer duration and 1.65 times longer distance (Table 4-11c). This is not surprising, since the retail core is located within walking distance of most Southern Village residences. A more in depth study of these trips should include the geocoding of the location and, if possible, the path of the physical activity trip in order to determine if the trip did in fact take place within the neighborhood.

Table 4-11: Physical Activity Trips by People by Neighborhood

a. All Physical Activity Trips

					All Physical Activity Trips								
		Total Trips			Trips			Duration (hours)			Distance (miles)		
	N	Mean	Std Dev	Range	Mean	Std Dev	Range	Mean	Std Dev	Range	Mean	Std Dev	Range
SV Single Family Homes	271	5.11	2.47	12.00	0.90	1.52	9.00	0.29	0.45	2.58	0.85	1.50	8.40
No Carrboro	366	5.26	2.89	16.00	0.49	1.06	8.00	0.20	0.43	3.06	0.89	2.92	30.00
No Carrboro (no outliers)*	366	5.26	2.89	16.00	0.48	1.05	8.00	0.18	0.40	3.06	0.67	1.68	10.00

b. Recreational Physical Activity Trips

					Recreational Physical Activity Trips								
		Total Trips			Trips			Duration (hours)			Distance (miles)		
	N	Mean	Std Dev	Range	Mean	Std Dev	Range	Mean	Std Dev	Range	Mean	Std Dev	Range
SV Single Family Homes	271	5.11	2.47	12.00	0.31	0.59	4.00	0.18	0.36	2.25	0.52	1.11	6.00
No Carrboro	366	5.26	2.89	16.00	0.25	0.57	4.00	0.15	0.35	2.50	0.69	2.51	28.00
No Carrboro (no outliers)*	366	5.25	2.89	16.00	0.24	0.56	4.00	0.14	0.33	2.50	0.47	1.31	10.00

c. Utilitarian Physical Activity Trips

					Utilitarian Physical Activity Trips								
		Total Trips			Trips			Duration (hours)			Distance (miles)		
	N	Mean	Std Dev	Range	Mean	Std Dev	Range	Mean	Std Dev	Range	Mean	Std Dev	Range
SV Single Family Homes	271	5.11	2.47	12.00	0.60	1.37	8.00	0.11	0.28	2.08	0.33	0.98	7.00
No Carrboro	366	5.26	2.89	16.00	0.23	0.80	6.00	0.05	0.18	1.74	0.20	0.92	10.00
No Carrboro (no outliers)*	366	5.25	2.89	16.00	0.23	0.80	6.00	0.05	0.18	1.74	0.20	0.92	10.00

* four outlying trips were removed - 15, 19, 20 and 28 mile bike rides

This section analyzed how our two neighborhoods compare to one another and to the regional baseline. It showed that while residents in Southern Village single-family homes own less automobiles per household, take less trips and auto trips, drive less distance and for less duration, and make fewer regional trips than northern Carrboro, these differences only hold for auto trips and trip distance at the person level.

Estimation of Trip Generation Models

Typically, category analysis or regression models are used to predict trip frequency for a region or a major development. In this section, we estimate regression models that are intended to understand the factors that influence travel behavior and that can also be used for prediction purposes. Therefore, we restrict the model specifications to variables that can be forecasted. Also, category analysis can be subsumed into regressions, therefore we focus on analyzing the data using regression.

In order to compare the results of our trip generation model to a regional baseline, we first estimated a household-level trip generation model using the abbreviated TTA dataset with household size, number of vehicles, and income ranges as the independent variables (Table 4-12). This last set of variables is indicator variables. The most interesting result of this model is that, in general terms, households with higher incomes are associated with more trips per household.

Table 4-12: Trip generation model of the Triangle

		Coeff.	T stat
Constant		2.262***	9.00
Size of Household		1.302***	15.76
Number of Vehicles		0.827***	7.75
Household Income	$20-30,000	-0.204	-0.70
	$30-40,000	0.323	1.06
	$40-50,000	0.890***	2.67
	$50-60,000	0.707**	2.23
	$60-80,000	1.036***	3.29
	$80-100,000	1.156***	2.93
	$100-150,000	1.347***	2.95
	$150-200,000	0.356	0.62
	> $200,000	3.267***	3.40
N		1731	
F statistic		63.48	
R-square		0.289	
Adjusted R-square		0.284	

Note: The mean, standard deviation, and range of the dependent variable (total trips) are 7.37, 4.31, and 25, respectively

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

A more complete trip generation model developed by Targa (2002) is attached as Appendix F. Targa's model takes into account census block level information such as race, density, and proportions of people commuting to work by various modes and is a better model for trip generation than a simple trip generation model when used at the regional level. However, Targa's model is not appropriate for our study at the household level since no comparable variables to those used in his model exist for our study.

With a baseline model in place, we then estimated trip generation models for each neighborhood. However, the income range variables that were significant at the regional level were not statistically significant for the neighborhood models and were therefore dropped from the neighborhood models. The insignificance of the income range variables at the household level may be due to the fact that there is not sufficient variation, given the high socioeconomic status of the respondents and also due to missing income data. Additionally, a linearity test between the dependent and independent variables showed that the relationship between the number of vehicles per household and number of trips was linear while the relationship between household size and the number of trips was not.

In this analysis, three sets of models are presented. The first model is an Ordinary Least Squares (OLS) regression that does not account for missing data[10] while the second model accounts for missing data. The third model is a negative binomial regression using the corrected data and the marginal effects. Negative binomial models account for the non-negative and discrete nature of trips. However, these models are more complex and difficult to interpret. Their marginal effects must be calculated at the variable means to analyze changes in independent variables, given that the changes are non-linear. Since the negative binomial regressions are generally consistent with the OLS regressions, the analysis in this section relies on interpreting the (simpler) corrected OLS regression.

The resulting trip generation models for the neighborhoods and for the region are presented in Table 4-13. These models allow us to distinguish between the effects of independent variables, i.e., household size and vehicle ownership across neighborhoods. The results of the negative binomial model are largely similar to the OLS regression, so we focus on discussing them. The trip generation models are significant at the 99 percent confidence level as measured by the F statistic, which means that the explanatory variables (household size and number of household vehicles) chosen for the models explain the variation in the dependent variable (number of household trips). The adjusted R^2 for the models, which indicates the ability of the explanatory variables to explain the variation in the dependent variable, is greatest for Southern Village. For example, the adjusted R^2 of 0.396 for Southern Village indicates that 39.6 percent of the variation in the dependent variable (number of household trips) is explained by the explanatory variables, while in northern Carrboro the adjusted R^2 is 25.8 percent and in the region as a whole it is 27.3 percent. In each of the models the coefficients of the explanatory variables are significant at the 99 percent confidence level. Variations in the effect of household size and number of vehicles on trip generation rates between Southern Village and northern Carrboro appear small (Table 4-13); as we see in the next section, the differences between total trips are statistically insignificant (90 percent confidence level). However, the households in Southern Village and northern Carrboro make substantially more trips than in the region. In northern Carrboro, the addition of one vehicle per household adds 2.40 household trips, compared with 2.25 in Southern Village and 0.97 in the region.

[10] In 63 households, one or more eligible people did not complete a travel diary. These people were assigned the mean number of trips per person and then were aggregated at the household level. However, no households were created in instances were each eligible person in that household did not complete a travel diary.

Table 4-13: Trip Generation Models

a. OLS (not accounting for missing data)

	TTA		All Households		Southern Village		Northern Carrboro	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	2.240***	9.994	2.104***	3.584	2.167***	3.173	1.998	1.650
Size of Household	1.396***	17.192	1.074***	6.534	1.198***	5.108	0.986***	3.879
Number of Vehicles	0.971***	9.411	2.138***	6.590	1.951***	4.376	2.307***	4.543
Mean of Dep. Var			9.18		8.31		10.19	
N	1732		405		217		188	
F statistic	326.345***		85.82***		51.566***		24.543***	
R-square	0.274		0.299		0.325		0.21	
Adjusted R-square	0.273		0.295		0.319		0.201	

b. OLS (accounting for missing data)

	TTA		All Households		Southern Village		Northern Carrboro	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	2.240***	9.994	1.946***	3.460	1.806***	2.674	2.358**	2.096
Size of Household	1.396***	17.192	1.270***	8.061	1.415***	6.094	1.123***	4.756
Number of Vehicles	0.971***	9.411	2.363***	7.606	2.248***	5.095	2.399***	5.087
Mean of Dep. Var			9.99		8.97		11.19	
N	1732		405		217		188	
F statistic	326.345***		122.34***		71.813***		33.433***	
R-square	0.274		0.378		0.402		0.265	
Adjusted R-square	0.273		0.375		0.396		0.258	

c. Negative Binomial

	All Households		Southern Village		Northern Carrboro	
	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat
Constant	1.431***	8.910	1.354***	5.440	1.581***	15.040
Size of Household	0.134***	8.220	0.153***	6.370	0.109***	5.270
Number of Vehicles	0.240***	23.550	0.252***	16.990	0.212***	5.400
Alpha	0.027	(p=0.000)	0.033	(p=0.001)	0.021	(p=0.013)
N	406		217		188	
Psuedo-R^2	0.087		0.0927		0.057	
LR χ^2(var)	202.88		114.31		60.84	
Prob > χ^2	0.000		0.000		0.000	
Log likelihood	-1069.6605		-559.4717		-506.138	

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

d. Marginal Effects

	All Households			Southern Village			Northern Carrboro		
	Mean	Coeff.	Z	Mean	Coeff.	Z	Mean	Coeff.	Z
Size of Household	2.80	1.28	(p=0.000)	2.37	1.31	(p=0.000)	3.31	1.19	(p=0.000)
Number of Vehicles	1.90	2.30	(p=0.000)	1.70	2.16	(p=0.000)	2.13	2.32	(p=0.000)

With X_1 as the number of people in household, X_2 as the number of cars in household, E as our error term and Y as the resulting number of trips per household the following regression equations can be formulated:

Regional Model: $Y = 2.240 + 1.396\ X_1 + 0.971\ X_2 + E$

Southern Village Model: $Y = 1.806 + 1.415\ X_1 + 2.248\ X_2 + E$

Northern Carrboro Model: $Y = 2.358 + 1.123\ X_1 + 2.399\ X_2 + E$

These models can be used to predict total residential trips per day for a zone or a new development. For instance, a 1 person, 1 car household will make 5.5 trips in Southern Village and 5.9 tips in northern Carrboro. A 2 person, 2 car household will make 9.1 and 9.4 trips in Southern Village and northern Carrboro neighborhoods respectively. These predictions are reasonable and consistent with our expectations. It should be noted that while the above Southern Village trip generation model can be replicated for similar traditional neighborhoods that have a mix of housing types, it would probably not work as well for traditionally designed neighborhoods that include only single-family homes. As mentioned earlier, it is best to compare like cohorts in our analysis. Accordingly, trip generation and subsequent models should be developed to separate out the single- and multi-family homes in Southern Village and compare these models to the households in Lake Hogan Farms, our original study site (and very equivalent to Southern Village in terms of age of development and socioeconomic status of the residents), and the rest of northern Carrboro, which are all single-family homes (5-3). This analysis of like cohorts is particularly important for our study since apartment and condominium households are smaller, have fewer cars, are less expensive to own or rent, and have lower incomes. Combined, these factors can cause apartment and condominium dwellers to have notably different travel behavior than single-family households.

Table 4-14 presents trip generation models for single-family homes. The models are highly statistically significant overall, as indicated by the F-statistic. For *single-family homes*, the Lake Hogan Farms model is the most explanatory, with an adjusted R^2 of 38.7 percent compared with adjusted R^2 of 32.4 percent in Southern Village and 20.6 percent in the other northern Carrboro neighborhoods. In each of the models the coefficients of the explanatory variables are significant at the 95 percent confidence level, though the constant for Southern Village multi-family homes and Lake Hogan Farms are insignificant. While the number of trips that an additional vehicle generates in Southern Village single-family homes (2.22) is similar to that in the other northern Carrboro neighborhood model (2.04), it is notably smaller than the single-family homes in Lake Hogan Farms (3.34). Each additional household vehicle in the Lake Hogan Farms generates 50.5 percent more trips than Southern Village single-family homes and 63.7 percent more trips than in the other northern Carrboro neighborhoods.

Table 4-14: Trip Generation Models (Single-Family Homes)

a. OLS (not accounting for missing data)

	Southern Village				*Northern Carrboro*			
	Single-Family		**Multi-Family**		**Lake Hogan Farms**		**Other Neighborhoods**	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	2.598**	2.567	0.865	0.782	0.693	0.324	2.615*	1.776
Size of Household	1.165***	4.285	1.485**	2.602	0.918**	2.020	0.971***	3.128
Number of Vehicles	1.753***	3.227	2.702***	2.858	3.211***	3.211	2.143***	3.416
Mean of Dep. Var	9.07		6.54		9.43		10.49	
N	152		65		53		135	
F statistic	25.375***		15.918***		8.814***		15.474***	
R-square	0.254		0.339		0.261		0.19	
Adjusted R-square	0.244		0.318		0.231		0.178	

b. OLS (accounting for missing data)

	Southern Village				*Northern Carrboro*			
	Single-Family		**Multi-Family**		**Lake Hogan Farms**		**Other Neighborhoods**	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	2.122**	2.155	0.625	0.548	-0.551	-0.288	3.561**	2.594
Size of Household	1.302***	4.924	2.196***	3.730	1.242***	3.053	1.054***	3.641
Number of Vehicles	2.216***	4.194	2.312**	2.371	3.339***	4.344	2.042***	3.490
Mean of Dep. Var	9.84		6.92		10.40		11.50	
N	152		65		53		135	
F statistic	37.187***		20.166***		17.383***		18.359***	
R-square	0.333		0.394		0.41		0.218	
Adjusted R-square	0.324		0.375		0.387		0.206	

c. Negative Binomial

	Southern Village				*Northern Carrboro*			
	Single-Family		**Multi-Family**		**Lake Hogan Farms**		**Other Neighborhoods**	
	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat
Constant	1.463***	14.040	1.076***	6.920	1.270***	6.880	1.700***	13.500
Size of Household	0.131***	5.190	0.292***	4.000	0.139***	3.670	0.097***	3.950
Number of Vehicles	0.231***	4.490	0.276**	2.370	0.286***	4.850	0.185***	3.760
Alpha	0.022	(p=0.032)	0.056	(p=0.011)	0.000	(p=0.500)	0.026	(p=0.010)
N	152		65		53		135	
Psuedo-R^2	0.075		0.094		0.096		0.046	
LR χ^2(var)	64.030		32.670		28.540		35.110	
Prob > χ^2	0.000		0.000		0.000		0.000	
Log likelihood	-397.1961		-158.0717		-134.689		-368.7211	

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

d. Marginal Effects

	Southern Village					
	Single-Family			**Multi-Family**		
	Mean	Coeff.	Z	Mean	Coeff.	Z
Size of Household	2.72	1.25	(p=0.000)	1.55	1.90	(p=0.000)
Number of Vehicles	1.89	2.21	(p=0.000)	1.25	1.80	(p=0.018)

	Northern Carrboro					
	Lake Hogan Farms			**Other Neighborhoods**		
	Mean	Coeff.	Z	Mean	Coeff.	Z
Size of Household	3.08	1.40	(p=0.000)	3.40	1.10	(p=0.000)
Number of Vehicles	2.13	2.87	(p=0.000)	2.13	2.09	(p=0.000)

Table 4-15 shows the external trip generation model for single-family homes in Southern Village and Lake Hogan Farms. These models are important since they focus on the two neighborhoods specified in our original study design. Overall, these models are statistically significant at the 99 percent confidence level, based on the F-statistic. The Lake Hogan Farms model is better at explaining the variation in number of household trips, with an adjusted R^2 of 34.5 percent, compared with 28.0 percent for Southern Village (this can be largely due to difference in sample sizes). While the coefficients of the explanatory variables are significant at the 95 percent confidence level, the constants are not statistically significant, even at the 10 percent confidence internal. Each additional vehicle per household in Lake Hogan Farms contributes 3.31 additional external trips per household, compared with 2.61 external trips per household in Southern Village. Thus there seems to be a stronger effect of automobile ownership on trip making in conventional neighborhoods.

Table 4-15: External Trip Generation Models (Single-Family Homes)

a. OLS (not accounting for missing data)

	Southern Village		Lake Hogan Farms	
	Coeff.	T stat	Coeff.	T stat
Constant	1.372	1.490	0.781	0.370
Size of Household	0.600***	2.428	0.723	1.612
Number of Vehicles	2.245***	4.542	2.759***	3.255
Mean of Dep. Var	7.24		8.87	
N	153		53	
F statistic	22.450***		7.938***	
R-square	0.232		0.241	
Adjusted R-square	0.221		0.211	

b. OLS (accounting for missing data)

	Southern Village		Lake Hogan Farms	
	Coeff.	T stat	Coeff.	T stat
Constant	0.993	1.072	-0.395	-0.203
Size of Household	0.710***	2.852	1.029**	2.489
Number of Vehicles	2.614***	5.255	3.308***	4.232
Mean of Dep. Var	7.85		9.79	
N	152		53	
F statistic	30.329***		14.698***	
R-square	0.289		0.370	
Adjusted R-square	0.28		0.345	

c. Negative Binomial

	Southern Village		Lake Hogan Farms	
	Coeff.	Z stat	Coeff.	Z stat
Constant	1.157***	9.610	1.246***	6.480
Size of Household	0.093***	3.170	0.125***	3.140
Number of Vehicles	0.325***	5.500	0.292***	4.700
Alpha	0.038	(p=0.007)	0.004	(p=0.429)
N	152		53	
Psuedo-R^2	0.066		0.084	
LR χ^2(var)	54.010		24.600	
Prob > χ^2	0.000		0.000	
Log likelihood	-384.553		-135.046	

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

d. Marginal Effects

	Southern Village			Lake Hogan Farms		
	Mean	Coeff.	Z	Mean	Coeff.	Z
Size of Household	2.72	0.71	(p=0.002)	3.08	1.19	(p=0.001)
Number of Vehicles	1.89	2.47	(p=0.000)	2.13	2.78	(p=0.000)

Tables 4-16 and 4-17 show auto trip generation models for Southern Village and northern Carrboro respectively. In each Table, 'All' indicates that the analysis is conducted for the entire (pooled) study area and allows us to make comparisons between both single-family and multifamily households in Southern Village and with single-family homes in northern Carrboro. The other models attempt to find differences in travel patterns within the Southern Village and northern Carrboro study areas.

The overall significance of the auto trip generation models for both Southern Village and northern Carrboro are significant at the 99 percent confidence level. The Lake Hogan Farms and Southern Village single-family homes models are the most explanatory, with R^2 of 36.2 percent and 33.6 percent respectively. Pooled auto trip generation models in Southern Village show that each vehicle contributes 2.22 additional trips compared with 2.54 in northern Carrboro—not much of a difference. However, automobile ownership exerts a strong but differential effect

within and across the two types of neighborhoods. Specifically, an additional vehicle is associated with fewer trips in multi-family homes than single family homes in Southern Village (1.4 versus 2.3 respectively). As expected, within Southern Village, the travel behavior of households with respect to number of vehicles owned, is notably different across single family and multi-family. Each additional vehicle in the single-family homes generates 0.91 (or 65.7 percent) more trips per household than in the multi-family homes. Also, within northern Carrboro, automobiles generate 1.06 (or 47.5 percent) more trips per household in Lake Hogan Farms than in the other northern Carrboro neighborhoods. The effect of vehicle ownership on single-family households in Southern Village is smaller than in Lake Hogan Farms (2.3 versus 3.3 respectively).

While the external trip model for Southern Village mirrors the pooled model, since it contains external trips for both housing types, the external trip model for northern Carrboro closely mirrors the Lake Hogan Farms model (the original study site in northern Carrboro). Since the external trip models only count automobile traffic in and out of each neighborhood, they can be used in conjunction with traffic count results that were performed during the study period to see how the two traffic generation approaches compare. Also note that the empirical effect of automobile ownership is higher in Lake Hogan Farms than in Southern Village, by about 1 external trip.

Table 4-16: Auto Trip Generation Models (Southern Village)

a. OLS (not accounting for missing data)

	All		Multi-Family		Single-Family		All External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	0.510	0.861	0.932	1.056	0.767	0.851	0.654	1.134
Size of Household	1.024***	5.029	0.846*	1.855	0.999***	4.124	0.701***	3.539
Number of Vehicles	1.972***	5.095	1.641**	2.174	1.934***	3.997	2.064***	5.479
Mean of Dep. Var	6.27		4.29		7.11		5.81	
N	217		65		152		217	
F statistic	58.662***		8.679***		29.426***		47.155***	
R-square	0.354		0.219		0.283		0.306	
Adjusted R-square	0.348		0.194		0.274		0.299	

b. OLS (accounting for missing data)

	All		Multi-Family		Single-Family		All External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	0.200	0.339	0.775	0.870	0.394	0.440	0.379	0.646
Size of Household	1.186***	5.836	1.313***	2.852	1.106***	4.601	0.852***	4.225
Number of Vehicles	2.223***	5.757	1.386*	1.818	2.297***	4.780	2.288***	5.972
Mean of Dep. Var	6.768		4.542		7.714		6.270	
N	217		65		152		217	
F statistic	76.926***		11.81***		39.274***		60.006***	
R-square	0.418		0.276		0.345		0.359	
Adjusted R-square	0.413		0.253		0.336		0.353	

c. Negative Binomial

	All		Multi-Family		Single-Family		All External	
	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat
Constant	0.887***	9.380	0.735***	3.900	1.043***	8.490	0.857***	8.670
Size of Household	0.169***	6.060	0.265***	2.950	0.142***	4.850	0.136***	4.560
Number of Vehicles	0.329***	6.090	0.254*	1.760	0.303***	5.050	0.351***	6.150
Alpha	0.049	(p=.001)	0.080	(p=0.026)	0.038	(p=0.012)	0.060	(p=0.000)
N	217		65		152		217	
Psuedo-R^2	0.097		0.063		0.077		0.084	
LR χ^2(var)	114.910		19.540		64.490		96.330	
Prob > χ^2	0.000		0.000		0.000		0.000	
Log likelihood	-534.354		-146.188		-385.377		-527.865	

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

d. Marginal Effects

	All			Multi-Family			Single-Family		
	Mean	Coeff.	Z	Mean	Coeff.	Z	Mean	Coeff.	Z
Size of Household	2.37	1.07	(p=0.000)	1.55	1.14	(p=0.003)	2.72	1.05	(p=0.000)
Number of Vehicles	1.70	2.08	(p=0.000)	1.25	1.10	(p=0.078)	1.89	2.24	(p=0.000)

	All External		
	Mean	Coeff.	Z
Size of Household	2.37	0.80	(p=0.000)
Number of Vehicles	1.70	2.07	(p=0.000)

Table 4-17: Auto Trip Generation Models (Northern Carrboro)

a. OLS (not accounting for missing data)

	All		Other Neighborhoods		Lake Hogan Farms		Lake Hogan External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	1.187	1.090	1.411	1.095	0.622	0.295	0.546	0.266
Size of Household	0.831***	3.637	0.852***	3.137	0.789*	1.755	0.754*	1.731
Number of Vehicles	2.453***	5.371	2.320***	4.227	2.765***	3.255	2.780***	3.379
Mean of Dep. Var	9.164		9.260		8.926		9.090	
N	188		135		53		53	
F statistic	28.575***		19.804***		8.284***		8.696***	
R-square	0.236		0.231		0.249		0.258	
Adjusted R-square	0.228		0.219		0.219		0.228	

b. OLS (accounting for missing data)

	All		Other Neighborhoods		Lake Hogan Farms		Lake Hogan External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	1.51	1.473	2.262*	1.855	-0.496	-0.257	-0.564	-0.288
Size of Household	0.954***	4.437	0.927***	3.604	1.084**	2.633	1.043**	2.605
Number of Vehicles	2.536***	5.901	2.229***	4.291	3.287***	4.239	3.299***	4.359
Mean of Dep. Var	10.065		10.17		9.802		9.98	
N	188		135		53		53	
F statistic	37.275***		22.588***		15.242***		15.74***	
R-square	0.287		0.255		0.379		0.386	
Adjusted R-square	0.28		0.244		0.354		0.362	

c. Negative Binomial

	All		Other Neighborhoods		Lake Hogan Farms		Lake Hogan External	
	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat
Constant	1.417***	13.25	1.485***	11.55	1.230***	6.44	1.208***	6.36
Size of Household	0.105***	5.02	0.099***	3.95	0.130***	3.31	0.128***	3.26
Number of Vehicles	0.244***	6.23	0.224***	4.55	0.292***	4.76	0.297***	4.93
Alpha	0.014	(p=0.080)	0.017	(p=0.081)	0.002	(p=0.468)	0.000	(p=0.636
N	188		135		53		53	
Psuedo-R^2	0.063		0.055		0.087		0.090	
LR χ^2(var)	66.100		41.560		25.670		26.270	
Prob > χ^2	0.000		0.000		0.000		0.000	
Log likelihood	-489.138		-354.125		-134.241		-132.948	

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

d. Marginal Effects

	All			Other Neighborhoods			Lake Hogan Farms		
	Mean	Coeff.	Z	Mean	Coeff.	Z	Mean	Coeff.	Z
Size of Household	3.31	1.04	(p=0.000)	3.40	0.98	(p=0.000)	3.08	1.24	(p=0.001)
Number of Vehicles	2.13	2.40	(p=0.000)	2.13	2.23	(p=0.000)	2.13	2.78	(p=0.000)

	Lake Hogan Farms External		
	Mean	Coeff.	Z
Size of Household	3.08	1.20	(p=0.001)
Number of Vehicles	2.13	2.78	(p=0.000)

Tables 4-18 and 4-19 show the trip distance models for Southern Village and northern Carrboro. For consistency, we use the same model specifications. For the Southern Village study area (Table 4-18), the F statistic indicates that each model is significant at the 99 percent confidence

level. However, only for the pooled 'All' and the single-family models are the explanatory variables significant at the 95 percent confidence level. For the pooled Southern Village model, each additional vehicle generates 16 additional miles per household; while in single-family homes each vehicle generates approximately 15.5 additional miles. However, in both models, the constant is insignificant. For the northern Carrboro study area (Table 4-19), the F statistic shows that only the pooled 'All' and Other Neighborhoods models for northern Carrboro are statistically significant. Each additional vehicle in the pooled model generates approximately 17.5 additional miles traveled compared with 24.2 additional miles for the Other Neighborhoods model. In addition, the constant for the pooled model is substantially larger than for the Other Neighborhoods model. In both models, the size of household variable is statistically insignificant (10 percent level). Thus automobile ownership has a differential effect across the two types of neighborhoods

Table 4-18: Trip Distance Models for Southern Village (miles)

a. OLS (not accounting for missing data)

	All		Multi-Family		Single-Family		All External	
	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat
Constant	11.311*	1.838	3.954	0.331	12.01	1.416	10.622*	1.726
Size of Household	5.219**	2.468	3.808	0.618	5.790**	2.542	5.003**	2.365
Number of Vehicles	14.376***	3.578	23.272**	2.282	12.841***	2.822	14.168***	3.525
Mean of Dep. Var	47.946		38.872		51.802		40.368	
N	217		65		152		217	
F statistic	21.123***		4.939***		12.849***		20.074***	
R-square	0.165		0.137		0.147		0.158	
Adjusted R-square	0.157		0.11		0.136		0.15	

b. OLS (accounting for missing data)

	All		Multi-Family		Single-Family		All External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	9.294	1.522	2.527	0.204	9.282	1.13	8.669	1.417
Size of Household	6.472***	3.084	8.04	1.258	6.578***	2.981	6.215***	2.957
Number of Vehicles	16.045***	4.024	20.955*	1.979	15.496***	3.515	15.784***	3.953
Mean of Dep. Var	51.717		41.132		56.214		50.046	
N	217		65		152		217	
F statistic	29.057***		5.676***		18.879***		27.49***	
R-square	0.214		0.155		0.202		0.204	
Adjusted R-square	0.206		0.127		0.191		0.197	

Table 4-19: Trip Distance Models for Northern Carrboro (miles)

a. OLS (not accounting for missing data)

	All		Other Neighborhoods		Lake Hogan Farms		Lake Hogan External	
	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat	Coeff.	Z stat
Constant	45.352***	3.395	33.701**	2.055	74.202***	3.404	74.069***	3.383
Size of Household	-2.610	-0.931	-4.445	-1.285	1.493	0.322	1.223	0.263
Number of Vehicles	16.873***	3.013	24.919***	3.567	-1.711	-0.195	-1.577	-0.179
Mean of Dep. Var	72.612		71.748		74.772		74.017	
N	188		135		53		53	
F statistic	4.545**		6.381***		0.061		0.043	
R-square	0.047		0.088		0.002		0.002	
Adjusted R-square	0.037		0.074		-0.037		-0.038	

b. OLS (accounting for missing data)

	All		Other Neighborhoods		Lake Hogan Farms		Lake Hogan External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	47.925***	3.617	16.597**	2.439	65.285***	20.134	65.237***	3.223
Size of Household	-1.631	-0.587	-3.851	-1.100	3.817***	4.282	3.525	0.819
Number of Vehicles	17.533***	3.156	24.195***	3.422	2.456	8.092	2.549	0.313
Mean of Dep. Var	79.793		79.009		81.754		80.931	
N	188		135		53		53	
F statistic	5.024***		5.856***		0.517		0.453	
R-square	0.052		0.081		0.02		0.018	
Adjusted R-square	0.041		0.068		-0.019		-0.022	

Tables 4-20 and 4-21 show the trip duration models for Southern Village and northern Carrboro neighborhoods. Each of the models is significant at the 95 percent confidence level except for the Lake Hogan Farms external trip duration model. The adjusted R^2 for the pooled model in Southern Village is notably greater than that of northern Carrboro. Within Southern Village, the multi-family models explain 31.9 percent of the variation in trip duration, compared with 8.4 percent for single-family homes of northern Carrboro. The pooled models show that the effect of vehicle ownership on trip duration is about the same—0.683 hours for Southern Village and 0.567 for northern Carrboro.

Table 4-20: Trip Duration Models for Southern Village (hours)

a. OLS (not accounting for missing data)

	All		Multi-Family		Single-Family		All External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	0.795***	3.925	0.107	0.311	1.230***	4.233	0.497***	2.767
Size of Household	0.226***	3.251	0.173	0.967	0.218***	2.795	0.173***	2.809
Number of Vehicles	0.598***	4.518	1.150***	0.390	0.399**	2.559	0.593***	5.060
Mean of Dep. Var	2.342		1.809		2.568		1.912	
N	217		65		152		217	
F statistic	34.804***		14.017***		12.796***		36.252***	
R-square	0.245		0.311		0.147		0.253	
Adjusted R-square	0.238		0.289		0.135		0.246	

b. OLS (accounting for missing data)

	All		Multi-Family		Single-Family		All External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	0.692***	3.466	0.041	0.115	1.095***	3.887	0.412**	2.300
Size of Household	0.287***	4.188	0.369**	2.002	0.257***	3.396	0.223***	3.620
Number of Vehicles	0.683***	5.237	1.043***	3.411	0.530***	3.506	0.663***	5.662
Mean of Dep. Var	2.526		1.914		2.786		2.062	
N	217		65		152		217	
F statistic	51.021***		15.961***		21.254***		49.979***	
R-square	0.323		0.34		0.222		0.318	
Adjusted R-square	0.317		0.319		0.212		0.312	

Table 4-21: Trip Duration Models for Northern Carrboro (hours)

a. OLS (not accounting for missing data)

	All		Other Neighborhoods		Lake Hogan Farms		Lake Hogan External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	1.637	4.535	1.518***	3.365	1.97***	3.410	1.905***	3.254
Size of Household	0.018	0.243	0.639***	3.325	0.321	1.382	0.356	1.512
Number of Vehicles	0.541	3.578	-0.003	-0.028	0.047	0.383	-0.026	-0.206
Mean of Dep. Var	2.858		2.873		2.819		2.572	
N	188		135		53		53	
F statistic	7.217***		6.073***		1.179		1.147	
R-square	0.072		0.084		0.045		0.044	
Adjusted R-square	0.062		0.070		0.007		0.006	

b. OLS (accounting for missing data)

	All		Other Neighborhoods		Lake Hogan Farms		Lake Hogan External	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	1.737***	5.036	1.784***	4.090	1.621	3.070	1.584***	2.975
Size of Household	0.057	0.784	0.611***	3.287	0.484	2.281	0.506**	2.365
Number of Vehicles	0.567***	3.922	0.020	0.224	0.138	1.230	0.058	0.513
Mean of Dep. Var	3.139		3.157		3.092		2.824	
N	188		135		53		53	
F statistic	9.569***		6.245***		4.068**		3.294*	
R-square	0.094		0.086		0.140		0.116	
Adjusted R-square	0.084		0.073		0.106		0.081	

In sum, the trip generation models estimated give reasonable results. There are intra-neighborhood and inter-neighborhood variations in travel behavior—though there is a substantial

difference in travel behavior across the Southern Village and northern Carrboro study areas, especially in terms of automobile trips, miles traveled and external trips. In particular, the effect of automobile ownership on trips is more pronounced in households of the conventional neighborhoods. In the next section, we investigate the statistical significance of differences in travel behavior across TNDs and conventional neighborhoods.

TND Travel Behavior Models

This section examines the effect of TND's on travel behavior. To rigorously examine the effect of neo-traditional neighborhoods on aspects of travel behavior several models are estimated. The aspects of travel behavior include the number of daily auto trips, trip distances and external trips. Negative binomial models are appropriate when the dependent variable is a count variable and therefore, they are presented in addition to the more familiar (and simpler) OLS models. For each of the models, the specification included household size and number of vehicles, while the TND effect, captured through an indicator variable, was of primary interest. In addition, physical activity can be a motivation for moving into TNDs. The effect of the traditional neighborhood on physical activity trip generation is also examined at the person level, while controlling for age and gender.

We tested the effect of the traditional neighborhood in other models—trip duration, trips tours, and trip stops—but they the TND effect was found to be statistically insignificant. Therefore we do not report those models. We do report the total trips model with a TND indicator variable in Appendix J. It shows that there is no statistical difference (90 percent confidence level) in terms of total household trips between the TND and conventional neighborhoods. This refutes our original hypothesis that households in TND will make more total trips, given their proximity to a mix of land uses.

Table 4-22 shows the neighborhood travel behavior model for auto trips. Overall, this model is significant at the 99 percent confidence level. The adjusted R^2 for the model indicates that 35.9 percent of the variation in the dependent variable is explained by the three explanatory variables (household size, number of household vehicles, and the Southern Village indicator variable). Additionally, each variable and the constant are statistically significant. The model shows that single-family households in Southern Village are associated with 1.25 fewer auto trips than households in northern Carrboro. These findings support our hypothesis that households in traditional neighborhoods make fewer automobile trips than households in conventional neighborhoods (despite them making about the same amount of total trips). The results of the negative binomial model are consistent with OLS. In addition, it shows that there is significant overdispersion in the data, i.e., the variance is greater than the mean of the distribution. This is indicated by the parameter α, which is an estimate of the degree of overdispersion.

Table 4-22: Regression Models for Auto Trips

a. OLS (not accounting for missing data)

	Coeff.	T stat
Constant	1.39**	2.13
Size of Household	0.91***	6.05
Number of Vehicles	2.27***	7.65
Southern Village	-1.06***	-2.93
Mean of Dep. Var	7.61	
N	406	
F statistic	81.08***	
R-square	0.377	
Adjusted R-square	0.372	

b. OLS (accounting for missing data)

	Coeff.	T stat
Constant	1.41**	2.24
Size of Household	1.06***	7.29
Number of Vehicles	2.42***	8.55
Southern Village	-1.25***	-3.57
Mean of Dep. Var	8.30	
N	406	
F statistic	109.58***	
R-square	0.450	
Adjusted R-square	0.446	

c. Negative Binomial

	Coeff.	Z stat
Constant	1.19***	14.84
Size of Household	0.14***	8.32
Number of Vehicles	0.29***	9.23
Southern Village	-0.16***	-3.81
Alpha	0.03	(p=0.00)
N	406	
Psuedo-R^2	0.108	
LR χ^2(var)	250.17	
Prob > χ^2	0.000	
Log likelihood	-1030.560	

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

d. Marginal Effects

	Mean	Coeff.	Z
Size of Household	2.80	1.08	8.39
Number of Vehicles	1.90	2.29	9.31
Southern Village	0.54	-1.25	-3.79

The regression models for external trips show that households in Southern Village make 1.53 fewer external trips, on average (Appendix J).

Table 4-23 shows the neighborhood travel model for trip distance. Overall, this model is statistically significant at the 99 percent confidence level. The adjusted R^2 for the model indicates that 19.5 percent of the variation in the dependent variable is explained by the three explanatory variables (household size, number of household vehicles, and the Southern Village indicator variable).

With regard to daily total trip lengths, we controlled for the number of vehicles and household size (which was insignificant) and found that single-family households in Southern Village travel approximately 18 fewer miles daily than households in northern Carrboro. This is a large number and is in part due to our anecdotal observation that proportionally more people who live in Southern Village work or go to school at the university whereas more people who live in northern Carrboro work at the Research Triangle Park or Raleigh or Greensboro, which are over 20 miles away. To test this anecdotal observation, we removed work trips from our model and found that single-family households in Southern Village still travel approximately 11 fewer miles daily than households in northern Carrboro. (This model is significant at the 99 percent confidence level and explains 7.9 percent of the variation in the dependent variable.) Because this difference is still large, it is likely that this finding is attributable to the fact that Southern

Village has a mix of uses (most notably a neighborhood grocery store and an elementary school) that bring origins and destinations closer whereas northern Carrboro does not. Accordingly, residents of northern Carrboro must travel several miles to the nearest commercial center when shopping or when taking their kids to school. Both of these findings are consistent with the findings in Table 4-7 and, taken in sum, support our hypothesis that households in a traditional neighborhood travel less distance than households in a conventional neighborhood.

Table 4-23: Trip Distance Models (miles)

a. OLS (not accounting for missing data)

	All Trips		Without Work Trips	
	Coeff.	T stat	Coeff.	T stat
Constant	32.19***	4.28	22.98***	4.020
Size of Household	1.25	0.72	0.33	0.250
Number of Vehicles	17.05***	5.06	6.55**	2.560
Southern Village	-16.14***	-3.86	-10.27***	-3.230
Mean of Dep. Var	59.40		30.89	
N	406		406	
F statistic	25.93***		10.02***	
R-square	0.1621		0.0696	
Adjusted R-square	0.1559		0.0626	

b. OLS (accounting for missing data)

	All Trips		Without Work Trips	
	Coeff.	T stat	Coeff.	T stat
Constant	32.90***	4.41	23.40***	4.010
Size of Household	2.41	1.40	0.93	0.690
Number of Vehicles	18.30***	5.47	7.20***	2.750
Southern Village	-17.95***	-4.32	-11.26***	-3.470
Mean of Dep. Var	64.75		33.67	
N	406		406	
F statistic	34.11		12.79	
R-square	0.2029		0.0871	
Adjusted R-square	0.197		0.0803	

Combined with the results of Table 4-7, Table 4-24 shows that while daily travel distances are shorter for single-family households in Southern Village than for households in northern Carrboro, there is no statistically significant difference in the time each household spends traveling daily. This finding makes sense (given the constant travel budget hypothesis, first suggested by Y. Zahavi), since alternative modes of transportation (available only in Southern Village) are typically slower than driving.

Table 4-24: Trip Duration Models (hours)

a. OLS (not accounting for missing data)

	Duration	
	Coeff.	T stat
Constant	1.13***	5.12
Size of Household	0.13**	2.48
Number of Vehicles	0.61***	6.19
Southern Villlage	-0.13	-1.01
Mean of Depend Var	2.58	
N	406	
F statistic	30.67***	
R-square	0.186	
Adjusted R-square	0.180	

b. OLS (accounting for missing data)

	Duration	
	Coeff.	T stat
Constant	1.11***	5.16
Size of Household	0.18***	3.61
Number of Vehicles	0.67***	7.00
Southern Villlage	-0.15	-1.23
Mean of Depend Var	2.81	
N	406	
F statistic	44.90***	
R-square	0.251	
Adjusted R-square	0.245	

With regard to physical activity trips, person level data for adults 16 years or older were analyzed. Table 4-25 shows that, on a daily basis, people on average make 0.670 physical activity trips for about 0.239 hours (about 14 minutes) and they travel about 0.873 miles. In the model, we controlled for gender (men are associated with 0.28 fewer physical activity trips per day than women) and age (for every year a person gains, that person is associated with 0.002 fewer physical activity trips per day, although this effect is statistically insignificant) and found that people in Southern are associated with 0.45 more exercise trips per day than people in northern Carrboro (Table 4-25). This finding is consistent with the finding in Table 4-11 that showed that people in Southern Village make on average 0.41 more exercise trips per day than

people in northern Carrboro. While exercise trips are historically underreported in travel diary type studies, presumably the underreporting is consistent between the two neighborhoods. Additionally, the duration of exercise trips are about 6 minutes longer per day, for people in single-family households in Southern Village than people in northern Carrboro. This is consistent with the finding in Table 4-11 that showed that people in Southern Village make on average 10 minutes more physical activity trips per day than people in northern Carrboro. There was no statistically significant difference in the distance people traveled across neighborhood types, even with the exclusion of the four outliers discussed earlier. Overall, however, our findings support the hypothesis that people in traditional neighborhoods make more physical activity trips than people in a conventional neighborhood.

Table 4-25: Physical Activity Trip Generation, Duration and Distance Models^

a. OLS

	All Physical Activity Trips					
	Trips		Duration (hours)		Distance (miles)	
	Coeff.	T stat	Coeff.	T stat	Coeff.	T stat
Constant	0.805***	4.57	0.136**	2.39	0.650***	3.02
Age	-0.004	-1.13	0.002*	1.94	0.003	0.73
Male	-0.315***	-3.26	-0.111***	-3.56	-0.238**	-2.01
Southern Village	0.452***	4.69	0.107***	3.46	0.146	1.24
Mean of Dep. Var	0.72		0.24			
N	713		713		711	
F statistic	12.60***		9.20***		2.02	
R-square	0.051		0.038		0.009	
Adjusted R-square	0.047		0.033		0.004	

*** Significant at the 99% confidence level
** Significant at the 95% confidence level
* Significant at the 90% confidence level
^Four outlying trips were removed: 15, 19, 20 and 28 mile bike rides

In sum, our original hypotheses that households in TNDs make fewer automobile trips, make shorter trips overall and make more physical activity trips than households in conventional neighborhoods appear to be correct. However, our hypothesis that traditional neighborhoods make more overall trips appears to have no statistical support.

Business Trip Generation Rates

This section analyzes the trip generation rates of the businesses located within Southern Village and how they compare to ITE trip generation rates. The business survey answers the question: To what extent do the component land uses—residential, office, retail, etc., attract off-site workers and visitors?

Given that Southern Village is a relatively young TND, the businesses have not yet stabilized. Yet the survey of business managers showed reasonable results. We compared the trip generation rates of employers within Southern Village to ITE's trip generation estimates (Appendix E). Eighteen employers existed at the time of the study and their types of business, sizes, and number of employees is listed in Table 4-26. This mix of stores and businesses within Southern Village may or may not be indicative of the mix of stores and businesses within other traditional neighborhoods. Out of the top eight local businesses visited most frequently by residents of six

Austin, Texas, neighborhoods–grocery stores, drug stores, restaurants, discount stores, convenience stores, video stores, laundromats or dry cleaners, and bakeries, respectively (Handy *et al.*, 1998)—Southern Village possesses three: A grocery store, restaurant, and dry cleaners. While Southern Village may not possess an exemplary number of frequently-visited neighborhood businesses, we can compare how the trip attractions to the stores within Southern Village compare to trip attractions for stores as predicted by ITE.

Table 4-26: Southern Village employers, their size, and their number of employees

Type of Employer	Size*	Number of Employees
Retail services:		
Bookstore	1750	4.5
Grocery Store	5800	25
Public facilities:		
Church	n/a	n/a
Elementary School	606 students	89.5
Entertainment and restaurants:		
Restaurant	2000	25
Restaurant	1000	12
Theater and arcade	4 screens	13
Private services:		
Drycleaner	2500	2
Marketing/sales	1800	9
Day Spa/Salon	3000	8
Law Office	1200	3
Accounting	3500	7
Investment Company	1500	3
Development company	2000	8.5
Clinic	3000	7.5
Day Care	6000 / 86 children	22.5
Public services:		
Non-profit	1700	102
Organization	1600	78.5
Business	3500	12
Total	41850	432

*In square feet unless otherwise noted

The business survey revealed that a total of 5,105 trips ends were taken in one day of which 4,299 (84.2 percent) were by customers and the rest by employees. The ITE procedure, when applied to the businesses predicted 5,918 trip ends. This is 13.7 percent fewer trip ends than reported. Furthermore, only 5.2 percent of the 432 employees reside in Southern Village. A large majority of the employees (92.4 percent) used personal vehicles to commute to work, given the free employee parking in Southern Village. In terms of customers/visitors, an estimated 39.2 percent reside in Southern Village. According to business representatives, 77.7 percent of the customers drive, 18.1 percent walk and 4.2 percent take the bus. The results show that Southern

Village employees use passenger cars as often as employees in conventional (stand-alone) facilities, but that customers are more likely to walk.

We found that while public facilities and public service businesses attract fewer vehicular trips than estimated by ITE, entertainment and restaurants, private services, and retail services attract more vehicular trips than estimated by ITE. The difference in results among business categories leads to a somewhat inconclusive answer as to whether or not the design of Southern Village is affecting the number of automobile trips that businesses are attracting. However, it should be noted that trip ends were not measured by count; instead, they were based on the estimates of the manager or owner of each business. Overall, our findings are also not consistent with the findings of the Colorado/Wyoming Section Technical Committee (1987) of ITE who found that average trip rates for individual shops in mixed use settings were around 2.5 percent below the mean rates published in ITE's *Trip Generation* (1991) manual.

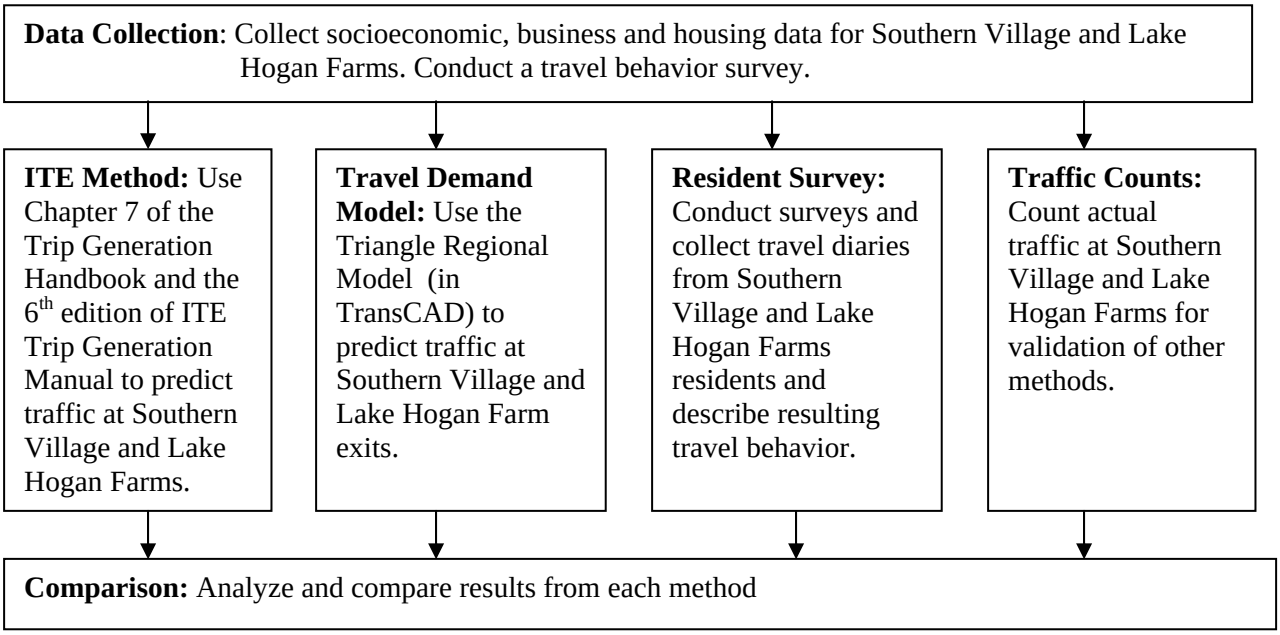
There was a relatively large difference between the reported and ITE predicted trip ends for the grocery store in Southern Village. The presence and impact of a grocery store within should be viewed in line with Handy and Clifton (2001) who identified a number of objective and subjective factors that influence a person's decision to shop at the store and how they travel there. Whereas objective factors include the size of the store, prices, ease of parking, and range of product selection, subjective factors include quality of products, crowds, atmosphere, and length of check-out lines. The significance of these factors varies for each individual and the time of day the individual chooses to shop. Accordingly, the impact of the presence of Weaver Street Market, a smaller, higher-end grocery store, within Southern Village may not be indicative of the presence of grocery stores in other traditional neighborhoods.

Chapter 5: Research Approach for Trip Generation

Introduction

This chapter describes four different methods to obtain trip generation rates and traffic estimates for the two neighborhoods, Southern Village and Lake Hogan Farms. First, ITE Manual procedures estimated trip rates and traffic estimates for the developments, which in the case of the Traditional Neighborhood Development (TND) were adjusted for internal capture and pass-by trips using the ITE Handbook. Second, local socioeconomic data and the Triangle Region travel demand model were used to estimate traffic for the developments. Third, the residents and business owners in both developments were surveyed and asked to complete travel diaries, which were then used to develop regression equations to predict total travel rates for the respective developments. Finally, results from the three approaches were compared to each other, as well as to actual traffic counts collected at all entrances and exits for the developments. A schematic figure illustrating the research approach is shown in Figure 5-1:

Figure 5-1: Research Approach

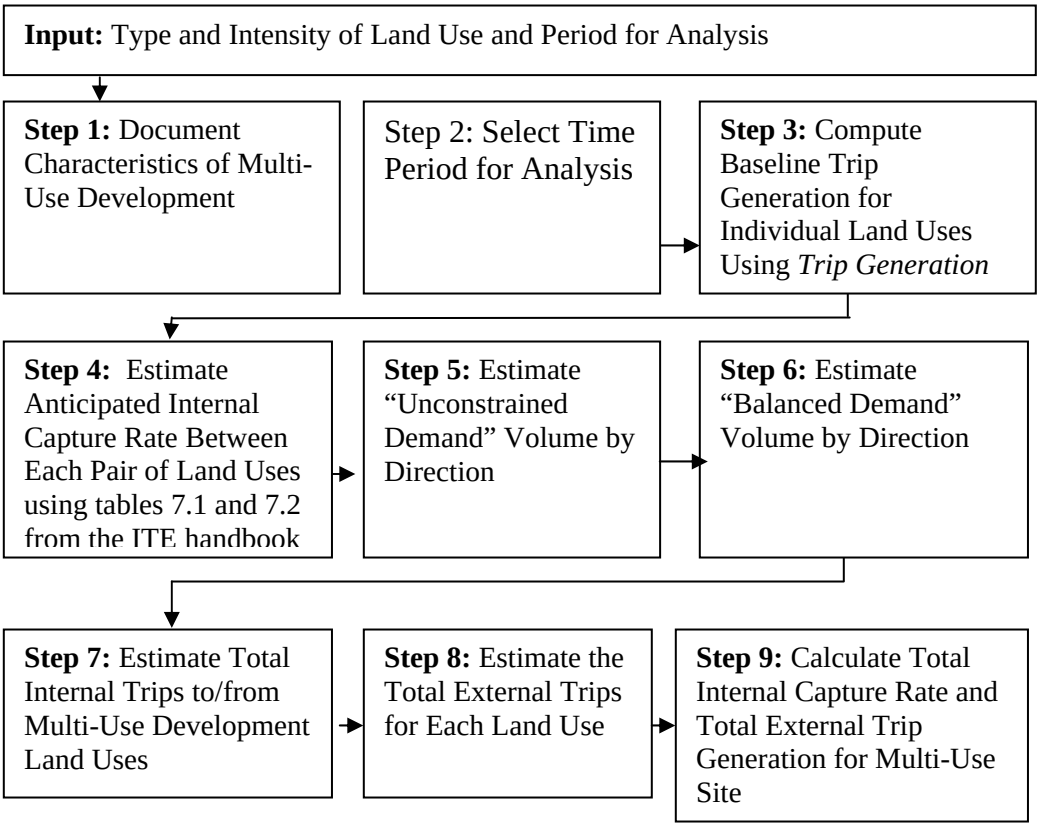


ITE Method

The ITE Trip Generation Handbook provides the foundation for this analysis (ITE, 2002). The Handbook uses a nine-step process for estimating trip generation at multi-use developments and

involves the use of a worksheet, in Appendix L. The procedure is outlined in Figure 3-2:

Figure 5-2: ITE Trip Generation Model



Step 1: Document Characteristics of Multi-Use Development

Enter into the worksheet, (Appendix M) the development name, a description of each land use including its ITE land use code and the size of each land use corresponding to the most appropriate independent variable used in ITE's *Trip Generation Manual.* If there are two or more separate areas with the same land use, combine their areas if they are within walking distance, or treat them as two entities if they require vehicle travel (for example between two offices). If the site has multiple residential components, compute the trip generation separately but record as only a single land use on the worksheet.

Step 2: Select Time Period for Analysis

Enter the time period into the worksheet because the internal capture rates differ for each time of day: weekday midday, weekday evening peak, and weekday daily. Since internal capture rates may also differ for the day of the week, it should be noted that the rates are based on data collected on Tuesday, Wednesdays, and Thursdays and the internal capture rates may need to be adjusted for analyses on other days.

Step 3: Compute Baseline Trip Generation for Individual Land Uses

Using the land uses defined in Step 1 and the time of day information from Step 2, compute the number of entering and exiting trips using rates for the land use as found in ITE's *Trip Generation* (ITE, 1997) or use acceptable local rates. For each land use, record the baseline trip generation in the column under the "TOTAL" heading (Appendix M)

Step 4: Estimate Anticipated Internal Capture Rate Between Each Pair of Land Uses

Estimate the number of trips going between each land use pair during the selected time period using internal capture rates presented in tables 7.1 and 7.2 in the ITE Trip Generation Handbook. The ITE Handbook uses internal capture rates between land uses, collected empirically in Florida, and recommends using reliable local rates if available.

For each land use pair in the development, there are four values recorded on the worksheet that represent the maximum potential for interaction between the two land uses (unconstrained demand):

Percent trips from Land Use A going to Land Use B
Percent trips to Land Use B coming from Land Use A
Percent trips from Land Use B going to Land Use A
Percent trips to Land Use A coming from Land Use B

The four rates for each land use pair written on the worksheet are the output of Step 4.

Step 5: Estimate "Unconstrained Demand" Volume by Direction

Multiply the percentages obtained in Step 4 by the appropriate trips entering and exiting each land use obtained in Step 3. Output of this step is the "Unconstrained Demand" Volume for each direction for each land use pair and the results are written on the worksheet (Appendix M).

Step 6: Estimate "Balanced Demand" Volume by Direction

The number of calculated trips from Land Use A to Land Use B may be different than the number of trips that ended at Land Use B that came from Land Use A because of the different internal capture rates. Compare the two values in each direction for each land use pairing and select the lower value. This value should be recorded as the "balanced demand" between each pair of land uses.

Step 7: Estimate Total Internal Trips to/from Multi-Use Development Land Uses

Sum the number of internal trips going *to* other land uses and then *from* other land uses. The percent internal capture for each land use can then be calculated by dividing the internal number of trips entering and exiting a land use by the *total* number of trips entering and exiting that land use from internal or external origins. Output from this step is the number of internal trips

entering and exiting each land use, and the calculated percentage of internal capture for each land use recorded on the worksheet.

Step 8: Estimate the Total External Trips for Each Land Use

Subtract the number of internal trips from the total trips to find the number of external trips for each land use. Output of this step is recorded on the worksheet for each land use, for entering and exiting traffic.

Step 9: Calculate Internal Capture Rate and Total External Trip Generation for Multi-Use Site

The number of external trips calculated in Step 8 for each land use are transcribed to the table of "net external trips" and summed to find the net external trip generation. The overall internal capture rate may be found by subtracting the ratio of calculated net external trips to total trips generated from 100 percent.

Discussion and Critique of the ITE Trip Generation Method

The Literature Review in Chapter 2 of this document discusses in detail the relative advantages and disadvantages of the ITE method including the adjustments for mixed-use developments. In summary the ITE method has the following advantages:

- The ITE Method takes types and sizes of different mixed land uses into account and calculates internal capture rates for the development to reduce the number of external trips.
- It allows and asks for variations of results with engineering judgment; professionals can distribute, assign and interpret trip generation rates.
- It is very time and cost efficient, because no expensive software is needed. Results can be obtained quickly using spreadsheet implementations.

The ITE method has the following shortcomings:

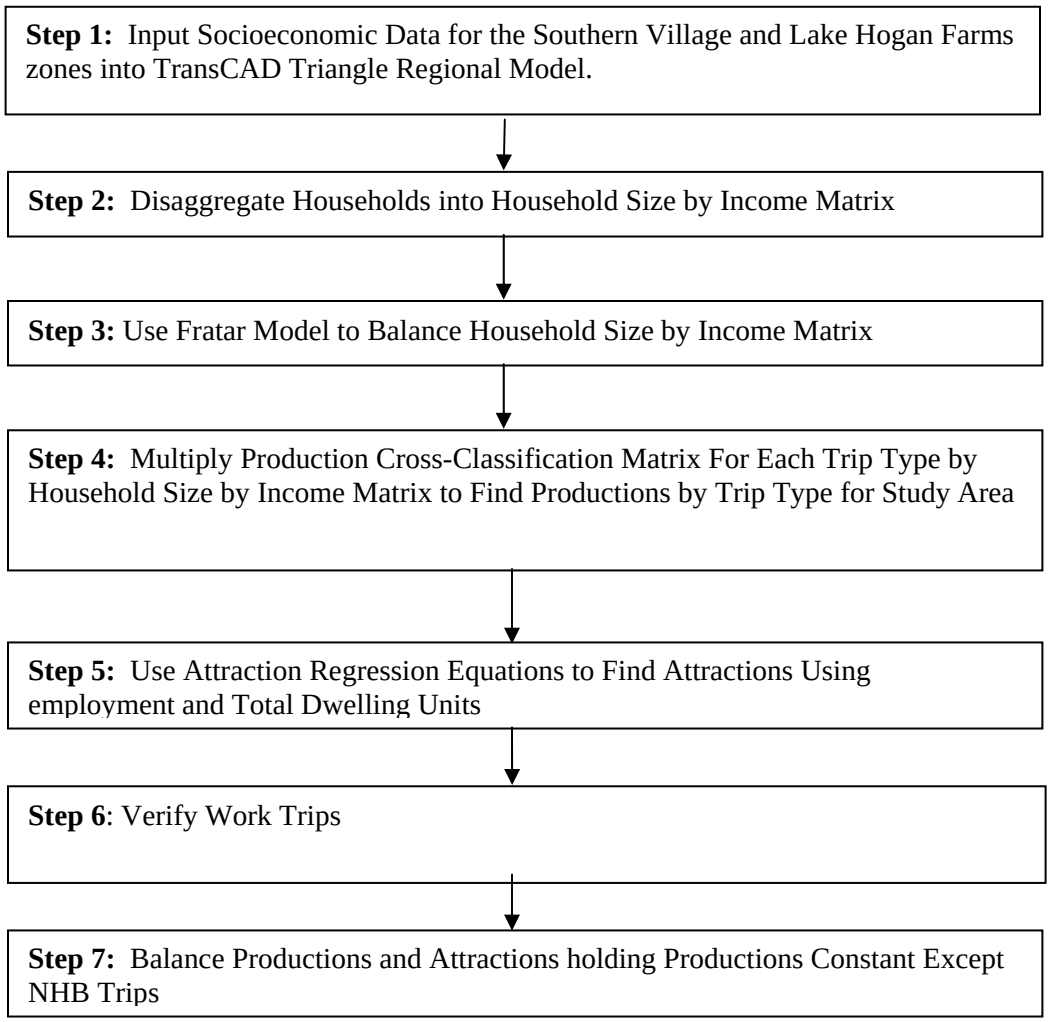
- The data for trip rates and adjustments originated in Florida from a relatively small number of TNDs. Therefore, the rates may not be transferable to nationwide applications.
- The method does not consider the location of the development relative to other competing or complimentary land uses in the region. Internal capture may be higher if no other developments are close.
- It does not account for transit accessibility and pedestrian trips, which tend to reduce the number of vehicle trips in TNDs.
- It does not consider distances between destinations, pedestrian friendliness of the network, or area type (urban/suburban).
- The internal capture rate assumes that the proportions of each land use remain relatively stable and that if enough data were available, one could predict the internal capture rate with sufficient confidence.
- Capacity, travel time and delay analysis are not included in the model. They have to be completed using other tools.

- The method does not perform trip distribution, traffic assignment, or mode split. These decisions have to be made using professional judgment.

Travel Demand Model

The North Carolina Department of Transportation developed Triangle Regional Model (TRM), uses TransCAD and predicts traffic volumes for the Triangle Region based on socioeconomic data and several different production and attraction models that vary by urban/rural locations. While the TRM is a complete travel demand model and performs all aspects of the 4-step process (Trip Generation, Distribution, Mode Split, and Traffic Assignment) this project focuses primarily on the Trip Generation portion of the model. Figure 5-3-3 shows the trip generation procedure used by the Triangle Regional Model.

Figure 5-3: TRM Trip Generation Method



Steps 1 through 3 involve separating the total number of households in the zone into categories based on size and income. This procedure was developed using the results from the Triangle

Regional Survey. For this project we are primarily concerned with the production and attraction models used in Steps 4 and 5.

Production Models

The Triangle Regional Model uses two types of trip production models: (1) a one-dimensional classification model based on a housing condition rating, which is a surrogate measure of income and associated travel; and (2) a cross-classification model based on household size and income. The trip attraction model used by the TRM is a regression model based on number of employees by five aggregate business types and the number of commercial vehicles in a zone.

Trip generation is produced for five trip purposes by the TRM: Home-Based Work (HBW), Home-Based Shopping (HBSH), Home-Based School (HBS), Home-Based Other (HBO), and Non-Home-Based (NHB). To begin the process, zonal socioeconomic data are entered into the model for each zone. Zonal data include area type (urban or rural), number of households, zone population, average household income (in 1995 dollars), average persons per household (population divided by number of households), the ratio of the average household income to the mean income for the area, number of industrial, retail, highway retail, office, and service employees, number of dwelling units, and number of university beds. Appendix N provides full table of the socioeconomic data categories, a description of each, and the data for Southern Village and Lake Hogan Farms.

The cross-classification models for estimating trip productions for each trip type in the TRM are based on the number of households stratified by household size and income group. Therefore, a disaggregation model was needed to translate the socioeconomic inputs of number of households, persons per household, and income ratio, into the number of households stratified by household size and income group. The theory underlying this model is that for any given zonal average household size, there is a specific “mix” of households for each household size. Likewise, for any given zonal average income range per household, there is a specific “mix” of households within each range. This method for determining the number of households by household size was developed by NCDOT using 1990 census data. The average household size was broken into ranges of 0.1 persons per household from 1-person households to households with 4 persons or greater. The development of the income disaggregation model followed the same approach, but used data from the 1995 Travel Behavior Survey and aggregated into five groups instead of four. Table 3-1 displays the urban trip generation rates for the Triangle Regional Model.

Table 5-1: TRM Trip Generation Urban Cross-Class Matrices

Urban HBW Trips

	Household Size (Persons/House)			
Income	**1**	**2**	**3**	**4**
Low	1.05	1.52	1.75	1.91
Low-Middle	1.05	1.88	1.88	1.91
Middle	1.12	1.92	1.92	2.39
Middle-High	1.12	2.08	2.08	2.39
High	1.12	2.08	2.08	2.39

Urban HBSH Trips

	Household Size (Persons/House)			
Income	1	2	3	4
Low	0.45	0.85	0.85	1.08
Low-Middle	0.45	0.85	0.85	1.08
Middle	0.45	0.85	0.85	1.08
Middle-High	0.45	0.86	0.86	1.38
High	0.45	0.94	0.94	1.38

Urban HBO Trips

	Household Size (Persons/House)			
Income	**1**	**2**	**3**	**4**
Low	1.2	2.37	3.76	6.97
Low-Middle	1.2	2.37	3.76	6.97
Middle	1.2	2.37	3.76	6.97
Middle-High	1.2	2.37	3.76	6.97
High	1.2	2.37	3.76	6.97

Urban NHB Trips

	Household Size (Persons/House)			
Income	**1**	**2**	**3**	**4**
Low	1.4	2.38	2.46	3.04
Low-Middle	1.74	2.38	2.46	3.04
Middle	1.74	2.74	2.84	4.11
Middle-High	1.74	2.74	2.84	4.5
High	1.74	2.74	4.63	5.43
University Beds	0.45			

Southern Village and Lake Hogan Farms are assumed to be urban areas based on their proximity to Chapel Hill. Thus, Table 3-1 trip tables were used by the TRM to determine trips for Southern Village and Lake Hogan Farms. Similar tables describe rural trip rates which are not needed in this research project.

Attraction Models

The models for trip attractions are based on regression equations that relate the trip attraction of a zone to a number of independent variables. The independent variables vary by trip purpose and include employment by type and dwelling units. The person trip attraction rates were developed by NCDOT using the Triangle Regional Survey.

The general form of the attraction equation is:

$$Attractions_{purpose}=K+a(A)+b(B)+c(C)$$

Where: K= Constant
a,b,c=coefficients
A,B,C = independent variables

Table 3-2 shows the coefficient values determined from the Triangle Regional Survey.

Table 5-2: Coefficient Values for Attraction

Regression Coefficients	HBW	HBSH	HBO	NHB
CONST	0	0	0	0
IND	1.41	0.1	0.65	1.3
RET	1.41	2.94	1.14	1.22
HWYRET	1.41	1.33	3.74	4.82
OFF	1.41	0.1	1.33	1.3
SERV	1.41	0.1	2.25	2.33
TOTDU	0	0.12	0.95	0.15

In the above table CONST = the constant, IND is industrial employment, RET is the retail employment, HWYRET is the highway retail employment (retail employment that falls into the category of fast food restaurants, service stations, etc), OFF is office employment, SERV is service employment, and TOTDU is the total number of dwelling units in the zone.

Additionally, further processing ensures that high-income jobs are not matched with low-income households in the trip distribution stage. This process is comprised of four steps:

1. Total home-based work trips are estimated for each zone using the Triangle production equations discussed previously.
2. The work trips by income group are estimated using the equation:
   $Trips_{inc}=TotalTrips*RegionalPercent_{inc}*Ratio_{Inc,area}$
3. The estimated trips from step 2 are balanced to equal total trips from step 1.
4. When all TAZs have been processed, work trips by income group are balanced to the regional level (from the production model).

This assures that the total attractions were estimated correctly by income level. The work attractions by income for each TAZ should sum to the total work attractions calculated for each TAZ using the total work attraction model.

Discussion and Critique of the Travel Demand Model

The Literature Review, in this document, discusses the relative advantages and disadvantages of using a Regional Travel Demand Model (TDM) for Traffic Impact Analysis. In summary the TDM method has the following advantages:

- The TDM uses information about regional land use and socioeconomic data and survey results to obtain trip generation. The model utilizes a cross-classification model to give deterministic estimates of traffic volumes throughout the region.
- It accounts for area type (urban and rural) and employment features of retail and office locations in the development.
- A regional model can incorporate effects of regional attractions and destination and assess the interaction between zones in the model.
- TND features like pass-by trips, internal capture, externally attracted traffic, and transit trips are reflected in the model.
- Capacity, travel time and delay analysis are included in the model
- The model includes internal and external trip distribution, mode split, and traffic assignment.
- Focusing and sub-area analysis techniques allow microscopic evaluation of zones containing TNDs.
- TDM methods can be integrated with micro simulations.

The TDM method has the following shortcomings with respect to site impact analysis:

- Without sub-area or micro simulation options the scale of a travel demand model is not refined enough to assess site-specific information, like the geometric layout of the neighborhood itself, and is therefore better suited for regional applications.
- The use of a regional model requires extensive training.
- Creating a regional TDM requires large amounts of data and the program comes at a significant cost.
- The socioeconomic data that is used for trip generation may be outdated and therefore may not reflect local characteristics accurately.

Components of Resident Survey

After UNC implemented the survey to residents of Southern Village and the Northern Carrboro neighborhoods, researchers developed household level trip generation models. This process is outlined in Volume 1 of this report. In chapter 5 of Volume 2 these equations will be compared to both the traffic counts taken at Southern Village and Lake Hogan Farms, and to standard ITE rates and equations.

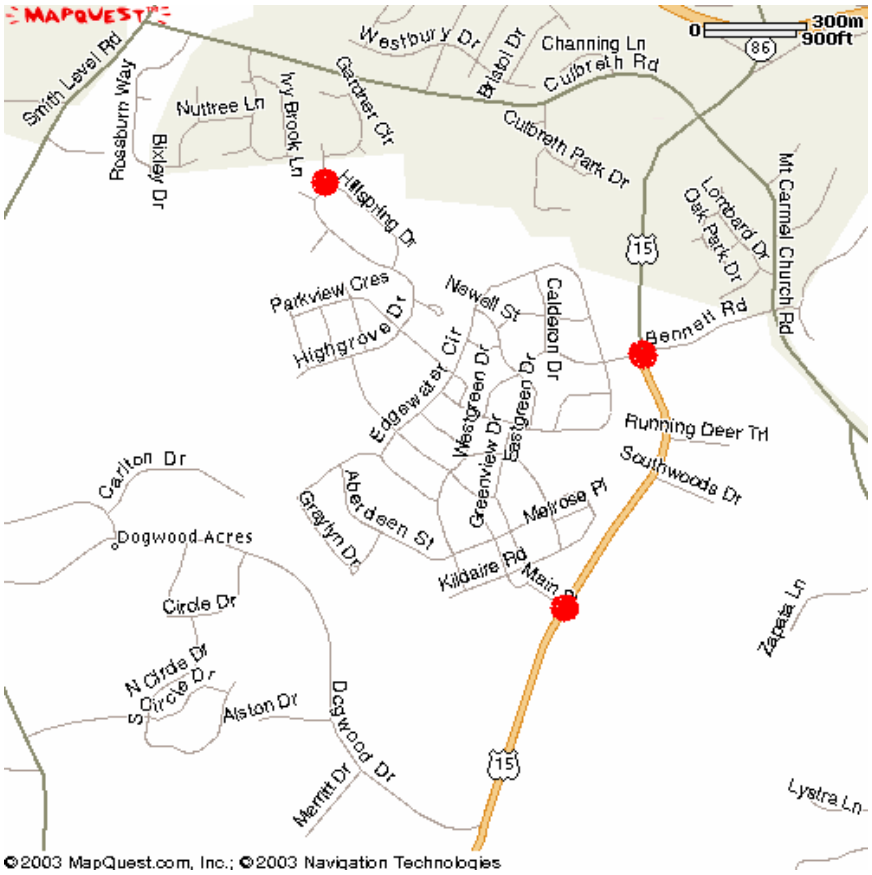
Collection of Traffic Counts

In chapter five of this report the results of the two methods of trip generation described above and the results from the residential survey performed by NCSU will be compared to actual traffic counts performed at the entrances/exits to the study neighborhood. The NCDOT traffic surveys unit performed traffic counts at all three entrances/exits to Southern Village and to the two entrances/exits to Lake Hogan Farms using pneumatic tube counters on March 18 and 19, 2003. A sample output can be found in Appendix O. The following steps outline the process.

Step 1: Determine All Entrance and Exit Points into the Study Area

Entrances and exits to the Southern Village and Lake Hogan Farms developments were determined via a site visit and using an updated map. Fortunately, both areas could be easily cordoned due the existence of only three entrances and exits to Southern Village and two to Lake Hogan Farms. Figures 3-4 and 3-5 show these entrances and exits.

Figure 5-4: Traffic Count Locations for Southern Village



Source: www.mapquest.com

Step 2: Set up Pneumatic Road Tubes for a Selected Time Period at Points Determined in Step One

NCDOT personnel set up pneumatic tubes at all three of the entrances and exits on Monday, March 17th. Data was collected on Tuesday, March 18th and Wednesday, March 19th.

Step 3: Record Data from Pneumatic Road Tubes.

Data was downloaded from the counters by NCDOT, put into spreadsheet form, and distributed to the researchers by hardcopy, and in electronic form.

Figure 5-5: Traffic Count Locations for Lake Hogan Farms

Source: http://www.ghldesign.com/lakehogan/

Discussion and Critique of Count Method

Pneumatic tube counters are a simple but accurate way of obtaining traffic counts. After installing the pneumatic tubes, no personnel are required to supervise the process. However there was a small problem at the Southern Village location. Highway construction at the southern US15-501 entrance to the development caused some drivers exiting the development to inadvertently run over the tube designated for vehicles exiting the development. NCDOT personnel determined that this would not cause significant error. The results of the traffic counts give vehicle trips entering and exiting the developments over 48 hours in 15-minute intervals. However, a shortcoming of taking counts at the entrances and exits is that internal trips are not

recorded. A vehicle must enter or leave the boundaries of Southern Village to be counted as a trip. Because this project only considers external trips from the development, this issue can be ignored. However, if further research is to be done on the internal behavior of mixed-use developments (especially if they are of larger scale), other methods of analysis may be preferable.

Chapter Summary

This chapter described four different methods to obtain trip generation rates and traffic estimates for Southern Village and Lake Hogan Farms. The methods discussed in this chapter involved the ITE Manual procedures, the Triangle Regional Model, resident and business surveys, and traffic counts collected at the developments.

Chapter 6: Analysis of Case Studies

This chapter describes the results from the trip generation methods outlined in Chapter 3 applied to the two case study neighborhoods, Southern Village and Lake Hogan Farms. For a detailed description of the neighborhoods, their geographic location, and design characteristics, refer to Appendix K.

Following the trip generation development of Chapter 3, this chapter provides the ITE trip generation estimates for Southern Village and Lake Hogan Farms and applies adjustments for internal capture. Next, the results of the Triangle Regional Model are shown followed by a summary comparing all results to each other and also to the results of the resident survey. The chapter also conducts a sensitivity analysis for the ITE Method in order to better understand how changes in trip generation and internal capture rates affect level of service estimates at intersections. The chapter concludes with a proto-type micro-simulation to demonstrate state-of-the-art traffic impact analysis methods.

ITE Trip Generation

Southern Village

The method of the ITE Trip Generation Manual and the ITE Handbook was used to develop trip generation estimates, as outlined in Chapter 3. The Southern Village and Lake Hogan Farms trip generation spreadsheets can be found in Appendix M. Table 6-1 summarizes the trip generation for Southern Village (2002) before adjustments for internal capture.

Table 6-1: Southern Village ITE Trip Generation (No Internal Capture)

				Average Daily Traffic		P.M. Peak		A.M. Peak	
Code	Land Use	Intensity	unit	entering	exiting	entering	exiting	entering	exiting
210	Single Family Homes	510	units	2440	2440	330	185	96	287
230	Condo+Townhouses	335	units	982	982	121	60	25	122
220	Apartments	250	units	829	829	104	51	20	107
443	Theater (4scrn)	10	thou sf	390	390	58	4	0	0
832	Bistro	2	thou sf	130	130	13	9	10	9
831	Restaurant	4.5	thou sf	202	202	23	11	0	0
850	Grocery w/café	6	thou sf	335	335	35	34	12	8
814	Gift store + cleaners	2	thou sf	41	41	2	3	6	7
710	Office space	95	thou sf	523	523	24	117	130	18
560	Church	27	thou sf	123	123	10	8	10	9
565	Daycare	6	thou sf	238	238	37	42	40	36
520	Elementary school	90	thou sf	541	541	73	208	184	118
492	Swim and tennis club	3	thou sf	26	26	3	3	0	0
			Total	6800	6800	832	735	535	720

Values in Table 6-1 represent total trip generation estimates for Southern Village using the ITE Trip Generation Manual (6th edition) and 2002 land use information for the neighborhood. The ITE Trip Generation Handbook method evaluates interactions of residential, office, and retail uses and calculates external trip reductions due to internal capture between those three zone types. Table 6-2 below summarizes the results of this method for multi-use developments for Southern Village. The total number of trips are less than shown in table 6-1, because the ITE

Trip Generation Handbook method does not consider land uses other than residential, office, and retail. Internal Capture rates for other land uses (school, daycare, church, and swim & tennis club) will be considered separately and are subsequently added to the total trip estimates.

Table 6-2: Southern Village Daily Internal Capture Results

Daily Net External Trips For Multi-Use Development				
	Land Use			
Land Use Category	Residential	Office	Retail	Total
Entering Trips	4,120	490	955	5,565
Exiting Trips	4,152	469	944	5,565
Total Trips	8,271	959	1,899	**11,130**
Single-Use Estimate	8,501	1,046	2,196	**11,744**
	Interim Internal Capture			**5.23%**

Table 6-2 indicates an overall daily internal capture rate of 5.23%. However, as indicated above the trips associated with the church, elementary school, daycare, and swim and tennis club cannot be accounted for using the ITE handbook method and must therefore be added. According to officials at Mary Scroggs Elementary School 238 of their 597 students live in Southern Village. This translates into an internal capture rate of about 40% for the school. Assuming that the same trip profile and internal capture rate exists for the church, daycare, and the swim & tennis club, the estimates for those land uses will be reduced by the same percentage. The total external trip generation translates to 12,246 vehicles per day, compared to the single use trip generation of 13,600 vehicles per day. This corresponds to a daily overall internal capture rate for Southern Village of **9.96%.**

Using the 2001 ITE Handbook Method for Multi-Use Development and the ITE PM peak trip generation Table 6-3 estimates are obtained for the PM peak. The numbers are less than those given in Table 6-1, because they incorporate reductions for internal capture.

Table 6-3: Southern Village PM Peak Hour Internal Capture Results

PM Peak Hour Trip Estimates with Internal Capture				
	Land Use			
Land Use Category	Residential	Office	Retail	Total
Entering Trips	546	22	116	684
Exiting Trips	284	113	51	448
Total Trips	830	135	167	**1,132**
Single Use Estimate (from Table 4-1)	851	142	191	**1,184**
	Overall Internal Capture			**4.39%**

As for the daily calculations, the PM peak hour trips associated with the church, elementary school, daycare, and swim and tennis club must be added to the results of Table 6-3. Without internal capture the church, school, daycare, and swim & tennis club add 123 inbound and 261 outbound PM trips. With the assumed 40% internal capture the inbound and outbound PM trips

are 74 and 157 respectively. Therefore, the single use trip generation estimate is 1568 vehicles in the peak hour and the net external trips are 1363 vehicles in the peak hour, resulting in an internal capture rate of **13.1%** for the p.m. peak.

The A.M. Peak Hour volumes are not analyzed because the ITE method does not account for internal capture in the AM peak.

In summary, the ITE trip generation method predicts that in November 2002, Southern Village generated approximately 12,250 vehicles daily on the surrounding network. This represents a 9.96% overall internal capture rate. In the PM peak Southern Village discharged 1363 vehicles onto the surrounding network, indicative of a 13.1% hourly internal capture rate. The findings are summarized in Table 6-4 below.

Table 6-4: Southern Village November 2002 Trip Generation

Southern Village November 2002 Trip Generation		
	Daily Traffic	PM Peak Hour Traffic
Trip Generation with internal capture	12250	1360
Single Use Trip Generation	13600	1568
Internal Capture Rate	9.96%	13.10%

Lake Hogan Farms

In March 2003, Lake Hogan Farms had 252 occupied single-family homes. Table 6-5 summarizes Lake Hogan Farms trip generation using the average ITE trip rates for single-family homes. There is no reduction due to internal capture, because Lake Hogan Farms is a single use, all residential development.

Table 6-5: Lake Hogan Farms March 2003 Trip Generation

Lake Hogan Farms March 2003 Trip Generation			
	Daily Traffic	PM Peak Hour	PM Peak Hour
Single Use Trip Generation (veh/time)	2419	189	254

Triangle Regional Model Trip Generation

The Triangle Regional Model uses a variety of socioeconomic data to predict trips for traffic analysis zones in the regional network. Updated data for Southern Village and Lake Hogan Farms came from a variety of sources, including the developers of each neighborhood and the surveys performed by the University of North Carolina at Chapel Hill. Using updated neighborhood socioeconomic data, the regional model determined the sum of the total daily trips entering and exiting each development (Table 6-6).

Table 6-6: TRM Trip Generation Estimates

Triangle Regional Model Daily Trip Estimates (1995 Model with 2003 S/E data)	
Southern Village (veh/day)	9610
Lake Hogan Farms (veh/day)	1884

Neighborhood Survey Trip Generation

Using responses to the surveys conducted at Southern Village and the Northern Carrboro neighborhoods, researchers at UNC Chapel Hill developed equations to describe the automobile trip generation characteristics of the residents.

Southern Village

Because Southern Village contains a variety of housing types, and because the total trips generated are different from the total external trips (because of internal capture), different rates were developed from the surveys to address specific areas of interest. The equations to develop the rates using the survey data are in the form

$$\text{Trip Rate} = \text{Coeff}_1*(\text{Average Value}_1) + \text{Coeff}_2*(\text{Average Value}_2) + \text{Constant}$$

The equations and coefficients used to generate the traffic estimates in the following discussion are given in the earlier sections of Chapter 3.

Table 6-7: Southern Village Resident Survey Trip Estimates (2003)

Survey Trip Generation Results for Southern Village			
Land Use Type	Rate (veh. trips/unit)	Intensity (# of units)	Daily Traffic Forecast (veh.
All Residential Households	6.29	1095	6885
Multi-Family Residential	5.90	585	3453
Single-Family Homes (SFH)	6.54	510	3335
SFH External	5.76	510	2939

Using the survey results, Table 6-7 summarizes rates for each land use type, the intensity (# of units) and the resulting daily traffic estimates. For the Single-Family Homes (SFH) category the

table further shows external trips, which implies that the SFH internal capture rate is 13.5%. The SFH internal capture rate does not represent an interaction of land uses as in the ITE method and is not necessarily indicative of other residential classifications.

Lake Hogan Farms

The survey included Lake Hogan Farms and several other similar neighborhoods in Northern Carrboro. It yielded two sets of equations: one for Northern Carrboro as a whole and one specifically for Lake Hogan Farms. The following table lists results of both equations, but in each case applies only to the housing intensity in Lake Hogan Farms alone.

Table 6-8: Lake Hogan Farms Resident Survey Trip Estimates

Survey Trip Generation Results for Lake Hogan Farms			
Land Use Type	**Rate (veh. trips/unit)**	**Intensity (# of units)**	**Traffic Forecast (veh/day)**
Single-Family Homes (SFH) - "Northern Carrboro Equation"	9.42	252	2347
Single-Family Homes (SFH) - "Lake Hogan Farms Equation"	9.39	252	2365

The intensity in Table 6-8 is the number of single family homes in Lake Hogan Farms and the trips are external auto trips.

Comparative Results and Discussion

As outlined in Chapter 5, trip generation uses the ITE method, the Triangle Regional Model (TRM), and the resident survey. All methods are compared to traffic counts taken at the entrances and exits to the developments by the NCDOT Traffic Survey Unit in March 2003.

Southern Village

Table 6-9 shows the trip generation results for each method and the percent they differ from the March 2003 traffic counts. The estimates in the ITE Trip Generation column were developed using the average rates for each particular land use, and the estimates in the March 2003 traffic counts column are an average of two days.

Table 6-9: Southern Village Daily Trip Generation Comparison

	ITE Trip Generation Method (Nov 2002)	**TRM Trip Generation (1995 Model w/2003 S/E Data)**	**March 2003 Traffic Counts**
Estimated External Trips	12250	9610	12609
Percent Difference to Traffic Counts	-2.85%	-23.78%	n/a

Compared to the NCDOT traffic counts the ITE Trip Generation Manual accurately estimates the trip generation for Southern Village. The difference of 2.85% reflects an under-estimation of 359 trips. Conversely, the Triangle Regional Model under-estimates by 2999 trips over 24 hours, which is a difference of 23.78%.

Table 6-10: Southern Village PM Peak Trip Generation Comparison

	ITE Trip Generation Method (Nov 2002)	March 2003 Traffic Counts
Estimated External Trips	1363	1336
Percent Difference to Traffic Counts	2.02%	n/a

Table 6-10 shows that for the PM Peak the ITE method also performs accurately, showing a difference of 2%. Since the TRM is a 24-hour model, no peak hour trip generation figures are available.

Considering the complex travel that takes place in a neo-traditional neighborhood, and the fact that the ITE Trip Generation Manual was developed using data from single-use, individual sites, it should be somewhat inaccurate for Southern Village. Conversely, since Lake Hogan Farms is a single-use site with no mixed development, the ITE should more accurately predict the daily and PM peak traffic.

Table 6-11: Lake Hogan Farms Daily Trip Generation Comparison

	ITE Trip Generation Method (Nov 2002)	TRM Trip Generation (1995 Model w/2003 S/E data)	March 2003 Traffic Counts
Estimated External Trips	2419	1884	2732
Percent Difference to Traffic Counts	-11.46%	-31.04%	n/a

Table 6-11 indicates that the Trip Generation Manual under-predicts the total entering and exiting traffic by 313 trips (11.46%). As with Southern Village, trip generation figures were developed using the TRM, and as before, the TRM underestimated the trips entering and exiting the development. Some portions of the development were still under construction during this study, and the additional trips associated with construction traffic could explain the difference. Even though the Trip Generation Manual underestimated the total daily trips leaving Lake Hogan Farms, it does a very good job of estimating the PM peak, only missing the total by five trips, representing an under-estimation of 2.01% (Table 4-12).

Table 6-12: Lake Hogan Farms PM Peak Trip Generation Comparison

	ITE Trip Generation Method (Nov 2002)	March 2003 Traffic Counts
Estimated External Trips	254	249
Percent Difference to Traffic Counts	2.01%	n/a

The ITE Manual estimates were also compared to those of the resident survey (Table 6-13). Internal capture is not considered, because the survey equations calculated total vehicle trips generated by each household (internal and external). The only exception to this is the last row in the table below, which shows the external generation for the SFH category (includes internal capture).

Table 6-13: Comparison of Survey and ITE Trip Generation, Southern Village

	Survey Daily Traffic	ITE Trip Generation	Difference	% Difference
All Residential	6885	8501	-1616	-19.0%
Multi-Family Residential	3453	3621	-168	-4.6%
Single-Family Homes (SFH)	3335	4881	-1545	-31.7%
SFH External	2939	4748	-1809	-38.1%

The trip generation estimates from the survey equations for Southern Village are lower than those predicted by the ITE Trip Generation Manual. Most of this difference can be attributed to the single-family households. The rate developed using the surveys from Southern Village was 6.54 trips per household. The average ITE is 9.57 trips per household. The rate for Southern Village developed in the survey falls within the range given in ITE Trip Generation Manual (4.31 to 21.85 trips per household), but it is much lower than the ITE rate used in this study. As noted in Tables 6-9 and 6-10, the ITE trip generation for Southern Village closely corresponds with the traffic counts collected at the exits to the development (within 3%), so the survey result appears low.

However, the more likely case is that the ITE rates for some land uses were high, and others low, but the balance came very close to the traffic counts. If the survey data is considered to be the "truth" then the ITE rate was artificially high, but an artificially low rate for another land use made up for the discrepancy. However, this argument may be unlikely. The single-family homes have the largest single impact on the trip generation of the development. The ITE rates for several other land uses would have to be very low to make up for a 30% over prediction in single family homes. This would mean that several businesses in the development were doing much more business than average businesses.

The location of business in the development, away from a major intersection, and their relatively narrow clientele would seem to suggest that at best they were performing on average. Site visits in peak hours seem to back this statement. In conclusion, for the Southern Village case, the ITE trip generation matched traffic counts. The discrepancy between the survey rates and the ITE

rates is difficult to explain. More studies should be completed with more cordon counts surrounding the different development areas (condos, apartments, single family homes, and businesses) to learn where the largest discrepancies lie between ITE and the actual trip generation characteristics of the development.

Lake Hogan Farms

Tables 6-14 to 6-16 show similar comparisons for Lake Hogan Farms. The trip generation estimates for Lake Hogan Farms using the two equations derived from the survey data are closer to the ITE trip generation estimates then traffic counts. This indicates that on the two days of counts people made more trips or the survey rates do not adequately describe the travel behavior of individuals in Lake Hogan Farms.

Table 6-14: Comparison of Survey and ITE Trip Generation, Lake Hogan Farms

	Survey Daily Traffic	ITE Trip Generation	Difference	% Difference
Single-Family Homes (SFH) - "Northern Carrboro Equation"	2374	2419	-45	-1.9%
Single-Family Homes (SFH) - "Lake Hogan Farms Equation"	2365	2419	-54	-2.2%
	Survey Daily Traffic	**Traffic Counts**	**Difference**	**% Difference**
Single-Family Homes (SFH) - "Northern Carrboro Equation"	2374	2732	-358	-13.1%
Single-Family Homes (SFH) - "Lake Hogan Farms Equation"	2365	2732	-367	-13.4%

Table 6-15: Summary of Southern Village Trip Generation

Southern Village Trip Generation Comparison						
	ITE Trip Generation		TRM Trip Gen.	Survey	Traffic Counts	
	PM Peak	Daily	Daily	Daily	Daily	PM Peak
Total Vehicle Trips	1568	13600	-	6885*	-	-
External Trips	1360	12250	9610	2939**	12609	1336
Internal Capture Trips	208	1350	-	396**	-	-
% Internal Capture	13.10%	9.96%	-	13.47%**	-	-

* Only Residential Neighborhoods

** Only Single-Family Home Residential

Table 6-16: Summary of Lake Hogan Farms Trip Generation

Lake Hogan Farms Trip Generation Comparison						
	ITE Trip Generation		TRM Trip Gen.	Survey	Traffic Counts	
	PM Peak	Daily	Daily	Daily	Daily	PM Peak
Total Vehicle Trips	254	2419	-	-	-	-
External Trips	254	2419	1884	2365*	2732	2732
Internal Capture Trips	0	0	-	-	-	-
% Internal Capture	0.00%	0.00%	-	-	-	-

* from 'Lake Hogan Farms' Equation

Sensitivity Analysis

This section summarizes a sensitivity analysis of the ITE trip generation results for the Southern Village Neighborhood Development. The results show the relative impacts of trip generation on intersection design with and without adjustments for mixed-use internal capture and the inherent variability of rates. Appendix P provides more details of the analysis including all data tables. The analysis consists of four main components:

1. Analyzing variations of trip rates within a 95% confidence interval
2. Assessing capacity and levels of service of an intersection for the 95% confidence interval and for other (hypothetical) percentages of increased traffic volumes
3. Comparing sensitivities of different land uses in the neighborhood
4. Evaluating effects of internal capture rate on intersection performance

Step 1. Trip Rate Variations in a 95% Confidence Interval

For the first step of the sensitivity analysis, the ITE trip generation method was performed three times for each land use:

- Using the mean values as listed in the ITE manual
- Using the mean values plus two standard deviations
- Using the mean values minus two standard deviations

Table 6-17 shows the trip rates for daily and peak hour traffic in a 95% confidence interval expressed as percent differences from the average rates.

Table 6-17: Variability of ITE Trip Generation Rates

Percent Difference of ITE Trip Rates for total traffic volumes in Southern Village					
Daily Traffic (# of vehicles)		**AM Peak Hour (# of vehicles)**		**PM Peak Hour (# of vehicles)**	
Entering	Exiting	Entering	Exiting	Entering	Exiting
Minus Two Standard Deviations					
-76.9%	-76.9%	-98.1%	-98.8%	-92.3%	-98.7%
Mean Values					
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Plus Two Standard Deviations					
81.2%	81.2%	186.0%	234.4%	194.0%	184.4%

Table 6-17 shows that in a 95% confidence interval, the maximum trip rate can be more than 200% greater than what the average rate suggests. The large variation in plus and minus two-sigma values is symptomatic of the wide range of U.S. locations for the data and in some cases the relatively few field data used to develop the trip rates in the ITE manual. In a real situation traffic engineers would likely adjust the average trip rates for a case study consistent with local conditions. The plus two standard deviation rates are, therefore, a high upper limit of trip rates, with actual trip rates falling somewhere in-between predicted average rates and these limits.

Step 2. Capacity Analysis for (Hypothetical) Increases in Traffic Volumes

The sensitivity analysis assessed effects of increasing PM traffic estimates on intersection levels of service. The analysis focused on the intersection of US15-501 and Main Street, the major entrance to Southern Village.

The capacity analysis of the intersection was accomplished using the HCS2000 software package. The analysis was completed with the average ITE trip generation predictions. Because the signal on the Main Street/US15-501 intersection is actuated, averages of field measurements of the actual signal times were taken to obtain average signal times for the analysis (Appendix O). The analysis was completed with the actual traffic volumes and assumed increases in traffic of 10%, 25%, 50%, 100%, 150% and two-sigma. Table 6-18 shows a summary of the capacity comparisons.

Table 6-18: Capacity Analysis for Percent Increases in Traffic Volumes

Approach	Direction	ITE forecast		SV volumes +10%		SV volumes +25%		SV volumes +50%	
		LOS	delay(s)	LOS	delay(s)	LOS	delay(s)	LOS	delay(s)
US15-501 NB	through	A	6.5	A	7.0	A	13.3	A	7.0
	left	B	10.4	B	12.8	B	7.0	B	14.3
US15-501 SB	through	B	13.1	B	17.6	B	17.6	B	17.6
	right	A	1.9	A	3.1	A	7.0	A	3.4
Main Street EB	left	D	43.6	E	64.2	E	68.2	E	79.0
	right	D	36.0	D	47.7	D	51.1	E	59.6
Intersection Totals		**B**	**16.6**	**C**	**22.9**	**C**	**24.7**	**C**	**28.8**
Approach	**Direction**	**ITE forecast**		**SV volumes +100%**		**SV volumes +150%**		**Plus Two-Sigma**	
		LOS	delay(s)	LOS	delay(s)	LOS	delay(s)	LOS	delay(s)
US15-501 NB	through	A	6.5	A	7.0	A	7.0	A	7.0
	left	B	10.4	B	16.8	C	20.0	C	29.4
US15-501 SB	through	B	13.1	B	17.6	B	17.6	B	17.6
	right	A	1.9	A	3.8	A	4.3	A	5.3
Main Street EB	left	D	43.6	F	140.1	F	249.5	F	351.5
	right	D	36.0	F	115.1	F	223.3	F	328.0
Intersection Totals		**B**	**16.6**	**D**	**51.5**	**F**	**97.1**	**F**	**140.6**

As expected, the levels of service for the intersection of Main Street and US15-501 get continuously worse with increasing traffic volumes. This analysis is interesting, however, in that the high delays are all associated with the exiting volumes from the development (the minor movements). The through movements on US15-501 remain at satisfactory levels of service even if the traffic exiting the Southern Village development increases by these large percentages. This behavior is understandable because the intersection is designed to carry large future volumes on US15-501.

Step 3. Comparison of Different Land Use Types

The analysis compares average rates predicted with the ITE method to the plus two standard deviations rates for each land use. Table 6-19 lists the percent difference between these two estimates and shows the difference in actual numbers of vehicles. A specific land use type may have little overall effects on traffic due to low intensity, despite a high standard deviation in its trip rate. Thus, this step identifies sensitive Southern Village land uses.

Table 6-19: Comparison of Different Land Use Types

Land Use Category	Intensity	% Difference From Average	Additional Vehciles from Average
Single Family Homes	510 units	77.1%	3764
Condos + Townhomes	335 units	105.5%	2070
Apartments	250 units	89.9%	1490
Office	95,000 sq.ft.	114.4%	1165
Retail	24,500 sq.ft.	138.7%	561
Church	27,000 sq.ft.	158.1%	389
Daycare	6,000 sq.ft.	53.1%	252
School	90,000 sq.ft.	116.7%	1264
Swim and Tennis Club	3,000 sq.ft.	158.6%	82
Total		**81.2%**	**11036**

Table 6-19 suggests that the most sensitive traffic predictions would probably result from the residential zones in Southern Village because of the relatively high intensity. The closest analytical attention should be paid to the traffic forecasts for residential land uses. Other land uses may have high percent differences, but they have a negligible overall effect because of relatively low intensities. Trip generation results should be treated with care, and professional judgment should be applied to verify the validity of the calculated rates for developments similar to Southern Village.

Step4: Effects of Internal Capture

The sensitivity analysis also compared the impacts of the average ITE rates predicted with rates that are adjusted for the calculated 13.1% internal capture. Table 4-20 compares the impacts of the reduced rates to the unadjusted ITE predictions.

Table 6-20: Effect of Internal Capture Rate on Capacity Analysis

Approach	Direction	without int. capture		with 13.1% Int. Capt.	
		LOS	delay(s)	LOS	delay(s)
US15-501 NB	through	A	6.5	A	6.5
	left	B	10.9	B	10.4
US15-501 SB	through	B	13.1	B	13.1
	right	A	2.0	A	1.9
Main Street EB	left	D	46.0	D	43.6
	right	D	39.2	D	36.0
Intersection Totals		**B**	**18.0**	**B**	**16.6**

Table 6-20 shows a negligible difference between levels of service and delays. The resulting improvement in overall intersection delay is 1.4 seconds for the p.m. peak hour, which suggests that impacts for other time periods of the day are even less. Furthermore, reduced Southern Village traffic due to the internal capture rate of 13.1% is distributed over all three exits/entrances. For each individual lane group this means that the actual impacts in number of vehicles are not significantly related to internal capture, and the effects on intersection capacity will be minor. Table 6-21 shows the distribution of the total traffic difference over the lane groups in the Main Street and US15-501 intersection.

Table 6-21: Volume Comparison for Main Street/US15-501

Volume Differences Between Trip Generation With and Without Internal Capture (p.m. peak hour)				
		internal capture 13.1%	**no internal capture**	**Difference in # of vehicles**
Total Volumes Predicted by ITE	Entering	723	832	**109**
	Exiting	639	735	**96**
Volume Percentages on Main Street	Entering (42%)	304	349	**46**
	Exiting (78%)	498	573	**75**
Volume Directional Splits for Turning Movements	Exiting to NB (40%)	199	229	**30**
	Exiting to SB (60%)	299	344	**45**
	Entering from NB (40%)	121	140	**18**
	Entering from SB (60%)	182	210	**27**

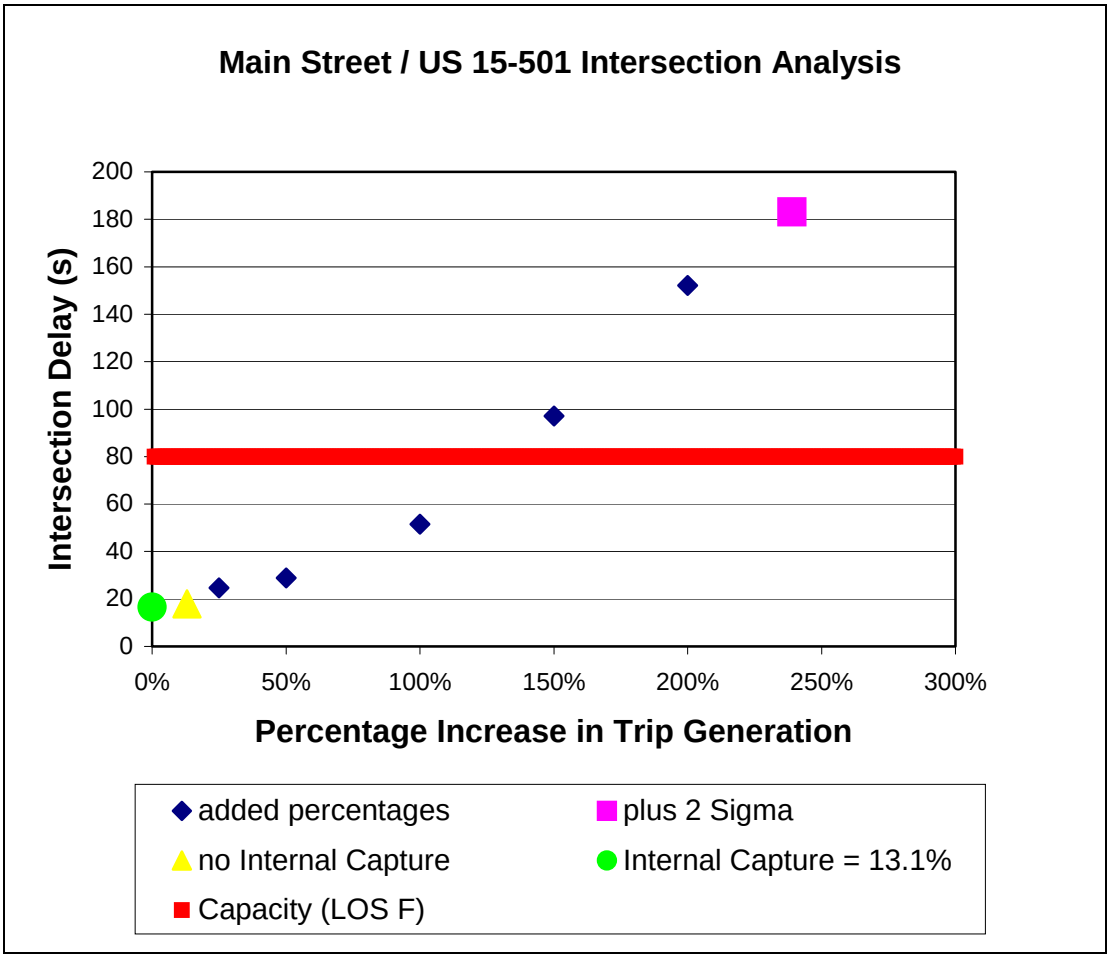
Table 6-21 shows that the internal capture rate observed for Southern Village results in less than 50 vehicles for every lane group per hour, which is less than one vehicle per minute. The impacts on Levels of Service (LOS) for the intersection are relatively insignificant. In this context it also needs to be stated that US15-501 is being widened, and that the widened roadway (which was used in this analysis) is likely designed to carry increased future traffic. The impacts on LOS may have been more significant in regions of higher density. TNDs similar to Southern Village that are located on arterials with volumes already closer to the capacity limit will likely have greater impacts on the surrounding road network. In those hypothetical cases, the impacts of 13% internal capture would then also have greater beneficial results. This case suggests that close attention needs to be paid to TNDs planned in over-capacity locations.

For cases like Southern Village, with perimeter roads that are major arterials, the sensitivity analysis suggests that it may not be necessary to calculate internal capture rates because there are only small impacts on the adjacent road network. In any event it is good practice to use the ITE handbook as a step in traffic impact analyses for traditional neighborhood developments.

Sensitivity Analysis Summary

The ITE trip generation manual can have very high standard deviations. Trip rates generated with the ITE method should compare to professional judgment and local rates. The sensitivity analysis shows that if the ITE method has underestimated traffic volumes, the levels of service on the Main Street and US15-501 intersection decrease significantly because of the intersection's design to handle lower volumes. Figure 6-1 below summarizes the results of this sensitivity analysis in a plot of intersection delay versus percentage increase in trip generation rates.

Figure 6-1: Sensitivity Analysis Summary



The heavy line in Figure 6-1 at 80 seconds total intersection delay represents a Level of Service 'F', at which the intersection is regarded as having exceeded its capacity. The circle symbol in the bottom left represents the average ITE trip generation rates minus the reductions for internal capture. The triangle next to it refers to the delay times calculated without the adjustment. The symbols show that both delay times are well below the capacity of the intersection, and the effect of internal capture is negligible. However, at the regional scale the combined internal capture of several Traditional Neighborhood Developments along the same collector route may conceivably have a beneficial effect on traffic.

Findings of the sensitivity analysis in summary are:

- ITE Trip generation can have large variability. It should be used carefully and should be adjusted for local conditions.
- If external traffic is higher than predicted, exiting neighborhood traffic delays will likely increase and result in unsatisfactory LOS for neighborhood traffic
- LOS of mainline traffic on arterials in this case was hardly affected by increasing traffic volumes entering and exiting the neighborhood

- Highest variability and additional vehicle trips resulted from residential generators in the development. Impacts of commercial and business land uses were less significant.
- The calculated (and observed) 13% internal capture has negligible effects on intersection LOS due to distribution effects.

Feasibility of Traffic Simulation Methods

The literature review in Chapter 2 has identified time-dependent traffic simulations as a possible alternative in the assessment of traffic impacts of Traditional Neighborhood Developments. While traffic simulation relies on other methods for trip generation (like the ITE method or a regional Travel Demand Model) it allows for a visual representation of traffic impacts on the simulated section of the road network. Traffic simulations such as CORSIM or VISSIM are therefore viable alternatives to the trip distribution and capacity analysis steps of a traditional traffic impact analysis. For this report a sample network for the Southern Village TND was developed in the VISSIM software package to evaluate the software as a traffic impact analysis tool. For complete documentation of the modeling process including screenshots and records of programming time refer to Appendix R.

The experience with the VISSIM software package has shown that the programming of an accurate representation of a TND neighborhood and surrounding streets requires a significant time investment and specifically trained staff. More importantly, the successful implementation of the simulation model requires trip generation and trip distribution estimates derived from other methods. For the visual analysis of the traffic impacts of the Southern Village case, the costs in training and programming time exceed the benefits of having a dynamic, visual representation of predicted traffic flows.

However, for future traffic impact assessments and as a regional planning tool, time-dependent traffic simulation is a very powerful tool. For example, simulation software presents the unique ability to model the interaction of several TND neighborhoods along the same corridor. Traffic simulations may provide an insight into traffic impacts and road network capacity for multiple TND developments. They allow for fast and easy adjustments of traffic volumes and roadway modifications and show impacts of such changing conditions visually, as well as, in the form of delay and travel time data output.

With an anticipated simplification of programming effort in the future and decreasing time requirements for creating models, simulation methods will more and more find their place as a TIA tool in the future. They allow the addition of public transportation modes and pedestrian movements in the modeling process, which will become an ever more important issue as the number of TND neighborhoods increases.

Conclusions

The ITE Trip Generation Manual does an acceptable job of estimating the daily and PM peak volumes for Southern Village. It also estimates the trips from Lake Hogan Farms accurately.

The Triangle Regional Model falls short when estimating the daily trips entering and exiting Southern Village and Lake Hogan farms. The under-prediction of traffic is likely due to the age of the model and the general infeasibility of using a regional model for neighborhood-level traffic prediction.

The trip generation rates developed using the surveys from Southern Village are much smaller than the rates for single family homes in the ITE Trip Generation manual, but are very close to the combination of apartments and condominiums. Because the ITE trip generation is about equal to the traffic counts, either the survey rates are artificially low, or more complex land use interactions are occurring.

From the sensitivity analysis it was observed that increasing traffic volumes entering and exiting the neighborhood negligibly affected the LOS of through traffic on the adjacent arterial and that the highest variability and additional vehicle trips resulted from residential generators in the development. Impacts of commercial and business land uses were less significant. In addition, the calculated (and observed) 13% Internal Capture has negligible effects on intersection LOS due to distribution effects.

Finally, for future traffic impact assessments and as a regional planning tool, time-dependent traffic simulation may prove to be a very powerful tool. The ability to model the complex internal interactions between pedestrians and vehicles in a mixed-use development can lead to greater understanding of the impacts of such design specifically with regard to larger developments that are more integrated into the urban fabric.

Chapter 7: Summary Findings, Conclusions and Recommendations

Traveler Behavior: Trip Generation

North Carolina is experiencing rapid growth, especially in the Charlotte, Piedmont Triad, and Research Triangle areas. One way to deal with the growth is to encourage traditional neighborhood developments, which attempt to create new growth by looking at the lessons from the past. Specifically, they promote alternative modes, mixed land uses and higher densities. This study was an attempt to understand the relationships between traditional neighborhood developments and transportation. The study finds no statistically significant difference between the *total* trips made by households in the TND surveyed and the comparable conventional developments. However, TND households substitute driving trips with alternative modes, i.e., the *automobile* trip generation rate for the TND was significantly lower (by 1.25 trips per day per household) than conventional neighborhoods. In addition, empirical evidence suggests that TND households have:

- Lower vehicle miles traveled—on average, TND single-family households travel 18 miles less per day.
- Higher share of alternative modes—in the TND, 78.4 percent of the trips were by personal vehicle compared with 89.9 percent in the conventional neighborhoods.
- Lower external trips—on average TND households made 1.53 less external trips per day.

The TND examined in this study internally captured a substantial share (20.2 percent) of the total trips produced. The conventional neighborhoods internally captured a much smaller share (5.5 percent) of the total trips. Therefore the difference between the internal trip capture rates for the two development types is 14.7 percent.

Note that 1.25 fewer automobile trips per household per day translates to 1150 fewer trips per day for the entire Southern Village development (920 residences * 1.25 trips). Likewise, 1.53 fewer external trips per household per day translates to 1408 fewer external trips per day (920 residences * 1.53 trips). If we assume that 8 percent of the traffic will occur during the afternoon peak period, then this will imply 113 fewer peak period trips (1408*0.08). Given that roadway capacity is approximately 2000 passenger cars per hour per lane and assuming that all 113 trips are made in single-occupant vehicles, a relatively small network impact of Southern Village will occur. Possibly several TND developments can be clustered together, perhaps in greenfields, if a substantial impact on network performance is to be achieved. Of course it will be important to think more about which types of clustering will be most appropriate in the various North Carolina contexts.

Our findings are also consistent with the literature reviewed at the beginning of this report. For example, in line with Cervero and Kockelman (1997) and Cervero and Radisch (1996), we find that households in TNDs travel fewer vehicle miles and make more physical activity trips (TND residents made 0.42 more exercise trips per day) than households in conventionally designed neighborhoods. Even as an example of an “island of neotraditional development in a sea of freeway-oriented suburbs” (Cervero, 1996), Southern Village’s design seems to influence travel

behavior by increasing alternative mode use and lowering vehicle miles traveled, which translates into fewer cars on roadways.

The results of the business survey revealed that the ITE procedure, when applied to the Southern Village businesses predicted 5,918 trip ends compared with 5,918 trip ends reported by the business managers. This is 13.7 percent fewer trip ends than reported. Furthermore, only 5.2 percent of the 432 employees reside in Southern Village and a large majority of the employees (92.4 percent) use personal vehicles to commute to work. This is not surprising given the high levels of automobile ownership in the area and free employee parking in Southern Village. A greater percentage of customers/visitors (39.2 percent) reside in Southern Village and about 18.1 percent reportedly walk to the businesses. The results show that Southern Village employees use passenger cars as often as employees in conventional (stand-alone) facilities, but that customers are more likely to walk.

Several important issues should be addressed in future studies, perhaps utilizing the same dataset or at least using this dataset and these findings as a baseline.

- Survey traditional and conventional neighborhoods that have a more diverse range of household incomes and household types. Because both the neighborhoods used in this study have relatively high incomes and housing values, we cannot refute scholars who believe that the harm in building more traditional neighborhoods is that they may backfire and actually end up generating more vehicle miles traveled: While this does not appear to be true for traditional neighborhoods that contain households with high incomes and high housing values, it may well be true for more socioeconomically diverse traditional neighborhood development. This issue clearly needs further investigation.
- There are many good reasons for children to walk or bicycle to school, e.g., it gives them the exercise they need and reduces automobile trips. By providing sidewalks and bicycling opportunities, TNDs may alleviate safety concerns and encourage parents and children to use these alternative modes. The data collected in this study allows us to quantify the use of alternative modes for children's school travel.
- With over 50 percent of the US population overweight and about 30 percent obese, the problem is costing an estimated $100 billion in healthcare costs. Part of the problem is transportation related, given the automobile dependency. Therefore, the health effects of transportation activities need investigation, e.g., do TNDs encourage more physical activity? Are people living in TNDs less likely to be overweight? Again, our data can provide at least partial answers to these questions.
- The possibility of self-selection should be thoroughly tested. While regression analysis of the responses to the attitudinal questions in this survey suggests the presence of self-selection, a longitudinal study that accounts for life-changing events is the best way to address self-selection biases.
- Finally, the Southern Village was a relatively new TND when it was surveyed. As the development matures and the diversity of businesses, land uses and residents within the development increases, it should be re-surveyed to get a sense of how residents' behavior changes over time—and if the "novelty effect" wears off. Indeed by understanding behavioral changes over time can we understand the dynamics of behavior that are so critical to reducing traffic congestion and improving air quality.

Traveler Behavior: Limitations

There are well-known limitations of survey research and this study recognizes them. Mail surveys typically have low response rates than other types of surveys, though we achieved a reasonably good response rate of 25 percent. This is consistent with other transportation surveys. Of course, non-response may introduce error. We contacted the non-respondents in the selected neighborhoods and urged them to participate, in addition to sending them reminders and assuring respondents of confidentiality. We also gave the respondents incentive coupons ($10 at the Weaver Street market) that they received upon completing the survey.

To control for non-sampling errors, a travel diary helped people note/recall daily trips. Other standard procedures, such as rechecking the data for coding errors and examining outliers were also used. Of course, we recognize that the there is a possibility of non-response errors in such surveys—though the response rates and the empirical results were reasonable and in accordance with theory and expectation.

There is evidence of self-selectivity is some of the attitudinal questions that were asked and may indicate that some people chose their residential location based at least in part on their desired travel patterns (Appendix D). Compared with residents in conventional neighborhoods, Southern Village residents are more likely to find it important to have shops and services near to their residences, believe children should have a large public play space within safe walking distance of their home, enjoy a house close to the sidewalk so they can see and interact with passerby, and to be comfortable living in close proximity to their neighbors ($p < 0.05$). They are less likely to believe that it is important for children to have a large backyard for playing.

Traveler Behavior: Recommendations

It is difficult to make general recommendations based on a study of two neighborhoods in the Chapel Hill-Carrboro area. At the same time, the study results are reasonable, they are consistent with the literature and the study was conducted using sound methodology. So we venture to make a few recommendations that flow from the results. Our findings of significantly lower automobile trips, lower vehicle miles traveled and fewer external trips in TNDs, lends empirical support to building more traditional neighborhoods as one way to encourage alternative mode use and alleviate regional traffic pressure and to improve regional air quality. While traditional neighborhoods generate fewer and shorter automobile trips than conventional neighborhoods, as pointed out in the previous section, one or two neighborhoods may not have a significant impact on traffic. So the possibly of clustering several TNDs should be considered, if a substantial impact on network performance is to be achieved.

In terms of travel demand forecasting, our findings suggest that travel behavior differs significantly between traditional and conventional neighborhoods, therefore, we recommend the use of alternative trip generation models for TNDs, such as those presented in this report.

The Statewide Planning Branch of the state government, which is responsible for preparing the North Carolina's *Statewide Multimodal Transportation Plan*, can perhaps promote TNDs by

reducing impact fees for these developments, given the higher internal trip capture rates of the TND. Where appropriate, Statewide Planning may consider contributing to infrastructure expenses such as road and sidewalk construction in TNDs, targeting TND developments for public transportation funding, and expanding and improving efforts to link land use and transportation planning across the state to make TNDs more successful. In general, the site design of Southern Village follows NCDOT's *TND Street Design Guidelines*, which suggest widths of 5 feet for sidewalks, 6 feet for planter strip, 18 foot lanes, 28 foot streets, informal 'on-street' parking as well as access to transit. The empirical evidence shows that the guidelines might be sufficiently encouraging the use of alternative modes.

State and local agencies could work together to support and streamline future traditional neighborhood developments. The NCDOT Bicycle and Pedestrian Division could support TNDs as a means to further the goals outlined in *Bicycling and Walking in North Carolina: A Long-Range Transportation Plan.* In particular, by providing safe and efficient bicycle and pedestrian infrastructure that offer connections between activity centers, TNDs encourage bicycling and walking as viable transportation option and support internal non-motorized mobility needs. This study found that traditional neighborhoods can increase bicycle and walking mode shares significantly. Additionally, with their mix of housing types, TNDs promote the use of public transportation. The NCDOT Public Transportation Division could promote TNDs as a means of providing greater accessibility and choice to people.

Finally, a related purpose of the surveys was to establish a benchmark/baseline of traveler behavior in TNDs and to provide data for future comparisons and modeling efforts. Given the success of the survey and results, we recommend that Southern Village serve as a future Laboratory or Testbed for innovative transportation-land use experiments

Traffic Analysis: Trip Generation

This section presents conclusions and recommendations from the trip generation analysis of Southern Village and Lake Hogan Farms and covers three main areas: trip generation methods, traffic impacts of neo-traditional developments, and neighborhood development. The comments pertain specifically to the two case study neighborhoods and may not transfer to other TNDs.

Traffic Analysis: Methods

As demonstrated in Chapter 6, ITE trip generation rates and methods are acceptable for predicting the trip generation of both Southern Village and Lake Hogan Farms. This result helps justify the ITE method for multi-use developments as outlined in Chapter 7 of the ITE Trip Generation Handbook, as well as the trip generation rates found in the sixth edition of the ITE Trip Generation Manual.

It is also apparent from trip generation Figures 6-9 and 6-11 in Chapter 6 that the Triangle Regional Model does a poor job of estimating trips from a single development like Southern Village. This is primarily due to the aggregate nature of the model, which is satisfactory for

predicting trips on a regional basis but not for estimating the entering and exiting flows for a single development. A secondary reason may be the age of the Triangle Regional Model. Some socioeconomic factors used to calibrate the model may have changed, particularly those related to the average income per capita in the Triangle Region.

At the neighborhood scale, simulation methods hold promise for analyzing the trip generation and traffic impacts of a single development, especially with a development that has complex interactions between private vehicles, pedestrians, and transit. With a simulation model, the trip generation of the development can be changed, and both the internal and external impacts can be analyzed quickly. As the collective expertise in creating simulation models grows at public agencies and private firms, simulation will play a much greater role in neighborhood traffic impact analyses.

Traffic Analysis: Impacts of Neo-Traditional Developments

The potential traffic reduction from Southern Village internal capture is less than the inherent variability in trip generation rates. As a result, access improvements for similar mixed-use developments should likely be as robust as for conventional developments.

Trip generation rates in the ITE Trip Generation Manual represent single-use sites with little or no interaction with other sites. ITE also provides special internal capture adjustments for mixed-use developments. Yet uncertainty is inherently present in the trip generation rates and the associated traffic impact analysis regardless of the type of development. In the Southern Village case the internal capture is within one standard deviation of rates published by ITE. This indicates that the internal capture traffic reduction is less than the variability in trip rates. Therefore, when attempting to predict traffic for a future development of comparable size, makeup, and location, the potential reduction in trips from internal capture may be less than the inherent variability in the traffic forecast. The relatively small amount of trip reduction compared to the trip rate variability implies that intersection access for developments comparable to Southern Village should be designed without consideration for internal capture.

A sensitivity study tested the conclusion regarding internal capture rates having little effect on access management. Trip generation and internal capture rates were varied, and the subsequent changes to the LOS at an external intersection were analyzed. The analysis indicated that the external intersection was designed to handle future increases in traffic along US 15-501 and that small traffic decreases due to internal capture did little to decrease delay at the intersection. This makes intuitive sense when considering the typical “over-design” of intersections along major highways.

Traffic Analysis: Implications for Neighborhood Development

While this study demonstrates that the traffic reduction from internal capture at Southern Village does little to affect the traffic level of service at nearby intersections, particularly in the peak periods, the ITE method indicates that external trips decrease by 10-13% based on the mix of land use. This reduction is consistent with the traveler behavior surveys. The trip reduction likely

results from internal non-work trips because there are few employment opportunities in Southern Village.

Besides potential traffic benefits, neo-traditional developments are attractive to real estate developers. The neighborhoods are dense, requiring relatively little land for a large number of dwellings. However, the makeup and location of such developments should be closely analyzed. ITE indicates that retail development has the highest internal capture, both from residences and from office space. The shopping opportunities of such developments should be increased and tailored to better meet the needs of the individuals living in the development, as more realistic and practical opportunities will certainly increase the total internal capture of the development

Neo-traditional developments should also be strongly encouraged as options for re-development in urban areas. The increase in trip opportunities with a grid network has the potential to increase internal capture. If such developments are placed in a constrained network, where vehicle travel is difficult, walking and transit ridership should increase. Such increase in internal capture in an urban setting may have a greater effect on traffic impacts than at the suburban fringe. Additionally, urban settings are where simulation modeling would be the most appropriate.

Traffic Analysis: Conclusions

ITE methods and rates are acceptable for predicting the trip generation of the mixed-use development Southern Village and the single-use development Lake Hogan Farms.

The Triangle Regional Model is not acceptable for predicting the trip generation of a single development.

Simulation holds promise for analyzing the impacts of a single development and can be integrated with regional models.

Internal capture traffic reduction for mixed-use developments is less than the variability in trip rates.

Small traffic decreases due to internal capture do little to decrease delay at “over-designed” intersections along major highways.

The increased trip opportunities and network connectivity found in urban areas may greatly increase internal capture compared to mixed–use development in the suburbs.

Traffic Analysis: Recommendations

Continue to use ITE methods and rates when analyzing the traffic impacts of neo-traditional and conventional developments.

Do not use aggregate travel demand models for individual site development traffic forecasting.

Design intersection access for mixed-use developments like Southern Village without consideration for internal capture.

Increase retail opportunities and tailor them to specifically meet the needs of neighborhood residents

Encourage more mixed-use development in urban areas.

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APPENDICES

Appendix A: Relevant studies, their location, sample, and independent variables

Study	Location	Sample	Independent Variable		
			Density	Land Uses	Design
Cervero & Kockelman (1997)	SF Bay Area	50 neighborhoods	Yes	Yes	Yes
Ewing *et al.* (1994)	Palm Beach County, FL	6 communities	Yes	Yes	
Holtzclaw (1990)	SF Bay Area	2 communities	Yes	Yes	
Holtzclaw (1994)	California	28 communities	Yes		
Kitamura, Mokhtarian and Laidet (1997)	SF Bay Area	5 neighborhoods	Yes	Yes	Yes
Boarnet and Crane (2001)	Southern California	Areawide	Yes	Yes	Yes
Kockelman (1997)	SF Bay Area	Regional	Yes	Yes	Yes
McNally and Kulkarni (1997)	Orange County	20 neighborhoods			
Cervero (1995)	SF Bay Area	14 neighborhoods	Yes	Yes	Yes
Cervero and Radisch (1996)	SF Bay Area	2 neighborhoods	Yes	Yes	Yes
Handy and Clifton (2001)	Austin, TX	6 neighborhoods	Yes	Yes	Yes
Handy (1993)	SF Bay Area	4 communities			
Berrigan & Troiano (2002)	United States	National	Yes[1]	Yes[1]	Yes[1]
Frank and Pivo (1994)	Seattle Metro Area	Areawide	Yes	Yes	
Crane and Crepeau (1998)	San Diego County	Countywide			Yes[2]
Craig *et al.* (2002)	Canada	27 neighborhoods	Yes	Yes	Yes
Boarnet and Sarmiento (1998)	Orange County	Countywide	Yes	Yes	Yes[2]
Cervero (2002)	Montgomery County, MD	Countywide	Yes	Yes	Yes
Cervero (1996)	United States	11 MSAs	Yes	Yes	

[1]With using home age as a proxy.
[2]Just looked at street pattern.

Appendix B: Process for selecting the neighborhoods used in this study

To best represent common neighborhood types in North Carolina, we wanted to select a conventional subdivision for which to compare the travel patterns of the residents of Southern Village. A comparison between such neighborhoods would maximize the usefulness and applicability of the results of our study. Accordingly, a matrix of neighborhood attributes was developed and then used to compare various area neighborhoods to one another and to Southern Village. The aim of this matrix was to identify a neighborhood that best embodies the characteristics of a conventional subdivision.

Out of a list of dozens of Chapel Hill and Carrboro neighborhoods, we separated out neighborhoods that were roughly the same area and were approximately the same distance from the University of North Carolina campus as Southern Village (see attached map). This selection was done in order to allow us to control for various elements in our study and to help minimize the inaccurate extrapolation of our findings. Using these criteria, we selected seven neighborhoods (including Southern Village) that are listed across the X-axis of the matrix. A short description of each neighborhood is provided below with an approximate range and average of property values (which does not factor in apartment complexes). Median income of the various neighborhoods would be a better measurement than property values for which to compare the neighborhoods by, but the Census has yet to release 2000 income information for North Carolina.

- *Southern Village* is a new neighborhood, begun in the late 1990s, which was developed as Chapel Hill's first Traditionally designed neighborhood (TND). A retail/commercial/ office area is located in the southern area of the development off of the highway and is surrounded by medium- and high-density housing. Southern Village is located at the south end of Chapel Hill and is just west of US Highway 15-501. Property values range from $240,000 to $481,499 with an average of $350,365.
- *Timberlyne* is a more conventional neighborhood that was first developed several decades ago. However, some areas of the neighborhood, including a 20-unit single-family subdivision and a large apartment complex, were built in the late 1990s and a few of the single-family homes are still under construction. A retail/commercial/ office area is located in the northwest corner of the development and is surrounded by mainly high-density housing. Timberlyne is located in northern Chapel Hill at the southeast corner of Airport Road and Weaver Dairy Road. Property values range from $196,000 to $521,331 with an average of $350,878.
- *Lake Hogan Farms* is a new, conventionally developed neighborhood that is still undergoing construction. Though 100 percent of its single-family detached homes have been built, none of its single-family attached homes have been completed. Accordingly, the development is at only about 75 percent occupancy. Lake Hogan Farms is located northwest of Carrboro and to the north of Homestead Road and to the east of Old State Highway 86. Property values range from $239,271 to $875,000 with an average of $416,008.
- *Glen Lennox* was developed several decades ago and is composed of single-story garden level apartments and detached single-family homes. A retail/commercial/office area is located in the northeast corner of the development and is surrounded by the garden level apartments. Glen Lennox is located in eastern Chapel Hill at the northeast corner of the

interchange of US Highway 15-501 and State Highway 54 and is bounded on the east by Chapel Hill Country Club's golf course. No property values are available because this neighborhood is primarily composed of rental units.

- *Lake Ellen* was developed several decades ago, is composed of exclusively single-family detached homes, and includes the North Forrest Hills neighborhood. Lake Ellen is located in northern Chapel Hill to the east of Airport Road and is bounded roughly by Piney Mountain Drive. Property values in North Forrest Hills range from $175,000 to $343,648 with an average of $225,412.
- *Culbreth* includes the Cobbleridge and Southbridge developments on both sides of Culbreth Road. Most of the developments in this area were built in the 1990s and are composed of single-family detached and attached homes. Culbreth is located at the southern end of Chapel Hill and is bounded by Smith Level Road to the west and US Highway 15-501 on the east. Property values in Cobbleridge range from $240,000 to $278,500 with an average of $255,800. Property values in Southbridge range from $244,900 to $350,000 with an average of $291,466.
- *Briarcliff* was developed several decades ago and is composed exclusively of single-family detached homes. Briarcliff is located in eastern Chapel Hill to the south of Ephesus Church Road and east of US Highway 15-501. Property values range from $129,000 to $270,000 with an average of $219,722.

Along the Y-axis of the matrix, a number of neighborhood features are grouped into five major categories: "Functional," "Safety," "Aesthetics," "Destinations," and "Comparison Considerations." These features have been identified by various studies as attributes that:

1. Define a TND;
2. Influence a person's decision to walk or ride a bicycle; and/or
3. Determine how the neighborhood compares to Southern Village.

Considered carefully, each of these attributes was deemed topical to our study.

Once the attributes and their method of measurement were developed, evaluators filled in the matrix for each of the seven neighborhoods while making site visits (see attached matrix at the end of this document). Results for three of the major categories – "Functional," "Safety," and "Aesthetic" features – were summed and ranked as were the two sub-categories of "Destinations" – "Mix of Uses" and "Facilities" (Table B-1).

Table B-1: Neighborhood Evaluation Results, Ranked Scores

Feature	*Southern Village*	*Timber-lyne*	*Lake Hogan Farms*	*Glen Lennox*	*Lake Ellen*	*Culbreth*	*Briarcliff*
Functional	1 (tie)	6	4	1 (tie)	7	3	5
Safety	1	3 (tie)	6	3 (tie)	7	2	3 (tie)
Aesthetics	1	5	6	2 (tie)	7	2 (tie)	4
Mix of Uses	1	2	5 (tie)	3	5 (tie)	4	5 (tie)
Facilities	1	4	5	2	6 (tie)	3	6 (tie)
TOTAL	1	3	5	2	7	4	6

Since the total points for each category or sub-category differ, the results of the evaluation are also presented as proportions of the total points available per category, sub-category, and total in Table B-2; these are graphed in Figure B-1. The neighborhoods are positioned on a continuum in Figure B-2 based on their total proportion.

Table B-2: Neighborhood Evaluation Results, Proportionate Score

Feature	*Southern Village*	*Timber-lyne*	*Lake Hogan Farms*	*Glen Lennox*	*Lake Ellen*	*Culbreth*	*Briarcliff*
Functional	0.69	0.42	0.56	0.69	0.38	0.60	0.44
Safety	0.60	0.52	0.48	0.52	0.36	0.56	0.52
Aesthetics	0.89	0.57	0.54	0.69	0.51	0.69	0.63
Mix of Uses	1.00	0.83	0.08	0.50	0.08	0.25	0.08
Facilities	0.65	0.40	0.35	0.50	0.30	0.45	0.30
TOTAL	**0.77**	**0.55**	**0.42**	**0.60**	**0.34**	**0.53**	**0.41**

Figure B-1: Comparison of Neighborhood Features

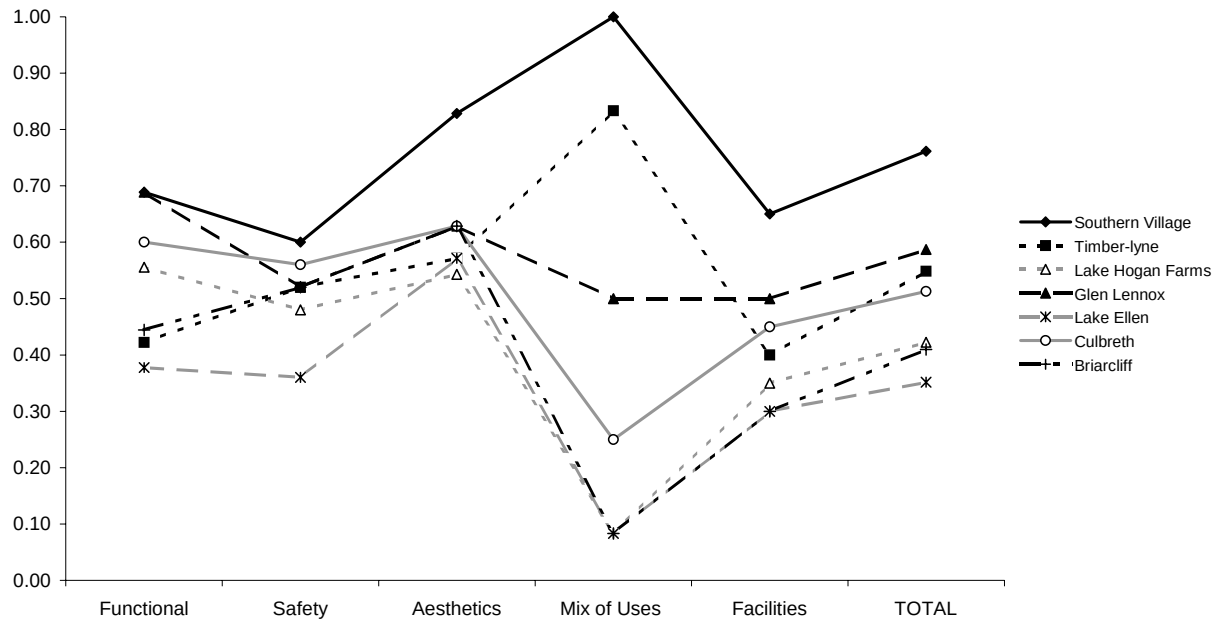
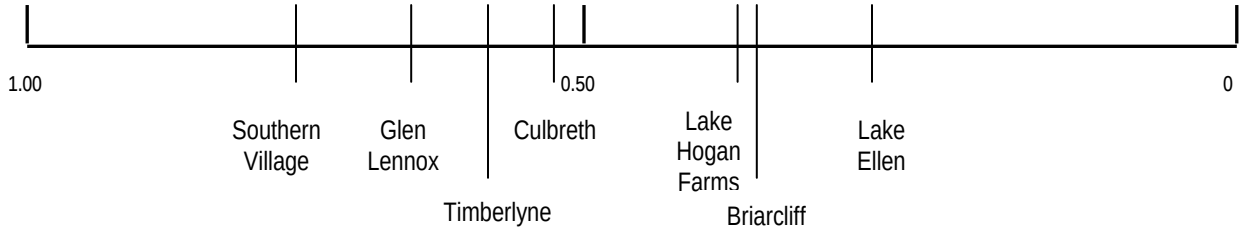


Figure B-2: Continuum of Neighborhoods



The results of our evaluation enable us to compare and contrast the features of the seven neighborhoods as they relate to our study. To visualize the meaning of the proportions in Table

B-2, assume that a score of "1" equates to being a 100-percent walkable and bikeable TND and a score of "0" equates to being a completely auto-dependent conventional neighborhood with respect to the feature being considered. Accordingly, Southern Village scored overall as being the neighborhood most like a walkable and bikeable TND. Glen Lennox, Timberlyne, and Culbreth followed respectively as second, third, and fourth, and Lake Hogan Farms, Briarcliff, and Lake Ellen followed respectively as fifth, sixth, and last. A summary of how each neighborhood compares in our evaluation follows.

- *Southern Village*, as expected, ranked first overall and ranked at the top with respect to having the most functional features, safety features, aesthetic features, mix of uses, and facilities. Relative to the other neighborhoods' scores for particular features, Southern Village scored at or near the top in most categories. However, Southern Village scored near the bottom for gradient and tree cover.
- *Glen Lennox*, ranked second overall, ranked in the top half in each of the main categories. Specifically, Glen Lennox tied for first for functional features, tied for third for safety features, tied for second for aesthetics, ranked third for mix of uses (but no schools or office space), and ranked second for facilities. Relative to the other neighborhoods' scores for particular features, Glen Lennox scored at or near the top for having no slopes, a good street design, and having numerous parks throughout the neighborhood. However, Glen Lennox scored near the bottom for having bike lanes and paths, crosswalks, and front porches facing the street.
- *Timberlyne*, ranked third overall, ranked in the top of some of the main categories, but towards the bottom in others. Specifically, Timberlyne ranked second-to-last for functional features, tied for third for safety features, ranked fifth for aesthetics, second for mix of uses (no schools present), and fourth for facilities. Relative to the other neighborhoods' scores for particular features, Timberlyne was not exceptional in any one area, except for featuring a number of land uses. Additionally, Timberlyne scored near the bottom for bike lanes and paths, front porches facing the street, and facilities for pedestrians (such as benches) and bicyclists (such as bike parking) and connected and narrower streets.
- *Culbreth*, ranked fourth overall, ranked in the top half in most of the main categories but near the bottom in others. Specifically, Culbreth ranked third for functional features, second for safety features, tied for second for aesthetics, second-to-last for mix of uses (although Culbreth does have a middle school), and third for facilities. Relative to the other neighborhoods' scores for particular features, Culbreth scored at or near the top for having good sidewalk continuity and narrow roads. However, Culbreth scored near the bottom for gradient, connected street design, and places for pedestrians to sit.
- *Lake Hogan Farms*, ranked fifth overall, ranked in the bottom half in each of the main categories. Specifically, Lake Hogan Farms ranked fourth for functional features, second-to-last for safety features, second-to-last for aesthetics, tied for last for mix of uses, and second-to-last for facilities. Relative to the other neighborhoods' scores for particular features, Lake Hogan Farms scored at or near the top for having good sidewalk continuity, interesting sights, and a number of parks throughout the neighborhood. However, Lake Hogan Farms scored near the bottom for connected street design, tree cover, setbacks, garages, facilities for pedestrians (such as benches) and bicyclists (such as bike parking), and public transportation.

- *Briarcliff*, ranked sixth overall, ranked in the bottom half in each of the main categories. Specifically, Briarcliff ranked fifth for functional features, tied for third for safety features, fourth for aesthetics, tied for last for mix of uses, and tied for last for facilities. Relative to the other neighborhoods' scores for particular features, Briarcliff scored at or near the top for having no slopes and good tree coverage. However, Briarcliff scored near the bottom for bike lanes and paths, sidewalk continuity, interesting sights, and parks.
- *Lake Ellen*, ranked last overall, ranked at the bottom in each of the main categories. Relative to the other neighborhoods' scores for particular features, Lake Ellen scored at or near the top for having good tree coverage and parks throughout the neighborhood. However, Lake Ellen scored at or near the bottom for a number of features, including sidewalks, bike lanes and paths, sidewalk continuity, on-street parking, lighting, surveillance, crosswalks, front porches facing the street, setbacks, and lot size.

Ultimately, by taking into account the results of our evaluation and other neighborhood characteristics, we chose a neighborhood which best represented a modern-day, conventional subdivision. Representative of most modern-day conventional subdivisions, three neighborhoods contain exclusively single-family detached housing: Lake Hogan Farms, Briarcliff, and Lake Ellen. However, we selected Lake Hogan Farms over Briarcliff and Lake Ellen since Lake Hogan Farms is the most recently developed (1990s and 2000s as opposed to 1960s to the 1980s), has comparable property values to Southern Village (an average of $416,008 versus Southern Village's $350,365 as opposed to $225,412 or $219,722 versus $350,365), is not well integrated with surrounding neighborhoods like most modern-day developments (see map), and does not have transit service like most modern-day developments (see map). Additionally, there are a number of similar neighborhoods (Wexford, the Highlands, Sunset Creek, and Fairoaks) that are close to Lake Hogan Farms and could be added to the study at a later date.

Figure B-3: Map of Neighborhood Candidates

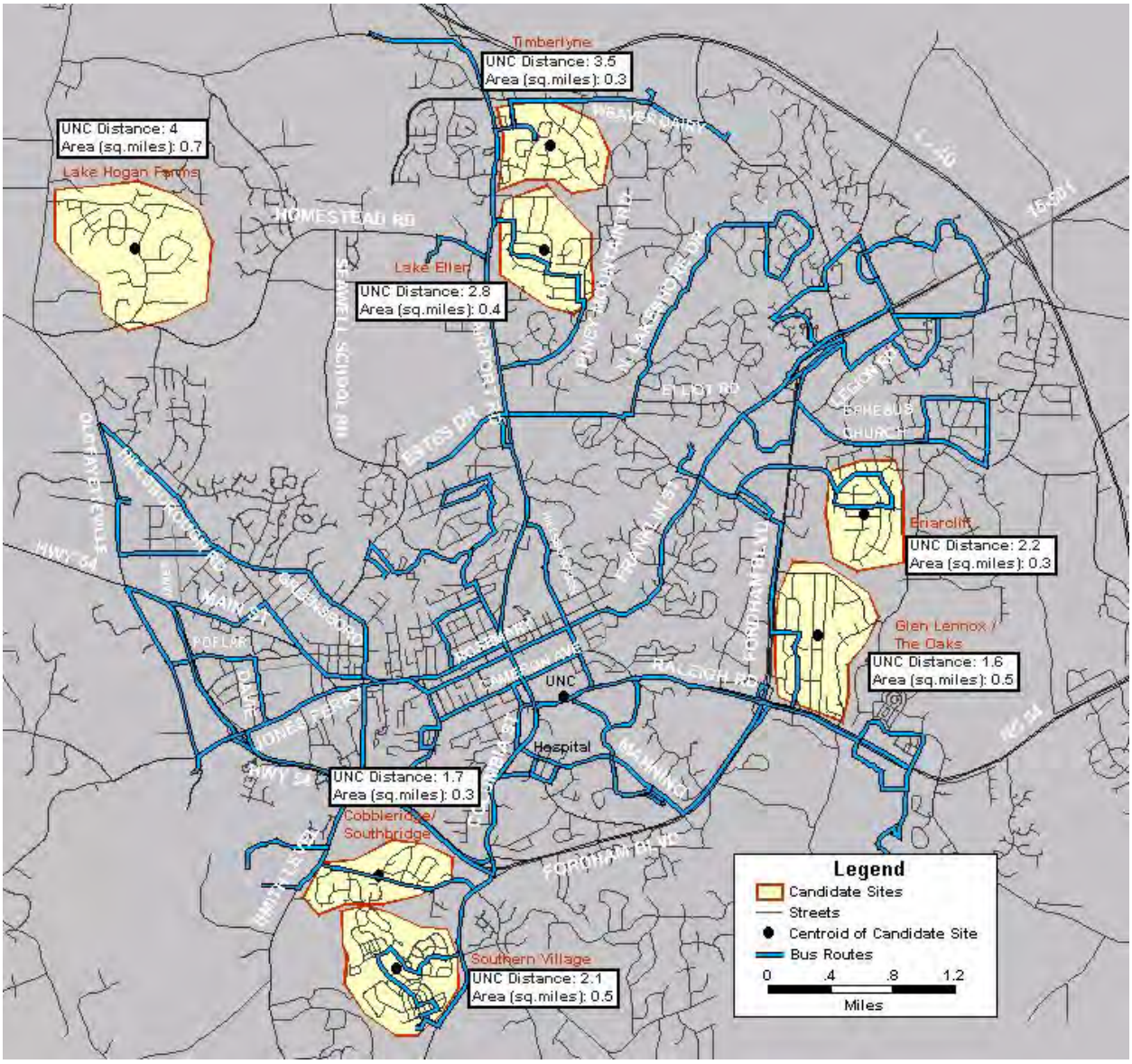


Table B-3: Neighborhood Evaluation Matrix

		Feature	Southern Village	Timberlyne	Lake Hogan Farms	Glen Lennox	Lake Ellen	Culbreth	Briarcliff	Measurement
			Neighborhood/Area							
Functional	Walking/ Cycling Surface	Sidewalks	5	3	4	3	1	4	2	5-point scale, 1 = not present, 5 = present everywhere
		Bike Lanes/Paths/Shoulders	3	1	2	1	1	2	1	5-point scale, 1 = not present, 5 = present everywhere
		Continuity	5	3	4	3	1	4	1	5-point scale, 1 = very poor, 5 = excellent
		Gradient	2	3	3	5	3	2	4	5-point scale, 1 = very steep, 5 = flat
	Streets	Street Design	4	2	2	4	3	2	3	5-point scale, 1 = lollipop, 5 = grid
		Width	3	1	2	4	3	4	3	5-point scale, 1 = wide, 5 = narrow
		On-Street Vehicle Parking	3	2	2	4	1	3	2	5-point scale, 1 = not present, 5 = present everywhere
	Traffic	Volume	4	3	4	4	3	4	3	5-point scale, 1 = very heavy, 5 = very light
		Speed	25	25	25	25	25	25	25	Speed limit on most streets
		Management/Control Devices	2	1	2	3	1	2	1	5-point scale, 1 = not present, 5 = present everywhere
		TOTAL (minus speed)	*31*	*19*	*25*	*31*	*17*	*27*	*20*	
Safety		Lighting	3	2	2	2	1	3	3	5-point scale, 1 = not present, 5 = present everywhere
		Surveillance	4	3	3	4	1	4	3	5-point scale, 1 = very poor, 5 = excellent
		Barking Dogs	4	5	5	5	5	3	5	5-point scale, 1 = present everywhere, 5 = not present
		Crosswalks	3	2	1	1	1	3	1	5-point scale, 1 = not present, 5 = present everywhere
		Crossing Aids	1	1	1	1	1	1	1	5-point scale, 1 = not present, 5 = present everywhere
		TOTAL	*15*	*13*	*12*	*13*	*9*	*14*	*13*	
Aesthetics		Trees/Shade	2	3	2	4	4	3	4	5-point scale, 1 = not present, 5 = present everywhere
		Cleanliness (pollution, graffiti, trash)	5	4	4	3	4	4	4	5-point scale, 1 = very poor, 5 = excellent
		Sights	5	2	4	3	3	3	2	5-point scale, 1 = very poor, 5 = excellent
		Setbacks	5	3	2	4	1	4	3	5-point scale, 1 = very distant, 5 = fronts the street
		Porches	5	1	3	2	2	3	3	5-point scale, 1 = not present, 5 = present everywhere
		Garages Facing Street	5	4	1	4	2	3	3	5-point scale, 1 = present everywhere, 5 = not present
		Lot Size	4	3	3	4	2	4	3	5-point scale, 1 = large, 5 = small
		TOTAL	*31*	*20*	*19*	*24*	*18*	*24*	*22*	
Destination	Mix of Uses	Office	2.5	2.5	0	0	0	0	0	Yes/No (Yes = 2.5, No = 0)
		Adjacent to other uses?	2.5	2.5	0	0	0	0	0	Yes/No (Yes = 2.5, No = 0)
		Retail	2.5	2.5	0	2.5	0	0	0	Yes/No (Yes = 2.5, No = 0)
		Adjacent to other uses?	2.5	2.5	0	2.5	0	0	0	Yes/No (Yes = 2.5, No = 0)
		Low-Density Residential	2.5	2.5	2.5	2.5	2.5	2.5	2.5	Yes/No (Yes = 2.5, No = 0)
		Adjacent to other uses?	2.5	2.5	0	2.5	0	0	0	Yes/No (Yes = 2.5, No = 0)
		Medium-Density Residential	2.5	2.5	0	2.5	0	2.5	0	Yes/No (Yes = 2.5, No = 0)
		Adjacent to other uses?	2.5	2.5	0	2.5	0	0	0	Yes/No (Yes = 2.5, No = 0)
		High-Density Residential	2.5	2.5	0	0	0	0	0	Yes/No (Yes = 2.5, No = 0)
		Adjacent to other uses?	2.5	2.5	0	0	0	0	0	Yes/No (Yes = 2.5, No = 0)
		School	2.5	0	0	0	0	2.5	0	Yes/No (Yes = 2.5, No = 0)
		Adjacent to other uses?	2.5	0	0	0	0	0	0	Yes/No (Yes = 2.5, No = 0)
		TOTAL	*30*	*25*	*3*	*15*	*3*	*8*	*3*	
	Facilities	Parks	4	2	4	4	3	3	2	5-point scale, 1 = not present, 5 = present everywhere
		Benches/Places to Sit	3	1	1	2	1	1	1	5-point scale, 1 = not present, 5 = present everywhere
		Public Transport	3	4	1	3	1	3	2	5-point scale, 1 = not present, 5 = present everywhere
		Bike Parking Facilities	3	1	1	1	1	2	1	5-point scale, 1 = not present, 5 = present everywhere
		TOTAL	*13*	*8*	*7*	*10*	*6*	*9*	*6*	
Comparison Considerations		Area (approximate)	0.5	0.3	0.7	0.5	0.4	0.3	0.3	Square Miles
		Distance to UNC (approximate)	2.1	3.5	4.0	1.6	2.8	1.7	2.2	Miles
		Grocery Store	Y	Y	N	N	N	N	N	Yes/No
		Movie Theater	Y	Y	N	N	N	N	N	Yes/No
		Cleaners	Y	Y	N	N	N	N	N	Yes/No
		Daycare	Y	N	N	N	N	N	N	Yes/No
		Recreational Facilities	Y	Y	Y	Y	N	Y	Y	Yes/No
		Restaurants	Y	Y	N	Y	N	N	N	Yes/No
		Church	Y	N	N	N	N	N	N	Yes/No

Appendix C: Income Response Rates by Neighborhood

		Responding	Under $20,000	$20,000 - $30,000	$30,001 - $40,000	$40,001 - $50,000	$50,001 - $60,000	$60,001 - $80,000	$80,001 - $100,000	$100,001 - $150,000	$150,001 - $200,000	Over $200,000
Southern Village	***SV Single-Family***	**66.7%**	**4.9%**	**0.0%**	**0.0%**	**3.9%**	**5.9%**	**7.8%**	**15.7%**	**34.3%**	**19.6%**	**7.8%**
	N=153	**102**	**5**	**0**	**0**	**4**	**6**	**8**	**16**	**35**	**20**	**8**
	SV Apts	64.1%	4.0%	8.0%	0.0%	24.0%	20.0%	24.0%	8.0%	8.0%	0.0%	4.0%
	N=39	25	1	2	0	6	5	6	2	2	0	1
	SV Condos	69.2%	11.1%	16.7%	33.3%	22.2%	11.1%	0.0%	0.0%	0.0%	0.0%	5.6%
	N=26	18	2	3	6	4	2	0	0	0	0	1
	Total SV HHs	66.5%	5.5%	3.4%	4.1%	9.7%	9.0%	9.7%	12.4%	25.5%	13.8%	6.9%
	N=218	145	8	5	6	14	13	14	18	37	20	10
Conventional Neighborhoods	Lake Hogan Farms	75.9%	0.0%	2.4%	0.0%	2.4%	0.0%	4.9%	29.3%	36.6%	12.2%	12.2%
	N=54	41	0	1	0	1	0	2	12	15	5	5
	The Highlands	75.0%	0.0%	0.0%	0.0%	3.7%	3.7%	14.8%	14.8%	29.6%	18.5%	14.8%
	N=36	27	0	0	0	1	1	4	4	8	5	4
	Sunset Creek	78.9%	0.0%	0.0%	0.0%	6.7%	6.7%	0.0%	20.0%	53.3%	13.3%	0.0%
	N=19	15	0	0	0	1	1	0	3	8	2	0
	Wexford	66.0%	6.5%	0.0%	0.0%	3.2%	3.2%	6.5%	9.7%	48.4%	9.7%	12.9%
	N=47	31	2	0	0	1	1	2	3	15	3	4
	Fairoaks	93.9%	3.2%	0.0%	9.7%	3.2%	12.9%	25.8%	25.8%	16.1%	0.0%	3.2%
	N=33	31	1	0	3	1	4	8	8	5	0	1
	Total Conv. HHs	**76.7%**	**2.1%**	**0.7%**	**2.1%**	**3.4%**	**4.8%**	**11.0%**	**20.7%**	**35.2%**	**10.3%**	**9.7%**
	N=189	**145**	**3**	**1**	**3**	**5**	**7**	**16**	**30**	**51**	**15**	**14**
	TTA (Region)	84.7%	14.0%	15.7%	13.9%	11.3%	13.5%	14.3%	7.8%	5.4%	3.1%	1.0%
	N=1732	1467	205	231	204	166	198	210	114	79	45	15

Appendix D: Means of responses to attitudinal questions by neighborhood type

Topic	*Neighborhood*	*N*	*Mean*	*Sig.*
I like the flexibility that driving allows	Southern Village No. Carrboro	167 207	4.54 4.61	0.412
I enjoy walking	Southern Village No. Carrboro	168 207	4.33 4.19	0.142
I am comfortable riding a bus	Southern Village No. Carrboro	168 206	3.40 3.16	0.064
I would like to have more time for leisure	Southern Village No. Carrboro	167 206	4.34 4.32	0.789
We should raise the price of gasoline to reduce congestion and air pollution	Southern Village No. Carrboro	168 207	2.67 2.73	0.689
It's important for children to have a large backyard for playing	Southern Village No. Carrboro	168 208	2.95 3.71	0.000
Sidewalks make walking easier in my neighborhood	Southern Village No. Carrboro	168 204	4.84 4.54	0.000
Environmental protection is an important issue	Southern Village No. Carrboro	168 208	4.51 4.50	0.988
I enjoy a house close to the sidewalk so that I can see and interact with passersby	Southern Village No. Carrboro	168 206	3.77 2.89	0.000
Too much land is consumed for new housing, stores, and offices	Southern Village No. Carrboro	167 208	3.57 3.44	0.236
I enjoy bicycling	Southern Village No. Carrboro	167 207	3.41 3.58	0.169
I can be comfortable living in close proximity to my neighbors	Southern Village No. Carrboro	168 207	4.09 3.31	0.000
Hills or other barriers in my neighborhood make walking/bicycling difficult	Southern Village No. Carrboro	167 207	2.53 2.18	0.006
My neighborhood seems safe for walking or bicycling	Southern Village No. Carrboro	168 208	4.63 4.50	0.083
Sitting in traffic aggravates me	Southern Village No. Carrboro	165 208	4.14 4.06	0.408
I prefer a lot of space between my home and the street	Southern Village No. Carrboro	168 208	2.68 3.50	0.000
Taking public transit is inconvenient	Southern Village No. Carrboro	168 207	3.32 3.68	0.004
Too many people drive alone	Southern Village No. Carrboro	167 208	3.79 3.82	0.757
Children should have a large public play space within safe walking distance of their home	Southern Village No. Carrboro	168 207	4.35 4.14	0.015
Having shops and services close by is important to me	Southern Village No. Carrboro	168 208	4.46 3.91	0.000

Appendix E: Southern Village Business Survey Report

Abstract—A goal of the study was understand the extent to which the component land uses—residential, office, retail, etc. attract off-site workers and visitors. The Business Survey was developed to assess this and understand trip attractions in Southern Village businesses/services and compare them to various business types categorized by the ITE Trip Generation Manual. The survey was conducted by interviewing business representatives directly. The comparison reveals some differences in trip generation between the businesses/land uses in Southern Village and stand-alone land uses in conventional contexts represented by ITE. The Public Facilities and Public Service businesses attracted fewer vehicular trips than those predicted by ITE. However, Entertainment and Restaurants, Private Services, and Retail Services attracted more vehicular trips than conventional contexts. Thus, when analyzed categorically this neo-traditional neighborhood development shows differences in trip generation.

Overview of Southern Village

Southern Village is a traditional neighborhood located in Chapel Hill, North Carolina. In 2003, 920 residential dwellings and nineteen businesses had been constructed and occupied. The area that was surveyed for this report was along Market Street. The street is located on the top of a small hill and ovular in shape. Businesses line the outside of the street and both a parking lot and green space are located in the center. The majority of the buildings are constructed with mottled brick standing two or three stories high. Several are mixed use buildings, meaning the first floor is office or retail space and the second floor is residential. As of 2003, there are still several vacant lots and commercial spaces available for future growth. A wide variety of businesses occupy the buildings. The vast majority are independent, small businesses that are located solely in Southern Village.

Goal of the Business Survey

The Business Survey was developed to assess trip generation in Southern Village, which will reveal the number of trips that businesses in the area attract. By comparing the results with various business types/land uses categorized by ITE, differences in trip generation patterns between Southern Village and conventional contexts will be evident. The result will show whether the goal of reducing vehicular trips in this TND is being attained. The design goals of Southern village include: interconnected streets, an extensive greenway system connecting neighborhoods to community facilities, bike paths, tree-lined sidewalks, easy access to open space, park and ride lot, and centrally located facilities to meet daily needs (food cooperative, dry-cleaning, restaurants, childcare, school, beautician, theater and arcade, playgrounds, fitness facilities, healthcare facilities).

Description of Business Survey

The North Carolina Department of Transportation, The University of North Carolina Chapel Hill Department of City and Regional Planning (DCRP), and The Department of Civil Engineering at North Carolina State University sponsored the survey as part of a Traditional Neighborhood Trip Generation Study. DCRP faculty and graduate students developed the survey's format. The survey collects the following information:

1. Type and size of business on several axes (physical facility size, number of employees, number of customers)
2. Number of employees and estimation of customers living in Southern Village
3. Information about reasons for business location in Southern Village, plus whether that location is "good"
4. Whether or not the business requires off-site work by its employees, and if so, whether they provide cars for employee use
5. Facilities and programs available to accommodate non-automobile travel

Business Survey Process

In January and February of 2003 a graduate student surveyed existing businesses in Southern Village. Survey times ranged from eight to twenty minutes and were given to managers, owners and public administrators. Several surveys required appointments, but most were conducted on the spot.

Coding and Analyzing the Business Surveys

Upon completion of the survey, the data was coded into a spreadsheet. Answers that were given as ranges, such as the number of customers a business receives on an average day, were recorded as a range. A second column was created for the average, which was used to analyze the data. To measure employee data, two employees working part time were considered one full time employee. The businesses were broken down into the following five categories:

Retail Products:

Market Street Books
Weaver Street Market

Public Facilities:

Scruggs Elementary School

Entertainment and Restaurants:

Anna's Old Fashioned Pizza and Trattoria
Quinn's Bistro
Lumina Theater and Arcade

Private Services:

Hangers Cleaner
Forever Young Spa
Brenner and Brenner Law Firm
William H. Bunch Professional Accounting, Consulting and Tax
Montgomery Development Carolina Corporation
Plum Spring Clinic
Chapel Hill Day Care Center
Edward Jones Investment

Public Services:

Active Living By Design
IPAS
Visiting International Faculty

Results

General results

Businesses had a wide range in the number of employees and square feet of space they occupied. Southern Village businesses employ 432 people full time (Table E-1). The average employee count was 24, while the average space occupied was 2,615 square feet. This reflects the small size of the businesses. Most cited that their reason for locating in the area was the "community feel" and convenience for customers. Several other businesses said they liked the design of the office space and/or they were looking to expand and Southern Village had the appropriate amount of space. All businesses reported that up to date, business is going as they had expected.

Table E-1: Employees per business

Name of Business	Number
Market Street Books	4.5
Anna's Old Fashioned Pizza and Trattoria	25
Weaver Street Market	25
Lumina Theater and Arcade	13
Active Living by Design	12
Hangers Cleaner	2
Tar Heel Sports Marketing	9
Forever Young Spa	8
Brenner and Brenner	3
William H Bunch	7
IPAS	102
Visiting International Faculty	78.5
Montgomery Development Company	8.5
Plum Spring Clinic	7.5
Quinn's Bistro	12
Chapel Hill Day Care Center	22.5
Scruggs Elementary School	89.5
Edward Jones Investment	3
Total:	432

Employees:

The sum of all the trip ends taken by Southern Village business' employees was reported to be 806 (Table E-2). This figure includes all offsite trips employees take during one business day and includes arriving and leaving work. The large majority, 92.4 percent, of employees used vehicles to commute to work. Only 3.5 percent of employees walked, 2.2 percent used public transit, and 1.3 percent biked. Three businesses owned vehicles for employee use. Most of the business-owned vehicles were parked off-site or were parked only temporarily in Southern Village. A parking lot centrally located to the businesses provides free parking for employees and customers.

Table E-2: Employee Trip Ends per Day

Name of Business	Number
Market Street Books	14
Anna's Old Fashioned Pizza and Trattoria	0
Weaver Street Market	70
Lumina Theater and Arcade	14
Active Living by Design	14
Hangers Cleaner	0
Tar Heel Sports Marketing	180
Forever Young Spa	0
Brenner and Brenner	80
William H Bunch	30
IPAS	154
Visiting International Faculty	72
Montgomery Development Company	64
Plum Spring Clinic	0
Quinn's Bistro	0
Chapel Hill Day Care Center	80
Scruggs Elementary School	16
Edward Jones Investment	18
Total:	806

A total of 22.5 full-time equivalent employees live and work in Southern Village (Appendix, Table E-3). Of them, only 1 person walks to work and the remaining 21.5 people either bike or use a personal vehicle for transportation.[11] Note that only 5.2 percent (22.5/432) of the people who work in Southern Village also reside in it. This low number is partly due to the relatively high living costs in Southern Village.

[11] The data provided by the survey gives the percent of the 806 Southern Village employees who walk, use a car, bike or take public transit to get to work. Since people who walk to work must work in Southern Village due to the neighborhood's relative isolation, all respondents who reported that they walk to work were assumed to live in Southern Village. After the number of people who walk to work was calculated (1 person) the total was subtracted from 22.5 (total reported living and working in SV), leaving the remainder of the people who bike, use automobile or use public transit (21.5). Since the nearest bus stop in the Southern Village is located next to the businesses, it is assumed that employees would not use the bus to reach the businesses, from their homes. Thus, there are 22.5 Southern Village residents and employees who use a car or bike to get to work.

Table E-3: Number of Employees Living in Southern Village (per Employeer)

Name of Business	Number
Market Street Books	0
Anna's Old Fashioned Pizza and Trattoria	2
Weaver Street Market	0
Lumina Theater and Arcade	3
Active Living by Design	1
Hangers Cleaner	0
Tar Heel Sports Marketing	0
Forever Young Spa	0
Brenner and Brenner	1
William H Bunch	0
IPAS	2
Visiting International Faculty	4

Combining customers and employees, a reported total of 5,105 trip ends were taken in one day, of which 4,299 were by customers.

Customers

Southern Village is able to attract a fair amount of customers from the neighborhood to its businesses. On average, 39.2 percent of business' customers are reportedly Southern Village residents (Table E-4). Conversely, 60.8 percent of the customers were off-site visitors. Tuesday's are the busiest day of the week for customer activity, although relatively all of the weekdays have approximately the same percentage ranging from 9.9 percent to 13.8 percent. On the weekend, total business activity is reduced. This is due to the fact that most private service businesses are closed.

Table E-4: Percent of Business Customers from Southern Village

Name of Business	Percent
Market Street Books	90
Anna's Old Fashioned Pizza and Trattoria	75
Weaver Street Market	60
Lumina Theater and Arcade	50
Active living by design	n/a
Hangers Cleaner	65
Tar Heel Sports Marketing	n/a
Forever Young Spa	45
Brenner and Brenner	0
William H Bunch	6
IPAS	0
Visiting International Faculty	0
Montgomery Development Company	20
Plum Spring Clinic	60
Quinn's Bistro	60
Chapel Hill Day Care Center	38
Scruggs Elementary School	33
Edward Jones Investment	25
Average:	39

The busiest time of the day is from 5-8 PM (Table E-5). The number of trip ends reported during the peak hour is displayed in Table E-6. Peak hour trip ends were calculated by taking 10 percent of all trips for the day. Most roads are designed to be wide enough for peak period traffic.

Table E-5: Customer Arrival Times

Business	7 to 9AM	9 to 11AM	11AM to 1PM	1 to 3PM	3 to 5PM	5 to 8PM	8PM to 12AM
Market Street Books	0	0	22.5	22.5	50	5	0
Anna's Old Fashioned Pizza and Trattoria	0	0	20	15	15	30	20
Weaver Street Market	5	10	20	10	10	40	5
Lumina Theater and Arcade	0	0	9	9	12	40	30
Active Living by Design	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Hangers Cleaner	35	7.5	7.5	7.5	7.5	35	0
Tar Heel Sports Marketing	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Forever Young Spa	0	50	0	10	10	30	0
Brenner and Brenner	n/a	n/a	n/a	n/a	n/a	n/a	n/a
William H Bunch	n/a	n/a	n/a	n/a	n/a	n/a	n/a
IPAS	0	50	50	0	0	0	0
Visiting International Faculty	0	50	0	0	50	0	0
Montgomery Development Company	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Plum Spring Clinic	5	15	15	25	25	15	0
Quinn's Bistro	0	0	30	10	0	50	10
Chapel Hill Day Care Center	42.5	7.5	0	0	50	0	0
Scruggs Elementary School	25	25	5	25	0	0	0
Edward Jones Investment	5	20	10	50	15	0	0
Total	117.5	235	189	184	244.5	245	65
Average	6.53	13.06	10.5	10.22	13.58	13.61	3.61

Table E-6: Peak Hour Trips

Name of Business	Number
Market Street Books	8.3
Anna's Old Fashioned Pizza and Trattoria	53
Weaver Street Market	180.4
Lumina Theater and Arcade	44
Active Living by Design	3.8
Hangers Cleaner	9.4
Tar Heel Sports Marketing	19.8
Forever Young Spa	8.6
Brenner and Brenner	8.6
William H Bunch	5.1
IPAS	36.8
Visiting International Faculty	23.3
Montgomery Development Company	8.1
Plum Spring Clinic	6.5
Quinn's Bistro	15.4
Chapel Hill Day Care Center	46.5
Scruggs Elementary School	29.5
Edward Jones Investment	3.4
Total:	510.5

According to business representatives, 77.7 percent of customers use the automobile, whereas 18.1 percent of customers are reported to walk. However, it should be noted that one business responded that 100 percent of their customers walk to their business because they opened recently. Due to their infancy, they believe that the only customers they are getting are people

who are from the neighborhood or stop by after visiting a nearby shop. Reporting 100 percent may have artificially inflated the average, since the sample size is small. The business expects this number will change once word spreads of their existence. The median number of customers that reportedly walk is 5.0 percent. An average 4.2 percent of businesses have customers who take the bus to reach them and no business reported that any customers bike.

Ten businesses reported having bike racks and six reported having showers for employees to use. Flextime for employees was the most common response for travel demand management options provided by businesses. Business concerns about travel demand management were infrequent bus service to the park and ride lot and limited carpooling options for employees' travel to work. The majority of businesses did not have any travel concerns for employees or customers.

Actual Vehicular Trips Versus ITE Predicted Vehicular Trips

The actual number of trip ends in Southern village was calculated by summing the number of employee trips and customer trips. Since ITE measures trip ends, which consist of entering and exiting an establishment, the employee and customer trip numbers were doubled.

The graphs below are the same style as the graphs displayed in the ITE book. The dots represent the number of trip ends reported by each business. There are at least two dots on each graph for one business. One dot represents the actual number of trip ends that was reported in the survey. The second dot represents the predicted number of trip ends as calculated by the ITE book. The black line allows the reader to predict the number of trip ends per square foot of space or number of employees, depending on the X-axis. The Public Facility graph does not have a linear equation due to a lack of businesses in the category.

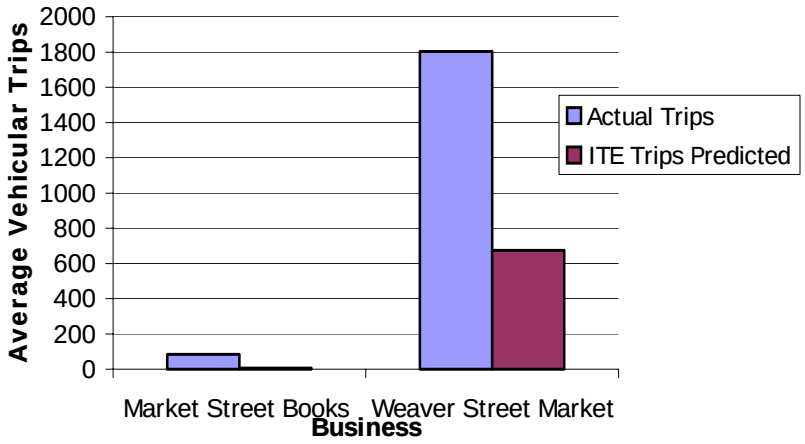
The Chapel Hill Daycare was excluded because ITE used the number of square feet of space to predict trip attraction, whereas the Private Service category used the number of employees. Similarly, Lumina Theater was excluded because ITE used the number of movie screens to predict trip attraction, whereas the Entertainment category used square feet of space.

The figures that follow represent other visual interpretations of the difference in trip attraction among Southern Village and conventional, ITE neighborhoods.

Retail Products

It is evident from Figure E-6 that the amount of actual trips far exceeds ITE's predicted number of trips.

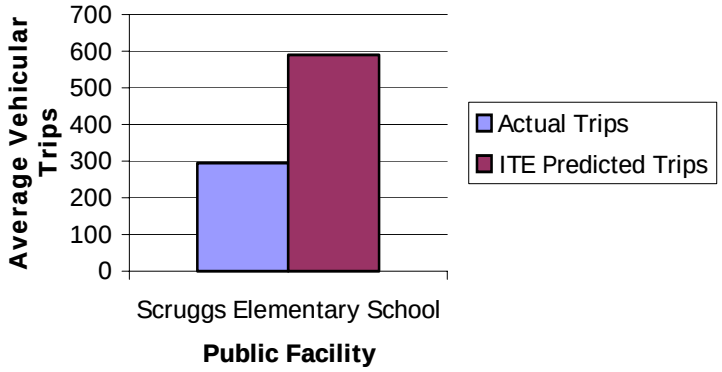
Figure E-1: Retail Products



Public Facilities:

The only public facility was Scruggs Elementary School. Figure E-7 shows that ITE predicted more trips than were actually taken. The school took 80 percent fewer trips than ITE predicted.

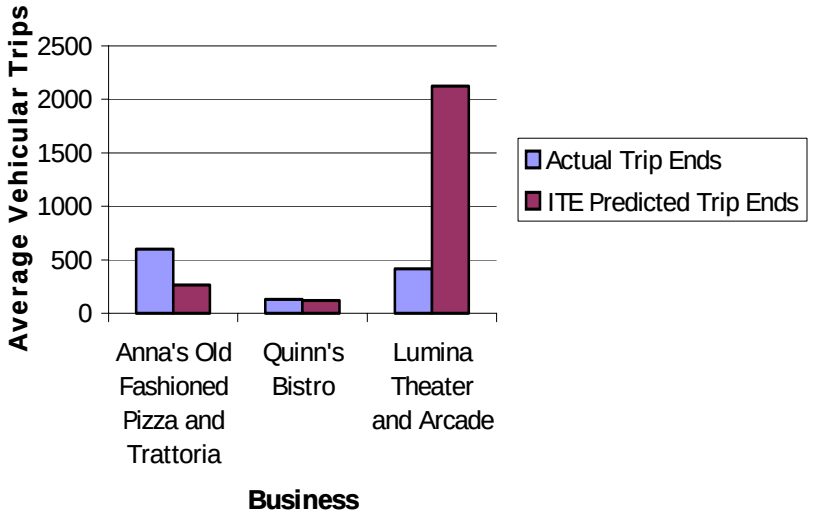
Figure E-2: Public Facilities



Entertainment and Restaurants

Both sit-down restaurants attract more automobile trips than ITE predicted. However, Lumina Theater has 81 percent fewer actual trips than ITE predicted as displayed in Figure E-8.

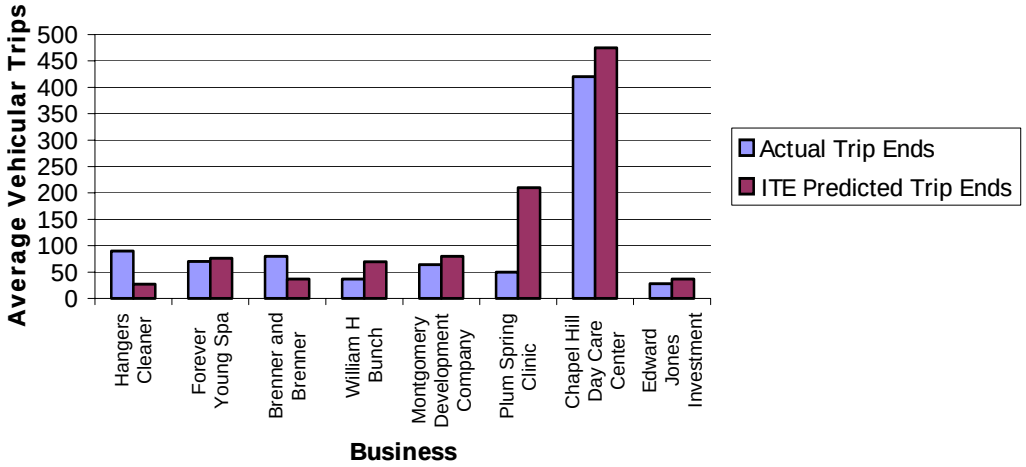
Figure E-3: Entertainment and Restaurants



Private Services

With the exception of Hangers Cleaners, Brenner and Brenner Law Firm and Plum Spring Clinic, the number of private service trip ends are similar to ITE's predicted trips (Figure E-9).

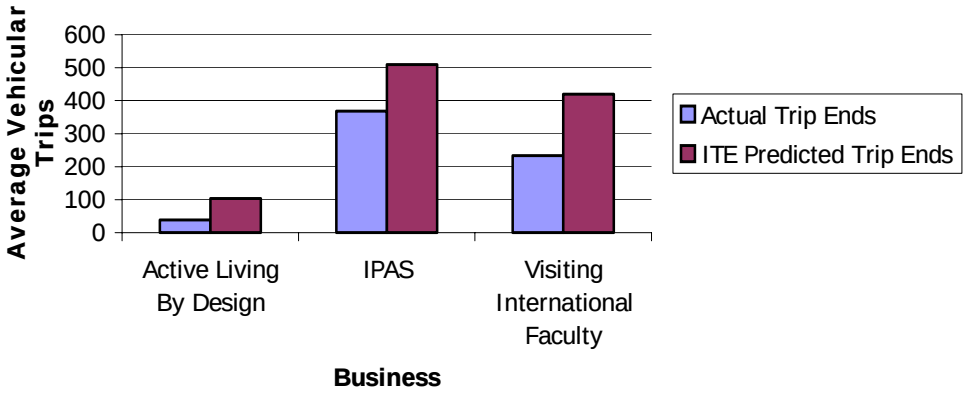
Figure E-4: Private Services



Public Services:

The Public Services in Southern Village averaged 79 percent fewer actual trips than ITE predicted (Figure E-10).

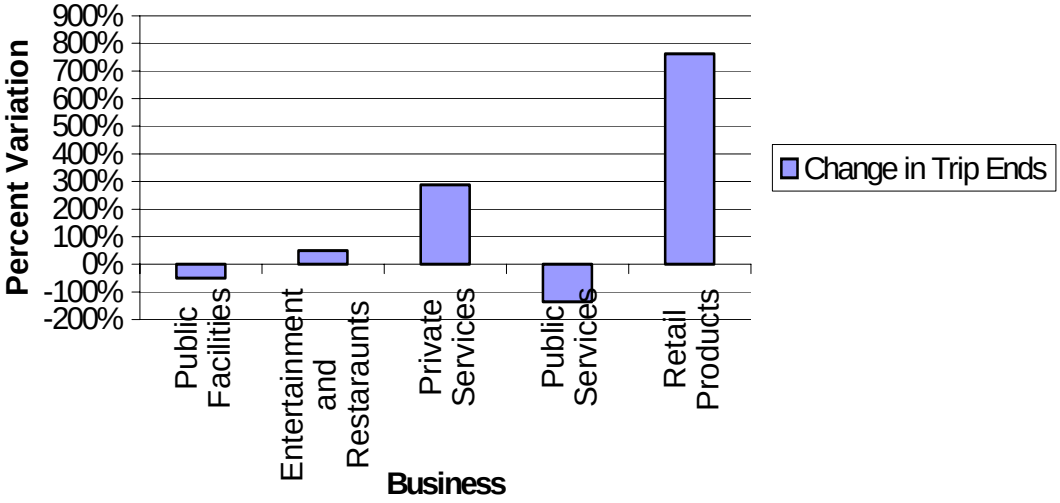
Figure E-5: Public Services



Possible Reasons for Trip Variations in Actual versus Predicted Trip Ends

The question of whether businesses are adapting to the alternative mode use goal of TNDs is unclear. Results display that certain industries are producing more automobile trips, while others are producing fewer. Figure E-11 shows the percent difference in actual trips ends versus predicted trip ends by business category. The Public Facilities and Public Service businesses are attracting fewer vehicular trips than conventional contexts. Entertainment and Restaurants, Private Services and Retail Services are attracting more vehicular trips than conventional contexts.

Figure E-6: Southern Village Trip End Variation from ITE



Due to the small sample size of businesses, it is not feasible to determine statistically if there is a relationship between the TND design of Southern Village and automobile trips. Since the evidence is inconclusive the possibility of the relationship cannot be discarded.

The age of Southern Village may be a reason for the variation in the number of automobile trips in comparison to a conventional facility forecasted by ITE. It is a relatively new development, with construction starting in the 1990s. Two businesses surveyed had been open for only one month. The newness of the businesses means that they may not have had time to maximize their client base.

Another possible reason for the variation is the fact that Southern Village residents are in the middle to upper income level. Conventional contexts, as measured by ITE, most likely include more diverse income levels. The income levels of customers who frequent Southern Village businesses may produce a different amount of trip ends.

Measurement error is another reason for variation. The survey was based on managers, owners and administrators perceptions of travel behavior. Since they are estimating employee and customer travel behavior, their responses cannot be considered fully reflective of actual travel behavior. The small sample size of both the ITE data and Southern Village businesses means that the results are less reliable than a larger sample size. Also, ITE did not consistently give a linear equation for their predicted trip ends, so several of the values are estimates based on tables printed in the ITE book.

Conclusions Regarding Business Survey

The business survey answers the question: To what extent do the component land uses—residential, office, retail, etc., attract off-site workers and visitors? Given that Southern Village is a relatively young TND, the businesses have not yet stabilized. Yet the survey of business managers showed reasonable results. A total of 5,105 trips ends were taken in one day of which 4,299 (84.2 percent) were by customers. It revealed that only 5.2 percent of the 432 employees reside in Southern Village. A large majority of the employees (92.4 percent) used personal vehicles to commute to work, given the free employee parking in Southern Village. In terms of customers/visitors, an estimated 39.2 percent reside in Southern Village. According to business representatives, 77.7 percent of the customers drive, 18.1 percent walk and 4.2 percent take the bus. The results show that Southern Village employees use passenger cars as often as employees in conventional (stand-alone) facilities, but that customers are more likely to walk.

The Southern Village business survey revealed that the Public Facilities and Public Service businesses are attracting fewer vehicular trips than those predicted by ITE for businesses located in conventional contexts. It also showed that Entertainment and Restaurants, Private Services and Retail Services are attracting more vehicular trips than conventional businesses.

Businesses Located in Southern Village

Market Street Books: A small independent bookstore www.marketstreetbooks.com
Weaver Street Market: Food cooperative selling organic and conventional goods www.weaverstreetmarket.coop
Scruggs Elementary School: Elementary School serving Chapel Hill
Anna's Old Fashioned Pizza and Trattoria: Both dine in and take out restaurant serving Italian entrees.
Quinn's Bistro: Sit down restaurant serving entrees, wine and ice cream
Lumina Theater and Arcade: An attached arcade and movie theater
Hangers Cleaner: Environmentally friendly dry cleaner
Forever Young Spa: Beauty salon and spa
Brenner and Brenner Law Firm: Law firm specializing in medical malpractice, business and civil litigation, family, employment, and federal and state criminal matters www.brennerandbrenner.com
William H. Bunch Professional Accounting, Consulting and Tax: www.WilliamHBunchCPA.com
Montgomery Development Carolina Corporation: Provides nationwide commercial general contracting services: www.montgomerydevelopment.com
Plum Spring Clinic: Integrated Medical Care www.plumspring.com
Chapel Hill Day Care Center: Day Care provider
Edward Jones Investment: Specialized in high quality, low-risk investments www.edwardjones.com
Active Living By Design: "Establishes and evaluates innovative approaches to increase physical activity through community design, public policies and communications strategies." www.activelivingbydesign.org
Ipas: Nonprofit that protects women's health and advances reproductive rights http://www.ipas.org/
Visiting International Faculty: A U.S. government-recognized exchange-program for teachers around the world www.vifprogram.com

Southern Village Business Survey

Date of interview_____

Interviewer _____

Business Name / Address	Contact Info Name / Phone	Type of Business	Size* or X=	# of Employees Full-time / Part-time
				Full_____ Part_____

* Square feet or number of movie screens or seating capacity, depending on business type, as suggested by ITE's trip generation manual.

General Information

May we have a copy of your annual report, or other material that would help us accurately describe your organization? _____

Reasons for Southern Village Location

Why did you choose to locate in Southern Village? _____
Examples: Good market conditions, convenience for employees or customers, commitment to neo-traditional village concept, architecture/design. _____

Is it turning out the way you expected? Yes No

Why or why not? _____

Employee Travel for Work

How frequently do your employees travel off site for business? _____employees daily

_____employees weekly

Does your organization own one or more vehicles for use by employees? Yes No

If so, how many and where are they parked? _____

Do you provide (free) paid parking for employees? _____

How do your employees get to your business? ___% by private car ___% by transit

___% by bike ___% by walking

___% other, please specify:_____

How many of your employees live in S. Village? _____

How many of your customers live in S. Village? _____

Business Hours and Travel Volumes

What are your hours of operation? _____

Day, Average Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
% of customers on							

Hours, Average Day	7am-9am	9am-11am	11am-1pm	1pm-3pm	3pm-5pm	5pm-8pm	8pm-12am
% of customers from							

If your company does business with the public, how many customers do you get on an average day? _____

How many customers enter and exit at peak hour? _____ Enter _____ Exit

How much does the average customer spend in your business? _____

How do your customers get to your business? ___% by private car ___% by transit

___% by bike ___% by walking

___% other, please specify:_____

Do you provide (free) paid parking for customers? _____

Encouragement for Alternative Travel Modes

Do you have any facilities that make it easier for people (employees or customers) to walk or ride a bicycle to your business (bike racks, bike lockers, showers, etc.)? Yes No

If so, please describe them _____

_____

Do you have travel demand management programs such as car-pool support, flex-time, telecommuting, or day-care facilities? Yes No

If so, please describe them: _____

_____

_____

Do you have any concerns about transportation for your employees or customers?

_____

_____

_____

_____

Appendix F: Targa, F. 2002. "Final Paper: Trip Generation – Land Use."

For Planning 129 Department of City and Regional Planning, University of North Carolina, Chapel Hill.

TRANSPORTATION MODELING
Trip Generation – Land Use

The project will develop regional baseline data and models for Trip Generation, Trip Distribution and Mode Choice in the Triangle region. These baselines will later be used to compare travel impacts of Southern Village to the rest of the Triangle region. These will detail the data collected, methods and computer tools used to develop baselines for comparison with Southern Village, and a discussion of how the baseline will be used to perform the comparison. This paper will address the following four questions:

- Comment on the model results in terms of parameter signs, their magnitudes and a statement about the significance of parameters and the model fit.
- What land use variables (if any) influence trip productions?
- Are your results consistent with literature you cited in the TND literature review?
- What are the implications of your findings for Southern Village?

Trip Generation This project will enlarge upon trip generation models created earlier in the semester, breaking out trip generation of Home-Based Work, Non-Home-Based, and Home-Based Other trips. Data available for this task include the 1995 Triangle Transportation Survey, the Census Transportation Planning Package, plus other data sets as available. This will require linking the trip file to the household file.

In the previous assignment for our class, we presented a model for trip generation at the household level using TTA's household survey conducted in 1995. The specification of our previous model included the traditional predictor variables for trip generation rates such as household size, number of vehicles in the household, household income level, type of home and stratum. Census data were joined to TTA's dataset in order to capture land use and accessibility measures.

Particularly, we are interested in testing the effect of density and accessibility-related measures on trip generation rates when controlling for other socio-demographic variables. The theory tells us that trip generation rates must vary with accessibility, based on utility tradeoffs between accessibility and activities (Ewing *et al*. 1996). The amount of additional trips will depend on how elastic the travel-activity demand with regard to changes in accessibility.

Therefore we expect that trip rates can be lowered by raising densities and mixing uses, at least for vehicle trips. However, our data do not allow us to differentiate between different trip purposes (e g. home-based trips, non-home-based other, and non-motorized trips). Moreover, other studies point out that the better accessibility that accompanies higher densities and mixed uses may have the opposite effect, raising vehicle trip rates rather than lowering them. All depends on the elasticities for specific trip purposes, how the substitution between non-motorized and vehicle modes plays out, and how they net up together in a measure of total trip generation rate like the one that we have in our dataset.

Table F-1: Comparison of Trip Generation Models for Different Trip Purposes

	Total Trips		HBW		HBSH				
	Coeff.	**t stat**	**Coeff.**	**t stat**	**Coeff.**	**T stat**	**μ**	**σ^2**	**Range**
HHSIZE	5.598***	23.65	-0.058*	-1.66	0.215***	5.60	2.33	1.21	6
NUMVEH	0.551*	1.75	0.017	0.36	0.000	-0.01	1.94	0.95	7
LICENSE DRIV	0.185	0.36	0.382***	5.01	0.255***	3.08	1.75	0.69	6
EMPLOYEES	0.285	0.86	0.927***	18.64	-0.274***	-5.07	1.23	0.80	5
MANAG/PROFF	0.642*	1.92	-0.015	-0.30	-0.067	-1.23	0.73	0.72	3
INCOME 20-40	0.704	0.93	0.083	0.73	0.303**	2.47	0.25	0.43	1
INCOME 40-60	1.633**	1.97	0.284**	2.30	0.453***	3.38	0.21	0.41	1
INCOME 60-80	2.097**	2.21	-0.059	-0.42	0.371**	2.41	0.12	0.33	1
INCOME 80-100	2.508**	2.27	0.052	0.32	0.755***	4.22	0.07	0.25	1
INCOME 100-150	1.596	1.30	-0.016	-0.09	0.478**	2.41	0.05	0.21	1
INCOME 150-200	-0.317	-0.21	-0.152	-0.69	0.023	0.10	0.03	0.16	1
INCOME 200+	5.735**	2.39	1.079***	3.01	0.336	0.86	0.01	0.09	1
INCOME not rep	0.469	0.55	0.091	0.72	0.320**	2.32	0.15	0.36	1
APT/CONDO	-1.193**	-1.96	0.102	1.13	-0.191*	-1.94	0.19	0.39	1
MOBILE	-2.826*	-1.73	-0.021	-0.09	-0.392	-1.48	0.02	0.14	1
STUDENT	-7.088	-1.43	0.129	0.17	-0.937	-1.17	0.00	0.04	1
OTHER	-1.386	-0.51	0.430	1.06	0.200	0.46	0.01	0.08	1
DENSITY	0.001**	2.22	0.000	1.53	0.000**	2.32	1,007	813	6,472
WHITE	0.059***	4.95	-0.002	-1.40	0.006***	2.99	72.36	20.36	98
COMMUTERS	0.047	1.61	0.009**	2.02	0.002	0.52	54.59	7.68	72
TRANSIT COM	0.224***	3.48	0.002	0.20	0.012	1.13	2.61	3.81	32
BIKE COM	0.280**	2.03	-0.017	-0.85	0.001	0.02	0.90	1.82	8
WALK	0.002	0.05	-0.001	-0.14	-0.003	-0.34	2.96	6.02	65
Constant	-7.243***	-3.76	-0.621**	-2.16	-0.343	-1.10			
N	1,667		1,667		1,667				
F statistic	63.79		35.56		8.27				
P > F	0.001		0.001		0.001				
R^2	0.472		0.332		0.104				
Adjusted R^2	0.464		0.323		0.091				
Root MSE	8.440		1.259		1.367				
Mean VIF	1.70		1.70		1.70				

Note: The mean, standard deviation, and range of TOTALTRI are 17.23, 11.48, and 77, respectively.
The mean, standard deviation, and range of HBW are 1.56, 1.53, and 10, respectively.
The mean, standard deviation, and range of HBSH are 1.21, 1.3, and 10, respectively.

*** Significant at the 99% confidence level
** Significant at the 95% confidence level
* Significant at the 90% confidence level

Table F-2: Comparison of Trip Generation Models for Different Trip Purposes (cont…)

	HBSC Coeff.	t stat	HBO Coeff.	t stat	NHB Coeff.	T stat			Range
HHSIZE	0.843***	28.48	1.275***	19.27	3.323***	18.89	2.33	1.21	6
NUMVEH	0.012	0.32	0.102	1.16	0.419*	1.79	1.94	0.95	7
LICENSE DRIV	-0.268***	-4.18	-0.100	-0.70	-0.084	-0.22	1.75	0.69	6
EMPLOYEES	-0.072*	-1.73	-0.564***	-6.05	0.268	1.08	1.23	0.80	5
MANAG/PROFF	-0.038	-0.90	0.203**	2.17	0.559**	2.25	0.73	0.72	3
INCOME 20-40	-0.356***	-3.75	0.128	0.60	0.548	0.97	0.25	0.43	1
INCOME 40-60	-0.559***	-5.39	0.137	0.59	1.318**	2.14	0.21	0.41	1
INCOME 60-80	-0.517***	-4.35	0.471*	1.77	1.831***	2.59	0.12	0.33	1
INCOME 80-100	-0.652***	-4.72	0.099	0.32	2.255***	2.75	0.07	0.25	1
INCOME 100-150	-0.293*	-1.92	0.104	0.30	1.324	1.45	0.05	0.21	1
INCOME 150-200	-0.652***	-3.53	0.316	0.77	0.148	0.14	0.03	0.16	1
INCOME 200+	-0.240	-0.80	1.000	1.49	3.560**	2.00	0.01	0.09	1
INCOME not rep	-0.568***	-5.34	0.391*	1.65	0.236	0.37	0.15	0.36	1
APT/CONDO	0.048	0.63	-0.373**	-2.20	-0.778*	-1.72	0.19	0.39	1
MOBILE	-0.204	-1.00	-0.657	-1.44	-1.552	-1.28	0.02	0.14	1
STUDENT	1.069*	1.72	-2.192	-1.58	-5.156	-1.40	0.00	0.04	1
OTHER	-0.361	-1.06	0.183	0.24	-1.837	-0.91	0.01	0.08	1
DENSITY	0.000	0.79	0.000	0.53	0.000*	1.85	1,007	813	6,472
WHITE	0.002	1.03	0.017***	5.02	0.037***	4.22	72.36	20.36	98
COMMUTERS	0.007**	2.03	-0.003	-0.33	0.031	1.43	54.59	7.68	72
TRANSIT COM	0.015*	1.82	0.063***	3.48	0.133***	2.78	2.61	3.81	32
BIKE COM	0.016	0.94	0.047	1.23	0.233**	2.27	0.90	1.82	8
WALK	0.010	1.58	0.003	0.21	-0.006	-0.18	2.96	6.02	65
Constant	-0.910***	-3.77	-1.180**	-2.19	-4.189***	-2.92			
N	1,667		1,667		1,667				
F statistic	48.46		31.94		43.74				
P > F	0.001		0.001		0.001				
R^2	0.404		0.309		0.380				
Adjusted R^2	0.396		0.299		0.371				
Root MSE	1.056		2.360		6.273				
Mean VIF	1.70		1.70		1.70				

Note: The mean, standard deviation, and range of HBSC are 0.69, 1.35, and 10, respectively.
The mean, standard deviation, and range of HBO are 2.71, 2.81, and 21, respectively.
The mean, standard deviation, and range of NHB are 11.05, 7.87, and 53, respectively.

*** Significant at the 99% confidence level
** Significant at the 95% confidence level
* Significant at the 90% confidence level

Comment on the model results in terms of parameter signs, their magnitudes and a statement about the significance of parameters and the model fit.

- The first model is the preferred model from the last assignment, which previously had 2,044 observations. However, we lost over 300 observations when we joined the TTA and Census datasets, mainly due to the fact that none of the TTA transit-enrichment households were geocoded; thus, they could not be joined with the Census dataset.
- In order to better account for density, Model 2 uses the Census block group density variable instead of TTA's stratum for urban, suburban, and rural households. Both density-related variables cannot be included in the same model due to the high degree of

collinearity between them. Although it is an average measure of the Census block group, the Census density is a more accurate variable for our model than TTA's categorical variable because it is a continuous variable that captures more variability of density in areas, while TTA's variable essentially assumed equal density within the stratum (e.g., all "urban" category observations are assumed to have an equal level of density). Although Model 2 does not improve the goodness of fit compared with Model 1, we decided to keep the density variable from the Census dataset instead of TTA's urban/suburban/rural variable in order to account for more variability in household's neighborhood density.

- In addition to using the density variable from the Census dataset instead of TTA's urban/suburban/rural variable (a land use-related measure), Model 3, our preferred model, includes proxy variables for local and regional accessibility, such as accessibility to non-motorized facilities and transit accessibility. We included an additional control for race as well. These variables are captured by proxies such as the proportion of the population who commutes to work (accounting for labor force participation), the proportion of commuters who use transit and bike, and the proportion of the population that is white. Like the Census density variable, these are averages for the Census block group.
- Poisson, negative binomial, and zero inflated negative binomial models are presented in the Appendix (available upon request). These models improved goodness of fit and prediction power compared with the OLS models presented below. However, due to the scope of this particular assignment we discuss OLS models and present in the Appendix MLE models, which for future research should be interpreted and analyzed.
- The overall significance of the three models (Table F-1) is good in terms of the F-test. The F-value of the models is higher than the F-critical; thus we can reject the hypothesis that all estimate parameters in the models are equal to zero. This means that the explanatory variables chosen for the models explain the variance in our dependent variable (TOTALTRI) to a certain degree. Indeed, the R-square for the models, and the adjusted R-square, which takes into account the number of explanatory variables introduced in the model, is higher for Model 3 than for Model 2. For example, the adjusted R-square for Model 3 indicates that 46.4 percent of the variance in the household total trip generation is explained with the explanatory or dependent variables chosen in the model. Additionally, the Root MSE for Model 3 is better than the Root MSE for Model 2. The VIF measures multi-collinearity among explanatory variables, where a mean of 4 or higher indicates a critical level. The degree of multi-collinearity decreases from Model 1 to 3 and it does not reach a critical value. However, the significance and parameter estimates of some of the variables that are correlated might be affected. The constant for Model 3 (-8.035) is significant at the 99 percent confidence level, is negative, and is large compared with to the coefficients. Though this constant is a problem for estimation, we conclude that Model 3 offers the best goodness of fit and is the preferred model. The rest of the coefficients for socioeconomic and demographic variables did not change with respect the specification model presented in the last assignment (sign and magnitude). Therefore we limit our discussion to our preferred model (Model 3) and for the coefficients of the new introduced variables.
  - The parameter estimate for density is statistically significant with a confidence level of 99 percent. Therefore, we can reject the null hypothesis that density does not affect the numbers of trips generated at the household level. The sign of the

parameter estimate is positive, meaning that the higher the density of the Census block group where the household is located, the higher the trips generated by the household. Indeed, the parameter estimate for density (0.001) indicates that for every additional person per square kilometer in the Census group block, 0.001 additional trips would be generated in two days, holding all other variables constant. This result can interpreted as an elasticity of 0.043, meaning that an increase of 100 percent in density in the Census group block is associated with an increase in 4.3 percent in the household trip generation rate.

- The parameter estimate for commuters is statistically significant with a confidence level of 90 percent. The sign of the parameter estimate is positive, meaning that the higher the proportion of commuters per Census block group (higher proportion of labor force participation), the higher the trips generated by the household. Indeed, the parameter estimate for commuters (0.0563) indicates that for an increase of one percentage point in the proportion of commuters per Census block group, 0.0563 additional trips would be generated in two days, holding all other variables constant.
- The parameter estimate for commuters who use transit is also statistically significant with a confidence level of 99 percent. The sign of the parameter estimate is positive, meaning that the higher the proportion of commuters using transit per Census block group, the higher the trips generated by the household. Indeed, the parameter estimate for transit commuters (0.253) indicates that for an increase of one percentage point in the proportion of transit commuters per Census group block, 0.253 additional trips would be generated in two days, holding all other variables constant. This result also tells us that higher accessibility to transit services or facilities is associated with higher trip generation rates. One again, we cannot make conclusions based on trip purposes because our dependent variable is for total trips. Instead, we can conclude that when all effects are netted up, the demand is elastic with regard to changes in accessibility to transit.
- The parameter estimate for commuters who bicycle to work is statistically significant with a confidence level of 99 percent. The sign of the parameter estimate is positive, meaning that the higher the proportion of commuters traveling by bicycle per Census block group, the higher the trips generated by the household. Indeed, the parameter estimate for bicycling commuters (0.359) indicates that for every additional percentage point increase in the proportion of transit commuters per Census group block, 0.359 additional trips would be generated in two days, holding all other variables constant. Similar to the proportion of transit commuters, we can conclude that higher accessibility to non-motorized transportation facilities is associated with higher trip generation rates (for all trip purposes). Instead, we can conclude that when all effects are netted up, the demand is elastic with regard to changes in accessibility to non-motorized facilities.
- Finally, the parameter estimate for white people is statistically significant with a confidence level of 99 percent. The sign of the parameter estimate is positive, meaning that the higher the proportion of white people per Census block group, the higher the trips generated by the household. The parameter estimate for white people (0.060) indicates that for an increase of one percentage point in the proportion of white people per Census group block, 0.060 additional trips would be generated in

two days, holding all other variables constant. Although this is not a land-use- or accessibility-related measure, it is control measure for race in the neighborhood.

What land use variables (if any) influence trip productions?

- According to our Models, density influences trip productions (accounting for proxy variables such as stratum or a direct measure of density at the Census block group level). Indeed we found an elasticity of 0.043, meaning that an increase of 100 percent in density in the Census group block is associated with an increase in 4.3 percent in the household trip generation rate. This elasticity is for the net effect on total trips by all purposes and we cannot generalize for specific trip purposes. Although they are not land use variables, we also found that accessibility-related measures (also related with density), such as the proportion of people who commute to work via transit and who commute to work via bicycle per Census block group, also influence trip productions. For all our results we found measures of association only; some must be influenced by self-selection issues.
-

Are the results consistent with literature you cited in the TND literature review?

Our finding that density is positively and significantly associated with trip generation is consistent with Ewing *et al*.'s theory 3 or 4 (1997). We found a positive association between density and trip generation rates. However, we cannot make conclusions based on a substitution effect among modes because of limitation issues in our data. Particularly, we cannot make conclusions about the elasticities for specific trip purposes or about the substitution between non-motorized and vehicle modes. We simply found how they netted up together in a measure of total trip generation rate.

These results match with some empirical results documented in previous studies (net total effect increases trip generation). However, it would be interesting to analyze the disaggregated elasticities for trip purposes and the substitution effects between non-motorized and vehicle modes.

Finally, the elasticity of 0.043 cannot be compared easily with the current literature because most of the studies deal with VMT elasticities.

What are the implications of the findings for Southern Village?

Since we know that Southern Village is denser than other, more conventional subdivisions in the Triangle, we hypothesize that trip generation rates for all trip purposes will be higher for households in Southern Village. More information about land use, specifically for measures of mixed use, and accessibility not only for non-motorized or transit facilities but also for local and regional accessibility to jobs, services, entertainment, and stores, would be useful. Additionally more information about trip purposes and travel contextual variables can improve the model specification.

Hypothetically, if households in Southern Village are located in denser neighborhoods with greater accessibility to transit services and non-motorized travel facilities (assuming that they

can be captured by proxy variables such as people commuting to work either via transit or bicycling), then we would hypothesize that trip generation rates for all trip purposes will be higher for households in Southern Village than for households in more conventional subdivisions.

Appendix G: Survey instrument and travel diary used in this study

Chapel Hill – Carrboro Neighborhood
Survey

March 1, 2003

Dear Head of Household,

The North Carolina Department of Transportation, in collaboration with the Department of City and Regional Planning at UNC-Chapel Hill and the Department of Civil Engineering at NC State, are conducting an important study about travel patterns. As part of this study, we are collecting information about how, when, and why you travel from one place to another. Your neighborhood is one of two neighborhoods that have been selected for this study. We will be mailing this survey to approximately 1800 households.

Your voluntary participation in this survey is greatly appreciated. When finished, please insert all survey items in the postage-paid envelope provided and deposit it in a mailbox. Sending in the survey is an indication of your willingness to participate in the study. If you get to a question you don't want to answer, please skip it and go on to the next one. The confidentiality of your responses is assured.

The survey is divided into two sections:

1. The first section is to be filled out only by the head of the household. In this section, you are asked to provide the first names of the people in your household. If you would like to use fictional names or initials, please do so, just be sure the same names or initials are used in the second section.
2. The second section is to be filled out by each member of your household age 16 or older. This second section is a travel diary that is used to record participant's travel behavior over a one-day period. Please have each member of your household fill out the travel diary for their trips on a Tuesday, Wednesday, or Thursday of a typical, non-Spring Break (if applicable), week as soon as possible. Please be sure the appropriate name and date is recorded in the upper portion of each travel diary.

Filling out the survey and travel diary does not take long and will improve local decision-makers' understanding of the transportation needs of area residents. To express our gratitude for your participation in this study, we will send you a $10 gift certificate to Weaver Street Market's Southern Village store upon the completion and receipt of your household's survey. In the upper right hand corner of the first page of the first section is a unique identification number that will enable us to send your household the gift certificate. If you would rather remain anonymous, feel free to cross off the number, but we will not be able to send you a gift certificate.

If you have any questions about the survey, please contact the project directors listed below. If you have any questions about your rights as a research participant, please contact Dr. Barbara Goldman, Chair of the Academic Affairs Institutional Review Board, at aa-irb-chair@unc.edu or 962-7761.

Thank you in advance,

Dr. Asad Khattak, Professor
UNC-Chapel Hill
City and Regional Planning

Dr. John Stone, Professor
NC State
Civil Engineering

Tel: 919-962-4760 Tel: 919-515-7732

Alert and Follow-up Postcards

Please Help Us By Filling Out An Important Survey That Will Be Sent To You Within The Next Couple Of Weeks

Chapel Hill - Carrboro Neighborhood Survey

The North Carolina Department of Transportation, along with the University of North Carolina and North Carolina State University, is conducting a study of travel patterns in your neighborhood. Within the next couple of weeks, a brief survey will be mailed to you. When the survey arrives, please take the time to fill it out and send it back in its enclosed postage-paid envelope.

In appreciation for receiving your completed survey, we will send you a $10 gift certificate to Weaver Street Market's Southern Village store.

Thank you for helping us improve the future of Chapel Hill and Carrboro. If you have any questions, please contact us at neighborhood_survey@unc.edu or at 962.4760.

Signed,

Asad Khattak, Project Coordinator

If You Have Yet To Mail Back The Survey We Mailed You Last Week, Please Do So As Soon As Possible

Chapel Hill - Carrboro Neighborhood Survey

A few weeks ago, the North Carolina Department of Transportation, along with the University of North Carolina and North Carolina State University, mailed a survey to your household about your travel patterns. If you have not responded yet, please do so as soon as possible. If you have misplaced the survey, please contact us. If you have misplaced the postage-paid, self-addressed envelope that was enclosed with the survey, please mail the survey back to the address on the front of this postcard.

In appreciation for receiving your completed survey, we will send you a $10 gift certificate to Weaver Street Market's Southern Village store.

Thank you for helping us improve the future of Chapel Hill and Carrboro. If you have any questions, please contact us at survey@email.unc.edu or at 962.4760.

Signed,

Asad Khattak, Project Coordinator

Chapel Hill - Carrboro Neighborhood Survey

DATE

Dear Household Member,

Thank you for taking the time to fill out our survey. Our records show that members of your household did not complete travel diaries or did not complete them for an appropriate day. The travel diary is used to record travel behavior over a one-day period for each household member. According to the survey your head of household filled out, the name given for these people are "«name_1»" and "«name_2»".

This information is very important to our study, so please use the enclosed diaries to record you or your household member's trips **on either a Tuesday, Wednesday, or Thursday by DATE** and return them in the enclosed, postage-paid envelope. Please be sure the appropriate name and date is recorded in the upper portion of each travel diary and that all one-way trips over 300 feet are recorded.

If you intentionally did not fill out the travel diary and still do not wish to provide us with this information, please disregard this letter. However, your response would improve local decision-makers' understanding of the transportation needs of area residents. **The confidentiality of your responses is assured.**

If you have any questions about the survey, please contact the project directors listed below. If you have any questions about your rights as a research participant, please contact Dr. Barbara Goldman, Chair of the Academic Affairs Institutional Review Board, at aa-irb@unc.edu or 962-7761.

Thank you once again for your time,

Dr. Asad Khattak, Professor
UNC-Chapel Hill
City and Regional Planning
Tel: 919-962-4760

Dr. John Stone, Professor
NC State
Civil Engineering
Tel: 919-515-7732

SECTION ONE (ONE COPY):

TO BE FILLED OUT BY THE *HEAD OF HOUSEHOLD ONLY*

SECTION ONE – ALL RESPONSES WILL BE KEPT STRICTLY **CONFIDENTIAL**.

Chapter 1: QUESTIONS ABOUT YOUR HOUSEHOLD (TO BE FILLED OUT BY THE *HEAD OF HOUSEHOLD* ONLY)

1. What type of home do you currently live in?

a Detached single house
b Duplex
c Townhouse or rowhouse
d Apartment
e Condominium
f Other [Specify]_____
g Don't know

2. Before moving here, in what type of home did you live in?

a Detached single house
b Duplex
c Townhouse or rowhouse
d Apartment
e Condominium
f Other [Specify]_____
g Don't know

3. Do you rent or own your current home?

a Own
b Rent
c Other [Specify]_____
d Don't know

4. What date did you move into your current neighborhood?

a _____Year b _____Month

5. Please list the type and year of each motor vehicle in your household, for Model use the list codes provided below [Include leased, vanpool, or company-owned motorized vehicles if they are used by household members on a regular basis]

Vehicle #1: ___ Model _____ Year
Vehicle #2: ___ Model _____ Year
Vehicle #3: ___ Model _____ Year
Vehicle #4: ___ Model _____ Year
Vehicle #5: ___ Model _____ Year

Codes for Model
A. sedan/hatchback/convertible/station wagon/coupe
B. van [mini, cargo, passenger, conversion]
C. sports utility vehicle [explorer, land rover, jeep, etc.]
D. pickup truck
E. other truck
F. rv [recreational vehicle]
G. motorcycle
H. other

6. Please list the first name, age, and sex of each member of your household including yourself. If the member is a school-aged child (age 5 to 18), please mark how the child gets to school. Please use fictitious names or initials if you would like. [Please do not include anyone who usually lives somewhere else or is just visiting, if there are more than six people living in your home, please list them and their information on the previous sheet]

Your First Name: _____ **Age**:_____

Licensed Driver? Yes No

Sex: Male Female

First Name: _____ **Age**:_____

Licensed Driver? Yes No

Sex: Male Female

If school-age, he/she travels to school by:

d Walk b Car ride or drives to school
e Bicycle c Transit (bus or school bus)
f Other [Specify]_____

First Name: _____ **Age**:_____

Licensed Driver? Yes No

Sex: Male Female

If school-age, he/she travels to school by:

d Walk b Car ride or drives to school
e Bicycle c Transit (bus or school bus)
f Other [Specify]_____

First Name: _____ **Age**:_____

Licensed Driver? Yes No

Sex: Male Female

If school-age, he/she travels to school by:

d Walk b Car ride or drives to school
e Bicycle c Transit (bus or school bus)
f Other [Specify]_____

First Name: _____ **Age**:_____

Licensed Driver? Yes No

Sex: Male Female

If school-age, he/she travels to school by:

d Walk b Car ride or drives to school
e Bicycle c Transit (bus or school bus)
f Other [Specify]_____

First Name: _____ **Age**:_____

Licensed Driver? Yes No

Sex: Male Female

If school-age, he/she travels to school by:

d Walk b Car ride or drives to school
e Bicycle c Transit (bus or school bus)
f Other [Specify]_____

IN THIS PART OF THE SECTION, YOU WILL BE ASKED ABOUT THE TRIPS YOU MAKE.

ONE TRIP IS CONSIDERED ANY ONE-WAY TRIP OVER 300 FEET.
ALL RESPONSES WILL BE KEPT STRICTLY CONFIDENTIAL.

Chapter 2: QUESTIONS ABOUT YOUR TRAVEL PATTERNS

1. What best describes your employment status? [Please check only one and answer the following questions accordingly]

a Work full-time outside the home
b Work part-time outside the home
} → **Please continue to Question 2**

c Student → **Please skip to Question 4**

d Work full-time at home
e Work part-time at home
f Unemployed (non-student)
g Retired
h Other [Specify]_____
} → **Please skip to Question 6**

2. What best describes your occupation?

a Clerical/Secretary
b Service
c Production/Manufacturing
d Executive/Managerial
e Skilled Trades
f Retired
g Sales/Retail
h Computer/Technical
i Medical/Health
j Other [Specify]_____

3. Do you ever telecommute/telework to work? If so, how many times per week?

a No a Yes, times per week _____

4. How much time does it typically take to travel to work or to school? [one-way travel]

a ____hours b ____minutes

5. How much do you typically spend on traveling to work or to school per week? [Include all gas, parking, or transit fares]

$_____

6. About how many miles per week do you travel by car?

_____miles

---

7. In a typical week, Monday through Friday, how often do you make the following one-way trips:

	0 times	1	2	3	4	5	6	7+ times
Drive to work or school by car								
Outside your neighborhood								
Within your neighborhood								
Carpool to work or school by car								
Outside your neighborhood								
Within your neighborhood								
Go to work or school using public transportation								
Outside your neighborhood								
Within your neighborhood								
Walk or bicycle to work or school								
Outside your neighborhood								
Within your neighborhood								
Transport someone (pickup someone, take and wait for someone, drop someone off)								
Outside your neighborhood								
Within your neighborhood								
Go shopping/run an errand								
Outside your neighborhood								
Within your neighborhood								
Go out for recreation, entertainment, or meals (watch/play sports, movie, museum, restaurant/bar, visit friends/relatives)								
Outside your neighborhood								
Within your neighborhood								

Chapter 3: QUESTIONS ABOUT YOUR ATTITUDES

On a scale of 1 to 5, express your level of agreement with the following statements. 1= strongly disagree…. 5= strongly agree [Circle a number for each statement]

1. I like the flexibility that driving allows

1	2	3	4	5
strongly disagree		neutral		strongly agree

2. I enjoy walking

1	2	3	4	5
strongly disagree		neutral		strongly agree

3. I am comfortable riding a bus

1	2	3	4	5
strongly disagree		neutral		strongly agree

4. I would like to have more time for leisure

1	2	3	4	5
strongly disagree		neutral		strongly agree

5. We should raise the price of gasoline to reduce congestion and air pollution

1	2	3	4	5
strongly disagree		neutral		strongly agree

6. It's important for children to have a large backyard for playing

1	2	3	4	5
strongly disagree		neutral		strongly agree

7. Sidewalks make walking easier in my neighborhood

1	2	3	4	5
strongly disagree		neutral		strongly agree

8. Environmental protection is an important issue

1	2	3	4	5
strongly disagree		neutral		strongly agree

9. I enjoy a house close to the sidewalk so that I can see and interact with passersby

1	2	3	4	5
strongly disagree		neutral		strongly agree

10. Too much land is consumed for new housing, stores, and offices

1	2	3	4	5
strongly disagree		neutral		strongly agree

11. I enjoy bicycling

1	2	3	4	5
strongly disagree		neutral		strongly agree

12. I can be comfortable living in close proximity to my neighbors

1	2	3	4	5
strongly disagree		neutral		strongly agree

13. Hills or other barriers in my neighborhood make walking/bicycling difficult

1	2	3	4	5
strongly disagree		neutral		strongly agree

14. My neighborhood seems safe for walking or bicycling

1	2	3	4	5
strongly disagree		neutral		strongly agree

15. Sitting in traffic aggravates me

1	2	3	4	5
strongly disagree		neutral		strongly agree

16. I prefer a lot of space between my home and the street

1	2	3	4	5
strongly disagree		neutral		strongly agree

17. Taking public transit is inconvenient

1	2	3	4	5
strongly disagree		neutral		strongly agree

18. Too many people drive alone

1	2	3	4	5
strongly disagree		neutral		strongly agree

19. Children should have a large public play space within safe walking distance of their home

1	2	3	4	5
strongly disagree		neutral		strongly agree

20. Having shops and services close by is important to me

1	2	3	4	5
strongly disagree		neutral		strongly agree

21. My ideal commuting time to work or school is:

___Less than 5 minutes
___Between 5 and 15 minutes
___Between 15 and 30 minutes
___More than 30 minutes

22. The longest acceptable time for me to commute to work or school is:

___Less than 5 minutes
___Between 5 and 15 minutes
___Between 15 and 30 minutes
___Between 30 and 45 minutes
___Between 45 and 1 hour
___More than 1 hour

QUESTIONS ABOUT YOUR ACTIVITIES

1. In a usual week, do you walk for at least 10 minutes at a time for recreation or exercise?

   No __ {skip to **Question 5**} Yes ___

2. How many days per week do you walk for at least 10 minutes at a time? _____

3. On days when you walk for at least 10 minutes at a time, how much total time per day do you spend walking?

   a ____hours b ____minutes

4. Where does your walking activity for recreation and exercise take place?

   a Always in my neighborhood
   b Mostly in my neighborhood
   c Sometimes in my neighborhood and sometimes elsewhere
   d Mostly away from my neighborhood
   e Always away from my neighborhood

Now consider moderate and vigorous physical activities. Moderate activities cause *small* increases in breathing or heart rate, while vigorous activities cause *large* increases in breathing or heart rate.

5. In a usual week, do you do MODERATE physical activities for at least 10 minutes at a time, such as brisk walks, bicycling, vacuuming, gardening, or anything else that causes SMALL INCREASES in breathing or heart rate?

   No __ {skip to **Question 9**} Yes ___

6. How many days per week do you do these moderate activities for at least 10 minutes at a time? _____

7. On days when you do moderate activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?

   a ____hours b ____minutes

8. What percentage of the total time that you spend on moderate activities do you spend:

   ___% At home

   ___% Outside of my home but in my neighborhood

   ___% Outside of my neighborhood

   = 100% **TOTAL**

Now consider vigorous activities that cause *large* increases in breathing or heart rate such as jogging, swimming, or aerobics.

9. In a usual week, do you do VIGOROUS physical activities for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes LARGE INCREASES in breathing or heart rate?

   No __ {skip to **Question 13**} Yes ___

10. How many days per week do you do these vigorous activities for at least 10 minutes at a time? _____

11. On days when you do vigorous activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?

    a ____hours b ____minutes

12. What percentage of the total time that you spend on vigorous activities do you spend:

    ___% At home

    ___% Outside of my home but in my neighborhood

    ___% Outside of my neighborhood

    = 100% **TOTAL**

13. What is your weight? _____ pounds

14. What is your height_____ feet_____ inches

15. How often have you used the Internet in the past 6 months at home?

    a Everyday
    b Almost everyday
    c Once a week
    d Once a month
    e Never

16. What is the highest level of education you have completed?

    a Less than High School
    b High School or GED
    c Vocational/Technical Degree
    d Some College or Associate's Degree
    e Bachelor's Degree (BA,BS)
    f Some graduate school, no degree
    g Graduate or Professional School

17. If you work, what is your approximate household income before taxes (information is strictly confidential)?

    a Under $20,000
    b $20,000-$30,000
    c $30,001-$40,000
    d $40,001-$50,000
    e $50,001-$60,000
    f $60,001-$80,000
    g $80,001-$100,000
    h $100,001-$150,000
    i $150,001-$200,000
    j Over $200,000

SECTION TWO (FIVE COPIES):

THIS SECTION IS TO BE FILLED OUT SEPARATELY BY
EACH HOUSEHOLD MEMBER OVER THE AGE OF 15.

PLEASE DISTRIBUTE EACH IDENTICAL COPY TO EACH HOUSEHOLD MEMBER OVER THE AGE OF 15.

PLEASE FILL-IN THE DATE IN THE TOP RIGHT-HAND SPACE PROVIDED ON THE NEXT PAGE.

PLEASE FILL-IN THE RESPONDENT'S NAME IN THE TOP LEFT-HAND SPACE PROVIDED ON THE NEXT PAGE.
PLEASE USE THE SAME NAME YOUR HEAD OF HOUSEHOLD PROVIDED IN SECTION 1.

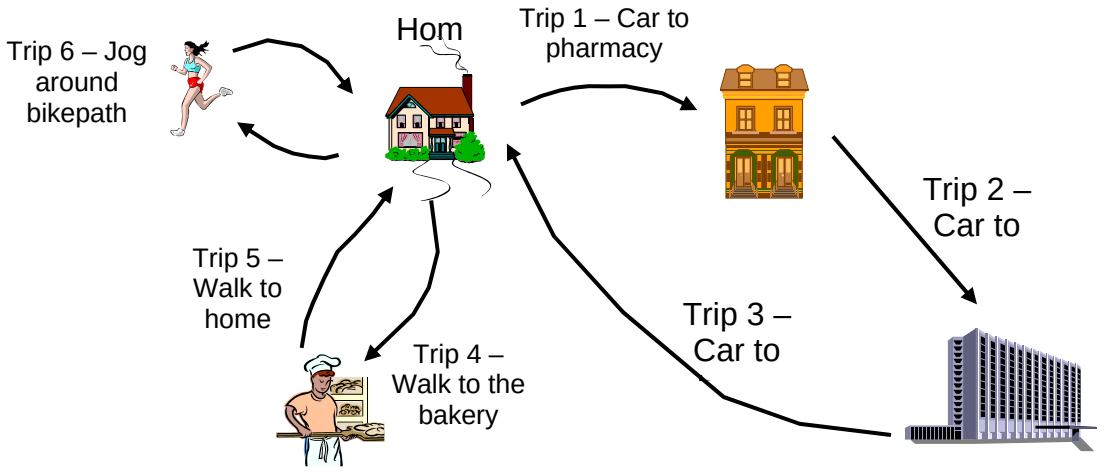
ALL RESPONSES WILL BE KEPT STRICTLY CONFIDENTIAL.

Chapter 6: TRAVEL DIARY FOR *EACH HOUSEHOLD MEMBER OVER THE AGE 16*

Instructions for completing your Travel Diary

- Use the diary on the back side of this page to record trips on your **travel day** and please record this date in the upper right hand corner of the page.
- Please fill-in your **name**, or the appropriate name your head of household provided in Section 1, in the top left-hand space provided on the back side of this page.
- The travel day starts at 4:00 a.m. and ends at 4:00 a.m. the next day.
- A **trip** is whenever you travel **from one place to another**. Use one line to record each trip. **Include:**
  - All trips you made for a specific reason, such as to go to work or school, buy gas, or drop someone off.
  - Return trips, such as coming home from work or school.
  - Walks, jogs, bike rides, and short drives. If you started and ended in the same place, list the farthest point you reached and record a return trip.
  - Trips of more than **300 feet**. These include walking for exercise, walking dogs, bike rides, etc.
  - **Do not** include stops just to change the type of transportation.
- If you made more than ten trips as part of your job (examples: a cab driver, delivery person, police officer):
  - **Don't** record the trips that were made as part of your job.
  - **Do** record the trips that got you to and from your work place.
  - **Do** record all other trips that **were not** part of your job.
- If you made more trips than will fit on the diary, record the rest on a blank sheet of paper.
- Estimate the **costs** of your travel to the best of your ability. Costs for taking the bus should only include bus fare. Costs for driving should only include parking. Costs for driving should **not** include gas, wear and tear, and ownership fees (such as insurance and depreciation) for the vehicle.

Example of Trips on a Travel Day



WHERE did you go ? (Name of place)	WHERE is it located? (List major cross streets)	What TIME did you start and end each trip?		WHY did you go there?	HOW did you travel? (List route if using bus)	How FAR was it? (blocks or miles)	COSTS associated with travel (parking & transit fare only)
		Started at:	Arrived at:				
1. Wilson's Pharmacy	*North St/Bryant Rd*	*8:15am*	*8:25am*	*Pick up medication*	*Drive*	*1/2 mile*	*$0.50 (parking meter)*
2. St. Mary's Hospital	*Park St. / Highway 101*	*8:35am*	*8:50am*	*Work*	*Drive*	*4 miles*	*$5.00 (parking garage)*
3. Home		*4:50pm*	*5:05pm*	*End of workday*	*Drive*	*4 miles*	*none*
4. Jackie's Bakery	*High St. / 8th Ave.*	*5:15pm*	*5:30pm*	*Get some bread*	*Walk*	*3 blocks*	*none*
5. Home		*5:45pm*	*6:00pm*	*Rest*	*Walk*	*3 blocks*	*none*
6. A jog	*Loop around bikepath*	*6:30pm*	*7:00pm*	*Exercise*	*Jogged*	*3 miles*	*none*

First Name: _____ **At the beginning of my travel day (4:00 a.m.) I was:** ☐ Home ☐ Some other place (specify)_____ **Date:**

WHERE did you go? (Name of place)	**WHERE** is it located? (List major cross streets)	**What TIME** did you start and end each trip?		**WHY** did you go there?	**HOW** did you travel? (List route if using bus)	**How FAR** was it? (blocks or miles)	**COSTS** associated with travel (parking & transit fare only)
		Started at:	Arrived at:				
1.							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
11.							

Appendix H: Survey Variables

Head of Household File/PA: Contents

Brief Description:
The Head of Household/PA file contains data specifically for the Head of Household and excludes other household members. Data is provided from the Household Survey, which only the Head of Household completed, as well as travel diary information for the Head of Household.

Part Zero: Head of Household File Neighborhood Data and Filters

0_1. HH_ID	household identification number
0_2. HDHH_ID (*key*)	head of household identification number
0_3. INCMPLT	travel diaries completed/not completed
0_4. FILTER1	completed/did not complete moderate and vigorous physical activity questions
0_5. FILTER2	completed moderate and vigorous physical activity questions and under 30 hours of moderate and vigorous physical activity per week
0_6. NGHB_CD	neighborhood code
0_7. TND	traditional neighborhood residence
$0_{8.}$ CONV	conventional neighborhood residence
$0_{9.}$ TND_SF	traditional neighborhood single-family residence
$0_{10.}$ TND_MF	traditional neighborhood multi-family residence
0_{11}. VALUE	value of home according to Orange County
0_{12}. ADDRESS	home address
0_{13}. CITY	city
0_{14}. STATE	state
0_{15}. ZIP	zip code

Part One: Household Questions from Household Survey

1. CUR_HOME	current home type
2. PRE_HOM	previous home type
2_a. PREHO_SF	previous home type is single-family
3. OWNRENT	own vs. rent current home
3_a. OWN	homeowner
4. MOVE	date resident moved into current home (mm-dd-yyyy)
4_a. YEARS	years at current residence
5. NO_CAR	number of cars owned by the household
5_a. VEH_1ML	model of vehicle one
5_b. VEH_1YR	year of vehicle one
5_c. VEH_2ML	model of vehicle two
5_d. VEH_2YR	year of vehicle two
5_e. VEH_3ML	model of vehicle three
5_f. VEH_3YR	year of vehicle three
5_g. VEH_4ML	model of vehicle four
$5_{h.}$ VEH_4YR	year of vehicle four

5_i. VEH_5ML	model of vehicle five
5_j. VEH_5YR	year of vehicle five
6. NO_HOME	number of persons in the household
6_a. UNDER_16	person is under 16 years old
6_b. NAME	person's first name
6_c. AGE	person's age
6_d. LICENSE	driver's license (yes/no)
6_e. SEX	sex (male/female)

Part Two: Travel Pattern Questions from Household Survey

1. EMPLOY	employment status (head of household)
1_a. EMP_OUT	employed outside of neighborhood dummy
1_b. STUDENT	student dummy
1_c. EMP_COM	comments (if EMPLOY is "other")
2. OCCUPA	occupation
2_a. OCC_COM	comments (if OCCUPA is "other")
3. TELECOM	telecommuting/teleworking frequency
4. TIME_1W	duration of one-way trip to work/school (decimal-hour)
5. SPEND_W	dollars spent traveling to work/school per week
6. MILES_W	miles traveled by car per week
7_{1a}. DRV_OUT	drive to work/school by car (outside neighborhood)
7_{1b}. DRV_IN	drive to work/school by car (inside neighborhood)
7_{2a}. CAR_OUT	carpool to work/school by car (outside neighborhood)
7_{2b}. CAR_IN	carpool to work/school by car (inside neighborhood)
7_{3a}. TRANOUT	travel to work/school using public transportation (outside neighborhood)
7_{3b}. TRAN_IN	travel to work/school using public transportation (inside neighborhood)
7_{4a}. WB_OUT	walk/bike to work/school (outside neighborhood)
7_{4b}. WB_IN	walk/bike to work/school (inside neighborhood)
7_{5a}. TRNSOUT	transport someone (outside neighborhood)
7_{5b}. TRNS_IN	transport someone (inside neighborhood)
7_{6a}. SHOPOUT	go shopping/run errand (outside neighborhood)
7_{6b}. SHOP_IN	go shopping/run errand (inside neighborhood)
7_{7a}. REC_OUT	go out for recreation (outside neighborhood)
7_{7b}. REC_IN	go out for recreation (inside neighborhood)

Part Three: Attitudinal Questions from Household Survey

1. FLEXDRV	flexibility of driving
2. ENJWALK	walking is enjoyable
3. COMFBUS	comfort with riding a bus
4. TMELEIS	leisure time
5. GASUP	price of gasoline
6. BACKYRD	large backyard for children
7. SIDEWLK	sidewalks in neighborhood
8. ENVIPRO	environmental protection

9. INTRACT	house proximity to sidewalk/interaction with passersby
10. LANDCON	land consumption for new housing, stores, offices
11. ENJBIKE	biking is enjoyable
12. CLOSENB	comfort with living in close proximity to neighbors
13. HILLS	hills in neighborhood
14. SAFE	safety of neighborhood for walking/biking
15. TRAFFIC	sitting in traffic
16. SPACE	space between home and street
17. PUBTRAN	public transit convenience
18. DRVALON	driving alone
19. PLAYSPC	public play space for children
20. SHOPSNB	shops and services close by
21. IDELCOM	ideal commuting time to work/school
22. ACCTCOM	longest acceptable commuting time to work/school

Part Four: Activities Questions from Household Survey

1. WALK_YN	walk at least ten minutes at a time (y/n)
2. WLK_DAY	number of days/week person walks 10+ minutes
3. WLK_TIM	total time per day spent walking (decimal-hours)
4. WALKLOC	location walking takes place
5. MOD_YN	moderate physical activities for 10+ minutes (y/n)
6. MOD_DAY	number of days/week person does moderate exercise
7. MOD_TIM	total time per day spent doing moderate exercise (decimal-hours)
8_a. MPR_HOM	percent of time spent on moderate exercise at home
8_b. MPR_NEI	percent of time spent on moderate exercise in neighborhood
8_c. MPR_OUT	percent of time spent on moderate exercise outside neighborhood
9. VIG_YN	vigorous physical activities for 10+ minutes (y/n)
10. VIG_DAY	number of days/week person does vigorous exercise
11. VIG_TIM	total time per day spent doing vigorous exercise (decimal-hours)
12_a. VPR_HOM	percent of time spent on vigorous exercise at home
12_b. VPR_NEI	percent of time spent on vigorous exercise in neighborhood
12_c. VPR_OUT	percent of time spent on vigorous exercise outside neighborhood
13. WEIGHT	respondent’s weight in pounds
14. HEIGHT	respondent’s height (decimal-feet)
14_a. HEIGHTIN	respondent’s height (inches)
14_a. BMI	respondent’s body-mass index
15. INTERNT	frequency of internet use
16. EDUCAT	highest level of education completed
16_a. COLLEGE	college education dummy
17. INCOME	household income

17$_a$. INC_MID household income (median of range)
18. MVPA duration of moderate and vigorous physical activity per week (hours)
19. MPA duration of moderate physical activity per week (hours)
20. VPA duration of vigorous physical activity per week (hours)
21. MVPA_HOM duration of home-based moderate and vigorous physical activity per week (hours)
22. MVPA_NEI duration of neighborhood-based moderate and vigorous physical activity per week (hours)
23. MVPA_OUT duration of external-based moderate and vigorous physical activity per week (hours)
24. MPA_HOM duration of home-based moderate physical activity per week (hours)
25. MPA_NEI duration of neighborhood-based moderate physical activity per week (hours)
26. MPA_OUT duration of external-based moderate physical activity per week (hours)
27. VPA_HOM duration of home-based vigorous physical activity per week (hours)
28. VPA_NEI duration of neighborhood-based vigorous physical activity per week (hours)
29. VPA_OUT duration of external-based vigorous physical activity per week (hours)
30. ACHIEVE achieves CDC recommendations for physical activity per week

Part Five: Trips from Travel Diary

1. T_TRIP total number of trips per day
2. T_TIME total travel time per day
3. T_DIST total number of miles traveled per day
4. T_CAR total number of driving trips per day
5. T_WALK total number of walking trips per day
6. T_STOP total number of stops in a tour of chain trips per day
7. T_TOUR total number of ends of the tour of chain trips per day
8. T_REG total number of regional trips per day
9. NWRKTRP total number of non-work trips per day
10. NWRKTME total travel time for non-work trips per day
11. NWRKDST total number of miles traveled for non-work trips per day
12. INT_TRP total number of trips made to destinations inside the neighborhood per day
13. EXT_TRP total number of trips made to destinations outside the neighborhood per day
14. EXT_TME total travel time to destinations outside the neighborhood per day
15. EXT_DST total number of miles traveled to destinations outside the neighborhood per day

16. EXT_CAR total number of trips made by automobile to destinations outside the neighborhood per day
17. PA_TRP number of physical activity trips
18. PA_TIM duration of physical activity trips (hours)
19. PA_DST distance of physical activity trips (miles)
20. REC_TRP number of recreational physical activity trips
21. REC _TIM duration of recreational physical activity trips (hours)
22. REC _DST distance of recreational physical activity trips (miles)
23. UTL_TRP number of utilitarian physical activity trips
24. UTL _TIM duration of utilitarian physical activity trips (hours)
25. UTL _DST distance of utilitarian physical activity trips (miles)
26. PA_TRP2 number of physical activity trips excluding four long trips
27. PA_TIM2 duration of physical activity trips excluding four long trips
28. PA_DST2 distance of physical activity trips excluding four long trips
29. REC_TRP2 number of recreational physical activity trips excluding four long trips
30. REC _TIM2 duration of recreational physical activity trips excluding four long trips
31. REC _DST2 distance of recreational physical activity trips excluding four long trips
32. UTL_TRP2 number of utilitarian physical activity trips excluding four long trips
33. UTL _TIM2 duration of utilitarian physical activity trips excluding four long trips
34. UTL _DST2 distance of utilitarian physical activity trips excluding four long trips

Head of Household File/PA: Detailed Description

Part Zero: Head of Household File Neighborhood Data and Filters

Name	Description
HH_ID	Household Identification Number
HDHH_ID	Head of Household ID
INCMPLT	Travel Diaries Completed/Not Completed

Value	Label
0	All Diaries Completed
1	Some/All Diaries Missing

FILTER1 Completed/did not complete moderate and vigorous physical activity questions

Value	Label
0	Not all moderate and vigorous physical activity questions complete
1	All moderate and vigorous physical activity questions complete

FILTER2 completed moderate and vigorous physical activity questions and under 30 hours of moderate and vigorous physical activity per week

Value	Label
0	Not all moderate and vigorous physical activity questions complete or over 30 hours of moderate and vigorous physical activity
1	All moderate and vigorous physical activity questions complete and under 30 hours of moderate and vigorous physical activity

NGHB_CD Neighborhood Code

Value	Label
1	Southern Village Households
2	Southern Village Apartments
3	Southern Village Condominiums
4	Lake Hogan Farm Households
5	Highlands Households
6	Sunset Households
7	Wexford Households
8	Fairoaks Households

TND Traditional Neighborhood Residence

Value	Label
0	Non-Traditional Neighborhood Residence
1	Traditional Neighborhood Residence

CONV

Value	Label
0	Non-Conventional Neighborhood Residence

	1	Conventional Neighborhood Residence
TND_SF	Value	Label
	0	Non-Traditional Neighborhood Single-Family Residence
	1	Traditional Neighborhood Single-Family Residence
TND_MF	Value	Label
	0	Non-Traditional Neighborhood Multi-Family Resident
	1	Traditional Neighborhood Multi-Family Resident
VALUE	Value of residence according to Orange County	
ADDRESS	Home Address	
CITY	City	
STATE	State	
ZIP	Zip Code	

Part One: Household Questions from Household Survey

CUR_HOME	Current Home Type	
	Value	Label
	1	Detached Single House
	2	Duplex
	3	Townhouse or Rowhouse
	4	Apartment
	5	Condominium
	6	Other
	7	Don’t Know
PRE_HOM	Previous Home Type	
	Value	Label
	1	Detached Single House
	2	Duplex
	3	Townhouse or Rowhouse
	4	Apartment
	5	Condominium
	6	Other
	7	Don’t Know
PREHO_SF	Previous Home Type is Single-Family Residence	
	Value	Label
	0	Not a Single-Family Residence
	1	Single-Family Residence
OWNRENT	Own vs. Rent Current Home	
	Value	Label

	1	Own
	2	Rent
	3	Other
	4	Don't Know

OWN — Homeowner

Value	Label
0	Does not own home
1	Homeowner

MOVE — Date resident moved into current home (mm-dd-yyyy)

YEARS — Number of years resident has lived at current home

NO_CAR — Number of cars owned by the household

VEH_1ML — Model of Vehicle One

Value	Label
1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_1YR — Year of Vehicle One

VEH_2ML — Model of Vehicle Two

Value	Label
1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_2YR — Year of Vehicle Two

VEH_3ML — Model of Vehicle Three

Value	Label

1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_3YR Year of Vehicle Three

VEH_4ML Model of Vehicle Four

Value	Label
1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_4YR Year of Vehicle Four

VEH_5ML Model of Vehicle Five

Value	Label
1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_5YR Year of Vehicle Five

NO_HOME Number of Persons in the Household

UNDER_16 Number of Persons in the Household Under 16 Years Old

NAME Person's First Name

AGE Person's Age

LICENSE Licensed Driver

Value	Label

0	Does not have a driver's license
1	Has a driver's license

SEX — Person's Sex

Value	Label
0	Female
1	Male

Part Two: Travel Pattern Questions from Household Survey

EMPLOY — Employment Status (Head of Household)

Value	Label
1	Work Full-Time Outside the Home
2	Work Part-Time Outside the Home
3	Student
4	Work Full-Time at Home
5	Work Part-Time at Home
6	Unemployed
7	Retired
8	Other

EMP_OUT — Head of Household is Employed Outside of the Home

Value	Label
0	Not Employed Outside the Home
1	Employed Outside the Home

STUDENT — Household Head is a Student

Value	Label
0	Not a Student
1	Student

EMP_COM — Comments (if EMPLOY is "Other")

OCCUPA — Occupation

Value	Label
1	Clerical/Secretary
2	Service
3	Production/Manufacturing
4	Executive/Managerial
5	Skilled Trades
6	Retired
7	Sales/Retail
8	Computer/Technical
9	Medical/Health
10	Other

OCC_COM — Comments (if OCCUPA is "Other")

TELECOM — Times per week head of household telecommutes/teleworks to work

TIME_1W	Duration of a typical one-way trip to work or school (in decimal-hours)
SPEND_W	Dollars spent traveling to work/school per week (includes gas, parking, and transit fares)
MILES_W	Number of miles traveled by car per week
DRV_OUT	How often resident drives to work or school by car, Monday – Friday (outside neighborhood)
DRV_IN	How often resident drives to work or school by car, Monday – Friday (inside neighborhood)
CAR_OUT	How often resident carpools to work or school by car, Monday – Friday (outside neighborhood)
CAR_IN	How often resident carpools to work or school by car, Monday – Friday (inside neighborhood)
TRANOUT	How often resident travels to work or school using public transportation, Monday – Friday (outside neighborhood)
TRAN_IN	How often resident travels to work or school using public transportation, Monday – Friday (inside neighborhood)
WB_OUT	How often Resident Walks or Bicycles to Work or School, Monday – Friday (outside Neighborhood)
WB_IN	How often resident walks or bicycles to work or school, Monday – Friday (inside neighborhood)
TRNSOUT	How often resident transports someone, Monday – Friday (outside neighborhood)
TRNS_IN	How often resident transports someone, Monday – Friday, (inside neighborhood)
SHOPOUT	How often resident shops/runs an errand, Monday – Friday (outside neighborhood)
SHOP_IN	How often resident shops/runs an errand, Monday – Friday (inside neighborhood)
REC_OUT	How often resident goes out for recreation, entertainment, or meals, Monday – Friday (outside neighborhood)
REC_IN	How often resident goes out for recreation, entertainment, or meals, Monday – Friday (inside neighborhood)

Part Three: Attitudinal Questions from Household Survey

FLEXDRV — I like the flexibility that driving allows

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

ENJWALK I enjoy walking

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

COMFBUS I am comfortable riding a bus

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

TMELEIS I would like to have more time for leisure

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

GASUP We should raise the price of gasoline to reduce congestion and air pollution

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

BACKYRD It's important for children to have a large backyard for

playing

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

SIDEWLK Sidewalks make walking easier in my neighborhood

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral

4	Agree
5	Strongly Agree

ENVIPRO — Environmental protection is an important issue

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

INTRACT — I enjoy a house close to the sidewalk so that I can see and interact with passersby

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

LANDCON — Too much land is consumed for new housing, stores, and offices

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

ENJBIKE — I enjoy bicycling

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

CLOSENB — I can be comfortable living in close proximity to my neighbors

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral

	4	Agree
	5	Strongly Agree

HILLS — Hills or other barriers in my neighborhood make walking/bicycling difficult

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

SAFE — My neighborhood seems safe for walking or bicycling

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

TRAFFIC — Sitting in traffic aggravates me

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

SPACE — I prefer a lot of space between my home and the street

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

PUBTRAN — Taking public transit is inconvenient

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

DRVALON — Too many people drive alone

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree

	5	Strongly Agree

PLAYSPC — Children should have a large public play space within safe walking distance of their home

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

SHOPSNB — Having shops and services close by is important to me

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

IDELCOM — Ideal Commuting Time to Work or School

Value	Label
1	Less than 5 minutes
2	Between 5 and 15 minutes
3	Between 15 and 30 minutes
4	More than 30 minutes

ACCTCOM — Longest Acceptable Commuting Time to Work or School

Value	Label
1	Less than 5 minutes
2	Between 5 and 15 minutes
3	Between 15 and 30 minutes
4	Between 30 and 45 minutes
5	Between 45 minutes and 1 hour
6	More than one hour

Part Four: Activities Questions from Household Survey

WALK_YN	In a usual week, do you walk for at least 10 minutes at a time for recreation or exercise?

Value	Label
0	No
1	Yes

WLK_DAY	Number of days per week respondent walks for a least 10 minutes at a time
WLK_TIM	Total time per day spent walking (decimal-hours)
WALKLOC	Location recreational/exercise walking takes place

Value	Label
1	Always in neighborhood
2	Mostly in neighborhood
3	Sometimes in neighborhood, sometimes elsewhere
4	Mostly away from neighborhood
5	Always away from neighborhood

MOD_YN	In a usual week, do you do moderate physical activities for at least 10 minutes at a time?

Value	Label
0	No
1	Yes

MOD_DAY	Number of days per week respondent does moderate activities for a least 10 minutes at a time
MOD_TIM	Total time per day spent doing moderate activities (decimal-hours)
MPR_HOM	Percent of total time spent on moderate activities spent at home
MPR_NEI	Percent of total time spent on moderate activities spent outside the home but in neighborhood
MPR_OUT	Percent of total time spent on moderate activities spent outside neighborhood
VIG_YN	In a usual week, do you do vigorous physical activities for at least 10 minutes at a time?

Value	Label
0	No
1	Yes

VIG_DAY	Number of days per week respondent does vigorous activities for a least 10 minutes at a time
VIG_TIM	Total time per day spent doing vigorous activities (decimal-hours)

VPR_HOM	Percent of total time spent on vigorous activities spent at home
VPR_NEI	Percent of total time spent on vigorous activities spent outside the home but in neighborhood
VPR_OUT	Percent of total time spent on vigorous activities spent outside neighborhood
WEIGHT	Respondent's weight in pounds
HEIGHT	Respondent's height in decimal-feet
HEIGHTIN	Respondent's height in inches
BMI	Body-Mass Index
INTERNT	How often respondent used the Internet at home over the past 6 months

Value	Label
1	Everyday
2	Almost everyday
3	Once a week
4	Once a month
5	Never

EDUCAT — Highest level of education completed by respondent

Value	Label
1	Less than High School
2	High School or GED
3	Vocational/Technical Degree
4	Some College or Associate's Degree
5	Bachelor's Degree (BA, BS)
6	Some graduate school, no degree
7	Graduate or Professional School

COLLEGE — Highest level of education completed by respondent

Value	Label
0	Less than college
1	College

INCOME — Household income before taxes

Value	Label
1	Under $20,000
2	$20,000 - $30,000
3	$30,001 - $40,000
4	$40,001 – $50,000
5	$50,001 – $60,000
6	$60,001 – $80,000
7	$80,001 – $100,000
8	$100,001 – $150,000

9	$150,001 – $200,000
10	Over $200,000

INC_MID — Household income before taxes (midpoint of range)

Value	Label
1	$10,000
2	$25,000
3	$35,000
4	$45,000
5	$55,000
6	$70,000
7	$90,000
8	$125,000
9	$175,000
10	$200,000

MVPA — Duration of moderate and vigorous physical activity per week (hours)
MPA — Duration of moderate physical activity per week (hours)
VPA — Duration of vigorous physical activity per week (hours)
MVPA_HOM — Duration of home-based moderate and vigorous physical activity per week (hours)
MVPA_NEI — Duration of neighborhood-based moderate and vigorous physical activity per week (hours)
MVPA_OUT — Duration of external-based moderate and vigorous physical activity per week (hours)
MPA_HOM — Duration of home-based moderate physical activity per week (hours)
MPA_NEI — Duration of neighborhood-based moderate physical activity per week (hours)
MPA_OUT — Duration of external-based moderate physical activity per week (hours)
VPA_HOM — Duration of home-based vigorous physical activity per week (hours)
VPA_NEI — Duration of neighborhood-based vigorous physical activity per week (hours)
VPA_OUT — Duration of external-based vigorous physical activity per week (hours)
ACHIEVE — Achieves CDC recommendations for physical activity per week

Part Five: Trips from Travel Diary

T_TRIP — Total number of trips per day
T_TIME — Total travel time per day
T_DIST — Total number of miles traveled per day
T_CAR — Total number of driving trips per day
T_WALK — Total number of walking trips per day

T_STOP	Total number of stops in a tour of chain trips per day
T_TOUR	Total number of ends of the tour of chain trips per day
T_REG	Total number of regional trips per day
NWRKTRIP	Total number of non-work trips per day
NWRKTIME	Total travel time for non-work trips per day
NWRKDIST	Total number of miles traveled for non-work trips per day
INT_TRIP	Total number of trips made to destinations inside the neighborhood per day
EXT_TRIP	Total number of trips made to destinations outside the neighborhood per day
EXT_TIME	Total travel time to destinations outside the neighborhood per day
EXT_DIST	Total number of miles traveled to destinations outside the neighborhood per day
EXT_CAR	Total number of trips made by automobile to destinations outside the neighborhood per day
PA_TRP	Number of physical activity trips
PA_TIM	Duration of physical activity trips
PA_DST	Distance of physical activity trips
REC_TRP	Number of recreational physical activity trips
REC _TIM	Duration of recreational physical activity trips
REC _DST	Distance of recreational physical activity trips
UTL_TRP	Number of utilitarian physical activity trips
UTL _TIM	Duration of utilitarian physical activity trips
UTL _DST	Distance of utilitarian physical activity trips
PA_TRP2	Number of physical activity trips excluding four long trips
PA_TIM2	Duration of physical activity trips excluding four long trips
PA_DST2	Distance of physical activity trips excluding four long trips
REC_TRP2	Number of recreational physical activity trips excluding four long trips
REC _TIM2	Duration of recreational physical activity trips excluding four long trips
REC _DST2	Distance of recreational physical activity trips excluding four long trips
UTL_TRP2	Number of utilitarian physical activity trips excluding four long trips
UTL _TIM2	Duration of utilitarian physical activity trips excluding four long trips
UTL _DST2	Distance of utilitarian physical activity trips excluding four long trips

Household File: Contents

Brief Description:
The Household File contains data at the household level, meaning that individual data is aggregated to the household level. Data is provided from the Household Survey and the travel diary. Some household members did not complete a travel diary, even if they were eligible to do so. The 'missing' people were assigned the mean of each travel behavior attribute and then were linked at the household level. No new households were created in instances where every eligible person in that household failed to complete a travel diary.

Part Zero: Head of Household File Neighborhood Data and Filters

0_1. HH_ID (*key*) household identification number
0_2. HDHH_ID person identification number
0_3. DIARIES travel diaries completed/not completed
0_4. FILTER1 completed/did not complete moderate and vigorous physical activity questions
0_5. FILTER2 completed moderate and vigorous physical activity questions and under 30 hours of moderate and vigorous physical activity per week
0_6. NGHB_CD neighborhood code
0_7. TND traditional neighborhood development
$0_{8.}$ CONV conventional residence
$0_{9.}$ TND_SF traditional neighborhood single-family
$0_{10.}$ TND_MF traditional neighborhood multi-family
$0_{11.}$ LHF Lake Hogan Farms residence
$0_{12.}$ OTHER conventional residence (excluding Lake Hogan Farms)
0_{13}. VALUE value of home according to Orange County
0_{14}. ADDRESS home address
0_{15}. CITY city
0_{16}. STATE state
0_{17}. ZIP zip code

Part One: Household Questions from Household Survey

1. CUR_HOME current home type
2. PRE_HOM previous home type
2_a. PREHO_SF previous home type is single-family
3. OWNRENT own vs. rent current home
3_a. OWN homeowner
4. MOVE date resident moved into current home (mm-dd-yyyy)
4_a. YEARS years at current residence
5. NO_CAR number of cars owned by the household
5_a. VEH_1ML model of vehicle one
5_b. VEH_1YR year of vehicle one
5_c. VEH_2ML model of vehicle two
5_d. VEH_2YR year of vehicle two
5_e. VEH_3ML model of vehicle three
5_f. VEH_3YR year of vehicle three

5_g. VEH_4ML	model of vehicle four
5_h. VEH_4YR	year of vehicle four
5_i. VEH_5ML	model of vehicle five
5_j. VEH_5YR	year of vehicle five
6. NO_HOME	number of persons in the household
6_a. UNDER_16	person is under 16 years old
6_b. NAME	person's first name
6_c. AGE	person's age
6_d. LICENSE	driver's license (yes/no)
6_e. SEX	sex (male/female)

Part Two: Travel Patterns Questions from Household Survey

1. EMPLOY	employment status (head of household)
1_a. EMP_OUT	employed outside of neighborhood dummy
1_b. STUDENT	student dummy
1_c. EMP_COM	comments (if EMPLOY is "other")
2. OCCUPA	occupation
2_a. OCC_COM	comments (if OCCUPA is "other")
3. TELECOM	telecommuting/teleworking frequency
4. TIME_1W	duration of one-way trip to work/school (decimal-hour)
5. SPEND_W	dollars spent traveling to work/school per week
6. MILES_W	miles traveled by car per week
7_{1a}. DRV_OUT	drive to work/school by car (outside neighborhood)
7_{1b}. DRV_IN	drive to work/school by car (inside neighborhood)
7_{2a}. CAR_OUT	carpool to work/school by car (outside neighborhood)
7_{2b}. CAR_IN	carpool to work/school by car (inside neighborhood)
7_{3a}. TRANOUT	travel to work/school using public transportation (outside neighborhood)
7_{3b}. TRAN_IN	travel to work/school using public transportation (inside neighborhood)
7_{4a}. WB_OUT	walk/bike to work/school (outside neighborhood)
7_{4b}. WB_IN	walk/bike to work/school (inside neighborhood)
7_{5a}. TRNSOUT	transport someone (outside neighborhood)
7_{5b}. TRNS_IN	transport someone (inside neighborhood)
7_{6a}. SHOPOUT	go shopping/run errand (outside neighborhood)
7_{6b}. SHOP_IN	go shopping/run errand (inside neighborhood)
7_{7a}. REC_OUT	go out for recreation (outside neighborhood)
7_{7b}. REC_IN	go out for recreation (inside neighborhood)

Part Three: Attitudes Questions from Household Survey

1. FLEXDRV	flexibility of driving
2. ENJWALK	walking is enjoyable
3. COMFBUS	comfort with riding a bus
4. TMELEIS	leisure time
5. GASUP	price of gasoline

6. BACKYRD	large backyard for children
7. SIDEWLK	sidewalks in neighborhood
8. ENVIPRO	environmental protection
9. INTRACT	house proximity to sidewalk/interaction with passersby
10. LANDCON	land consumption for new housing, stores, offices
11. ENJBIKE	biking is enjoyable
12. CLOSENB	comfort with living in close proximity to neighbors
13. HILLS	hills in neighborhood
14. SAFE	safety of neighborhood for walking/biking
15. TRAFFIC	sitting in traffic
16. SPACE	space between home and street
17. PUBTRAN	public transit convenience
18. DRVALON	driving alone
19. PLAYSPC	public play space for children
20. SHOPSNB	shops and services close by
21. IDELCOM	ideal commuting time to work/school
22. ACCTCOM	longest acceptable commuting time to work/school

Part Four: Activities Questions from Household Survey

1. WALK_YN	walk at least ten minutes at a time (y/n)
2. WLK_DAY	number of days/week person walks 10+ minutes
3. WLK_TIM	total time per day spent walking (decimal-hours)
4. WALKLOC	location walking takes place
5. MOD_YN	moderate physical activities for 10+ minutes (y/n)
6. MOD_DAY	number of days/week person does moderate exercise
7. MOD_TIM	total time per day spent doing moderate exercise (decimal-hours)
8_a. MPR_HOM	percent of time spent on moderate exercise at home
8_b. MPR_NEI	percent of time spent on moderate exercise in neighborhood
8_c. MPR_OUT	percent of time spent on moderate exercise outside neighborhood
9. VIG_YN	vigorous physical activities for 10+ minutes (y/n)
10. VIG_DAY	number of days/week person does vigorous exercise
11. VIG_TIM	total time per day spent doing vigorous exercise (decimal-hours)
12_a. VPR_HOM	percent of time spent on vigorous exercise at home
12_b. VPR_NEI	percent of time spent on vigorous exercise in neighborhood
12_c. VPR_OUT	percent of time spent on vigorous exercise outside neighborhood
13. WEIGHT	respondent’s weight in pounds
14. HEIGHT	respondent’s height (decimal-feet)
14_a. HEIGHTIN	respondent’s height (inches)
14_a. BMI	respondent’s body-mass index
15. INTERNT	frequency of internet use

16. EDUCAT — highest level of education completed
16_a. COLLEGE — college education dummy
17. INCOME — household income
17_a. INC_MID — household income (midpoint of range)
17_b. INC_1 — household income is under $20,000
17_c. INC_2 — household income is $20,001 to $30,000
17_d. INC_3 — household income is $30,001 to $40,000
17_e. INC_4 — household income is $40,001 to $50,000
17_f. INC_5 — household income is $50,001 to $60,000
17_g. INC_6 — household income is $60,001 to $80,000
17_h. INC_7 — household income is $80,001 to $100,000
17_i. INC_8 — household income is $100,001 to $150,000
17_j. INC_9 — household income is $150,001 to $200,000
17_k. INC_10 — household income is over $200,000

Part Five: Household Trips from Travel Diary

1_a. T_TRIP — total number of trips per household per day
1_b. T_TRIP2 — total number of trips per household per day (corrected*)
2_a. HB_WORK — home-based work trips per household
2_b. HB_WORK2 — home-based work trips per household (corrected*)
2_c. HB_SHOP — home-based shopping trips per household
2_d. HB_SHOP2 — home-base shopping trips per household (corrected*)
2_e. HB_SCH — home-based school trips per household
2_f. HB_SCH2 — home-based school trips per household (corrected*)
2_g. HB_OTH — home-based other trips per household
2_h. HB_OTH2 — home-based other trips per household (corrected*)
2_i. NON_HB — non-home based trips per household
2_j. NON_HB2 — non-home based trips per household (corrected*)
3_a. T_TIME — total travel time per household per day
3_b. T_TIME2 — total travel time per household per day (corrected*)
4_a. T_DIST — total number of miles traveled per household per day
4_b. T_DIST2 — total number of miles traveled per household per day (corrected*)
5_a. T_CAR — total number of driving trips per household per day
5_b. T_CAR2 — total number of driving trips per household per day (corrected*)
6_a. T_WALK — total number of walking trips per household per day
6_b. T_WALK2 — total number of walking trips per household per day (corrected*)
7_a. T_STOP — total number of stops in a tour of chain trips per household per day
7_b. T_STOP2 — total number of stops in a tour of chain trips per household per day (corrected*)
8_a. T_TOUR — total number of ends of the tour of chain trips per household per day

8_b. T_TOUR2 total number of ends of the tour of chain trips per household per day (corrected*)

9_a. STP_TR total number stops per tour per household

9_b. STP_TR2 total number of stops per tour per household (corrected*)

10_a. T_REG total number of regional trips per household per day

10_b. T_REG2 total number of regional trips per household per day (corrected*)

11_a. NWRKTRP total number of non-work trips per household per day

11_b. NWRKTRP2 total number of non-work trips per household per day (corrected*)

12_a. NWRKTME total travel time for non-work trips per household per day

12_b. NWRKTME2 total travel time for non-work trips per household per day (corrected*)

13_a. NWRKDST total number of miles traveled for non-work trips per household per day

13_b. NWRKDST2 total number of miles traveled for non-work trips per household per day (corrected*)

14_a. INT_TRP total number of trips made to destinations inside the neighborhood per household per day

14_b. INT_TRP2 total number of trips made to destinations inside the neighborhood per household per day (corrected*)

15_a. EXT_TRP total number of trips made to destinations outside the neighborhood per household per day

15_b. EXT_TRP2 total number of trips made to destinations outside the neighborhood per household per day (corrected*)

16_a. EXT_TME total travel time to destinations outside the neighborhood per household per day

16_b. EXT_TME2 total travel time to destinations outside the neighborhood per household per day (corrected*)

17_a. EXT_DST total number of miles traveled to destinations outside the neighborhood per household per day

17_b. EXT_DST2 total number of miles traveled to destinations outside the neighborhood per household per day (corrected*)

18_a. EXT_CAR total number of trips made by automobile to destinations outside the neighborhood per household per day

18_b. EXT_CAR2 total number of trips made by automobile to destinations outside the neighborhood per household per day (corrected*)

19. PA_TRP number of physical activity trips per household

20. PA_TIM duration of physical activity trips per household (hours)

21. PA_DST distance of physical activity trips per household (miles)

22. REC_TRP number of recreational physical activity trips per household

23. REC _TIM duration of recreational physical activity trips per household (hours)

24. REC _DST distance of recreational physical activity trips per household (miles)
25. UTL_TRP number of utilitarian physical activity trips per household
26. UTL _TIM duration of utilitarian physical activity trips per household (hours)
27. UTL _DST distance of utilitarian physical activity trips per household (miles)
28. MVPA duration of moderate and vigorous physical activity per week (hours)
29. MPA duration of moderate physical activity per week (hours)
30. VPA duration of vigorous physical activity per week (hours)
31. MVPA_HOM duration of home-based moderate and vigorous physical activity per week (hours)
32. MVPA_NEI duration of neighborhood-based moderate and vigorous physical activity per week (hours)
33. MVPA_OUT duration of external-based moderate and vigorous physical activity per week (hours)
34. MPA_HOM duration of home-based moderate physical activity per week (hours)
35. MPA_NEI duration of neighborhood-based moderate physical activity per week (hours)
36. MPA_OUT duration of external-based moderate physical activity per week (hours)
37. VPA_HOM duration of home-based vigorous physical activity per week (hours)
38. VPA_NEI duration of neighborhood-based vigorous physical activity per week (hours)
39. VPA_OUT duration of external-based vigorous physical activity per week (hours)
40. ACHIEVE achieves CDC recommendations for physical activity per week

* Accounts for ‘missing’ trip data, where one or more eligible people did not complete a travel diary. The ‘missing’ people were assigned the mean of each travel behavior attribute and then were aggregated at the household level. No households were created in instances were each eligible person in that household failed to complete a travel diary. The inclusion of this missing data provides a more accurate picture of household travel behavior that can be compared to the TTA regional data.

Household File: Variable Description

Name	Description
HH_ID	Household Identification Number
HDHH_ID	Head of Household ID
DIARIES	Travel Diaries Completed/Not Completed

Value	Label
0	Some/All Diaries Missing
1	All Diaries Completed

FILTER1 Completed/did not complete moderate and vigorous physical activity questions

Value	Label
0	Not all moderate and vigorous physical activity questions complete
1	All moderate and vigorous physical activity questions complete

FILTER2 Completed moderate and vigorous physical activity questions and under 30 hours of moderate and vigorous physical activity per week

Value	Label
0	Not all moderate and vigorous physical activity questions complete or over 30 hours of moderate and vigorous physical activity
1	All moderate and vigorous physical activity questions complete and under 30 hours of moderate and vigorous physical activity

NGHB_CD Neighborhood Code

Value	Label
1	Southern Village Households
2	Southern Village Apartments
3	Southern Village Condominiums
4	Lake Hogan Farm Households
5	Highlands Households
6	Sunset Households
7	Wexford Households
8	Fairoaks Households

TND Traditional Neighborhood Residence

Value	Label
0	Non-Traditional Neighborhood Residence
1	Traditional Neighborhood Residence

CONV

Value	Label
0	Non-Conventional Neighborhood Residence

	1	Conventional Neighborhood Residence
TND_SF	Value	Label
	0	Non-Traditional Neighborhood Single-Family Resident
	1	Traditional Neighborhood Single-Family Resident
TND_MF	Value	Label
	0	Non-Traditional Neighborhood Multi-Family Resident
	1	Traditional Neighborhood Multi-Family Resident
LHF	Value	Label
	0	Non-Lake Hogan Farms Residence
	1	Lake Hogan Farms Residence
OTHER	Value	Label
	0	Non-Lake Hogan Farms Conv. Residence
	1	Lake Hogan Farms Conventional Residence
ADDRESS	Home Address	
CITY	City	
STATE	State	
ZIP	Zip Code	
CUR_HOME	Current Home Type	
	Value	Label
	1	Detached Single House
	2	Duplex
	3	Townhouse or Rowhouse
	4	Apartment
	5	Condominium
	6	Other
	7	Don’t Know
PRE_HOM	Previous Home Type	
	Value	Label
	1	Detached Single House
	2	Duplex
	3	Townhouse or Rowhouse
	4	Apartment
	5	Condominium
	6	Other
	7	Don’t Know
PREHO_SF	Previous Home Type is Single-Family Residence	
	Value	Label

	0	Not a Single-Family Residence
	1	Single-Family Residence

OWNRENT — Own vs. Rent Current Home

Value	Label
1	Own
2	Rent
3	Other
4	Don't Know

OWN — Homeowner

Value	Label
0	Does not own home
1	Homeowner

MOVE — Date resident moved into current home (mm-dd-yyyy)

YEARS — Number of years resident has lived at current home

NO_CAR — Number of cars owned by the household

VEH_1ML — Model of Vehicle One

Value	Label
1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_1YR — Year of Vehicle One

VEH_2ML — Model of Vehicle Two

Value	Label
1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_2YR — Year of Vehicle Two

VEH_3ML — Model of Vehicle Three

Value	Label

1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_3YR Year of Vehicle Three

VEH_4ML Model of Vehicle Four

Value	Label
1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_4YR Year of Vehicle Four

VEH_5ML Model of Vehicle Five

Value	Label
1	Sedan/Hatchback/Convertible/Station Wagon/Coupe
2	Van (Mini, Cargo, Passenger, Conversion)
3	Sports Utility Vehicle
4	Pickup Truck
5	Other Truck
6	Recreational Vehicle
7	Motorcycle
8	Other

VEH_5YR Year of Vehicle Five

NO_HOME Number of Persons in the Household

UNDER_16 Number of Persons in the Household Under 16 Years Old

NAME Person's First Name

AGE Person's Age

LICENSE Licensed Driver

Value	Label

0	Does not have a driver's license
1	Has a driver's license

SEX — Person's Sex

Value	Label
0	Female
1	Male

EMPLOY — Employment Status (Head of Household)

Value	Label
1	Work Full-Time Outside the Home
2	Work Part-Time Outside the Home
3	Student
4	Work Full-Time at Home
5	Work Part-Time at Home
6	Unemployed
7	Retired
8	Other

EMP_OUT — Head of Household is Employed Outside of the Home

Value	Label
0	Not Employed Outside the Home
1	Employed Outside the Home

STUDENT — Household Head is a Student

Value	Label
0	Not a Student
1	Student

EMP_COM — Comments (if EMPLOY is "Other")

OCCUPA — Occupation

Value	Label
1	Clerical/Secretary
2	Service
3	Production/Manufacturing
4	Executive/Managerial
5	Skilled Trades
6	Retired
7	Sales/Retail
8	Computer/Technical
9	Medical/Health
10	Other

OCC_COM — Comments (if OCCUPA is "Other")

TELECOM — Times per week head of household telecommutes/teleworks to work

TIME_1W — Duration of a typical one-way trip to work or school (in decimal-hours)

SPEND_W	Dollars spent traveling to work/school per week (includes gas, parking, and transit fares)
MILES_W	Number of miles traveled by car per week
DRV_OUT	How often resident drives to work or school by car, Monday – Friday (outside neighborhood)
DRV_IN	How often resident drives to work or school by car, Monday – Friday (inside neighborhood)
CAR_OUT	How often resident carpools to work or school by car, Monday – Friday (outside neighborhood)
CAR_IN	How often resident carpools to work or school by car, Monday – Friday (inside neighborhood)
TRANOUT	How often resident travels to work or school using public transportation, Monday – Friday (outside neighborhood)
TRAN_IN	How often resident travels to work or school using public transportation, Monday – Friday (inside neighborhood)
WB_OUT	How often Resident Walks or Bicycles to Work or School, Monday – Friday (outside Neighborhood)
WB_IN	How often resident walks or bicycles to work or school, Monday – Friday (inside neighborhood)
TRNSOUT	How often resident transports someone, Monday – Friday (outside neighborhood)
TRNS_IN	How often resident transports someone, Monday – Friday, (inside neighborhood)
SHOPOUT	How often resident shops/runs an errand, Monday – Friday (outside neighborhood)
SHOP_IN	How often resident shops/runs an errand, Monday – Friday (inside neighborhood)
REC_OUT	How often resident goes out for recreation, entertainment, or meals, Monday – Friday (outside neighborhood)
REC_IN	How often resident goes out for recreation, entertainment, or meals, Monday – Friday (inside neighborhood)
FLEXDRV	I like the flexibility that driving allows

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

ENJWALK I enjoy walking

Value	Label

1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

COMFBUS — I am comfortable riding a bus

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

TMELEIS — I would like to have more time for leisure

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

GASUP — We should raise the price of gasoline to reduce congestion and air pollution

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

BACKYRD — It's important for children to have a large backyard for playing

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

SIDEWLK — Sidewalks make walking easier in my neighborhood

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

ENVIPRO — Environmental protection is an important issue

Value	Label

1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

INTRACT — I enjoy a house close to the sidewalk so that I can see and interact with passersby

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

LANDCON — Too much land is consumed for new housing, stores, and offices

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

ENJBIKE — I enjoy bicycling

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

CLOSENB — I can be comfortable living in close proximity to my neighbors

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

HILLS — Hills or other barriers in my neighborhood make walking/bicycling difficult

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

SAFE — My neighborhood seems safe for walking or bicycling

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

TRAFFIC — Sitting in traffic aggravates me

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

SPACE — I prefer a lot of space between my home and the street

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

PUBTRAN — Taking public transit is inconvenient

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

DRVALON — Too many people drive alone

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

PLAYSPC — Children should have a large public play space within safe walking distance of their home

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

SHOPSNB — Having shops and services close by is important to me

Value	Label
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

IDELCOM — Ideal Commuting Time to Work or School

Value	Label
1	Less than 5 minutes
2	Between 5 and 15 minutes
3	Between 15 and 30 minutes
4	More than 30 minutes

ACCTCOM — Longest Acceptable Commuting Time to Work or School

Value	Label
1	Less than 5 minutes
2	Between 5 and 15 minutes
3	Between 15 and 30 minutes
4	Between 30 and 45 minutes
5	Between 45 minutes and 1 hour
6	More than 1 hour

WALK_YN — In a usual week, do you walk for at least 10 minutes at a time for recreation or exercise?

Value	Label
0	No
1	Yes

WLK_DAY — Number of days per week respondent walks for a least 10 minutes at a time

WLK_TIM — Total time per day spent walking (decimal-hours)

WALKLOC — Location recreational/exercise walking takes place

Value	Label

	1 Always in neighborhood 2 Mostly in neighborhood 3 Sometimes in neighborhood, sometimes elsewhere 4 Mostly away from neighborhood 5 Always away from neighborhood
MOD_YN	In a usual week, do you do moderate physical activities for at least 10 minutes at a time? Value Label 0 No 1 No
MOD_DAY	Number of days per week respondent does moderate activities for a least 10 minutes at a time
MOD_TIM	Total time per day spent doing moderate activities (decimal-hours)
MPR_HOM	Percent of total time spent on moderate activities spent at home
MPR_NEI	Percent of total time spent on moderate activities spent outside the home but in neighborhood
MPR_OUT	Percent of total time spent on moderate activities spent outside neighborhood
VIG_YN	In a usual week, do you do vigorous physical activities for at least 10 minutes at a time? Value Label 0 No 1 No
VIG_DAY	Number of days per week respondent does vigorous activities for a least 10 minutes at a time
VIG_TIM	Total time per day spent doing vigorous activities (decimal-hours)
VPR_HOM	Percent of total time spent on vigorous activities spent at home
VPR_NEI	Percent of total time spent on vigorous activities spent outside the home but in neighborhood
VPR_OUT	Percent of total time spent on vigorous activities spent outside neighborhood
WEIGHT	Respondent’s weight in pounds
HEIGHT	Respondent’s height in decimal-feet
HEIGHTIN	Respondent’s height in inches
BMI	Body-Mass Index

INTERNT — How often respondent used the Internet at home over the past 6 months

Value	Label
1	Everyday
2	Almost everyday
3	Once a week
4	Once a month
5	Never

EDUCAT — Highest level of education completed by respondent

Value	Label
1	Less than High School
2	High School or GED
3	Vocational/Technical Degree
4	Some College or Associate's Degree
5	Bachelor's Degree (BA, BS)
6	Some graduate school, no degree
7	Graduate or Professional School

COLLEGE — Highest level of education completed by respondent

Value	Label
0	Less than college
1	College

INCOME — Household income before taxes

Value	Label
1	Under $20,000
2	$20,000 - $30,000
3	$30,001 - $40,000
4	$40,001 – $50,000
5	$50,001 – $60,000
6	$60,001 – $80,000
7	$80,001 – $100,000
8	$100,001 – $150,000
9	$150,001 – $200,000
10	Over $200,000

INC_MID — Household income before taxes (midpoint of range)

Value	Label
1	$10,000
2	$25,000
3	$35,000
4	$45,000
5	$55,000
6	$70,000
7	$90,000
8	$125,000
9	$175,000
10	$200,000

INC_1 — Household income under $20,000

Value	Label
0	Household income is not under $20,000
1	Household income is under $20,000

INC_2 — Household income between $20,001 – $30,000

Value	Label
0	Household income is not between $20,001 – $30,000
1	Household income is between $20,001 – $30,000

INC_3 — Household income between $30,001 – $40,000

Value	Label
0	Household income is not between $30,001 – $40,000
1	Household income is between $30,001 – $40,000

INC_4 — Household income between $40,001 – $50,000

Value	Label
0	Household income is not between $40,001 – $50,000
1	Household income is between $40,001 - $50,000

INC_5 — Household income between $50,001 – $60,000

Value	Label
0	Household income is not between $50,001 – $60,000
1	Household income is between $50,001 – $60,000

INC_6 Household income between $60,001 – $80,000

Value	Label
0	Household income is not between $60,001 – $80,000
1	Household income is between $60,001 - $80,000

INC_7 Household income between $80,001 – $100,000

Value	Label
0	Household income is not between $80,001 – $100,000
1	Household income is between $80,001 – $100,000

INC_8 Household income between $100,001 – $150,000

Value	Label
0	Household income is not between $100,001 – $150,000
1	Household income is between $100,001 – $150,000

INC_9 Household income between $150,001 – $200,000

Value	Label
0	Household income is not between $150,001 – $200,000
1	Household income is between $150,001 – $200,000

INC_10 Household income above $200,000

Value	Label
0	Household income is not over $200,000
1	Household income is over $200,000

T_TRIP Total number of trips per household per day

T_TRIP2 Total number of trips per household per day (corrected*)

HB_WORK Home-based work trips

HB_WORK2 Home-based work trips (corrected*)

HB_SHOP Home-based shopping trips

HB_SHOP2 Home-base shopping trips (corrected*)

HB_SCH Home-based school trips

HB_SCH2 Home-based school trips (corrected*)

HB_OTH Home-based other trips

HB_OTH2 Home-based other trips (corrected*)

NON_HB Non-home based trips

NON_HB2 Non-home based trips (corrected*)

T_TIME Total travel time per household per day

T_TIME2 Total travel time per household per day (corrected*)

T_DIST Total number of miles traveled per household per day

T_DIST2 (corrected*)	Total number of miles traveled per household per day
T_CAR	Total number of driving trips per household per day
T_CAR2	Total number of driving trips per household per day (corrected*)
T_WALK	Total number of walking trips per household per day
T_WALK2	Total number of walking trips per household per day (corrected*)
T_STOP	Total number of stops in a tour of chain trips per household per day
T_STOP2	Total number of stops in a tour of chain trips per household per day (corrected*)
T_TOUR	Total number of ends of the tour of chain trips per household per day
T_TOUR2	Total number of ends of the tour of chain trips per household per day (corrected*)
STP_TR	Total number of stops per tour
STP_TR2	Total number of stops per tour (corrected*)
T_REG	Total number of regional trips per household per day
T_REG2	Total number of regional trips per household per day (corrected*)
NWRKTRP	Total number of non-work trips per household per day
NWRKTRP2	Total number of non-work trips per household per day (corrected*)
NWRKTME	Total travel time for non-work trips per household per day
NWRKTME2	Total travel time for non-work trips per household per day (corrected*)
NWRKDST	Total number of miles traveled for non-work trips per household per day
NWRKDST2	Total number of miles traveled for non-work trips per household per day (corrected*)
INT_TRP	Total number of trips made to destinations inside the neighborhood per household per day
INT_TRP2	Total number of trips made to destinations inside the neighborhood per household per day (corrected*)
EXT_TRP	Total number of trips made to destinations outside the neighborhood per household per day
EXT_TRP2	Total number of trips made to destinations outside the neighborhood per household per day (corrected*)
EXT_TIM	Total travel time to destinations outside the neighborhood per household per day

EXT_TIM2	Total travel time to destinations outside the neighborhood per household per day (corrected*)
EXT_DST	Total number of miles traveled to destinations outside the neighborhood per household per day
EXT_DST2	Total number of miles traveled to destinations outside the neighborhood per household per day (corrected*)
EXT_CAR	Total number of trips made by automobile to destinations outside the neighborhood per household per day
EXT_CAR2	Total number of trips made by automobile to destinations outside the neighborhood per household per day (corrected*)
PA_TRP	Number of physical activity trips per household per day
PA_TIM	Duration of physical activity trips (hours) per household per day
PA_DST	Distance of physical activity trips (miles) per household per day
REC_TRP	Number of recreational physical activity trips per household per day
REC _TIM	Duration of recreational physical activity trips (hours) per household per day
REC _DST	Distance of recreational physical activity trips (miles) per household per day
UTL_TRP	Number of utilitarian physical activity trips per household per day
UTL _TIM	Duration of utilitarian physical activity trips (hours) per household per day
UTL _DST	Distance of utilitarian physical activity trips (miles) per household per day
MVPA	Duration of moderate and vigorous physical activity per week (hours)
MPA	Duration of moderate physical activity per week (hours)
VPA	Duration of vigorous physical activity per week (hours)
MVPA_HOM	Duration of home-based moderate and vigorous physical activity per week (hours)
MVPA_NEI	Duration of neighborhood-based moderate and vigorous physical activity per week (hours)
MVPA_OUT	Duration of external-based moderate and vigorous physical activity per week (hours)
MPA_HOM	Duration of home-based moderate physical activity per week (hours)
MPA_NEI	Duration of neighborhood-based moderate physical activity per week (hours)
MPA_OUT	Duration of external-based moderate physical activity per week (hours)
VPA_HOM	Duration of home-based vigorous physical activity per week (hours)

VPA_NEI	Duration of neighborhood-based vigorous physical activity per week (hours)
VPA_OUT	Duration of external-based vigorous physical activity per week (hours)
ACHIEVE	Achieves CDC recommendations for physical activity per week

* Accounts for ‘missing’ trip data, where one or more eligible people did not complete a travel diary. This occurred in 63 households. If these individuals were left unaccounted for, our analysis at the household level might misrepresent travel behavior. The ‘missing’ people were assigned the mean of each travel behavior attribute and then were aggregated at the household level. No households were created in instances were each eligible person in that household failed to complete a travel diary. The inclusion of this missing data provides a more accurate picture of household travel behavior that can be compared to the TTA regional data.

Trip File: Contents

Brief Description:
Contains unaggregated data from the travel diary.

1. HH_ID	household identification number
2. DIARIES	travel diaries completed/not completed
3. NGHB_CD	neighborhood code
4. TND	traditional neighborhood development residence
5. PERSNUM	person number
6. PER_ID	household identification number plus person number
7. NAME	person's first name
8. DATE	date travel diary was completed
9. DAY	day of the week travel diary was completed
10. TRIP	signifies that a trip was made
11. ACT_NO	activity number
12. ACT_ID (*key*)	person identification number plus activity number
13. DPARTLO	departure location
14. NMEDEST	name of destination
15. ARIVELO	arrival location
16. BEG_TIME	time trip began
17. HOUR	approximate hour trip began
18. END_TIME	time trip ended
19. TOT_TIME	total duration of trip
20. REASON	reason for trip
21. TYPE	type of trip
21_a. HB_WORK	home-based work trip
21_b. HB_SHOP	home-based shopping trip
21_c. HB_SCH	home-based school trip
21_d. HB_OTH	home-based other trip
21_e. NON_HB	non-home-based trip
22. MODE	mode used for trip
23. WALK	walking trip
24. DRIVE	driving trip in private vehicle
25. STOP	a stop in a tour of chain trips
26. TOUR	end of the tour of chain trips or a trip with no stops
27. DIST_MIL	distance of the trip
28. REGION	regional trip
29. INTERNAL	trip took place in neighborhood
30. BUSACCPR	mode used to access park and ride bus (ns route)
31. PA_TRP	trip mode was walking or bicycling
32. PA_REC	trip mode was walk/bike for recreational purposes
33. PA_UTL	trip mode was walk/bike for utilitarian purposes
34. BUS_RTE	bus route used
35. COST	cost of trip
36. NWRKTRP	non-work trip
37. ENTERER	data enterer

Trip File: Variable Description

Name	Description
HH_ID	Household Identification Number
DIARIES	Travel Diaries Completed/Not Completed

Value	Label
0	Some/All Diaries Missing
1	All Diaries Completed

NGHB_CD — Neighborhood Code

Value	Label
1	Southern Village Households
2	Southern Village Apartments
3	Southern Village Condominiums
4	Lake Hogan Farm Households
5	Highlands Households
6	Sunset Households
7	Wexford Households
8	Fairoaks Households

TND — Traditional Neighborhood Residence

Value	Label
0	Conventional Residence
1	Southern Village Residence

PERSNUM	Person Number (for persons 16 years and older)
PER_ID	Household Identification Number with Person Number added as last two digits
NAME	Person's first name or initials
DATE	Date travel diary was completed
DAY	Day of the week travel diary was completed

Value	Label
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday
7	Sunday

TRIP	"1" signifies that a trip was made
ACT_NO	Activity Number
ACT_ID	Household Identification Number with Activity Number added as last two digits
DPARTLO	Departure location (often described by the intersection of two major roads)
NMEDEST	Name of destination

ARIVELO	Arrival location (often described by the intersection of two major roads)
BEG_TIM	Time trip began (military decimal-hours)
HOUR	Approximate hour trip began (rounded to nearest hour, military time)
END_TIM	Time trip ended (military decimal-hours)
TOT_TIM	Total duration of trip (decimal-hours)
REASON	Reason trip was made, as specified by respondent
TYPE	Type of trip

Value	Label
1	Home-Based Work
2	Home-Based Shop
3	Home-Based School
4	Home-Based Other
5	Non-Home-Based

HB_WORK — Home-based work trip

Value	Label
0	Non- Home-based work Trip
1	Home-based work Trip

HB_SHOP — Home-based shopping trip

Value	Label
0	Non- Home-based shopping Trip
1	Home-based shopping Trip

HB_SCH — Home-based school trip

Value	Label
0	Non- Home-based school Trip
1	Home-based school Trip

HB_OTH — Home-based other trip

Value	Label
0	Non- Home-based other Trip
1	Home-based other Trip

NON_HB — Non-home based trip

Value	Label
0	Not a non-home based trip
1	Non-home based trip

MODE — Mode used for trip

Value	Label
1	Private Vehicle
2	Bus
3	Walk
4	Bike
5	Other

WALK — Walking trip

Value	Label
0	Non-Walking Trip
1	Walking Trip

DRIVE — Driving trip in private vehicle

Value	Label
0	Non-Driving Trip
1	Driving Trip

STOP — A stop in a tour of chain trips

Value	Label
0	Not a stop in a tour of chain trips
1	A stop in a tour of chain trips

TOUR — End of a tour of chain trips or a trip with no stops

Value	Label
0	Not the end of a tour of chain trips or a trip with no stops
1	End of a tour of chain trips or a trip with no stops

DIST_MIL — Distance of the trip (in decimal-miles)

REGION — Regional trip

Value	Label
0	Trip was ≤10 miles
1	Trip was >10 miles

INTERNAL — Trip took place in neighborhood

Value	Label
0	Trip took place outside neighborhood
1	Trip took place in neighborhood

BUSACCPR — Mode used to access park and ride bus (NS Route)

Value	Label
1	Private Vehicle
2	Bus
3	Walk
4	Bike
5	Other

PA_TRP — The mode choice was walking or bicycling

Value	Label
0	Mode choice was not walking or bicycling
1	Mode choice was walking or bicycling

PA_REC — The walking or bicycling trip was for recreational purposes

Value	Label
0	Trip was not for recreational purposes
1	Trip was for recreational purposes

PA_UTL — The walking or bicycling trip was for utilitarian purposes

Value	Label
0	Trip was not for utilitarian purposes
1	Trip was for utilitarian purposes

BUS_RTE — Bus Route Used

COST — Cost of Trip (includes transit fares and parking fees)

ENTERER — Data Enterer

Value	Label
1	Ben
2	Steve
3	Helen
4	Sarah
5	Jennifer
6	David

Trips Per Person File: Contents

Brief Description:
Contains data from the travel diary and is aggregated to the person level.

HH_ID	household identification number
PER_ID*(key)*	person identification number
NGHB_CD	neighborhood code
TND	traditional neighborhood development
TND_SF	traditional neighborhood single-family residence
TND_MF	traditional neighborhood multi-family residence
DIARIES	travel diaries completed/not completed
VALUE	value of residence according to Orange County
CUR_HOME	current home type
PRE_HOM	previous home type
PREHO_SF	previous home type is single-family
OWNRENT	own vs. rent current home
OWN	homeowner
MOVE	date resident moved into current home (mm-dd-yyyy)
YEARS	years at current residence
NO_CAR	number of cars owned by the household
NO_HOME	number of persons in the household
NAME	person's name
AGE	person's age
LICENSE	driver's license (yes/no)
SEX	sex (male/female)
INCOME	household income
INC_MID	midpoint of income level range
INC_MID2	midpoint of income level range, missing values coded at mean
T_TRIP	total number of trips per household per day
T_TIME	total travel time per household per day
T_DIST	total number of miles traveled per day
T_CAR	total number of driving trips per day
T_WALK	total number of walking trips per day
T_STOP	total number of stops in a tour of chain trips per day
T_TOUR	total number of ends of the tour of chain trips per day
STP_TR	total number of stops per tour per day
T_REG	total number of regional trips per day
NWRKTRP	total number of non-work trips per day
NWRKTIM	total travel time for non-work trips per day
NWRKDST	total number of miles traveled for non-work trips per day
INT_TIP	total number of trips made to destinations inside the neighborhood per day
EXT_TRP	total number of trips made to destinations outside the neighborhood per day

EXT_TIM	total travel time to destinations outside the neighborhood per day
EXT_DST	total number of miles traveled to destinations outside the neighborhood per day
EXT_CAR	total number of trips made by automobile to destinations outside the neighborhood per day
PA_TRP	number of physical activity trips
PA_TIM	duration of physical activity trips
PA_DST	distance of physical activity trips
REC_TRP	number of recreational physical activity trips
REC _TIM	duration of recreational physical activity trips
REC _DST	distance of recreational physical activity trips
UTL_TRP	number of utilitarian physical activity trips
UTL _TIM	duration of utilitarian physical activity trips
UTL _DST	distance of utilitarian physical activity trips
PA_TRP2	number of physical activity trips*
PA_TIM2	duration of physical activity trips*
PA_DST2	distance of physical activity trips *
REC_TRP2	number of recreational physical activity trips*
REC _TIM2	duration of recreational physical activity trips*
REC _DST2	distance of recreational physical activity trips*
UTL_TRP2	number of utilitarian physical activity trips*
UTL _TIM2	duration of utilitarian physical activity trips*
UTL _DST2	distance of utilitarian physical activity trips*

* excludes four long bicycle rides

Trips per Person File: Variable Description

Name	Description
HH_ID	Household Identification Number
PER_ID	Person Identification Number
NGHB_CD	Neighborhood Code

Value	Label
1	Southern Village Households
2	Southern Village Apartments
3	Southern Village Condominiums
4	Lake Hogan Farm Households
5	Highlands Households
6	Sunset Households
7	Wexford Households
8	Fairoaks Households

TND — Traditional Neighborhood Development

Value	Label
0	Not a Southern Village Residence
1	Southern Village Residence

TND_SF — Traditional Neighborhood Single Family Home

Value	Label
0	Not a Traditional Neighborhood Single Family Home
1	Traditional Neighborhood Single Family Home

TND_MF — Traditional Neighborhood Multi-Family Home

Value	Label
0	Non-Traditional Neighborhood Multi-Family Home
1	Traditional Neighborhood Multi-Family Home

DIARIES — Travel Diaries Completed/Not Completed

Value	Label
0	Some/All Diaries Missing
1	All Diaries Completed

VALUE — Value of residence according to Orange County

CUR_HOME — Current Home Type

Value	Label
1	Detached Single House
2	Duplex
3	Townhouse or Rowhouse
4	Apartment
5	Condominium
6	Other

	7	Don't Know

PRE_HOM — Previous Home Type

Value	Label
1	Detached Single House
2	Duplex
3	Townhouse or Rowhouse
4	Apartment
5	Condominium
6	Other
9	Don't Know

PREHO_SF — Previous Home Type is Single-Family Residence

Value	Label
0	Not a Single-Family Residence
1	Single-Family Residence

OWNRENT — Own vs. Rent Current Home

Value	Label
1	Own
2	Rent
3	Other
4	Don't Know

OWN — Homeowner

Value	Label
0	Does not own home
1	Homeowner

MOVE — Date resident moved into current home (mm-dd-yyyy)

YEARS — Number of years resident has lived at current home

NO_CAR — Number of cars owned by the household

NO_HOME — Number of persons in the household

PER_NUM — person number

NAME — Person's First Name

AGE — Person's Age

LICENSE — Licensed Driver (Yes or No)

Value	Label
0	Does <u>not</u> have a driver's license
1	Has a driver's license

SEX — Person's Sex (male or female)

Value	Label
0	Female
1	Male

INCOME — Household income before taxes

Value	Label
1	Under $20,000

2	$20,000 - $30,000
3	$30,001 - $40,000
4	$40,001 – $50,000
5	$50,001 – $60,000
6	$60,001 – $80,000
7	$80,001 – $100,000
8	$100,001 – $150,000
9	$150,001 – $200,000
10	Over $200,000

INC_MID — Household income before taxes (midpoint of range)

Value	Label
1	$10,000
2	$25,000
3	$35,000
4	$45,000
5	$55,000
6	$70,000
7	$90,000
8	$125,000
9	$175,000
10	$200,000

INC_MID2 — Household income before taxes (midpoint of range), missing values coded at the mean

Value	Label
1	$10,000
2	$25,000
3	$35,000
4	$45,000
5	$55,000
6	$70,000
7	$90,000
8	$125,000
9	$175,000
10	$200,000

T_TRIP	Total number of trips per day
T_TIME	Total travel time per day
T_DIST	Total number of miles traveled per day
T_CAR	Total number of driving trips per day
T_WALK	Total number of walking trips per day
T_STOP	Total number of stops in a tour of chain trips per day
T_TOUR	Total number of ends of the tour of chain trips per day
STP_TR	Total number of stops per tour per day
T_REG	Total number of regional trips per day
NWRKTRP	Total number of non-work trips per day

NWRKTIM	Total travel time for non-work trips per day
NWRKDST	Total number of miles traveled for non-work trips per day
INT_TRP	Total number of trips made to destinations inside the neighborhood per day
EXT_TRP	Total number of trips made to destinations outside the neighborhood per day
EXT_TIM	Total travel time to destinations outside the neighborhood per day
EXT_DST	Total number of miles traveled to destinations outside the neighborhood per day
EXT_CAR	Total number of trips made by automobile to destinations outside the neighborhood per day
PA_TRP	Number of physical activity trips
PA_TIM	Duration of physical activity trips (hours)
PA_DST	Distance of physical activity trips (miles)
REC_TRP	Number of recreational physical activity trips
REC _TIM	Duration of recreational physical activity trips (hours)
REC _DST	Distance of recreational physical activity trips (miles)
UTL_TRP	Number of utilitarian physical activity trips
UTL _TIM	Duration of utilitarian physical activity trips (hours)
UTL _DST	Distance of utilitarian physical activity trips (miles)
PA_TRP2	Number of physical activity trips*
PA_TIM2	Duration of physical activity trips (hours)*
PA_DST2	Distance of physical activity trips (miles)*
REC_TRP2	Number of recreational physical activity trips*
REC _TIM2	Duration of recreational physical activity trips (hours)*
REC _DST2	Distance of recreational physical activity trips (miles)*
UTL_TRP2	Number of utilitarian physical activity trips*
UTL _TIM2	Duration of utilitarian physical activity trips (hours)*
UTL _DST2	Distance of utilitarian physical activity trips (miles)*

* excluding four long bicycle rides

Person File: Contents

Brief Description:
Contains data for those individuals reported in the Household Survey.

1. HH_ID	household identification number
2. NGHB_CD	neighborhood code
3. DIARIES	diaries completed/not completed
4. VALUE	value of home according to Orange County
5. CUR_HOME	current home type
6. PRE_HOM	previous home type
7. OWNRENT	own vs. rent current home
8. MOVE	date resident moved into current home
9. NO_CAR	number of cars owned by the household
10. NO_HOME	number of persons in the household
11. PERSNUM	person number
12. PER_ID (*key*)	household identification number plus person number
13. NAME	person's first name
14. AGE	person's age
15. LICENSE	driver's license (yes/no)
16. SEX	sex (male/female)
17. SCHL_MD	mode by which person travels to school
18. INCOME	household income

Person File: Variable Description

Name	Description
HH_ID	Household Identification Number
NGHB_CD	Neighborhood Code

Value	Label
1	Southern Village Households
2	Southern Village Apartments
3	Southern Village Condominiums
4	Lake Hogan Farm Households
5	Highlands Households
6	Sunset Households
7	Wexford Households
8	Fairoaks Households

DIARIES — Diaries Completed/Not Completed

Value	Label
0	Some/All Household Travel Diaries Missing
1	All Household Travel Diaries Completed

VALUE	Value of residence according to Orange County
CUR_HOME	Current Home Type

Value	Label
1	Detached Single House
2	Duplex
3	Townhouse or Rowhouse
4	Apartment
5	Condominium
6	Other
7	Don't Know

PRE_HOM — Previous Home Type

Value	Label
1	Detached Single House
2	Duplex
3	Townhouse or Rowhouse
4	Apartment
5	Condominium
6	Other
7	Don't Know

OWNRENT — Own vs. Rent Current Home

Value	Label
1	Own
2	Rent
3	Other
4	Don't Know

MOVE	Date resident moved into current home (mm-dd-yyyy)
NO_CAR	Number of cars owned by the household
NO_HOME	Number of persons in the household
PERSNUM	Person Number (for persons 16 years and older)
PER_ID	Household Identification Number with Person Number added as last two digits
NAME	Person's First Name
AGE	Person's Age
LICENSE	Licensed Driver (Yes or No)

Value	Label
0	Does not have a driver's license
1	Has a driver's license

SEX — Person's Sex (male or female)

Value	Label
0	Female
1	Male

SCHL_MD — Mode by which person travels to school

Value	Label
1	Car Ride or Drives to School
2	Transit (Bus or School Bus)
3	Walk
4	Bicycle
5	Other
6	Combination of modes

INCOME — Household income before taxes

Value	Label
1	Under $20,000
2	$20,000 - $30,000
3	$30,001 - $40,000
4	$40,001 – $50,000
5	$50,001 – $60,000
6	$60,001 – $80,000
7	$80,001 – $100,000
8	$100,001 – $150,000
9	$150,001 – $200,000
10	Over $200,000

Appendix I: Selected Modeling Results

Table I-1: Regression models for total trips

a. OLS (not accounting for missing data)

	Coeff.	T stat
Constant	2.02***	2.73
Size of Household	1.08***	6.33
Number of Vehicles	2.16***	6.52
Southern Village	0.09	0.21
Mean of Dep. Var	9.180	
N	405	
F statistic	56.79***	
R-square	0.298	
Adjusted R-square	0.293	

b. OLS (accounting for missing data)

	Coeff.	T stat
Constant	1.95***	2.76
Size of Household	1.26***	7.74
Number of Vehicles	2.37***	7.49
Southern Village	0.00	0.01
Mean of Dep. Var	10.000	
N	405	
F statistic	80.90***	
R-square	0.377	
Adjusted R-square	0.372	

c. Negative Binomial

	Coeff.	Z stat
Constant	1.44***	19.65
Size of Household	0.13***	8.54
Number of Vehicles	0.24***	8.07
Southern Village	-0.01	-0.17
Alpha	0.03	(p=0.00)
N	405	
Psuedo-R^2	0.086	
LR χ^2(var)	201.93	
Prob > χ^2	0.000	
Log likelihood	-1067.566	

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

d. Marginal Effects

	Mean	Coeff.	Z
Size of Household	2.80	1.27	8.60
Number of Vehicles	1.90	2.30	8.12
Southern Village	0.54	-0.06	-0.17

Table I-2: Regression models for external trips

a. OLS (not accounting for missing data)

	Coeff.	T stat
Constant	2.45***	3.59
Size of Household	0.81***	5.120
Number of Vehicles	2.12***	6.930
Southern Village	-1.32***	-3.490
Mean of Dep. Var	8.02	
N	406	
F statistic	68.210	
R-square	0.337	
Adjusted R-square	0.332	

b. OLS (accounting for missing data)

	Coeff.	T stat
Constant	2.51***	3.780
Size of Household	0.96***	6.3
Number of Vehicles	2.30***	7.72
Southern Village	-1.53***	-4.15
Mean of Dep. Var	8.74	
N	406	
F statistic	92.900	
R-square	0.409	
Adjusted R-square	0.405	

c. Negative Binomial

	Coeff.	Z stat
Constant	1.38***	17.670
Size of Household	0.12***	7.260
Number of Vehicles	0.26***	8.390
Southern Village	-0.18***	-4.380
Alpha	0.03	(p=0.00)
N	406	
Psuedo-R^2	0.098	
LR χ^2(var)	226.31	
Prob > χ^2	0.000	
Log likelihood	-1037.544	

*** Significant at the 99% confidence level

** Significant at the 95% confidence level

* Significant at the 90% confidence level

d. Marginal Effects

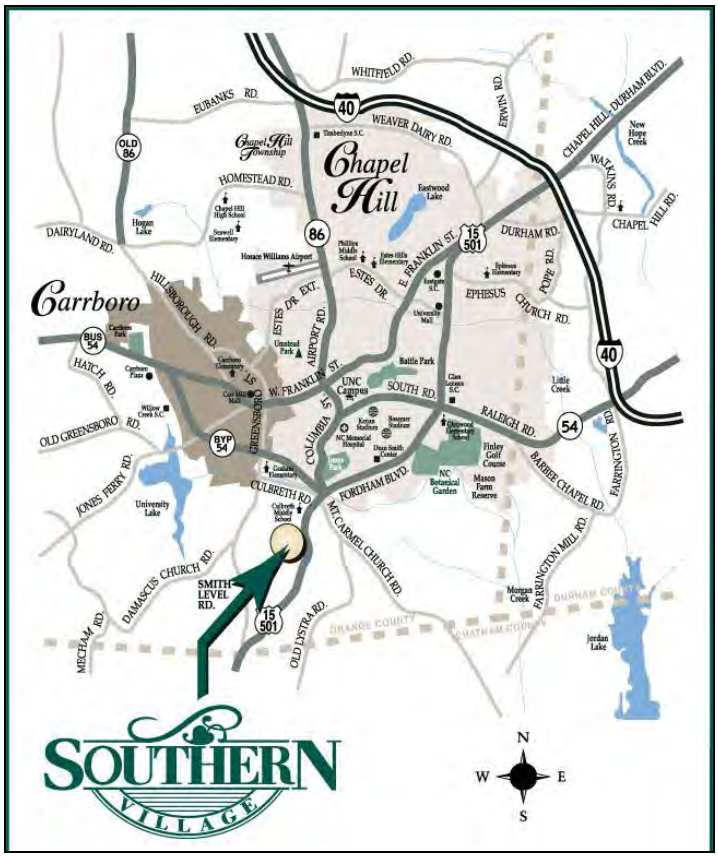
	Mean	Coeff.	Z
Size of Household	2.80	0.99	7.31
Number of Vehicles	1.90	2.18	8.44
Southern Village	0.54	-1.50	-4.34

Appendix J: Neighborhood Descriptions

Southern Village:

Southern Village is located south of Chapel Hill, North Carolina just south of the NC 54 bypass. It is located on US15-501, a major north/south arterial that leads into downtown Chapel Hill to the campus of the University of North Carolina and UNC hospital. US15-501 is currently being widened to a four lane, undivided facility. To the North, Culbreth Road, a two-lane east-west collector street, borders Southern Village (see Figure A1-1).

Figure J-1: Southern Village Location



Source: www.southernvillage.com

Southern Village is a Neotraditional Neighborhood Development as it contains several different land uses, including a central commercial and retail core. Housing types include detached single-family homes, condominiums, townhouses, and apartments. All residential housing is convenient to a swim/tennis club and to various businesses within the neighborhood. The 120,000 square feet central business core contains office and retail space, including a grocery store, movie theater, church, daycare, and an elementary school. Table A1-1 summaries the different land uses in the neighborhood.

Table J-1: Southern Village Land Use Intensities

Land Use	Intensity	unit	Code
Single Family Homes	510	units	210
Condo+Townhouses	335	units	230
Apartments	250	units	220
Theater (4scrn)	10	thousand square feet	443
Bistro	2	thousand square feet	832
Italian Rest	4.5	thousand square feet	831
grocery w/cafe	6	thousand square feet	850
gift store + dry cleaners	2	thousand square feet	814
office space	95	thousand square feet	710
church	27	thousand square feet	560
daycare	6	thousand square feet	565
elementary sch	90	thousand square feet	520
swim and tennis club	3	thousand square feet	492

Two bus lines serve the development and provide residents with access to downtown Chapel Hill and the university. There are three entrances to Southern Village; two along US 15-501 and one in the northwest corner of the development, just north of the Highgrove neighborhood connecting to Culbreth Road (Figure A1-2).

Figure J-2: Southern Village Interior Layout

Source: www.southernvillage.com

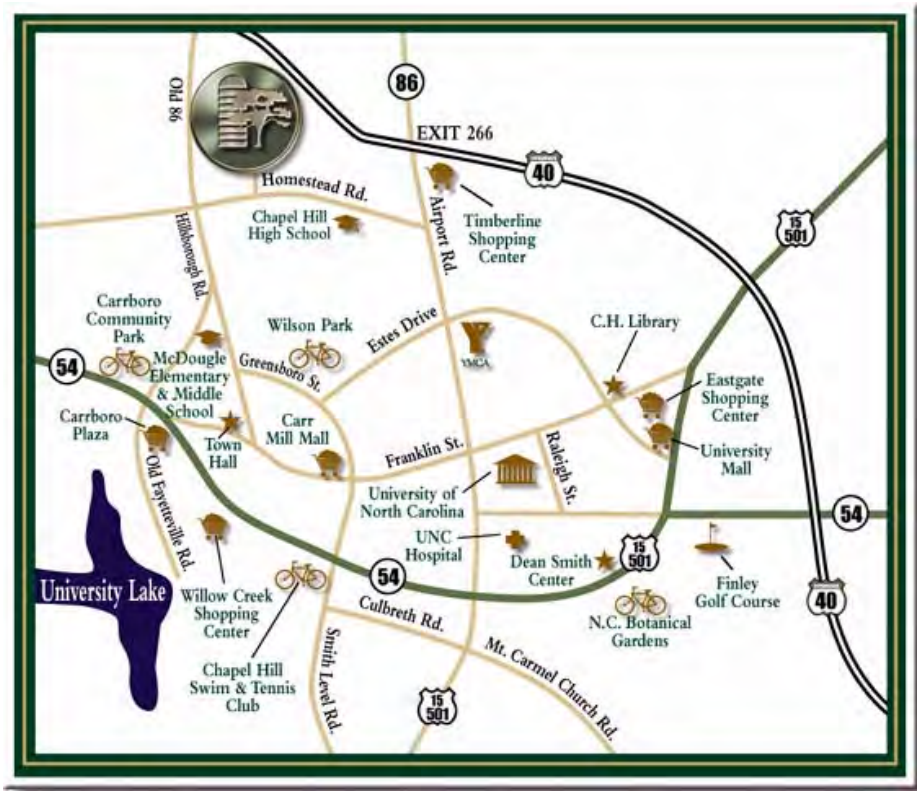
ITE defines a multi use development as one that "is typically a single real-estate project that consists of two or more ITE land use classifications between which trips can be made without using the off-site road system" (2001 ITE Trip Generation Handbook). Southern Village fits this description by having multiple land uses and a vast network of sidewalks and greenways. Consistent with Neotraditional Neighborhoods Development guidelines the street layout is a grid system intended to increase internal route choice. Furthermore, most building properties are elongated rectangles with the short side facing the street. This in combination with grid layout and pleasant sidewalks is encouraged to promote walking and bike use and thus decreasing vehicular traffic. The commercial village core offers a desirable destination for shopping and recreational use. Overall, neotraditional neighborhood design intends to capture a significant number of trips within the development, thus decreasing vehicular impacts on the surrounding road network. Figure A1-3 shows a typical building front in Southern Village, characterized by sidewalks, street trees, narrow houses, and short building setback.

Figure J-3: Southern Village Streetscape

Lake Hogan Farms:

Lake Hogan Farms is located north of Chapel Hill along Homestead Rd. It is approximately 10 miles north of the Southern Village neighborhood, but approximately equidistant to downtown Chapel Hill and the university (Figure

Figure J-4: Lake Hogan Farms Location



Source: http://www.ghldesign.com/lakehogan

Lake Hogan Farms is a conventional, single use development consisting of 252 single-family dwellings. Two entrances serve this development. The main entrance is south of the development along Homestead Rd. A secondary entrance is located to the west of the development, along Old NC 86. All of the homes are fairly expensive and most are on half-ace lots. The development has a swimming and tennis club. There are some shopping and biking trails, however, not to the extent found in Southern Village. Lake Hogan Farms does not have shopping venues or other such amenities. Figure A1-4 shows a map of the interior layout of Lake Hogan Farms.

Figure J-5: Lake Hogan Farms Interior Layout

Source: http://www.ghldesign.com/lakehogan

The map above shows that the Lake Hogan Farms neighborhood does not have the same grid layout as can be found in Southern Village. Consistent with suburban neighborhood design principles, the development is characterized by large lots and cul-de-sacs to increase a feeling of privacy. It is clearly visible which roads serve as the main collectors and are intended to move traffic in and out of the neighborhood. The lack of shopping venues and other desirable destinations within the development minimizes internal traffic and conceptually results in a greater relative impact on the surrounding road network. Figure A1-5 below shows a photo of the Lake Hogan Farms neighborhood.

Figure J-6: Lake Hogan Farms Streetscape

FEATURE	NEO TRADITIONAL DEVELOPMENT (NTD)	CONVENTIONAL SUBURBAN DEVELOPMENT (CSD)
Basic Layout	Interconnected network of streets dispersing trips	Hierarchical layout designed to collect and channelize trips
Driveways	Garages and driveways located behind the buildings for pleasing streetscape	Driveways, garages prominent in the front
Building setback	Typically no minimum setback, houses located close to street with front porches that promote neighborhood feeling	Typically 15 feet setback or more from street, deep yards make neighborhood conversationdifficult; few and narrow porches; large areas to maintain.
Architecture	Houses mostly long and narrow, mixed architectural styles and varying sizes that are affordable to people at different stages of life	Houses oftentimes square, all houses and houseplans of similar size and price; uniform appearance of development
Street Design	Street arranged in grid pattern, creates great route choice and distributes traffic, also designed to slow traffic flow	Collector roads with cul-de-sacs, create congestion; all traffic enters/exits at few locations
Use of Alleys	Encouraged to accommodate narrower lots and fewer driveways on local streets, which allow for narrower streets	Often discouraged, especially in residential areas
Design Speed	Typically 20 mph or even less, with design elements to assure design speed equal to travel speed	Typically 25-30 mph minimum, designed to recognize 85th percentile rate of travel
Street Width	Typically narrow street to encourage slow travel speeds, delay from slo passing maneuvers and obstacles is desirable	Wide Street to allow safe vehicle movements in two directions, while still accounting for possible obstacles on the side of the road
Curb Radii	Selected considering impacts on pedestrian street crossing times and types of vehicles expected or desired to generally use the street	Generally selected to ensure in-lane turning movements for all types of vehicles
Intersection geometry	civic buildings and safety, unsignalized possible, hypthetically more efficient turning movements, as more and un-signalized intersections	Designed for efficiency, speed of vehicular traffic, cost of operation and safety
Street trees and landscaping	Encouraged to form part of the street space; larger sizes and small clearances desirable	Where allowed, strictly controlled as to size and location according to Intersection and Stopping Sight Distance Specifications
Street Lighting	more and smaller streetlights of lesser wattage and scale	Few, large, high and efficient luminaires
Sidewalks	Sidewalks lined with trees transform streets into “public rooms” and promote walking	Oftentimes no sidewalks; if existing, usually not lined with trees and not as pleasing
Sidewalk Width and location	5-foot minimum, generally within right-of-way and parallel with the street	Typically 4 foot minimum, in parts of the country encouraged outside the right-of-way or to undulate
Construction Centerline not always coincing with design	Encouraged where it serves to form vista terminations	not permitted
Parking	On-Street encouraged and counted toward minimum parking requirements; off-street generally located midblock or to the rear of buildings	Off-Street preferred, but often located between buildings and the adjacent street (driveways)
Trip Generation	greater in-project opportunities for "captured trips"; hypothetically reduced internal vehicle miles traveled	Developed from a sum of the users; few captured trips
Traffic Flow	Uninterrupted flow more likely, as more and un-signalized intersections; hypothetically grid network has higher capacity; possibility of real-time route decisions	All flow towards main collector out of development; congestion at entrance/exit likely

Figure J-7: Park & Ride Lot, Southern Village

Figure J-8: Chapel Hill Transit Service, Southern Village

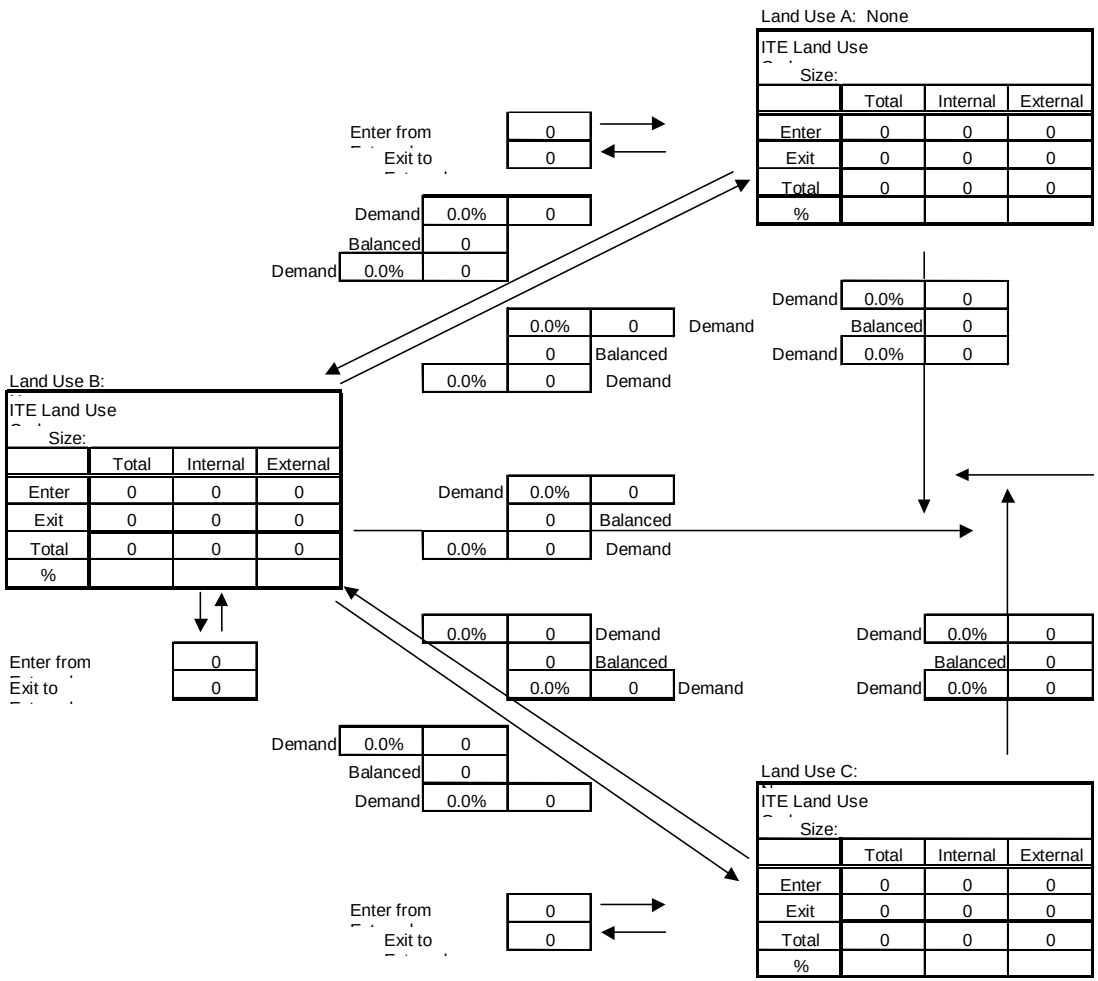
Figure J-9: Proximity of homes in Southern Village

Figure J-10: Green Way in Southern Village

Appendix K: Sample ITE Trip Generation Spreadsheets

ITE MULTI-USE PROJECT INTERNAL CAPTURE

(Source: Chapter 7, ITE *Trip Generation Handbook*, October 1998)



Project Number:
Project Name:
Scenario:
Analysis Period: PM Peak
Analyst:

Land Use A: None

ITE Land Use Code			
Size:			
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%			

	0.0%	0	Demand
		0	Balanced
	0.0%	0	Demand

Demand	0.0%	0
Balanced		0
Demand	0.0%	0

Demand	0.0%	0
Balanced		0
Demand	0.0%	0

Land Use D: None

ITE Land Use Code			
Size:			
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%			

Demand	0.0%	0
Balanced		0
Demand	0.0%	0

Demand	0.0%	0
Balanced		0
Demand	0.0%	0

Demand	0.0%	0
Balanced		0
Demand	0.0%	0

Demand	0.0%	0
Balanced		0
Demand	0.0%	0

Enter from External:	0
Exit to External:	0

	0.0%	0
		0
	0.0%	0

Demand
Balanced
Demand

Land Use C: None

ITE Land Use Code			
Size:			
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%			

NET EXTERNAL TRIPS FOR MULTI-USE DEVELOPMENT

Category	Land Use A	Land Use B	Land Use C	Land Use D	Total
Enter	0	0	0	0	0
Exit	0	0	0	0	0
Total	0	0	0	0	**0**
Single Use Trip Gen Estimate	0	0	0	0	**0**

Overall Internal Capture =

Table 7.1 Unconstrained Internal Capture Rates for Trip Origins within a Multi-Use Development

		WEEKDAY		
		MIDDAY PEAK HOUR	P.M. PEAK HOUR OF ADJACENT STREET TRAFFIC	DAILY
from OFFICE	to Office	2%	1%	2%
	to Retail	20%	23%	22%
	to Residential	0%	2%	2%
from RETAIL	to Office	3%	3%	3%
	to Retail	29%	20%	30%
	to Residential	7%	12%	11%
from RESIDENTIAL	to Office	0%	0%	0%
	to Retail	34%	53%	38%
	to Residential	0%	0%	0%

Table 7.2 Unconstrained Internal Capture Rates for Trip Destinations within a Multi-Use Development

		WEEKDAY		
		MIDDAY PEAK HOUR	P.M. PEAK HOUR OF ADJACENT STREET TRAFFIC	DAILY
to OFFICE	from Office	6%	6%	2%
	from Retail	38%	31%	15%
	from Residential	0%	0%	0%
to RETAIL	from Office	4%	2%	4%
	from Retail	31%	20%	28%
	from Residential	5%	9%	9%
to RESIDENTIAL	from Office	0%	2%	3%
	from Retail	37%	31%	33%
	from Residential	0%	0%	0%

Appendix L: Southern Village ITE Trip Generation

Code	Land Use	Intensity	unit	ADT rate	ADT	%ent	%exit	enter	exit	AM Rate	AM gen	%ent	%exit	enter	exit	PM rate
210	Single Family Homes	510	units	9.57	4880.7	50	50	2440.35	2440.35	0.75	382.5	25	75	95.625	286.875	1.01
230	Condo+Townhouses	335	units	5.86	1963.1	50	50	981.55	981.55	0.44	147.4	17	83	25.058	122.342	0.54
220	Apartments	250	units	6.63	1657.5	50	50	828.75	828.75	0.51	127.5	16	84	20.4	107.1	0.62
443	Theater (4scrn)	10	thou sf	78.06	780.6	50	50	390.3	390.3	0.22	2.2			0	0	6.16
832	Bistro	2	thou sf	130.34	260.68	50	50	130.34	130.34	9.27	18.54	52	48	9.6408	8.8992	10.86
831	Italian Rest	4.5	thou sf	89.95	404.775	50	50	202.3875	202.3875	0.81	3.645			0	0	7.49
850	grocery w/cafe	6	thou sf	111.51	669.06	50	50	334.53	334.53	3.25	19.5	61	39	11.895	7.605	11.51
814	gift store + dry cleaners	2	thou sf	40.67	81.34	50	50	40.67	40.67	6.41	12.82	48	52	6.1536	6.6664	2.59
710	office space	95	thou sf	11.01	1045.95	50	50	522.975	522.975	1.56	148.2	88	12	130.416	17.784	1.49
560	church	27	thou sf	9.11	245.97	50	50	122.985	122.985	0.72	19.44	54	46	10.4976	8.9424	0.66
565	daycare	6	thou sf	79.26	475.56	50	50	237.78	237.78	12.71	76.26	53	47	40.4178	35.8422	13.2
520	elementary sch	90	thou sf	12.03	1082.7	50	50	541.35	541.35	3.36	302.4	61	39	184.464	117.936	
492	swim and tennis club	3	thou sf	17.14	51.42	50	50	25.71	25.71	1.46	4.38			0	0	1.83
	Total							**6799.678**	**6799.678**					**534.5678**	**719.9922**	
Residential																
210	Single Family Homes	510	units	9.57	4880.7	50	50	2440.35	2440.35	0.75	382.5	25	75	95.625	286.875	1.01
233	Condo+Townhouses	335	units	5.86	1963.1	50	50	981.55	981.55	0.44	147.4	17	83	25.058	122.342	0.54
220	Apartments	250	units	6.63	1657.5	50	50	828.75	828.75	0.51	127.5	16	84	20.4	107.1	0.62
443	Theater (4scrn)	10	thou sf	78.06	780.6	50	50	390.3	390.3	0.22	2.2			0	0	6.16
Office																
710	office space	95	thou sf	11.01	1045.95	50	50	522.975	522.975	1.56	148.2	88	12	130.416	17.784	1.49
Retail																
443	Theater (4scrn)	10	thou sf	78.06	780.6	50	50	390.3	390.3	0.22	2.2			0	0	6.16
832	Bistro	2	thou sf	130.34	260.68	50	50	130.34	130.34	9.27	18.54	52	48	9.6408	8.8992	10.86
831	Italian Rest	4.5	thou sf	89.95	404.775	50	50	202.3875	202.3875	0.81	3.645			0	0	7.49
850	grocery w/cafe	6	thou sf	111.51	669.06	50	50	334.53	334.53	3.25	19.5	61	39	11.895	7.605	11.51
814	gift store + dry cleaners	2	thou sf	40.67	81.34	50	50	40.67	40.67	6.41	12.82	48	52	6.1536	6.6664	2.59

ITE MULTI-USE PROJECT INTERNAL CAPTURE WORKSHEET
(Source: Chapter 7, ITE Trip Generation Handbook, October 1998)

Project Number:
Project Name: SV Tripgen Nov 2002
Scenario:
Analysis Period: Daily
Analyst:

Land Use A: Residential (All Residential)

ITE Land Use Code			
Size: 210sf 233cond/twnh 220apt			
	Total	Internal	External
Enter	4,251	131	4,120
Exit	4,251	99	4,152
Total	8,501	230	8,271
%	100%	**3%**	97%

Enter from External: 4,120
Exit to External: 4,152

Demand	0.0%	0
Balanced	0	
Demand	0.0%	0

3.0%	128	Demand
	10	Balanced
2.0%	10	Demand

0.0%	0	Demand
	0	Balanced
0.0%	0	Demand

Demand	0.0%	0
Balanced	0	
Demand	0.0%	0

Demand	38.0%	1615
	Balanced	99
Demand	9.0%	99

Land Use B: Office (Office)

ITE Land Use Code 710			
Size: 95thousf			
	Total	Internal	External
Enter	522.975	33	489.975
Exit	522.975	54	468.975
Total	1045.95	87	958.95
%	100%	**8%**	92%

Enter from External: 490
Exit to External: 469

Demand	0.0%	0
	0	Balanced
0.0%	0	Demand

Demand	0.0%	0
Balanced	0	
Demand	0.0%	0

Land Use D: None

ITE Land Use Code			
Size:			
	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%			

Enter from External: 0
Exit to External: 0

15.0%	78	Demand
	33	Balanced
3.0%	33	Demand

Demand	33.0%	1403
	Balanced	121
Demand	11.0%	121

Demand	0.0%	0
Balanced	0	
Demand	0.0%	0

Demand	22.0%	115
Balanced	44	
Demand	4.0%	44

0.0%	0	Demand
	0	Balanced
0.0%	0	Demand

Land Use C: Retail (All Retail)

ITE Land Use Code			
Size: theat bistro ital groc drycl gift s			
	Total	Internal	External
Enter	1098.228	143	955.228
Exit	1098.228	154	944.228
Total	2196.456	297	1899.456
%	100%	**14%**	86%

Enter from External: 955
Exit to External: 944

NET EXTERNAL TRIPS FOR MULTI-USE DEVELOPMENT

Category	Land Use A	B	C	D	Total
Enter	4,120	490	955	0	5,565
Exit	4,152	469	944	0	5,565
Total	8,271	959	1,899	0	**11,130**
Single Use Trip Gen Estimate	8,501	1,046	2,196	0	**11,744**

Overall Internal Capture = 0.052283

ITE MULTI-USE PROJECT INTERNAL CAPTURE WORKSHEET
(Source: Chapter 7, ITE Trip Generation Handbook, October 1998)

Project Number:
Project Name: SV Tripgen Nov 2002
Scenario:
Analysis Period: PM Peak
Analyst:

Land Use A: Residential (All Residential)

ITE Land Use Code
Size: 210sf 233cond/twnh 220apt

	Total	Internal	External
Enter	555	9	546
Exit	296	12	284
Total	851	21	830
%	100%	**2%**	98%

Enter from External: 546
Exit to External: 284

Land Use B: Office (Office)

ITE Land Use Code 710
Size: 95thousf

	Total	Internal	External
Enter	24.0635	2	22.0635
Exit	117.4865	5	112.4865
Total	141.55	7	134.55
%	100%	**5%**	95%

Enter from External: 22
Exit to External: 112

Land Use C: Retail (All Retail)

ITE Land Use Code
Size: theat bistro ital groc drycl gift s

	Total	Internal	External
Enter	130.9664	15	115.9664
Exit	60.29865	9	51.29865
Total	191.265	24	167.265
%	100%	**13%**	87%

Enter from External: 116
Exit to External: 51

Land Use D: None

ITE Land Use Code
Size:

	Total	Internal	External
Enter	0	0	0
Exit	0	0	0
Total	0	0	0
%			

Enter from External: 0
Exit to External: 0

												0.0%	0	Demand
													0	Balanced
												0.0%	0	Demand
						Demand	53.0%	157						
			2.0%	11	Demand		Balanced	12	Demand	0.0%	0			
			2	Balanced		Demand	9.0%	12		Balanced	0			
		2.0%	2	Demand						Demand	0.0%	0		
									Demand	0.0%	0			
										Balanced	0			
										Demand	0.0%	0		
		31.0%	7	Demand		Demand	31.0%	172		Demand	0.0%	0		
			2	Balanced			Balanced	7		Balanced	0			
			3.0%	2	Demand	Demand	12.0%	7	Demand	0.0%	0			
	Demand	23.0%	27									0.0%	0	Demand
	Balanced	3											0	Balanced
	Demand	2.0%	3									0.0%	0	Demand

NET EXTERNAL TRIPS FOR MULTI-USE DEVELOPMENT

Category	Land Use A	Land Use B	Land Use C	Land Use D	Total
Enter	546	22	116	0	684
Exit	284	112	51	0	448
Total	830	135	167	0	**1,132**
Single Use Trip Gen Estimate	851	142	191	0	**1,184**

Overall Internal Capture = 0.043926

Appendix M: Triangle Regional Model Socio-economic Data

DEM 95 Field	Description	SV value	LHF Value	Source
TAZ	TAZ of zone (1-2471)	1382	1720	GIS Layer
ATYPE	Area Type	1 (urban)	1 (urban)	Both are Urban
HH	Number of Households	1095	252	Real Estate Sources
POP	Population	2716	784	Surveys
INC	Average income in zone	105000	123386	Surveys
Avghh	Average household size	2.48	3.11	Pop/#of HH
INCRATIO	Median Income for study area / INC – this is calculated by the model	2.706	3.18	TAZ Income/Average Area Income
IND	Industrial Employment	0	0	Visits to Businesses
RET	Retail Employment	52	0	Visits to Businesses
HWY	Highway Employment	0	0	Visits to Businesses
OFF	Office Employment	118	0	Visits to Businesses
SER	Service Employment	181	0	Visits to Businesses
DWELLUNIT	Dwelling Units	1095	252	Visits to Businesses
UNIV	University	0	0	Visits to Businesses
AIRPORT	Airport	0	0	No Airports Present
HOSP	Hospital Beds	0	0	No Hospitals Present
UBEDS	University Beds	0	0	No Dormitories Present
[%AUTOEE]	Percent Auto External-External traffic	0	0	Zones are not external stations
[%CVEE]	Percent CV External-External traffic	0	0	Zones are not external stations
TERMTIME	Terminal time – from termtime.prn	1	2	Previously programmed in model
PARKCOST	Parking Cost – from parking.prn	0	0	Previously programmed in model
SHUTTLE	Whether shuttle service is provided	0	0	Previously programmed in model
DOORSTEP	Door step service	0	0	Previously programmed in model
CBDWALK	Designation of CBD Walk	1	0	Previously programmed in model
CCWALKDIST	Distance from centroid to walk network	0	0	Previously programmed in model
STOPSPACE	Stop spacing	0.7952	2.5341	Previously programmed in model
ZONEAREA	Zonal area	0.3708	0	Previously programmed in model
GISDIST	Distance from centroid to nearest stop	1	1	Previously programmed in model
SHORTWALK	Percent short walk	48	0	Previously programmed in model
LONGWALK	Percent long walk	52	0	Previously programmed in model
DISTGROUP	Dist group	6	6	Previously programmed in model

Appendix N: Signal Timing and Traffic Counts

This appendix contains signal timing data collected by NCSU researchers and traffic count data collected by the NCDOT Traffic Survey Unit.

Intersection Analysis Southern Village	
Main Street / US15-501	
PM PEAK	29-Jul-03

	Phase Description						
	Left/Right out		protected Left in		Through		
Cycle #	Green	Y/AR	Green	Y/AR	Green	Y/AR	**Cycle Length**
1	20	4	0	0	50	4	**78**
1	25	4	0	0	50	4	**83**
2	15	4	0	0	75	4	**98**
2	13	4	0	0	75	4	**96**
3	31	4	0	0	90	4	**129**
3	30	4	0	0	90	4	**128**
4	20	4	0	0	35	4	**63**
4	13	4	0	0	35	4	**56**
5	11	4	0	0	50	4	**69**
5	10	4	0	0	52	4	**70**
6	30	4	0	0	50	4	**88**
6	32	4	0	0	54	4	**94**
7	17	4	0	0	60	4	**85**
7	18	4	0	0	65	4	**91**
8	30	4	6	3	60	4	**107**
8	32	4	5	4	58	4	**107**
9	16	4	0	0	45	4	**69**
9	13	4	0	0	45	4	**66**
10	17	4	0	0	80	4	**105**
10	17	4	0	0	82	4	**107**
11	21	4	0	0	75	4	**104**
11	21	4	0	0	75	4	**104**
12	31	4	0	0	52	4	**91**
12	31	4	0	0	50	4	**89**
AVERAGE:	**21.42**	**4.00**	**0.46**	**0.29**	**60.54**	**4.00**	**90.71**

all numbers given in secons

Summary Intersection Timing for Main Street and US15-501			
Road	**Movement**	**avg.green (s)**	**Y/AR**
US 15-501	through	60.5	4.0
US 15-502	protected left	21.4	4.0
Main Street	left/right	0.5	4.0
Average cycle length (s)		**90.7**	

Traffic Survey Unit
North Carolina Department of Transportation

HRP 2003-13
Traffic Data Collection

Prepared by K. Taylor
24-Mar-03

Station	Location	Status
1	US 15-501 South of Main Street	Not Collected Due to Construction
2	Main Street West of US 15-501	Collected
3	US 15-501 North of Main Street	Collected
4	US 15-501 South of Arlen Park Drive	Not Collected Due to Construction
5	Arlen Park Drive West of US 15-501	Collected
6	US 15-501 North of Arlen Park Drive	Collected
7	Highgrove Drive South of Gardner Street	Collected
8	Culbreth Road (SR 1994) East of Weyer Road	Collected
9	Culbreth Road (SR 1994) West of Weyer Road	Collected
10	Homestead Road (SR 1777) East of Lake Hogan Farm Road	Collected
11	Lake Hogan Farm Road North of Homestead Road (SR 1777)	Collected
12	Homestead Road (SR 1777) West of Lake Hogan Farm Road	Equipment Failure WB, EB Data Only
13	Old NC 86 (SR 1009) South of Hogan Ridge Court	Collected
14	Hogan Ridge Court East of Old NC 86 (SR 1009)	Collected
15	Old NC 86 (SR 1009) North of Hogan Ridge Court	Collected

Summary of Trip Generator Driveways

Southern Village

March 18, 2003

Location	Entering	Exiting	Total
Station 2	3274	4005	7279
Station 5	1413	1254	2667
Station 7	1327	1067	2394
Total	6014	6326	12340

March 19, 2003

Location	Entering	Exiting	Total
Station 2	3472	4237	7709
Station 5	1560	1284	2844
Station 7	1044	1299	2343
Total	6076	6820	12896

Hogan Farms

March 18, 2003

Location	Entering	Exiting	Total
Station 11	1120	1091	2211
Station 14	152	246	398
Total	1272	1337	2609

March 19, 2003

Location	Entering	Exiting	Total
Station 11	1286	1126	2412
Station 14	193	249	442
Total	1479	1375	2854

Traffic Survey Unit/NCDOT
Volume Counts

Location: Main Street West of US 15-501
County: Orange

Date: March 18, 2003

15 Min Counts				Sliding Hourly Totals			
Start	Direction		15 Min	Start	Direction		Hour
Time	EB	WB	Total	Time	EB	WB	Total
0:00	4	0	4	0:00	9	7	16
0:15	3	4	7	0:15	5	8	13
0:30	1	2	3	0:30	2	4	6
0:45	1	1	2	0:45	3	5	8
1:00	0	1	1	1:00	4	4	8
1:15	0	0	0	1:15	4	3	7
1:30	2	3	5	1:30	4	6	10
1:45	2	0	2	1:45	3	4	7
2:00	0	0	0	2:00	1	4	5
2:15	0	3	3	2:15	1	5	6
2:30	1	1	2	2:30	1	5	6
2:45	0	0	0	2:45	0	4	4
3:00	0	1	1	3:00	0	4	4
3:15	0	3	3	3:15	0	3	3
3:30	0	0	0	3:30	3	1	4
3:45	0	0	0	3:45	3	1	4
4:00	0	0	0	4:00	5	1	6
4:15	3	1	4	4:15	5	1	6
4:30	0	0	0	4:30	3	2	5
4:45	2	0	2	4:45	6	6	12
5:00	0	0	0	5:00	10	18	28
5:15	1	2	3	5:15	16	21	37
5:30	3	4	7	5:30	25	39	64
5:45	6	12	18	5:45	36	63	99
6:00	6	3	9	6:00	49	96	145
6:15	10	20	30	6:15	69	156	225
6:30	14	28	42	6:30	90	258	348
6:45	19	45	64	6:45	163	419	582
7:00	26	63	89	7:00	312	500	812
7:15	31	122	153	7:15	392	523	915
7:30	87	189	276	7:30	453	497	950
7:45	168	126	294	7:45	423	398	821
8:00	106	86	192	8:00	333	342	675
8:15	92	96	188	8:15	282	337	619
8:30	57	90	147	8:30	230	309	539
8:45	78	70	148	8:45	233	259	492
9:00	55	81	136	9:00	214	234	448
9:15	40	68	108	9:15	212	193	405
9:30	60	40	100	9:30	209	174	383
9:45	59	45	104	9:45	199	168	367
10:00	53	40	93	10:00	184	158	342
10:15	37	49	86	10:15	160	147	307
10:30	50	34	84	10:30	170	135	305
10:45	44	35	79	10:45	182	132	314
11:00	29	29	58	11:00	208	143	351
11:15	47	37	84	11:15	221	150	371
11:30	62	31	93	11:30	225	150	375
11:45	70	46	116	11:45	230	164	394
12:00	42	36	78	12:00	214	154	368
12:15	51	37	88	12:15	220	157	377
12:30	67	45	112	12:30	227	156	383
12:45	54	36	90	12:45	219	154	373
13:00	48	39	87	13:00	215	159	374
13:15	58	36	94	13:15	204	155	359
13:30	59	43	102	13:30	187	185	372
13:45	50	41	91	13:45	197	214	411
14:00	37	35	72	14:00	240	209	449
14:15	41	66	107	14:15	285	209	494
14:30	69	72	141	14:30	286	184	470
14:45	93	36	129	14:45	302	156	458
15:00	82	35	117	15:00	271	162	433
15:15	42	41	83	15:15	258	164	422
15:30	85	44	129	15:30	302	176	478
15:45	62	42	104	15:45	309	168	477
16:00	69	37	106	16:00	359	188	547
16:15	86	53	139	16:15	435	203	638
16:30	92	36	128	16:30	490	230	720
16:45	112	62	174	16:45	579	269	848
17:00	145	52	197	17:00	571	251	822
17:15	141	80	221	17:15	512	239	751
17:30	181	75	256	17:30	443	209	652
17:45	104	44	148	17:45	321	201	522
18:00	86	40	126	18:00	278	217	495
18:15	72	50	122	18:15	242	230	472
18:30	59	67	126	18:30	241	230	471
18:45	61	60	121	18:45	227	195	422
19:00	50	53	103	19:00	205	174	379
19:15	71	50	121	19:15	198	150	348
19:30	45	32	77	19:30	150	129	279
19:45	39	39	78	19:45	143	124	267
20:00	43	29	72	20:00	114	102	216
20:15	23	29	52	20:15	96	90	186
20:30	38	27	65	20:30	104	77	181
20:45	10	17	27	20:45	114	67	181
21:00	25	17	42	21:00	119	57	176
21:15	31	16	47	21:15	110	56	166
21:30	48	17	65	21:30	95	55	150
21:45	15	7	22	21:45	51	43	94
22:00	16	16	32	22:00	46	46	92
22:15	16	15	31	22:15	34	39	73
22:30	4	5	9	22:30	24	35	59
22:45	10	10	20	22:45	36	49	85
23:00	4	9	13	23:00	44	44	88
23:15	6	11	17				
23:30	16	19	35				
23:45	18	5	23				
Total	4005	3274	7279				

Date: March 19, 2003

15 Min Counts				Sliding Hourly Totals			
Start	Direction		15 Min	Start	Direction		Hour
Time	EB	WB	Total	Time	EB	WB	Total
0:00	4	6	10	0:00	14	13	27
0:15	6	3	9	0:15	12	7	19
0:30	4	3	7	0:30	6	4	10
0:45	0	1	1	0:45	2	2	4
1:00	2	0	2	1:00	4	3	7
1:15	0	0	0	1:15	2	3	5
1:30	0	1	1	1:30	3	5	8
1:45	2	2	4	1:45	3	5	8
2:00	0	0	0	2:00	1	4	5
2:15	1	2	3	2:15	1	4	5
2:30	0	1	1	2:30	0	2	2
2:45	0	1	1	2:45	0	1	1
3:00	0	0	0	3:00	0	0	0
3:15	0	0	0	3:15	0	0	0
3:30	0	0	0	3:30	0	0	0
3:45	0	0	0	3:45	1	0	1
4:00	0	0	0	4:00	1	0	1
4:15	0	0	0	4:15	1	0	1
4:30	1	0	1	4:30	3	2	5
4:45	0	0	0	4:45	5	5	10
5:00	0	0	0	5:00	12	16	28
5:15	2	2	4	5:15	18	26	44
5:30	3	3	6	5:30	24	51	75
5:45	7	11	18	5:45	33	64	97
6:00	6	10	16	6:00	42	97	139
6:15	8	27	35	6:15	74	133	207
6:30	12	16	28	6:30	116	238	354
6:45	16	44	60	6:45	189	421	610
7:00	38	46	84	7:00	344	517	861
7:15	50	132	182	7:15	390	588	978
7:30	85	199	284	7:30	424	555	979
7:45	171	140	311	7:45	399	422	821
8:00	84	117	201	8:00	315	373	688
8:15	84	99	183	8:15	282	338	620
8:30	60	66	126	8:30	267	306	573
8:45	87	91	178	8:45	288	302	590
9:00	51	82	133	9:00	249	275	524
9:15	69	67	136	9:15	250	240	490
9:30	81	62	143	9:30	217	216	433
9:45	48	64	112	9:45	189	188	377
10:00	52	47	99	10:00	197	165	362
10:15	36	43	79	10:15	193	163	356
10:30	53	34	87	10:30	221	150	371
10:45	56	41	97	10:45	238	150	388
11:00	48	45	93	11:00	253	152	405
11:15	64	30	94	11:15	271	148	419
11:30	70	34	104	11:30	288	178	466
11:45	71	43	114	11:45	275	181	456
12:00	66	41	107	12:00	257	199	456
12:15	81	60	141	12:15	278	199	477
12:30	57	37	94	12:30	258	197	455
12:45	53	61	114	12:45	277	209	486
13:00	87	41	128	13:00	271	200	471
13:15	61	58	119	13:15	232	208	440
13:30	76	49	125	13:30	224	208	432
13:45	47	52	99	13:45	233	210	443
14:00	48	49	97	14:00	283	218	501
14:15	53	58	111	14:15	303	209	512
14:30	85	51	136	14:30	323	179	502
14:45	97	60	157	14:45	318	158	476
15:00	68	40	108	15:00	294	148	442
15:15	73	28	101	15:15	325	155	480
15:30	80	30	110	15:30	346	181	527
15:45	73	50	123	15:45	383	206	589
16:00	99	47	146	16:00	424	220	644
16:15	94	54	148	16:15	447	243	690
16:30	117	55	172	16:30	480	272	752
16:45	114	64	178	16:45	520	306	826
17:00	122	70	192	17:00	529	301	830
17:15	127	83	210	17:15	495	284	779
17:30	157	89	246	17:30	449	254	703
17:45	123	59	182	17:45	343	223	566
18:00	88	53	141	18:00	297	219	516
18:15	81	53	134	18:15	285	213	498
18:30	51	58	109	18:30	250	198	448
18:45	77	55	132	18:45	243	167	410
19:00	76	47	123	19:00	201	147	348
19:15	46	38	84	19:15	159	125	284
19:30	44	27	71	19:30	140	111	251
19:45	35	35	70	19:45	123	97	220
20:00	34	25	59	20:00	119	82	201
20:15	27	24	51	20:15	101	73	174
20:30	27	13	40	20:30	94	73	167
20:45	31	20	51	20:45	88	77	165
21:00	16	16	32	21:00	70	68	138
21:15	20	24	44	21:15	64	63	127
21:30	21	17	38	21:30	55	47	102
21:45	13	11	24	21:45	46	38	84
22:00	10	11	21	22:00	40	33	73
22:15	11	8	19	22:15	31	31	62
22:30	12	8	20	22:30	30	28	58
22:45	7	6	13	22:45	21	22	43
23:00	1	9	10	23:00	20	22	42
23:15	10	5	15				
23:30	3	2	5				
23:45	6	6	12				
Total	4237	3472	7709				

Appendix O: - Sensitivity Analysis Discussion

This appendix presents the sensitivity analysis of the ITE trip generation results for the Southern Village Neighborhood Development in more detail. The complete spreadsheets used for this analysis are given in Appendix M.

Chapter 6 has shown that the ITE trip generation method with adjustments for internal capture results in fairly accurate estimates of peak hour traffic volumes for the Southern Village neighborhood. These results suggest that the ITE method, which combines ITE manual and handbook, is a good choice for forecasting traffic generated by Traditional Neighborhood Developments similar to Southern Village. However, some trip rates for specific land uses (residential, recreational and commercial) that are given in the ITE trip generation manual are based on small sample sizes. As a result, some of the trip rates have relatively high standard deviations and have to be treated with care. The following sensitivity analysis assessed what variations in the traffic forecasts are possible based on variability of the trip rates. Furthermore, it evaluated the effects of such variations on the levels of service of the adjacent intersection of Main Street and US 15-501 at Southern Village. The analysis consists of four main components:

5. Analyzing variations of trip rates within a 95% confidence interval
6. Assessing capacity and levels of service of an intersection for the 95% confidence interval and for other (hypothetical) percentages of increased traffic volumes
7. Comparing sensitivities of different land uses in the neighborhood
8. Evaluating effects of internal capture rate on intersection performance

The first step of this sensitivity analysis uses the 95% confidence interval for ITE trip rates for the different land uses, which is equivalent to two standard deviations of the average rates listed in the ITE manual. This method represents a common method of data analysis used in statistics, and is performed here for that reason. Trip rates increased by two standard deviations (two-sigma) should result in very high traffic estimates and unacceptable operational levels of service of intersections in Southern Village and may not be very useful in real life. The two standard deviation estimate does, however, present a good starting point for this analysis.

In the second step, the traffic volumes generated in the first step are used to predict the levels of service of the intersection of Main Street and US15-501 under two-sigma conditions. The traffic volumes entering and exiting Southern Village are increased by specific percentages below the two-sigma level. This step allows developing a sense of how much of an increase in traffic volumes the particular intersection can handle and at what percent increase in traffic the intersection delays become unacceptable. In a practical context, this worst-case percent increase can be interpreted as resulting from an erroneous or extreme prediction of trip rates. If the trip rate forecast were excessive compared to reality, then the actual traffic would be less than predicted and the intersection would be over-designed. Conversely, if the trip rate prediction were too low, the actual higher traffic volumes would result in worse levels of service than expected.

The third step of the analysis looks at each land use type in Southern Village individually and assesses its sensitivity for increases in traffic volumes. The average rate and the two-sigma

rate for each land use are evaluated in terms of percent difference and difference in actual numbers of vehicles for each land use. This section shows which of the land uses would be most likely to have large impacts on overall traffic in the case of a wrong estimate, assuming constant land use intensity.

In the last step the analysis concentrates on very specific characteristics of the Main Street/ US15-501 intersection in Southern Village. While the first three steps of the sensitivity analysis represent hypothetical scenarios that might result from high trip rates predictions, the fourth step focuses on the actual situation in the neighborhood. This step of the analysis therefore includes the issues that are most practical and may be most interesting to professionals, as they represent actual applications and practical implications of the ITE trip generation method.

Step 1. Trip Rate Variations in a 95% Confidence Interval

For the first step of the sensitivity analysis, the ITE trip generation method was performed for each land use three times:

- Using the mean values as listed in the ITE manual
- Using the mean values plus two standard deviations
- Using the mean values minus two standard deviations

A range of plus and minus two standard deviations from the average corresponds to a 95% confidence interval, according to statistical theory. It is common practice in statistics to calculate this 95% confidence interval, in order to gain an understanding of the precision and variability of the results. Table O-1 below presents the overall trip rates for daily and peak hour traffic, measured in number of vehicles, for the entire neighborhood. Table O-2 shows the same numbers expressed as percent differences from the average rates.

Table O-1: Trip Rate Variations (number of vehicles)

Trip Volumes generated with ITE trip generation method for total number of vehicles in Southern Village					
Daily Traffic (# of vehicles)		**AM Peak Hour (# of vehicles)**		**PM Peak Hour (# of vehicles)**	
Entering	Exiting	Entering	Exiting	Entering	Exiting
Minus Two Standard Deviations					
1571.7	1571.7	10.5	8.9	64.0	9.5
Mean Values					
6799.7	6799.7	542.6	722.2	832.3	734.8
Plus Two Standard Deviations					
12317.8	12317.8	1551.8	2415.1	2447.1	2089.7

Table O-2: Trip Rate Variations (Percent Difference)

Percent Difference of ITE Trip Rates for total traffic volumes in Southern Village					
Daily Traffic (# of vehicles)		**AM Peak Hour (# of vehicles)**		**PM Peak Hour (# of vehicles)**	
Entering	Exiting	Entering	Exiting	Entering	Exiting
Minus Two Standard Deviations					
-76.9%	-76.9%	-98.1%	-98.8%	-92.3%	-98.7%
Mean Values					
0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Plus Two Standard Deviations					
81.2%	81.2%	186.0%	234.4%	194.0%	184.4%

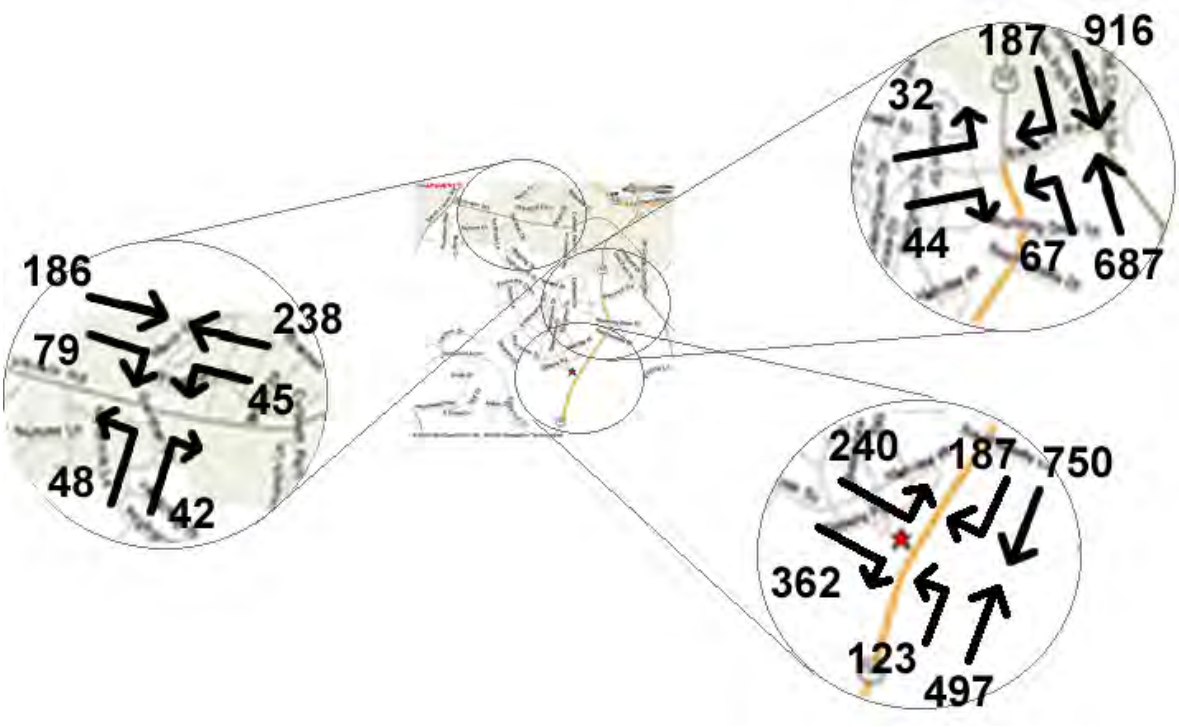
Results in Table O-2 show that the trip rates obtained with the ITE trip generation methods may vary greatly. The tables show that in a 95% confidence interval, the maximum trip rate can be more than 200% greater than what the average rate suggests. In summary the use of a variation of two standard deviations resulted in extremely different traffic volumes. The large variation in plus and minus two-sigma values is symptomatic of the relatively few field data used to develop the trip rates in the ITE manual. In a real situation it is unlikely that such large differences would occur between trip generation forecasts and actual trip rates. Traffic engineers would likely adjust the average trip rates for a case study consistent with local conditions. The plus two standard deviation rates are, therefore, a high upper limit of trip rates, with actual trip rates falling somewhere in-between predicted average rates and these limits.

The following section shows what effects such high traffic estimates can have and how the levels of service of an intersection adjacent to Southern Village change under conditions at the upper limits of the 95% confidence interval. The section then analyzes the same intersection for other percent increases of entering and exiting traffic volumes that may be more likely to occur in a real situation.

Step 2. Capacity Analysis for (Hypothetical) Increases in Traffic Volumes

The sensitivity analysis of intersection levels of service in response to traffic estimates focused on the main entrance to Southern Village - the intersection of US15-501 and Main Street. Actual traffic counts at the entrances and exits to the neighborhood presented in Appendix O show that this is indeed the main entrance because it has the highest entering and exiting volumes compared to the other two entrances at the a.m. and p.m. peak hours. Thus, the Main Street and US 15-501 intersection would likely experience congestion impacts first and would be a reasonable choice for a sensitivity analysis. Figure O-1 below shows a map of the neighborhood with the current p.m. peak hour traffic volumes obtained by NCDOT counts..

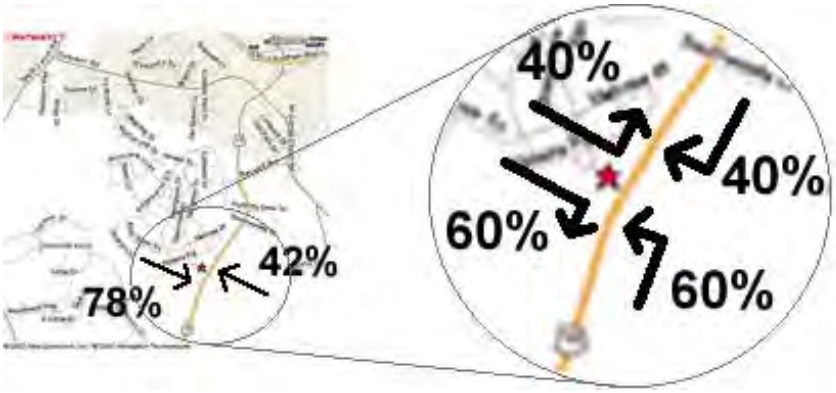
Figure O-1: Traffic Volumes in Southern Village, p.m. peak hour (vehicles/hour)



The analysis concentrated on the p.m. peak hour, as that represents the highest traffic volume in the area and typically has the highest likelihood of congestion. The analysis of the intersection assumes current traffic volumes on all streets external to the Southern Village neighborhood. The entering and exiting volumes were then calculated from the two standard deviation estimates and by other percent increases. The two-sigma category represents the highest trip rates and depending on the land use intensity may represent flows that are unreasonable for this intersection. The resulting flows surpass capacity constraints of the intersection and are worst-case scenarios. The other percent increases fall below the two-sigma rates and represent a broad range of possible traffic increases. These flows can be used to estimate at what hypothetical percent increase in traffic, the intersection will experience significant delays and at what point capacity is reached.

Values shown in Figure O-1 represent total entering and exiting volumes for the entire development. To obtain traffic volumes for the intersection of interest only, the percentage distribution of traffic between the three exits was assumed to be the same as it is in the actual traffic counts. The distribution for directional splits was done in the same manner. The percentage of total traffic volumes of the development on Main Street is 42% of entering and 78% of exiting vehicles. The outbound directional split of Main Street is 40% northbound and 60% southbound. The inbound directional split is 40% from the northbound approach and 60% from the southbound approach. The percentages are shown in Figure O-2 below.

Figure O-2: Turn Percentages in Southern Village



The capacity analysis of the intersection was accomplished using the HCS2000 software package. The analysis was completed with the average ITE trip generation predictions. Because the signal on the Main Street/US15-501 intersection is actuated, averages of field measurements of the actual signal times were taken to obtain average signal times for the analysis (Table O-3).

Table O-3: Actual Signal Times Main Street/US15-501

Green Times for Main Street and US15-501			
Road	**Movement**	**avg.green (s)**	**Y/AR**
US 15-501	through	60.5	4.0
US 15-501	protected left	5.5 / 0.0*	4.0
Main Street	left/right	21.4	4.0
Average cycle length (s)		**90.7**	

Table O-3 shows average green times for the signal and yellow/all red (Y/AR) times as provided in the signal-timing plan. The timing analysis was conducted on a Tuesday between the hours of 5 and 6 p.m. The measured green times were averaged for each phase over the entire count period. The asterisk next to the protected left movement from US 15-501 onto Main Street indicates that while the counts were conducted, this particular phase only appeared twice. At all other times, the left turning volumes were low enough that all vehicles were able to turn during the phase for the through movement and the protected left turn phase therefore wasn't actuated. The average green time for the two occurrences of the protected left phase was 5.5 seconds, while the average distributed over the entire count period was close to zero seconds. In the following intersection analysis, green and Y/AR for this phase were therefore assumed to be zero during the p.m. peak hour.

The analysis was then repeated with the trip rates plus two standard deviations. For this step, the maximum green times from the signal-timing plan were assumed, because it is reasonable to assume that the signal has reached maximum capacity under these high volume conditions. Green times in an actuated signal will increase with higher traffic volumes, because the detector in the roads are triggered more frequently with higher flows. Although it is not exactly known to what degree the green times will increase, it is a reasonable assumption that they have reached the maximum allowable with volumes as high as in this case. All other variables, such as geometry factors, vehicle types, yellow and all-red times were kept

constant throughout the analysis. Table O-4 below shows the summary of the capacity comparison.

Table O-4: Capacity Analysis for Plus Two Standard Deviations

Approach	Direction	Average ITE Rates		Plu Two-Sigma	
		LOS	delay(s)	LOS	delay(s)
US15-501 NB	through	A	6.5	A	7.0
	left	B	10.4	C	29.4
US15-501 SB	through	B	13.1	B	17.6
	right	A	1.9	A	5.3
Main Street EB	left	D	43.6	F	351.5
	right	D	36.0	F	328.0
Intersection Totals		**B**	**16.6**	**F**	**140.6**

The table shows that the intersection levels of service were significantly reduced in the second scenario. If indeed the ITE trip rate predictions had been underestimating the impacts by two standard deviations, the effects on the Main Street/US15-501 intersection would be detrimental. Therefore, the level of service of the main entrance, within a 95% confidence interval, is estimated to be between LOS B and F. In practice this means, that even if the ITE prediction was appropriate in the case of Southern Village, it may under or over predict in other cases. Engineers and consultants should therefore always be aware that there is a range of trip rates possible, and the most professional judgment should be used to validate the results.

In order to gain a better understanding of the capacity threshold of the intersection, further adjustments were made. The main question in this context was at what point the intersection would be over capacity and require additional lanes. As discussed in the previous paragraphs, it is possible that the ITE trip generation method indeed under-predicted the effects of a traditional neighborhood development. The next step of the sensitivity analysis, therefore repeated the HCS2000 capacity analysis assuming that actual traffic volumes are higher than predicted by set percentages. Tables O-5.1 and O-5.2 below show the levels of service and delays per lane group for assumed volumes that are 10%, 25%, 50%, 100%, and 150% over the volumes predicted by ITE.

Table O-5.1: Capacity Analysis for Percent Increase in Traffic Volumes

Approach	**Direction**	**ITE forecast**		**SV volumes +10%**		**SV volumes +25%**		**SV volumes +50%**	
		LOS	delay(s)	LOS	delay(s)	LOS	delay(s)	LOS	delay(s)
US15-501 NB	through	A	6.5	A	7.0	A	13.3	A	7.0
	left	B	10.4	B	12.8	B	7.0	B	14.3
US15-501 SB	through	B	13.1	B	17.6	B	17.6	B	17.6
	right	A	1.9	A	3.1	A	7.0	A	3.4
Main Street EB	left	D	43.6	E	64.2	E	68.2	E	79.0
	right	D	36.0	D	47.7	D	51.1	E	59.6
Intersection Totals		**B**	**16.6**	**C**	**22.9**	**C**	**24.7**	**C**	**28.8**

Table O-5.2: Capacity Analysis for Percent Increase in Traffic Volumes (contd.)

Approach	Direction	ITE forecast		SV volumes +100%		SV volumes +150%		SV volumes +200%	
		LOS	delay(s)	LOS	delay(s)	LOS	delay(s)	LOS	delay(s)
US15-501 NB	through	A	6.5	A	7.0	A	7.0	A	7.0
	left	B	10.4	B	16.8	C	20.0	C	24.6
US15-501 SB	through	B	13.1	B	17.6	B	17.6	B	17.6
	right	A	1.9	A	3.8	A	4.3	A	4.8
Main Street EB	left	D	43.6	F	140.1	F	249.5	F	369.7
	right	D	36.0	F	115.1	F	223.3	F	341.6
Intersection Totals		**B**	**16.6**	**D**	**51.5**	**F**	**97.1**	**F**	**152.1**

As tables O-5.1 and O-5.2 above show, the consequences of inappropriate trip rates can have significant effects on the levels of service of adjacent intersections in the development. As expected, the levels of service for the intersection of Main Street and US15-501 get continuously worse with increasing traffic volumes. This analysis is interesting, however, in that the high delays are all associated with the exiting volumes from the development (the minor movements). The through movements on US15-501 remain at satisfactory levels of service even if the traffic exiting the Southern Village development were to increase by these large percentages. This means that even if the developer had underestimated the impacts of the new neighborhood, the effects on the regional network would be almost negligible.

Step 3. Comparison of Different Land Use Types

The first two sections of the sensitivity analysis show that significant increases in predicted traffic volumes, compared to original TND estimates, could result from variations in the ITE trip rates. As discussed it is unlikely that an error in the magnitude of plus two standard deviations would occur, however, it is very well possible that the forecast volumes resulting from ITE trip generation do not match local conditions. In this context it is interesting to know, which land uses in Southern Village are most sensitive to changes, i.e. have the highest variability in the research results underlying the published trip rates.

This section of the analysis, therefore, looks at each land use in the Southern Village separately. The average rates predicted from the ITE method are compared to the plus two standard deviations rates listed in section 1. For each land use, those two rates are compared and the percent difference between the two is calculated. Furthermore, the differences in actual numbers of vehicles are listed. This is done because a specific land use type may have little overall effects on traffic due to low intensity, despite a high standard deviation in its trip rate. Table O-6 summaries the findings.

Table O-6: Comparison of Different Land Use Types

Land Use Category	Intensity	% Difference From Average	Additional Vehciles from Average
Single Family Homes	510 units	77.1%	3764
Condos + Townhomes	335 units	105.5%	2070
Apartments	250 units	89.9%	1490
Office	95,000 sq.ft.	114.4%	1165
Retail	24,500 sq.ft.	138.7%	561
Church	27,000 sq.ft.	158.1%	389
Daycare	6,000 sq.ft.	53.1%	252
School	90,000 sq.ft.	116.7%	1264
Swim and Tennis Club	3,000 sq.ft.	158.6%	82
Total		**81.2%**	**11036**

As the table above shows, there are significant differences between the average rates and the plus two standard deviations rates. The largest percent differences occur for the Swim Club, the Church and Retail Stores. All of these, however, result in relatively small increases in the number of vehicles. Also, it is unlikely that predictions for the church will be so much larger for the p.m. peak hour, as most church traffic occurs on Sunday mornings. The largest increases in number of vehicles result from all three residential land use types and the school. For the school, a similar argument applies as mentioned for the church, as increases in the given magnitude are very doubtful for the p.m. peak period.

In summary the results suggest that the most significant increases in traffic predictions would probably result from the residential zones in Southern Village. It is therefore suggested that the closest attention be paid to the traffic forecasts for these three land uses. Trip generation results should be questioned and professional judgment be applied to verify the validity of the calculated rates for development similar to Southern Village.

4. Effects of Internal Capture

The final step of the sensitivity analysis compared the impacts of the average ITE rates predicted using the ITE manual with those rates that were adjusted for internal capture. The ITE trip generation handbook suggests that due to the mixed land use of traditional neighborhood developments a significant percentage of trips are captured within the development. The results of the Southern Village traffic impact analysis indicated a 13.1% capture rate because of significant internal trips to schools, daycare, restaurants, and shopping venues. The sensitivity analysis compared the impacts of these reduced rates to the unadjusted ITE predictions. Again, the distribution of traffic volumes among the three exits and among turn movements was done consistent with the percentages from the actual counts (see Figure O-2). The results of the analysis are shown in Table O-7 below.

Table O-7: Capacity Analysis With and Without Internal Capture

Approach	Direction	without int. capture		with 13.1% Int. Capt.	
		LOS	delay(s)	LOS	delay(s)
US15-501 NB	through	A	6.5	A	6.5
	left	B	10.9	B	10.4
US15-501 SB	through	B	13.1	B	13.1
	right	A	2.0	A	1.9
Main Street EB	left	D	46.0	D	43.6
	right	D	39.2	D	36.0
Intersection Totals		**B**	**18.0**	**B**	**16.6**

Table O-7 shows that the difference between levels of service and delays for the two cases is negligible. The resulting improvement in overall intersection delay is merely 1.4 seconds for the p.m. peak hour, which suggests that impacts for other time periods of the day are even less. Furthermore, reduced Southern Village traffic due to the internal capture rate of 13.1% is distributed over all three exits/entrances and then for the directional turning split of each intersection. For each individual lane group this means that the actual impacts in number of vehicles are not significant and the effects on intersection capacity will, therefore, be minor. Table O-8 shows the distribution of the total traffic difference over the lane groups in the Main Street and US15-501 intersection.

Table O-8: Volume Comparison for Main Street/US15-501

Volume Differences Between Trip Generation With and Without Internal Capture (p.m. peak hour)				
		internal capture 13.1%	**no internal capture**	**Difference in # of vehicles**
Total Volumes Predicted by ITE	Entering	723	832	**109**
	Exiting	639	735	**96**
Volume Percentages on Main Street	Entering (42%)	304	349	**46**
	Exiting (78%)	498	573	**75**
Volume Directional Splits for Turning Movements	Exiting to NB (40%)	199	229	**30**
	Exiting to SB (60%)	299	344	**45**
	Entering from NB (40%)	121	140	**18**
	Entering from SB (60%)	182	210	**27**

The table shows that the internal capture rate observed for Southern Village only results in less than 50 vehicles for every lane group per hour, which is significantly less than one vehicle per minute. With this in mind it is understandable that the impacts on Levels of Service for the intersection are relatively insignificant. In this context it also needs to be stated that US15-501 is currently being widened, and that the widened roadway (which was used in this analysis) was likely designed to carry significant increases in future traffic. The minor impacts on LOS on US15-501 shown here, may have resulted in more severe impacts in more dense areas. TNDs similar to Southern Village that are located on arterials with volumes already closer to the capacity limit, will likely have greater impacts on the surrounding road network. In those hypothetical cases, the impacts of 13% internal capture would then also have more significant results, theoretically. This case suggests that close attention needs to be paid to TNDs planned in over-capacity locations. Effects of internal capture from amenities can then be attractive for marketing of the product, even if traffic impacts are not clearly predictable.

For this particular case, with perimeter roads that are major arterials, these results suggest that it may not be necessary to calculate internal capture rates for the development at all, as there is virtually no difference in impacts on the adjacent road network. However, since our analysis has shown that the calculated rates with internal capture were extremely close to the actual counts, it is good practice to use the ITE handbook as a step in traffic impact analyses for traditional neighborhood developments.

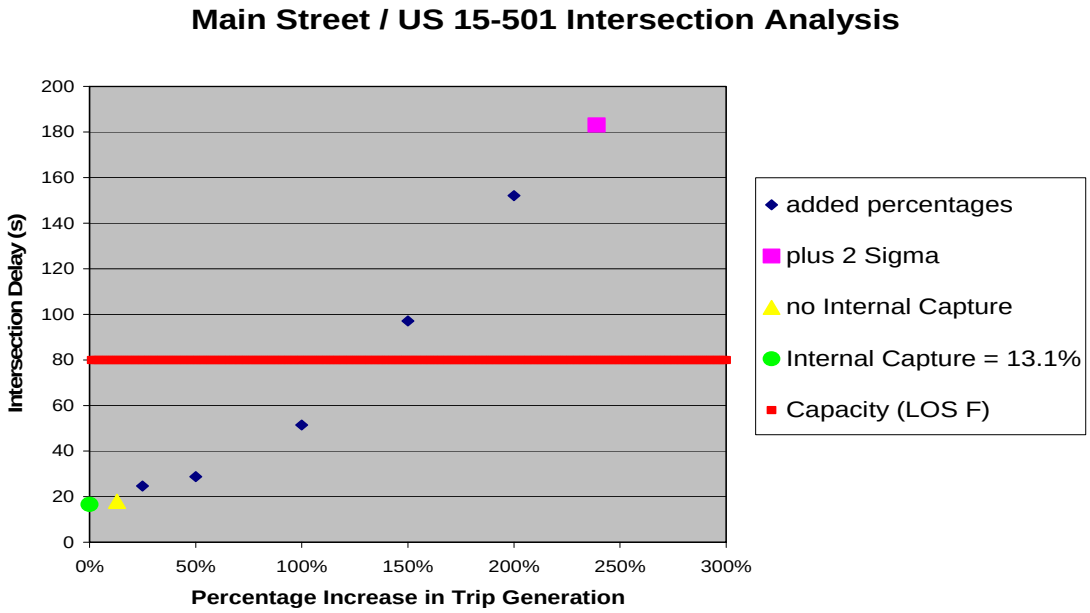
Sensitivity Analysis Summary

The ITE trip generation manual can have very high standard deviations and trip rates generated with the ITE method should be validated by professional judgment. The sensitivity analysis showed that if the ITE method had indeed underestimated traffic volumes, the levels of service on the Main Street and US15-501 intersection would have been decreased significantly. The analysis was done first using plus two standard deviation rates and second using rates that were increased by certain percentages below the 95% confidence upper limit. While the plus two standard deviation rates expectedly put the studied intersection over capacity, increases of lower percentages still resulted in significant increases in intersection delays.

The analysis further showed that in the assessment of a neighborhood similar to Southern Village, the results of the ITE trip generation should be regarded with care, even if the estimate was fairly accurate for this case. In particular, the rates predicting residential volumes can be subject to high variability and would have resulted in the largest increases in numbers of vehicles in the case of Southern Village.

In the final step, the sensitivity analysis evaluated effects of internal capture on the Main Street/US15-501 intersection. The results showed, that the calculated 13.1% internal capture rate for Southern Village had negligible effects on delays and levels of service for the studied intersection. This outcome was explained by the fact that the total reduction of trips by 13.1% in reality is divided up among the three exits/entrances and then split into the different turning directions. Also, the intersection has a high design year intended to carry high future traffic volumes on the major thoroughfare US15-501. In this sense, the total internal capture of 109 vehicles in the p.m. peak hour only results in increases below 50 vehicles per lane group per hour, which has virtually no effect on the performance of the studied intersection. Figure O-3 below summarizes the results of this sensitivity analysis in a plot of intersection delay versus percentage increase in trip generation rates.

Figure O-3: Sensitivity Analysis Summary



In Figure O-3 the heavy line at 80 seconds total intersection delay represents a Level of Service 'F', at which the intersection is regarded as having exceeded its capacity. The circle symbol in the bottom left represents the average ITE trip generation rates minus the reductions for internal capture. The triangle next to it refers to the delay times calculated without the adjustment. The plot then shows that both delay times are well below the capacity of the intersection. The effect of internal capture may therefore be considered negligible, if only one TND neighborhood is assessed. However, imagining regional effects of this reduction through internal capture, for a number of TNDs along the same collector road, the results of a similar capacity analysis would likely be different. The combined internal capture of several Traditional Neighborhood Developments, conceivably will have a significant effect on the performance of the regional road network.

Findings of the sensitivity analysis in summary are:

- ITE forecasts can have high deviations and predictions should be validated with professional judgment
- If traffic is higher than predicted, the delays of exiting traffic on adjacent intersections will likely increase and result in unsatisfactory LOS for neighborhood traffic
- LOS of through traffic on adjacent arterial in this case was hardly affected by increasing traffic volumes entering and exiting the neighborhood
- Highest variability and additional vehicle trips resulted from residential generators in the development. Impacts of commercial and business land uses were less significant.
- The calculated (and observed) 13% Internal Capture has negligible effects on intersection LOS due to distribution effects

Appendix P: Sensitivity Analysis Tables

US15-501/Main Street
Traffic Volumes - Forecasts

Annual Growth Rate 1%

		actual counts 2003	Forecast 5 years at 1% growth	Forecast 10 years at 1% growth	Forecast 20 years at 1% growth	Forecast 30 years at 1% growth
NB	through	497	522	549	606	670
	left	123	129	136	150	166
	Total	620	652	685	757	836
SB	through	750	788	828	915	1011
	right	187	197	207	228	252
	Total	937	985	1035	1143	1263
EB	left	240	252	265	293	323
	right	362	380	400	442	488
	Total	602	633	665	735	811

Annual Growth Rate 2%

		actual counts 2003	Forecast 5 years at 2% growth	Forecast 10 years at 2% growth	Forecast 20 years at 2% growth	Forecast 30 years at 2% growth
NB	through	497	549	606	739	900
	left	123	136	150	183	223
	Total	620	685	756	921	1123
SB	through	750	828	914	1114	1359
	right	187	206	228	278	339
	Total	937	1035	1142	1392	1697
EB	left	240	265	293	357	435
	right	362	400	441	538	656
	Total	602	665	734	895	1090

Annual Growth Rate 3%

		actual counts 2003	Forecast 5 years at 3% growth	Forecast 10 years at 3% growth	Forecast 20 years at 3% growth	Forecast 30 years at 3% growth
NB	through	497	576	668	898	1206
	left	123	143	165	222	299
	Total	620	719	833	1120	1505
SB	through	750	869	1008	1355	1820
	right	187	217	251	338	454
	Total	937	1086	1259	1692	2274
EB	left	240	278	323	433	583
	right	362	420	486	654	879
	Total	602	698	809	1087	1461

US15-501/Main Street
Volumes/LOS/Delays - Forecasts

		actual counts 2003			Forecast 5 years at 1% growth			Forecast 10 years at 1% growth			Forecast 20 years at 1% growth			Forecast 30 years at 1% growth		
		vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)
NB	through	497	A	7.0	522	A	7.1	549	A	7.2	606	A	7.3	670	A	7.5
	left	123	B	12.5	129	B	13.3	136	B	14.3	150	B	16.9	166	C	20.7
	Total	620	A	8.1	652	A	8.3	685	A	8.6	757	A	9.2	836	B	10.1
SB	through	750	B	17.6	788	B	17.9	828	B	18.2	915	B	18.9	1011	B	19.7
	right	187	A	3.1	197	A	3.1	207	A	3.2	228	A	3.2	252	A	3.3
	Total	937	B	14.7	985	B	14.9	1035	B	15.2	1143	B	15.8	1263	B	16.5
EB	left	240	E	66.9	252	E	68.7	265	E	70.9	293	E	77.3	323	F	87.7
	right	362	D	50.1	380	D	51.6	400	D	53.5	442	E	58.7	488	E	67.4
	Total	602	E	56.8	633	E	58.4	665	E	60.5	735	E	66.1	811	E	75.5
Intersection Totals		**2159**	**C**	**24.5**	**2269**	**C**	**25.2**	**2385**	**C**	**25.9**	**2634**	**C**	**27.9**	**2910**	**C**	**31.1**

		actual counts 2003			Forecast 5 years at 2% growth			Forecast 10 years at 2% growth			Forecast 20 years at 2% growth			Forecast 30 years at 2% growth		
		vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)
NB	through	497	A	7.0	549	A	7.2	606	A	7.3	739	A	7.7	900	A	8.3
	left	123	B	12.5	136	B	14.3	150	B	16.9	183	C	26.3	223	D	47.9
	Total	620	A	8.1	685	A	8.6	756	A	9.2	921	B	11.4	1123	B	16.1
SB	through	750	B	17.6	828	B	18.2	914	B	18.9	1114	C	20.7	1359	C	23.7
	right	187	A	3.1	206	A	3.1	228	A	3.2	278	A	3.4	339	A	3.7
	Total	937	B	14.7	1035	B	15.2	1142	B	15.8	1392	B	17.3	1697	B	19.7
EB	left	240	E	66.9	265	E	70.9	293	E	77.3	357	F	106.7	435	F	177.8
	right	362	D	50.1	400	D	53.5	441	E	58.5	538	F	84.0	656	F	154.4
	Total	602	E	56.8	665	E	60.5	734	E	66.0	895	F	93.0	1090	F	163.7
Intersection Totals		**2159**	**C**	**24.5**	**2384**	**C**	**25.9**	**2632**	**C**	**27.9**	**3208**	**D**	**36.7**	**3911**	**E**	**58.8**

		actual counts 2003			Forecast 5 years at 3% growth			Forecast 10 years at 3% growth			Forecast 20 years at 3% growth			Forecast 30 years at 3% growth		
		vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)
NB	through	497	A	7.0	576	A	7.2	668	A	7.5	898	A	8.3	1206	A	9.5
	left	123	B	12.5	143	B	15.5	165	C	20.5	222	D	47.5	299	F	109.3
	Total	620	A	8.1	719	A	8.9	833	B	10.1	1120	B	16.0	1505	C	29.3
SB	through	750	B	17.6	869	B	18.5	1008	B	19.7	1355	C	23.6	1820	C	34.3
	right	187	A	3.1	217	A	3.2	251	A	3.3	338	A	3.7	454	A	4.2
	Total	937	B	14.7	1086	B	15.5	1259	B	16.4	1692	B	19.6	2274	C	28.3
EB	left	240	E	66.9	278	E	73.6	323	F	87.7	433	F	175.7	583	F	351.5
	right	362	D	50.1	420	E	55.8	486	E	66.9	654	F	152.9	879	F	328.0
	Total	602	E	56.8	698	E	62.9	809	E	75.2	1087	F	162.0	1461	F	337.3
Intersection Totals		**2159**	**C**	**24.5**	**2503**	**C**	**26.8**	**2902**	**C**	**31.0**	**3899**	**E**	**58.3**	**5240**	**F**	**114.8**

US15-501/Main Street - PM peak
Volumes/LOS/Delays - with +2Std from ITE-TG

Total ITE-TG prediction in:	832
Total ITE-TG prediction out:	735

Total Volume in:	2447.15
Total Volume out:	2089.69

Main Street Directional Split:	OUT to NB:	40%	IN from NB:	40%
	OUT to SB:	60%	IN from SB:	60%

Percentage on Main Street in:	42%
Percentage on Main Street out:	78%

		actual counts 2003 with measured green times			ITE trip generation predictions with measured green times (without internal capture)			Volumes with +2STD from ITE trip generation: max. greens on Main and measured green times on other approaches			Volumes with +2STD from ITE trip generation: max. green times on all approaches		
		vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)
NB	through	497	A	7.0	497	A	6.5	497	A	9.5	497	A	7.0
	left	123	B	12.5	140	B	10.9	411	D	41.9	411	C	29.4
	Total	620	A	8.1	637	A	7.5	908	C	24.2	908	B	17.2
SB	through	750	B	17.6	750	B	13.1	750	B	17.1	750	B	17.6
	right	187	A	3.1	210	A	2.0	617	A	3.4	617	A	5.3
	Total	937	B	14.7	960	B	10.7	1367	B	10.9	1367	B	12.1
EB	left	240	E	66.9	229	D	46.0	652	F	148.5	652	F	351.5
	right	362	D	50.1	344	D	39.2	978	F	256.0	978	F	328.0
	Total	602	E	56.8	573	D	41.9	1630	F	213.1	1630	F	337.3
Intersection Totals		**2159**	**C**	**24.5**	**2170**	**B**	**18.0**	**3905**	**F**	**93.2**	**3905**	**F**	**140.6**

Average Rates		
	In	Out
	832	735
on Main	350	573
40%	140	229
60%	210	344

plus 2 Std. Dev.		
	In	Out
	2447	2090
on Main	1028	1630
40%	411	652
60%	617	978

		Average ITE Rates		Plus two St.Dev.	
Approach	Direction	LOS	delay(s)	LOS	delay(s)
NB	through	A	6.5	A	7.0
	left	B	10.9	C	29.4
SB	through	B	13.1	B	17.6
	right	A	2.0	A	5.3
EB	left	D	46.0	F	351.5
	right	D	39.2	F	328.0
Intersection Totals		**B**	**18.0**	**F**	**140.6**

Volume Distribution with and without internal capture

with internal capture 13.1%			without internal capture		
	In	Out		In	Out
Total	723	639	Total	832	735
on Main	304	498	on Main	350	573
40%	122	199	40%	140	229
60%	182	299	60%	210	344

Volume Differences Between Trip Generation With and Without Internal Capture				
		internal capture 13.1%	**no internal capture**	**Difference in # of vehicles**
Total Volumes Predicted by ITE	Entering	723	832	**109**
	Exiting	639	735	**96**
Volume Percentages on Main Street	Entering (42%)	304	349	**46**
	Exiting (78%)	498	573	**75**
Volume Directional Splits for Turning Movements	Exiting to NB (40%)	199	229	**30**
	Exiting to SB (60%)	299	344	**45**
	Entering from NB (40%)	121	140	**18**
	Entering from SB (60%)	182	210	**27**

US15-501/Main Street - PM peak
Volumes/LOS/Delays - with/without internal capture

	IC 13.1%	no IC
Total ITE-TG prediction in:	723	832
Total ITE-TG prediction out:	639	735

Plus 2 Std. Dev.	
Total Volume in:	2447.15
Total Volume out:	2089.69

Main Street Directional Split:				
	OUT to NB:	40%	IN from NB:	40%
	OUT to SB:	60%	IN from SB:	60%

Percentage on Main Street in:	42%
Percentage on Main Street out:	78%

		ITE trip generation predictions with measured green times - **with internal capture 13.1%**			ITE trip generation predictions with measured green times - **without internal capture**			Volumes with +2STD from ITE trip generation: max. greens on Main and measured green times on other approaches			Volumes with +2STD from ITE trip generation: max. green times on all approaches		
		vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)
NB	through	497	A	6.5	497	A	6.5	497	A	9.5	497	A	7.0
	left	122	B	10.4	140	B	10.9	411	D	41.9	411	C	29.4
	Total	619	A	7.3	637	A	7.5	908	C	24.2	908	B	17.2
SB	through	750	B	13.1	750	B	13.1	750	B	17.1	750	B	17.6
	right	182	A	1.9	210	A	2.0	617	A	3.4	617	A	5.3
	Total	932	B	10.9	960	B	10.7	1367	B	10.9	1367	B	12.1
EB	left	199	D	43.6	229	D	46.0	652	F	148.5	652	F	351.5
	right	299	D	36.0	344	D	39.2	978	F	256.0	978	F	328.0
	Total	498	D	38.9	573	D	41.9	1630	F	213.1	1630	F	337.3
Intersection Totals		**2049**	**B**	**16.6**	**2170**	**B**	**18.0**	**3905**	**F**	**93.2**	**3905**	**F**	**140.6**

with internal capture 13.1%			**without internal capture**			**+2 STD Volumes**		
	In	Out		In	Out		In	Out
Total	723	639	Total	832	735		2447	2090
on Main	304	498	on Main	350	573	on Main	1028	1630
40%	122	199	40%	140	229	40%	411	652
60%	182	299	60%	210	344	60%	617	978

		without int. capture		**with int.capt. 13.1%**		**Plus two St.Dev.**	
Approach	Direction	LOS	delay(s)	LOS	delay(s)	LOS	delay(s)
NB	through	A	6.5	A	6.5	A	7.0
	left	B	10.9	B	10.4	C	29.4
SB	through	B	13.1	B	13.1	B	17.6
	right	A	2.0	A	1.9	A	5.3
EB	left	D	46.0	D	43.6	F	351.5
	right	D	39.2	D	36.0	F	328.0
Intersection Totals		**B**	**18.0**	**B**	**16.6**	**F**	**140.6**

US15-501/Main Street - PM peak
Volumes/LOS/Delays - percentages added for possible underprediction

	IC 13.1%	no IC
Total ITE-TG prediction in:	723	832
Total ITE-TG prediction out:	639	735

Main Street Directional Split:	OUT to NB:	40%	IN from NB:	40%
	OUT to SB:	60%	IN from SB:	60%

		ITE trip generation predictions with measured green times - **without internal capture**			ITE trip generation predictions with measured green times - **with internal capture 13.1%**			ITE trip generation predictions - with internal capture 13.1% - **SV volumes +50%**			ITE trip generation predictions - with internal capture13.1% - **SV volumes +100%**			ITE trip generation predictions - with internal capture 13.1%- **SV volumes +150%**		
		vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)	vph	LOS	delay(s)
NB	through	497	A	6.5	497	A	6.5	497	A	7.0	497	A	7.0	497	A	7.0
	left	140	B	10.9	122	B	10.4	182	B	14.3	243	B	16.8	304	C	20.0
	Total	637	A	7.5	619	A	7.3	679	A	9.0	740	B	10.2	801	B	12.0
SB	through	750	B	13.1	750	B	13.1	750	B	17.6	750	B	17.6	750	B	17.6
	right	210	A	2.0	182	A	1.9	273	A	3.4	365	A	3.8	456	A	4.3
	Total	960	B	10.7	932	B	10.9	1023	B	13.8	1115	B	13.1	1206	B	12.6
EB	left	229	D	46.0	199	D	43.6	299	E	79.0	398	F	140.1	498	F	249.5
	right	344	D	39.2	299	D	36.0	448	E	59.6	598	F	115.1	747	F	223.3
	Total	573	D	41.9	498	D	38.9	747	E	67.4	996	F	125.1	1245	F	233.8
Intersection Totals		**2170**	**B**	**18.0**	**2049**	**B**	**16.6**	**2449**	**C**	**28.8**	**2851**	**D**	**51.5**	**3252**	**F**	**97.1**

without internal capture			**with internal capture 13.1%**			**volumes plus 50%**			**volumes plus 50%**			**volumes plus 150%**		
	In	Out		In	Out		In	Out		In	Out		In	Out
Total	832	735	Total	723	639	Total	1085	958	Total	1447	1277	Total	1808	1596
on Main	350	573	on Main	304	498	on Main	456	747	on Main	608	996	on Main	759	1245
40%	140	229	40%	122	199	40%	182	299	40%	243	398	40%	304	498
60%	210	344	60%	182	299	60%	273	448	60%	365	598	60%	456	747

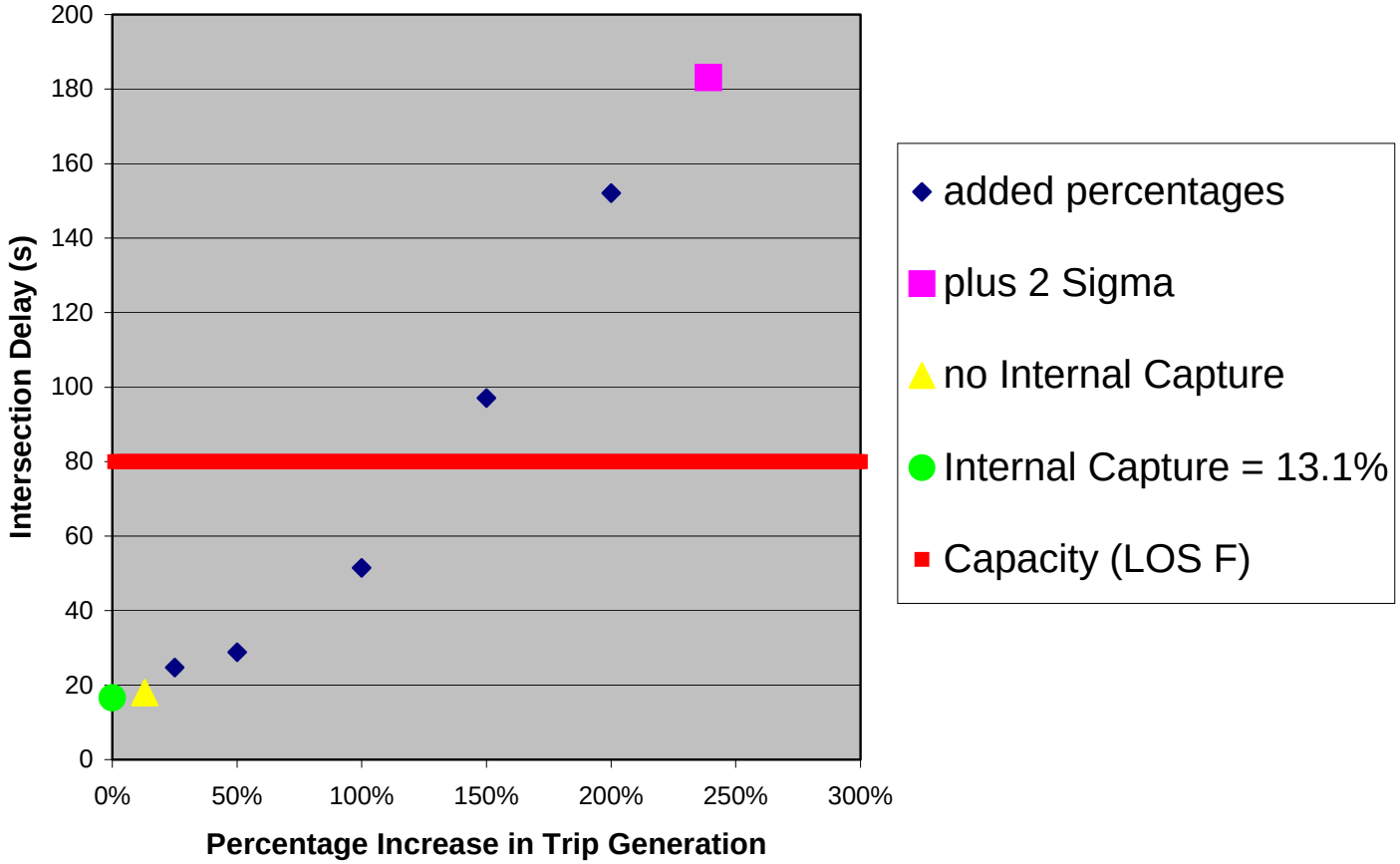
Approach	Direction	**ITE forecast**		**SV volumes +10%**		**SV volumes +25%**		**SV volumes +50%**	
		LOS	delay(s)	LOS	delay(s)	LOS	delay(s)	LOS	delay(s)
US15-501	through	A	6.5	A	7.0	A	13.3	A	7.0
NB	left	B	10.4	B	12.8	B	7.0	B	14.3
US15-501	through	B	13.1	B	17.6	B	17.6	B	17.6
SB	right	A	1.9	A	3.1	A	7.0	A	3.4
Main Street	left	D	43.6	E	64.2	E	68.2	E	79.0
EB	right	D	36.0	D	47.7	D	51.1	E	59.6
Intersection Totals		**B**	**16.6**	**C**	**22.9**	**C**	**24.7**	**C**	**28.8**

max. g measured
vph
497
411
908
750
617
1367
652
978
1630
3905

Approach	Direction	**ITE forecast**		**SV volumes +100%**		**SV volumes +150%**		**SV volumes +200%**	
		LOS	delay(s)	LOS	delay(s)	LOS	delay(s)	LOS	delay(s)
US15-501	through	A	6.5	A	7.0	A	7.0	A	7.0
NB	left	B	10.4	B	16.8	C	20.0	C	24.6
US15-501	through	B	13.1	B	17.6	B	17.6	B	17.6
SB	right	A	1.9	A	3.8	A	4.3	A	4.8
Main Street	left	D	43.6	F	140.1	F	249.5	F	369.7
EB	right	D	36.0	F	115.1	F	223.3	F	341.6
Intersection Totals		**B**	**16.6**	**D**	**51.5**	**F**	**97.1**	**F**	**152.1**

Approach	Direction	**without int. capture**		**with 13.1% Int. Capt.**	
		LOS	delay(s)	LOS	delay(s)
US15-501	through	A	6.5	A	6.5
NB	left	B	10.9	B	10.4
US15-501	through	B	13.1	B	13.1
SB	right	A	2.0	A	1.9
Main Street	left	D	46.0	D	43.6
EB	right	D	39.2	D	36.0
Intersection Totals		**B**	**18.0**	**B**	**16.6**

Main Street / US 15-501 Intersection Analysis



Appendix Q: Resident Survey

This Appendix presents a summary of the resident survey conducted by the research team of the Department of City and Regional Planning at the University of North Carolina at Chapel Hill. The following data tables and equations are those used for comparison with other trip generation methods used in this report.

Southern Village:

Southern Village contains a variety of housing types including single-family homes, apartments, condominiums and townhouses. The results from the resident survey were used to develop equations for the different residential land uses in the broad categories of single-family and multifamily residential. These equations can then be used in combination with land use intensities to estimate rates for generated traffic of each land use. The equations developed from the survey are all given in the following form:

$$Trip\ Rate = Coeff_1*(Average\ Value_1) + Coeff_2*(Average\ Value_2) + Constant$$

The two main variables in the equation were "Size of Household" and "Number of Vehicles". For each of the variables an average value was calculated that remained constant across all calculations for Southern Village. In addition coefficients were calculated for each land use classification.

Residential land uses in Southern Village were divided in the classifications "All Households", "Multi-Family Residential", and "Single-Family Homes". The survey produced separate equations for each of these categories that described the amount of total traffic generated. In addition, a fourth equation describes external traffic only for the "Single-Family Homes" category, which allows for a rough estimate of internal for that land use.

Table Q-1 below summarizes the calculated coefficients for the "All household" category

Table Q-1 Village Trip Generation "All Housholds"

	All Households				
	Coeff	**Average Val**			
Constant	0.586	1	0.586		
Size of Household	1.212	2.28	2.76336		
Number of Vehicles	1.781	1.65	2.93865	**Intensity**	**ADT**
		Rate	6.28801	1095	6885.371

Using the coefficients listed in table Q-1 the equation to describe the trip rate for all residential households is as follows:

Trip Rate (All Households) = 1.212*(2.28) + 1.781*(1.65) + 0.586
= 6.28801 trips/resid.unit/day

Multiplying the calculated rate with the overall intensity of residential housing in Southern Village yields the total number of average daily traffic generated from residential land uses. The resident survey therefore estimates 6885 trips per day estimated from all residences in Southern Village.

Similar to the example above, coefficient were developed for “Multi-Family” and “Single-Family” residential units separately. “Multi-Family” residential includes apartments, condominiums, and town homes in Southern Village. Tables Q-2 and Q-3 below summarize obtained coefficients. The equations used to calculate the rates are provided following each table.

Table Q-2: Southern Village Trip Generation "Multi-Family Households”

	Multi-Family				
	Coeff	**Average Val**			
Constant	0.288	1	0.288		
Size of Household	1.29	2.28	2.9412		
Number of Vehicles	1.62	1.65	2.673	**Intensity**	**ADT**
		Rate	5.9022	585	3452.787

Trip Rate (Multi-Family) = 1.29*(2.28) + 1.62*(1.65) + 0.288
= 5.9022 trips/resid.unit/day

Table Q-3: Southern Village Trip Generation "Single-Family Households”

	Single Family				
	Coeff	**Average Val**			
Constant	1.377	1	1.377		
Size of Household	1.111	2.28	2.53308		
Number of Vehicles	1.594	1.65	2.6301	**Intensity**	**ADT**
		Rate	6.54018	510	3335.492

Trip Rate (Single-Family) = 1.111*(2.28) + 1.594*(1.65) + 1.377
= 6.54018 trips/resid.unit/day

Finally, the survey derived coefficients for external trips only of single-family residential units. Table Q-4 shows coefficients and the equation used to calculate estimated vehicle from single-family homes that leave the development.

Table Q-4: Southern Village Trip Generation "Single-Family External”

	S/F External				
	Coeff	**Average Val**			
Constant	0.851	1	0.851		
Size of Household	0.833	2.28	1.89924		
Number of Vehicles	1.826	1.65	3.0129	**Intensity**	**ADT**
		Rate	5.76314	510	2939.201

Trip Rate (S/F External) = 0.833*(2.28) + 1.826*(1.65) + 0.851
= 5.76314 trips/resid.unit/day

Table Q-5: Southern Village Resident Survey Trip Estimates Summary

Survey Trip Generation Results for Southern Village			
Land Use Type	Rate (veh. trips/unit)	Intensity (# of units)	Daily Traffic Forecast (veh.
All Residential Households	6.29	1095	6885
Multi-Family Residential	5.90	585	3453
Single-Family Homes (SFH)	6.54	510	3335
SFH External	5.76	510	2939

Summarizing the survey results, Table Q-5 shows rates for each land use type, the intensity and the resulting daily traffic estimates. For the Single-Family homes category the table further shows external trips only. From the two SFH the internal capture rate then is calculated to be 11.9%. It is important to note that this internal capture rate only corresponds to Single Family homes and was obtained only from responses given in the resident survey. It therefore does not represent an interaction of land uses as in the ITE method and is not necessarily indicative of other residential classifications.

Lake Hogan Farms

In order to obtain a sufficient sample size of responses to the resident surveys, several neighborhoods in close proximity to Lake Hogan Farms were administered the same questionnaire. In the evaluation of the survey results two separate equations were developed one for Lake Hogan Farms alone, and a second one for all surveyed “Northern Carrboro” neighborhoods. The equations were developed in the same form as discussed above for Southern Village The following tables list the coefficients, average values and the completed equations for both data sets. In each case only the housing intensity for Lake Hogan Farms was applied.

Table Q-6: Lake Hogan Farms Trip Generation "Northern Carrboro Equation”

	Coeff.	Average Val			
Constant	1.457	1	1.457		
Size of Household	0.997	3.26	3.25022		
Number of Vehicles	2.234	2.11	4.71374	Intensity	ADT
		Rate	9.42096	252	2374.082

Trip Rate (Northern Carrboro) = 0.997*(3.26) + 2.234*(2.11) + 1.457
= 9.42096 ***trips/resid.unit/day***

Table Q-7: Lake Hogan Farms Trip Generation "Lake Hogan Farms Equation"

	Coeff.	Average Val			
Constant	3.378	1	3.378		
Size of Household	1.166	3.26	3.80116		
Number of Vehicles	1.046	2.11	2.20706	**Intensity**	**ADT**
		Rate	9.38622	252	2365.327

Trip Rate (Lake Hogan Farms) = 1.166*(3.26) + 1.046*(2.11) + 3.378
= 9.38622 ***trips/resid.unit/day***

The intensity in the above tables is the number of single family homes in Lake Hogan Farms. The calculated trips are average daily traffic estimates for the Lake Hogan Farms development. All trips can be considered external, because there is no internal capture in a single-land-use development. Table Q-8 below summarizes the results of the resident survey calculations for Lake Hogan Farms.

Table Q-8: Lake Hogan Farms Resident Survey Trip Estimates Summary

Survey Trip Generation Results for Lake Hogan Farms			
Land Use Type	**Rate (veh. trips/unit)**	**Intensity (# of units)**	**Daily Traffic Forecast (veh.**
Single-Family Homes (SFH) - "Northern Carrboro Equation"	9.42	252	2347
Single-Family Homes (SFH) - "Lake Hogan Farms Equation"	9.39	252	2365

Appendix R: Simulation

Why Simulation?

The literature review in Chapter 2 has identified time-dependent traffic simulations as a possible alternative in the assessment of traffic impacts of Traditional Neighborhood Developments (TND). To further assess the feasibility of using traffic simulations for Traffic Impact Analysis (TIA) applications, the scope of this report included creating a sample simulation model and evaluate its benefits versus time effort and cost.

While traffic simulations rely on other methods for trip generation (like the ITE method or a regional Travel Demand Model) it allows for a visual representation of traffic impacts on the simulated section of the road network. Traffic simulations such as CORSIM, SIMTRAFFIC or VISSIM may therefore become viable alternatives to the trip distribution and capacity analysis steps of a TIA. In recent years, consultants have used simulation models increasingly, because of their ability to represent and analyze system-wide traffic behavior. Furthermore, simulations have become a strong political tool, as they are relatively easy to follow visually and enable professionals to better convey traffic engineering concepts and findings to a broad public audience.

This appendix summarizes the process of constructing a simulation model of the Southern Village neighborhood in the VISSIM software package, developed by PT-Vision and the University of Karlsruhe, Germany. The VISSIM model was chosen over other models such as CORSIM or SIMTRAFFIC because its program code includes a “dynamic assignment” routine, which could feasibly be used to model internal travel behavior in the neighborhoods. Also, VISSIM includes a three-dimensional visualization of traffic, which increases its political marketability. For a more detailed discussion of benefits and drawbacks of traffic simulation models over other TIA methods please refer to the Literature Review in Chapter 2 of this report.

Objectives

For this project, only the Southern Village neighborhood was included in the simulation analysis. Southern Village is bigger than the Lake Hogan Farms development and was believed to be more interesting in a modeling application, as the interaction of different land uses leads to a significant amount of internal traffic (internal capture). The model developed includes the major roads within the neighborhood and collectors and arterials adjacent to the neighborhood.

Developing a simulation model of Southern Village had the following objectives:

- Built a model showing all major internal and external roads to the neighborhood
- Represent external traffic consistent with traffic counts taken at the entrances and exits to the development
- Incorporate internally generated traffic as predicted from the ITE trip generation method
- Evaluate traffic flow in the model visually

- Compare costs of developing the model with potential benefits for TIA application and make recommendations for future use

Method

Before programming a simulation model in VISSIM it is helpful to decide on assumptions for the model. In some cases values predefined in VISSIM may not be applicable for the region and need to be adapted accordingly to let the model behave accurately. Having decided on necessary data parameters in advance greatly facilitates data input and also assures consistency for the model. Table R-1 lists of assumptions was used for the Southern Village model:

Table R-1: List of Assumptions for VISSIM Model

Assumptions of VISSIM Model		
Turn curvature (Spline):	6 curve points for left, 4 for right turns, 2 for straight	
Priority rules:	Consistent with traffic rules	
Traffic Composition:	Assumed defaults	
Turning Movements:	All left turns into left lane (where applicable)	
	All right turns into right lane (where applicable)	
Signals:	Assume fixed-time signals	
	Assume field measurements for green allocation	
Speed Distribution:	Assume ± 4 mph of posted speed limit	
Ped. Speed Distribution:	Desired speed between 3.0 and 4.0 mph [3.0, 4.0] mph	
Speed Reductions:	Left Turns:	Cars [18.6, 24.9] mph
		HGV [15.5, 18.6] mph
	Right Turns:	Cars [15.5, 18.6] mph
		HGV [12.4, 15.5] mph
	Merge:	NONE
	Major Approaches:	NONE
	Minor Approaches:	Cars [18.6, 24.9] mph
		HGV [15.5, 18.6] mph
Gap acceptance:	Right Turn:	min. gap = 3.0 sec
		min. headway = 16.4ft (5m)
	Left Turn:	min. gap = 5.0 sec
		min. headway = 32.8ft (10m)
	Through:	min. gap = 5.0 sec
		min. headway = 32.8ft (10m)

The following steps were taken to complete the simulation model in the VISSIM software package.

1. Obtain an aerial photograph of the study area in the “Bitmap” file format (.bmp) with sufficient resolution to identify road features and building layouts. The availability of a GIS file containing an aerial photo layer, as well as, road centerlines and property lines may facilitate programming (the file still needs to be exported as a bitmap).

Then determine the scale of the photo file by identifying known features and providing the software with an accurate distance measurement between two landmarks.

2. Layout the road network as desired by following road alignments visible in the aerial photo or centerlines in a converted GIS file.
3. Join roads with left turn and right turn connectors. It may be desirable to decide on a fixed number of "curve points" (Spline) for consistency.
4. Configure Speed Distributions to be used by vehicles in zones of a certain speed limit (in this case for 25mph, 35mph, and 45mph). Also configure speed distribution for pedestrians.
5. Input traffic compositions for regular traffic (% trucks) and pedestrian traffic
6. Enter vehicle generators into the network with traffic volumes and time distribution of traffic (US15-501 NB and SB; Mt. Carmel Church Rd NB; Culbreth Rd. EB; Internal Generators)
7. Specify desired speed distributions (speed limits) following traffic generator points and at locations where speed limit changes
8. Insert speed reduction zones at intersections (turning movements and throughs)
9. Program Routing Decisions following generator points and at the three entrance points to the development
10. Place stop signs where applicable
11. Enter necessary priority rules at all unsignalized intersections
12. Program signal timings for signalized intersection and add priority rules where necessary

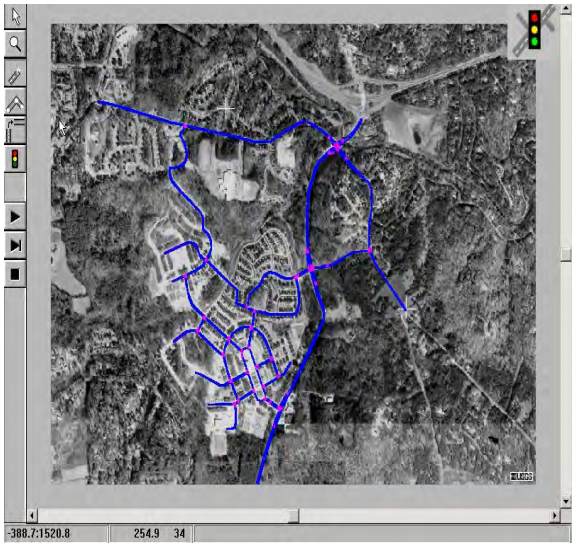
Table R-2 summarizes the method and includes estimates of working hours spent for each step.

Table R-2: VISSIM Programming Time

VISSIM Time Sheet		
	Taks	**Time**
1	Aerial photo	4.0
2	Road Network	9.5
3	Draw Connectors	5.0
4	Speed Distributions	1.0
5	Traffic Compositions	1.0
6	Traffic Generators	12.0
7	Speed Limits	1.0
8	Speed Reductions	3.0
9	Routing Decisions	15.0
10	Stop Signs	1.0
11	Priority Rules	6.0
12	Signal Timing	4.5
13	Operations	10.0
14	Tutoral	27.0
15	Other	30.5
	TOTAL	**130.5**

In the following several screenshots of the completed simulation model are shown. Figure R-1 shows the aerial photograph and the entire superimposed VISSIM model. The aerial photo was taken before the entire neighborhood was completed, but included sufficient detail to allow for programming.

Figure R-1: Overview of VISSIM model



The next two images show close-ups of two intersections modeled in the VISSIM simulation of Southern Village. Figure R-2 shows the intersection of Main Street and US15-501, the main entrance and exit into the development. In the background the one-way loop in the commercial village center of Southern Village is visible. The parking lot inside the loop serves as a traffic attractor and generator. The image is provided in the three-dimensional view featured in the VISSIM software.

Figure R-2: Intersection of US15-501 and Main Street

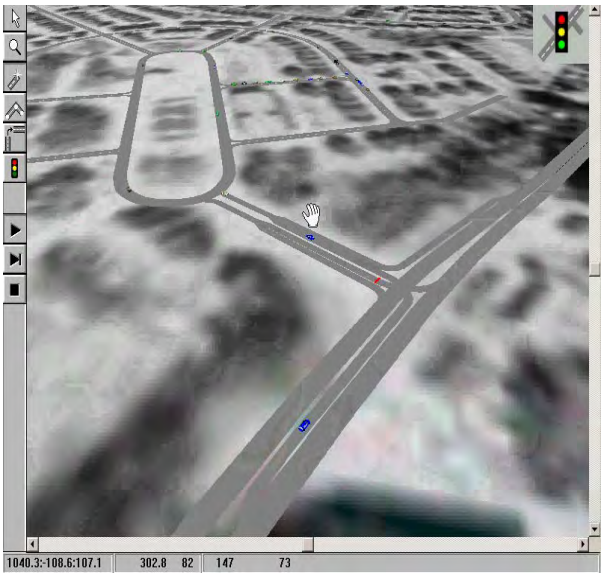
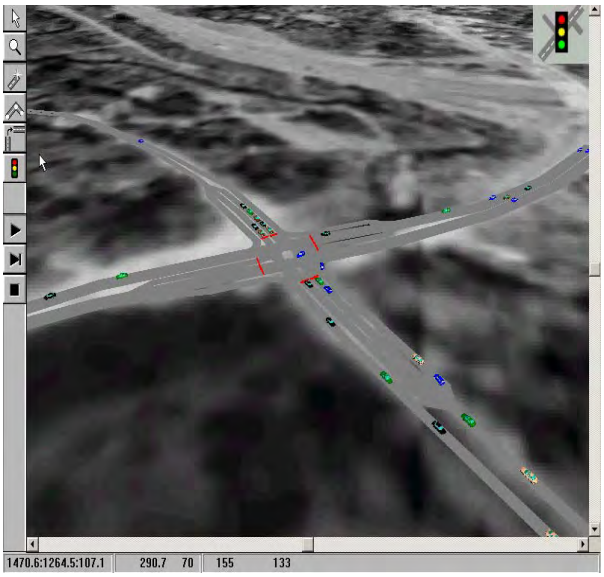


Figure R-3 shows the intersection of US15-501 and Culbreth Rd. located to the north of the neighborhood. The latter intersection is most likely to be affected by traffic generated by the development.

Figure R-3: Intersection of US15-501 and Culbreth Road



Discussion

The experience with the VISSIM software package has shown that the programming of an accurate representation of a TND neighborhood and surrounding streets requires a significant time input and specifically trained staff. More importantly the successful implementation of the simulation model requires trip generation and trip distribution estimates derived from other methods. For the visual analysis of the traffic impacts of one isolated neighborhood as was done here with Southern Village, the costs in training and programming time therefore exceed the benefits of having a dynamic, optical representation of predicted traffic flows.

However, for future traffic impact assessments and as a regional planning tool, time-dependent traffic simulation may prove to be a very powerful tool. Simulation software represents the unique ability to model the interaction of several TND neighborhoods along the same corridor for example. Traffic Simulations may therefore provide an insight in traffic impacts and road network capacity for multiple TND developments. They allow for a fast and easy adjustment of traffic volumes and roadway modification and show impacts of such changing conditions visually, as well as, in the form of delay and travel time data output.

With an anticipated simplification of programming effort in the future and decreasing time requirements for creating models, simulation methods are likely to find their place as a TIA tool in the future. They allow the addition of public transportation modes and pedestrian movements in the modeling process, which will become an ever more important issue as the number of TND neighborhoods increases.

As discussed in Chapter 2, it may also become feasible in the future to integrate traffic simulations with regional travel demand model, which would greatly facilitate the required amount of data input. Such methodology would possibly allow using regional traffic generation data for overall network analyses and inserting simulation models in specific areas that require a more focused assessment.

Transportation Planning for Heartland Town Square-

A Major Regional Mixed-Use Project

Brentwood, NY

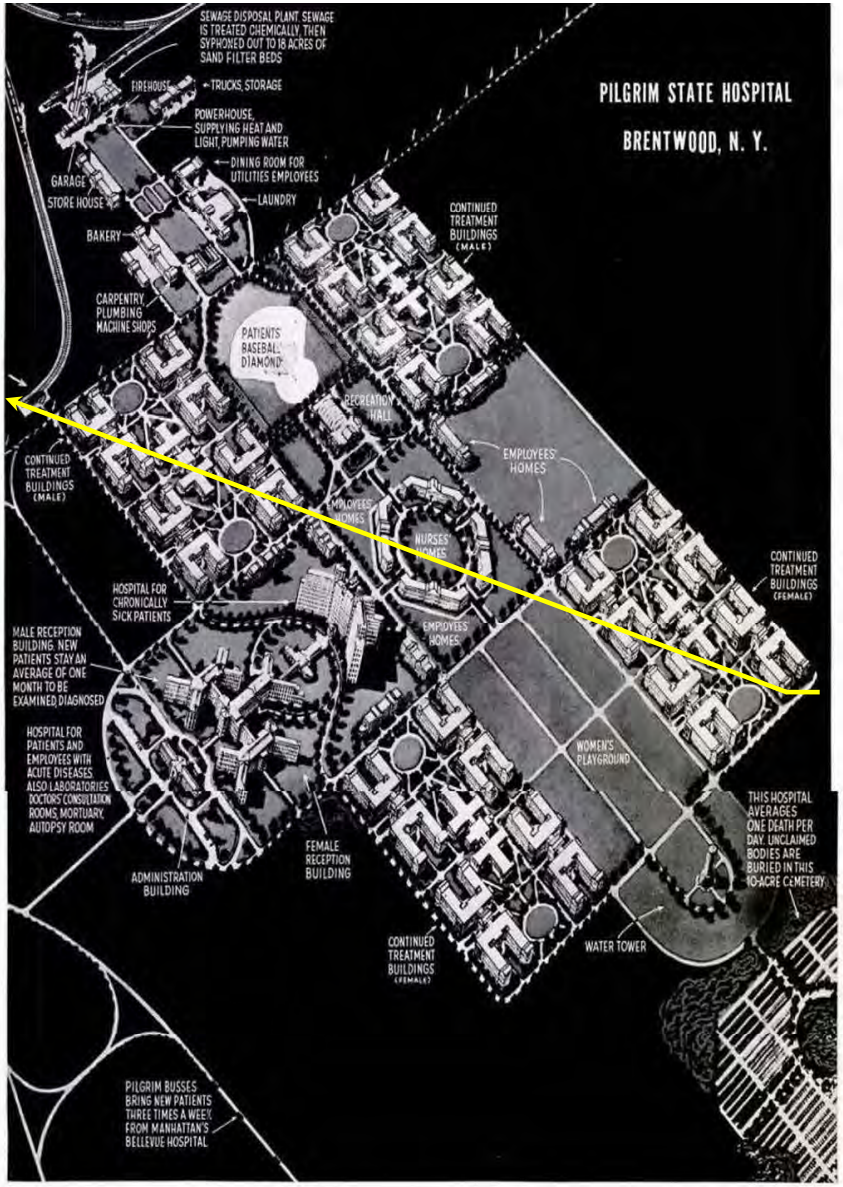
Presented to:
ITE 2011 Northeastern District Meeting

Presented by:
Robert M. Eschbacher, PE
VHB Engineering, Surveying & Landscape Architecture, P.C.

May 26, 2011

The Story

- Downtowns are the key to reversing troubling trends
- Nassau County has virtually nowhere left to build, and Suffolk's open space could be gone within a decade
- **Young adults move away**
- Smart Growth at Heartland Town Square (HTS)
  - Residents live close to work
  - Shops, other businesses and civic uses merge in an integrated neighborhood environment
  - Minimizes the need for single occupancy vehicles



The History

- Pilgrim State Hospital was named after Dr. Charles W. Pilgrim, Commissioner of Mental Health in the early 1900s
- When it was built, Pilgrim was the largest facility of its kind in the world

TRAIN STATION

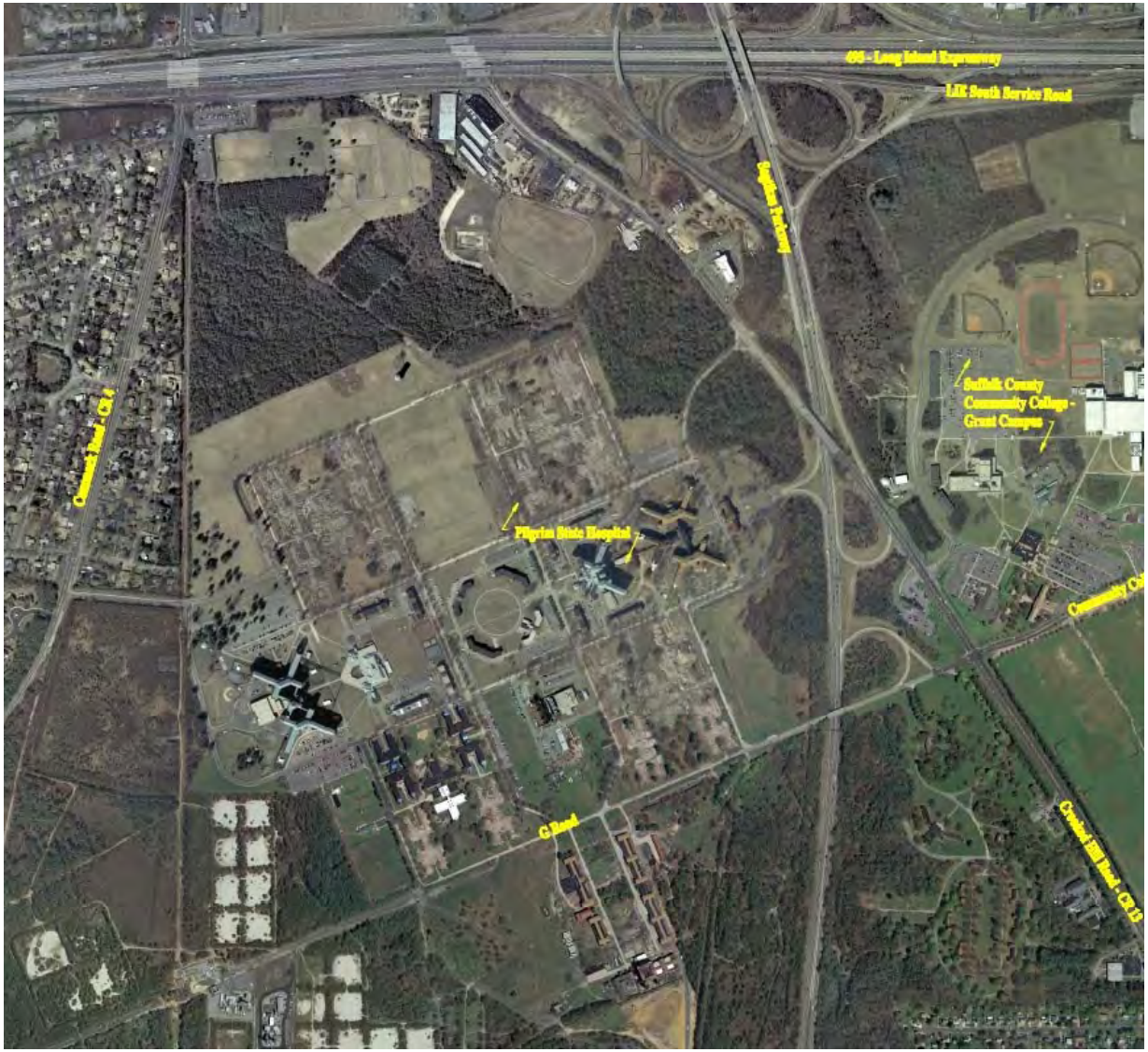
The History

- NYS bought approx. 1,000 acres of land in Brentwood and began construction of Pilgrim in 1930
- Opened in 1931, Pilgrim had its own LIRR station, fire and police departments, power plant, potters field, swine farm, church, water tower, and staff housing
- Underground tunnels were used for transporting food as well as carrying steam pipes
- The number of patients peaked in 1954 with 13,875

The Present

- As patients were discharged and services became available in the community, the need for large facilities to treat the mentally ill diminished
- Today, Pilgrim reflects the history and best practices for care and treatment and has become a modern healthcare delivery system serving the mentally ill adults of Long Island

The Present


495 - Long Island Expressway
LIE South Service Road
Southern Parkway
Suffolk County Community College - Grant Campus
Pilgrim State Hospital
G Road

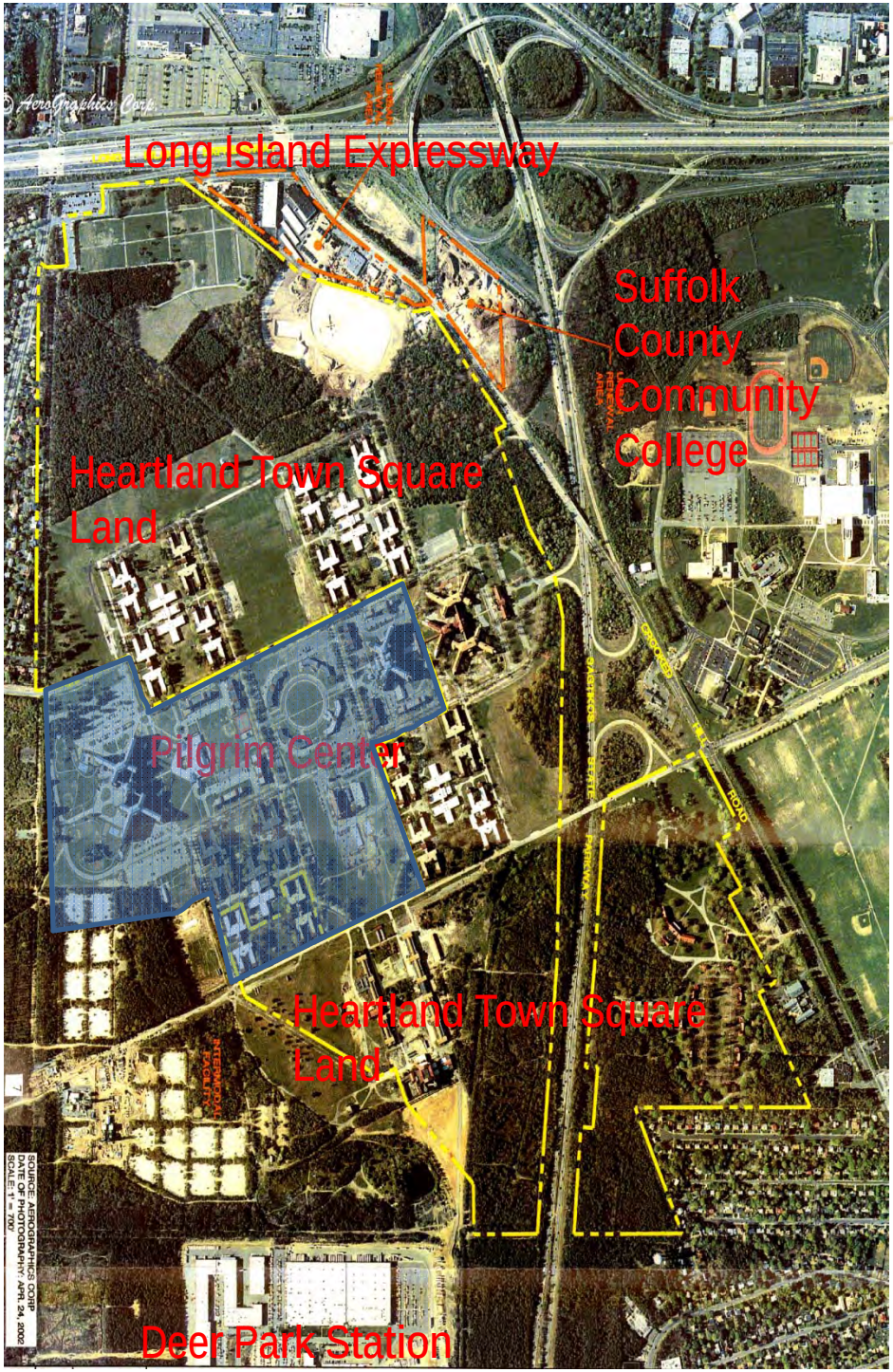
The Future

Table of Uses by Phase

Use	Phase I	Phase II	Phase III	TOTAL
Residential (units)	3,500	3,500	2,000	9,000
Office (SF)	625,000	1,600,000	1,125,000	3,350,000
Civic (SF)	210,500	5,000	0	215,500
Retail (SF)	560,000	390,000	50,000	1,000,000

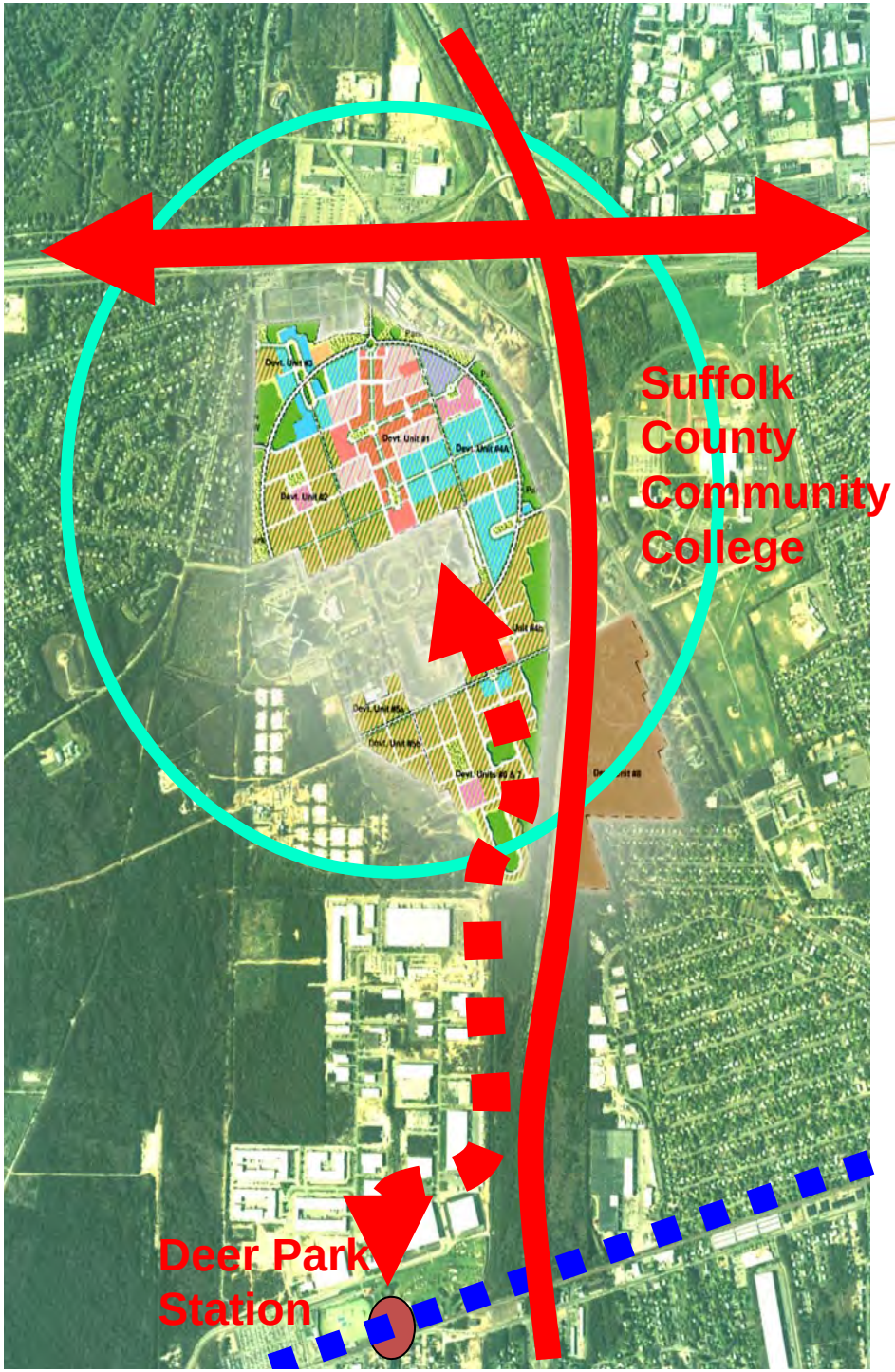
Trips Generated and Reduced by Internal Capture

	AM Weekday	PM Weekday	Saturday Midday
Full Build (unadjusted)	6,041	9,252	7,003
Full Build (adjusted)	5,184	7,440	5,395
Internal capture rate	14%	20%	23%



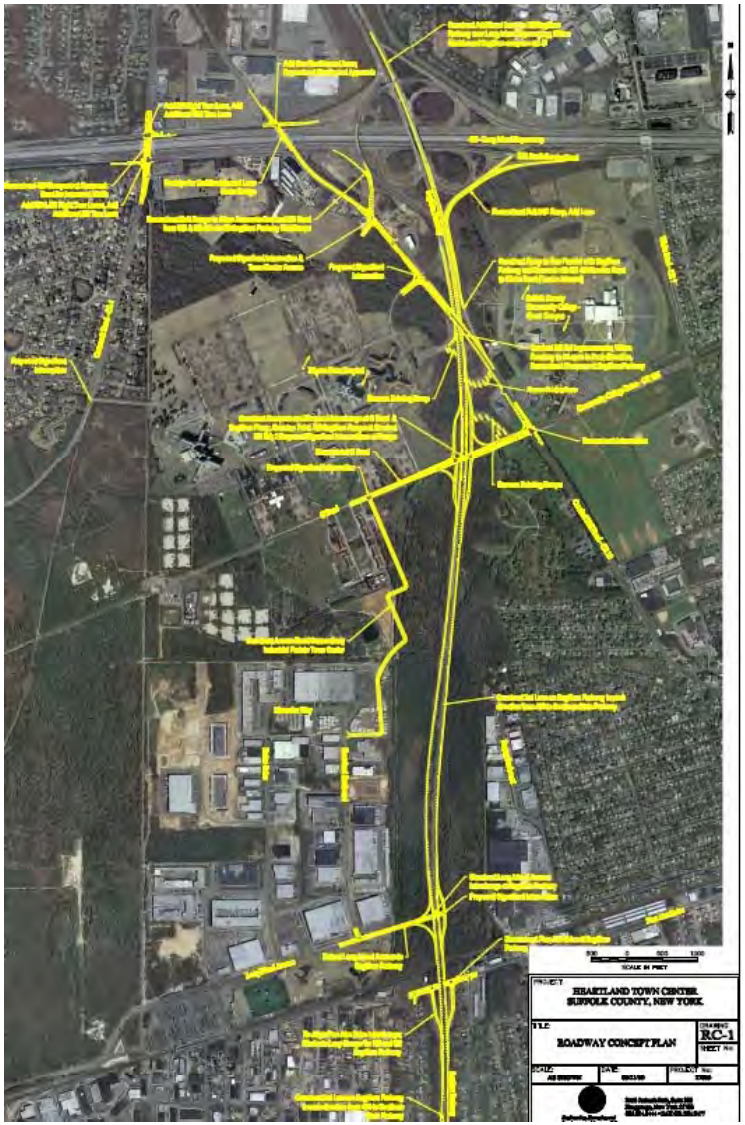
The Future

- The Planned Redevelopment District occupies 476 acres of land decommissioned by the State
- It is strategically located close to LIRR at the junction of the Long Island Expressway and the Sagtikos Parkway at the midpoint of Long Island



Regional Access

- Five minute ride to LIRR; less than an hour to NYC
- Direct access to Long Island Expressway and Sagtikos Parkway
- Less than 2 miles from Northern State Parkway
- Less than 2.5 miles from Southern State Parkway
- Less than 3.5 miles from Sunrise Highway



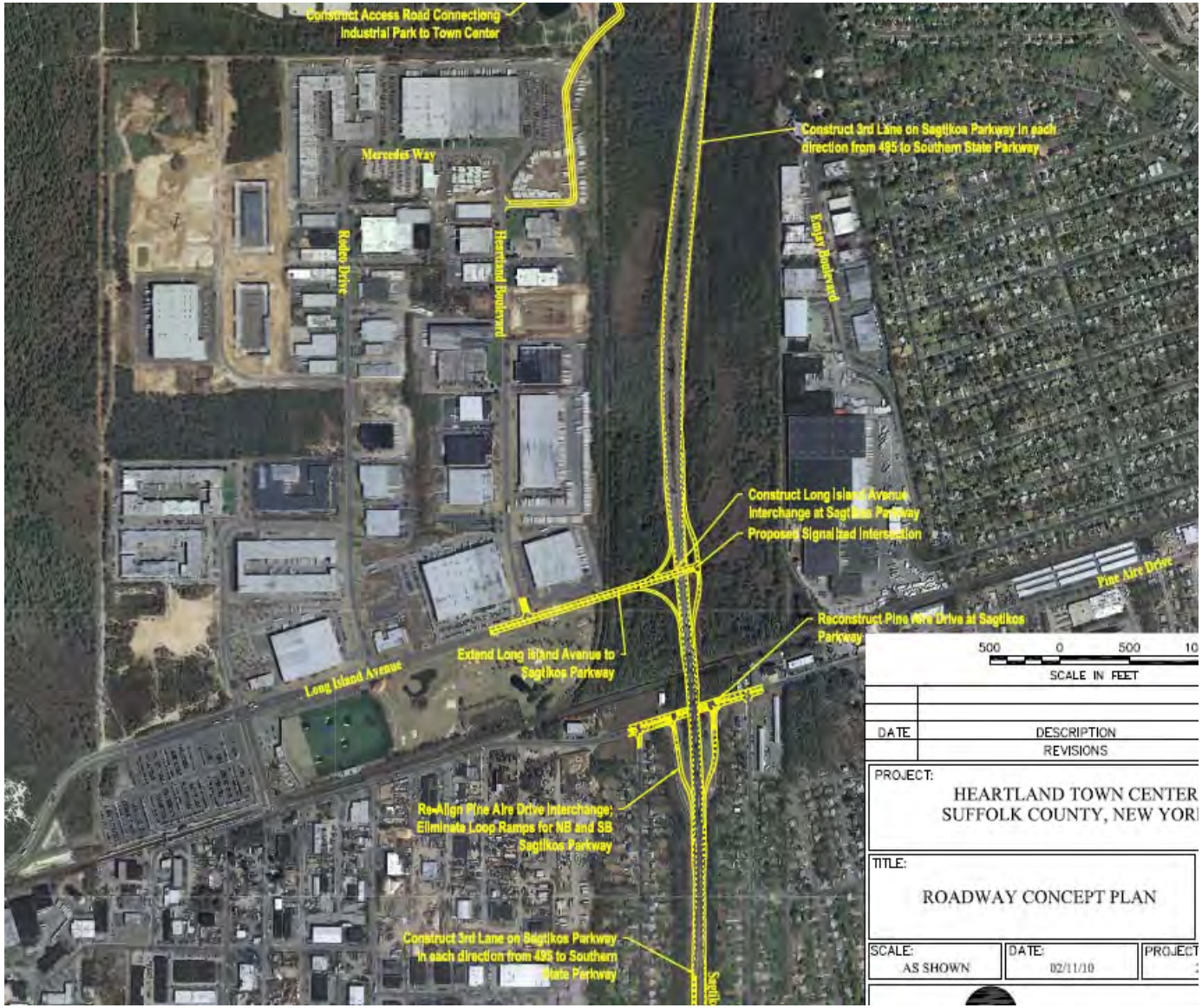
The Future

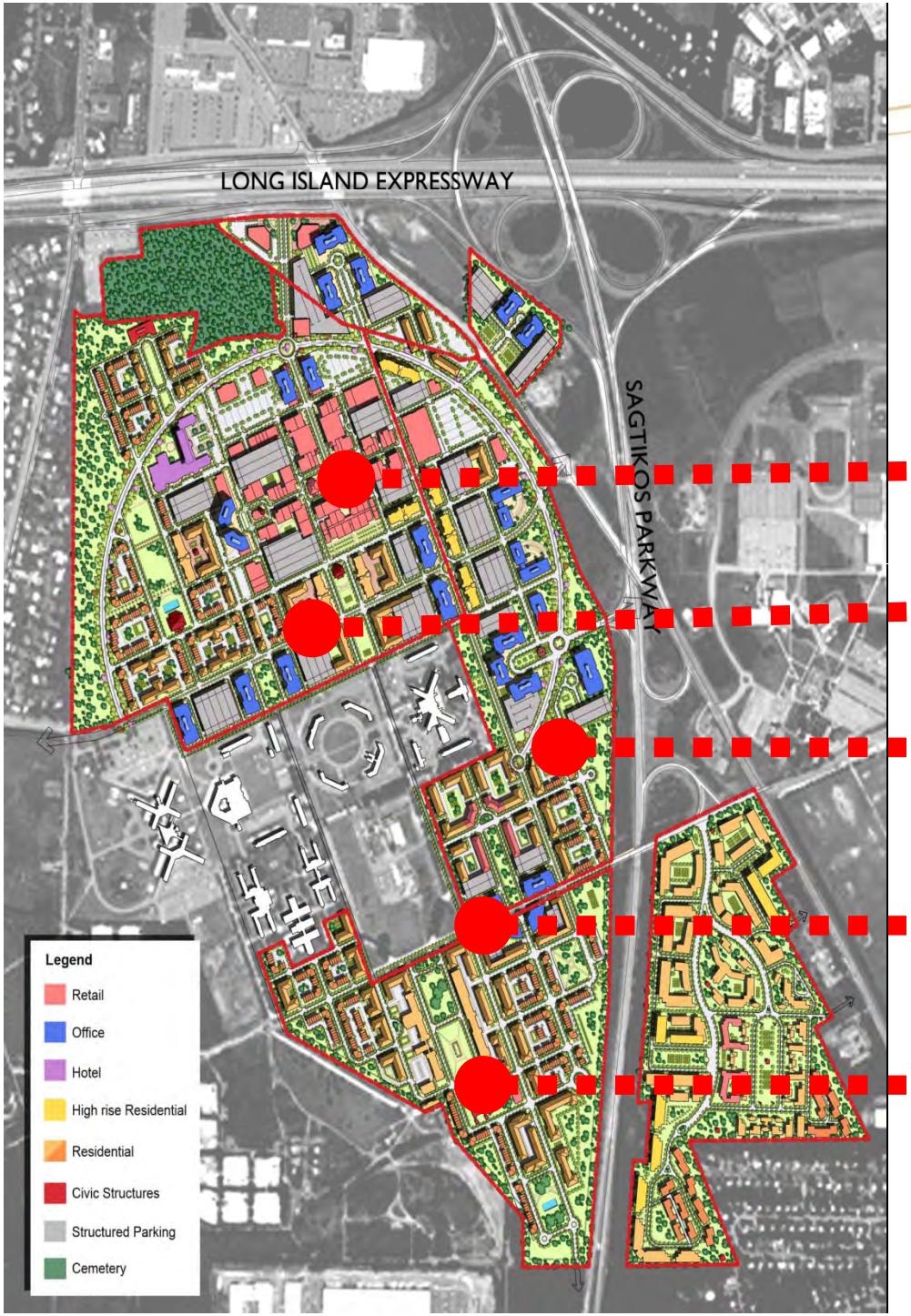
- Widen Sagtikos Parkway
- New LIE Ramp Configuration
- New Interchange
- Modified Interchange
- Intersection Improvements
- Internal Transit Service

The Future

Reconstruct Intersection
Reconstruct Intersection
495 - Long Island Expressway
LIE South Service Road
Reconstruct 495 Overpass at Commack Road for increased Width Intersection Improvements
Reconstruct 495 Overpass at Crooked Hill Road for Increased Width
Reconstruct Exit Ramps to Allow Access to Crooked Hill Road from WB & EB 495 via SB Sagtikos Parkway Exit Ramps
Sagtikos Parkway
Reconstruct Exit S1E Ramp, Add Lane
Construct Additional NB Commack Road Lane
Proposed Signalized Intersection & Town Center Access
Proposed Signalized Intersection
Construct Ramp to Run Parallel with Sagtikos Parkway and Connect with EB 495 Service Road to Wicks Road (Trucks Allowed)
Wicks Road - CR 7
Suffolk County Community College - Grant Campus
Crooked Hill Rd Improvements; Widen Roadway to 3 Lanes in Each Direction, Reconstruct Overpass at Sagtikos Parkway
Pilgrim State Hospital
Remove Existing Ramp
Community College Drive - CR 104
Commack Road - CR 4
Construct Overpass and Diamond Interchange at G Road & Sagtikos Pkwy; Abandon Exist. NB Sagtikos Ramps at Crooked Hill Rd; 2 Proposed Signalized Intersections at Ramps
Reconstruct Intersection
Reconstruct G Road
Proposed Signalized Intersection
Remove Existing Ramps
G Road
Crooked Hill Road - CR 13

The Future


Construct Access Road Connecting Industrial Park to Town Center
Mercedes Way
Rodeo Drive
Heartland Boulevard
Construct 3rd Lane on Sagtikos Parkway in each direction from 495 to Southern State Parkway
Enjay Boulevard
Construct Long Island Avenue Interchange at Sagtikos Parkway
Proposed Signalized Intersection
Pine Aire Drive
Reconstruct Pine Aire Drive at Sagtikos Parkway
Extend Long Island Avenue to Sagtikos Parkway
Long Island Avenue
Re-Align Pine Aire Drive Interchange; Eliminate Loop Ramps for NB and SB Sagtikos Parkway
Construct 3rd Lane on Sagtikos Parkway in each direction from 495 to Southern State Parkway
500 0 500
SCALE IN FEET
DATE
DESCRIPTION
REVISIONS
PROJECT:
HEARTLAND TOWN CENTER
SUFFOLK COUNTY, NEW YORK
TITLE:
ROADWAY CONCEPT PLAN
SCALE:
AS SHOWN
DATE:
02/11/10
PROJECT



Key Elements of the Conceptual Plan

- Mixed-use town center
- Pedestrian-friendly street grid
- System of interconnected public and semi-private open spaces
- Residential neighborhoods with mix of housing types
- Converting the former power plant and workshops into a Cultural Arts Center

Key Elements of the Conceptual Plan

Phase One

230 acres mixed-use development will establish the Town Center and give the community an identity and sense of place

Mixed-use includes:

- 560,000 square feet of retail
- 3,500 units of rental, for sale, and workforce housing
- 210,500 square feet of civic space
- 625,000 square feet of commercial uses (offices, hotels, etc.)

Key Elements of the Conceptual Plan

Key Elements of the Conceptual Plan

The "Main" Street

- Pedestrian-friendly with on-street parking
- Energized by street level retail, restaurants and cafes
- Generous sidewalks for easy pedestrian flow
- Office and residential space on upper floors

Key Elements of the Conceptual Plan

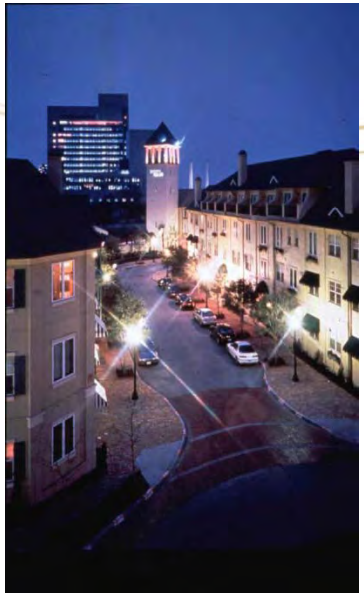
Open space for all age groups

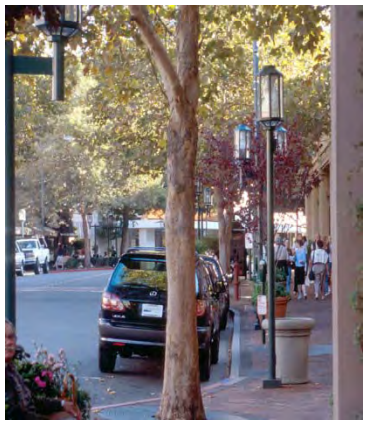
- Neighborhood Parks
- Children's Play Space
- Community Recreation Space
- Buffer Zones and Groundwater Recharge Zones

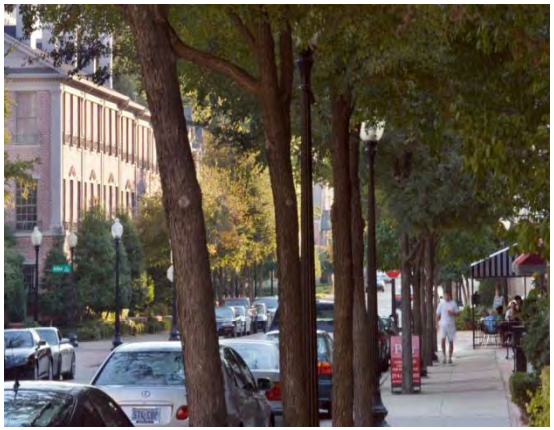
Key Elements of the Conceptual Plan

Conversion of the power plant and workshops into a Cultural Arts Center

- Community art classes
- Indoor and outdoor art exhibits & sculpture garden
- Performing arts venues for dance, drama, comedy and musical theater
- Galleries, studios and workshops







Key Elements of the Conceptual Plan

A connected, pedestrian-friendly street systems

- The “Main Street”
- Shopping Streets
- Residential Yield Streets
- Mews & Alleys
- Collector Streets
- Ring Road

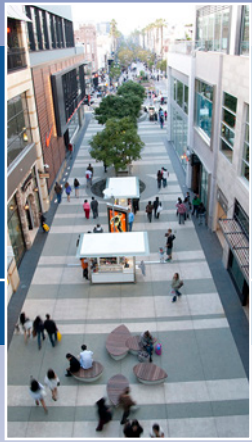
Thank you

7

GETTING TRIP GENERATION RIGHT

Eliminating the Bias Against Mixed Use Development

By Jerry Walters, Brian Bochner, and Reid Ewing



American Planning Association

Making Great Communities Happen

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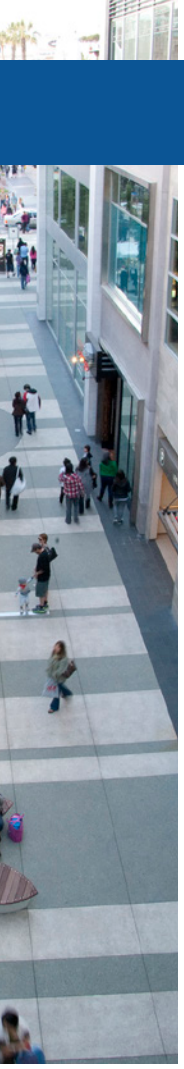


When planners, developers, or traffic engineers conduct traffic impact analyses for proposed developments, they typically use the trip-generation data and analysis methods published by the Institute of Transportation Engineers (ITE) in its *Trip Generation* report and *Trip Generation Handbook*. However, standard traffic engineering practice does not account for project characteristics such as the mix and balance of land uses, compactness of design, neighborhood connectivity and walkability, infill versus remote location, and the variety of transportation choices offered. This can have significant implications when the project in question is a mixed use development.

The conventional methods used by traffic engineers throughout the U.S. to evaluate traffic impacts fail to account for the benefits of mixed use and other forms of lower-impact development. They exaggerate estimates of impacts and result in excessive development costs, skewed public perceptions, and decision maker resistance. These techniques overlook the full potential for internalizing trips through interaction among on-site activities and the extent to which development with a variety of nearby complementary destinations and high-quality transit access will produce less traffic. These effects can reduce the number of vehicle trips generated to a far greater degree than recognized in standard traffic engineering practice.

The ITE trip-generation data and analysis methods apply primarily to single-use and freestanding sites, which limits their applicability to compact, mixed-use, transit oriented developments (ITE 2004, 2012). The *Handbook* does include an approach based on limited data on mixed use developments, but only from six sites in Florida, not nearly enough to cover today's diverse mixed use developments across the United States.

It is important that planners and developers recognize the implications of using standard ITE trip generation data and methodologies for mixed use developments and use methods that more accurately estimate traffic generated by these projects. Commonly used methods unjustifiably favor types of development that consume greater resources and generate greater impacts, shifting our attention away from development forms and locations that stimulate higher levels of social interaction and benefit to established communities.

Researchers have attempted to analyze how a mix of uses in a compact, walkable project design affects trip generation and on-the-ground traffic impacts. In 2011, two major studies introduced methodologies for predicting traffic generation from mixed use development. The researchers on those studies have now collaborated to combine the advantages of both and provide, in this *PAS Memo*, an even more complete and reliable approach to measuring the benefits of such forms of development. Using this new approach, planners conducting trip-generation analysis for mixed use development projects will produce more accurate forecasts of traffic generation, which will allow more appropriate on-site design features and off-site mitigation measures.

The Problem with Conventional Traffic Impact Analysis

Traffic analysis is intended to inform planners, community members, and public officials of the most suitable planning features and infrastructure elements needed to support new development. However, the conventional methods were developed during an era when most new development was single use, stand alone, highway oriented, and suburban. Standard practices ascribe similar levels of impact to mixed-use, integrated, transit-oriented, and infill development, and consequently overlook the benefits of — and impose unreasonable obstacles to — appropriate planning and approval of such "smart growth" forms.

The standard analytic process used for planning, design, and impact analysis does not account for the degree to which well-designed mixed use development places shops, restaurants, offices, and residences in close proximity to one another, shortening internal trips between them and making more trips conducive to walking, biking, or riding transit. Such reductions in traffic and vehicle miles traveled reduce fuel consumption, greenhouse-gas and other emissions, and exposure of residents to passing traffic and the related threats to comfort, health, and safety. Reduced vehicular travel can also lessen the need to construct new or wider streets and highways, allowing communities to economize on infrastructure. Mixed use developments (MXD) also create opportunities for shared parking, which can reduce the number of spaces needed in parking lot and garage construction.

Traffic-Reducing Attributes of Mixed Use Development

Many of the attributes of lower-impact development can reduce traffic generation compared with conventional single-use suburban development forms:

Diverse land uses and activities can fill basic needs nearby, thereby reducing automobile travel. They allow for linkage of trips in multipurpose trip chains, with a single auto trip to an activity center followed by several short trips on foot. Mixed use sites also create the opportunity for shared parking, which in turn encourages multipurpose trips and reduces the tendency to make separate automobile trips from one destination to the next.

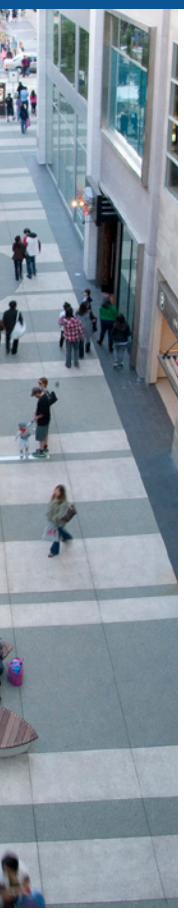
Higher densities and intensities of development provide opportunities for residents, employees, and visitors to circulate among larger numbers of businesses and activities by walking, bicycling, or making short trips by automobile. Higher concentrations of land use also support higher quality and higher-frequency transit service, offering tenants and visitors a viable alternative to driving. High land values and cost to provide parking also leads to higher parking prices, a disincentive to driving versus other available modes of travel.

Walkable urban design and interconnected streets generally reduce the perceived and real separation among destinations, encourage walking and cycling, and reduce the circuitousness and length of each trip.

Short distances to transit help make transit a viable alternative to the automobile and can create activity centers with sufficient street life, amenities, and walking connections where needs and entertainment can be accomplished without independent car trips.

Accessibility to complementary destinations outside the development reduces distances between jobs and housing, services and entertainment, and recreation, often making automobile travel unnecessary. Placed at infill locations, complementary new development that satisfies local needs can also reduce trip making by residents, employees, and shoppers in the surrounding community.

Socio-demographic compatibility can further reduce auto traffic to the extent that developments are designed to attract and accommodate residents with low auto ownership (through, for example, parking supply limits), low travel needs (based on, for example, family size,



fewer employed residents, lower income, or age range), or close affiliation with other project elements or surrounding land uses (linked, or simply compatible, jobs and residents).

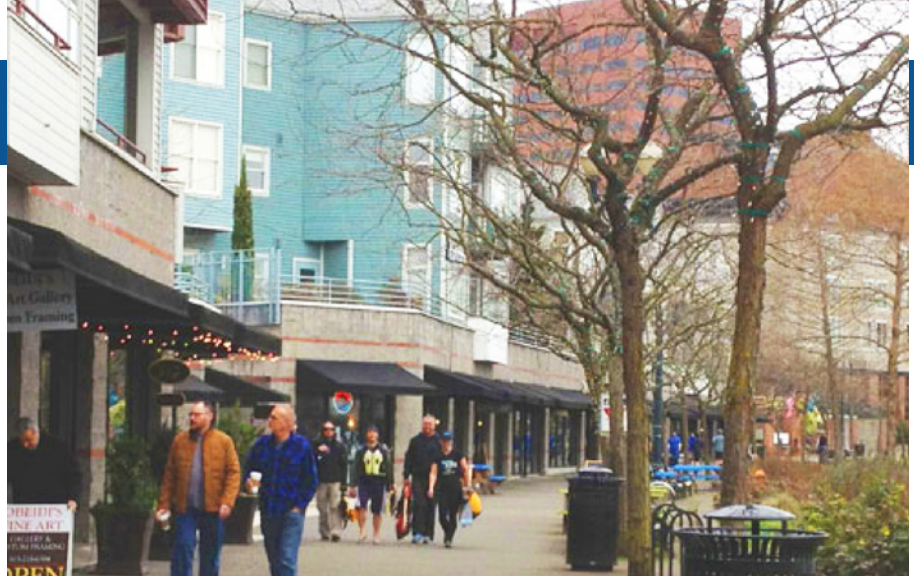
Scale of development affects feasibility for communities and employers to provide travel demand options and management services that can shift traveler modes from the auto to alternative modes of travel. Residents and businesses that self-select into such sites and settings are also often more amenable to travelling less or using alternatives to the automobile. Transportation demand management (TDM) programs are both more likely to be available and more likely to be successful in compact, central, transit-supported settings.

The danger of using traditional traffic-generation data based on single-use facilities is that it misrepresents the true traffic generation impacts of mixed use development. The consequences of miscalculating the benefits of mixed-use development may include unreasonable development cost, exaggerated impacts and mitigation responsibilities, skewed public perceptions, and decision maker resistance. This penalizes mixed use development proposals, often tipping the balance in favor of projects that offer fewer benefits and ultimately generate higher impacts. Denying "smart" forms of development does not reduce the overall market demand for housing and business, so the building disallowed ends up in other locations within the region, often in less accessible locations, at lower densities, and in less-mixed use configurations. The end result can be more traffic and higher regional vehicle-miles traveled than had the smart-growth development been approved.

Understandably, communities and public reviewers want to minimize the risk of unmitigated impacts. However, doing so through the application of overly conservative project evaluation criteria undermines the pursuit of other community values, such as vibrant neighborhoods with integrated development and activities that minimize the need to travel and the impacts produced by excessive unnecessary use of the automobile.

Conservative traffic-generation estimates have supply-side impacts, affecting design and cost of streets and parking. Within constrained sites, over design of traffic elements can limit the space available for revenue-producing land uses and increase other development costs. Development fee programs also rely heavily on traffic-generation estimates from the ITE *Trip Generation Manual*; this can lead to setting excessively high fee rates on mixed use development. Unquestioning use of the ITE data can unreasonably jeopardize a MXD project's approval, financial feasibility, and design quality.

Mixed use sites can take many forms, but all offer a diversity of uses in walkable settings. Oakland City Center BART (left); RiverPlace, Portland, Oregon (opposite page).



of walking and biking and allows for shared parking.

Design: connectivity, walkability. Good design improves connectivity, encourages walking and biking, and reduces travel distance.

New Research Evidence for Mixed Use Development Trip Generation

Several hundred studies over the past 20 years have confirmed that the built environment affects travel generation (Ewing and Cervero 2010). Development features associated with reduced trip rates include a series of "D" variables: density, diversity of uses, design of urban environment, distance from transit, destination accessibility, development scale, demographics of inhabitants, and demand management. In the past three years, research has examined more directly the relative influence of each factor and their interactions and has sought to corroborate the research results through field verification. Organizations such as the U.S. Environmental Protection Agency and the National Academy of Sciences Transportation Research Board have sponsored several of the more reputable studies on the subject.

The Eight "D" Variables

The most advanced research has confirmed that trip rate reductions are quantifiably associated with the attributes of mixed use development, defined in terms of these characteristics of urban development patterns:

Density: dwellings, jobs per acre. Higher densities shorten trip lengths, allow for more walking and biking, and support quality transit.

Diversity: mix of housing, jobs, retail. A diverse neighborhood allows for easier trip linking and shortens distances between trips. It also promotes higher levels

Destinations: regional accessibility. Destination accessibility links travel purposes, shortens trips, and offers transportation options.

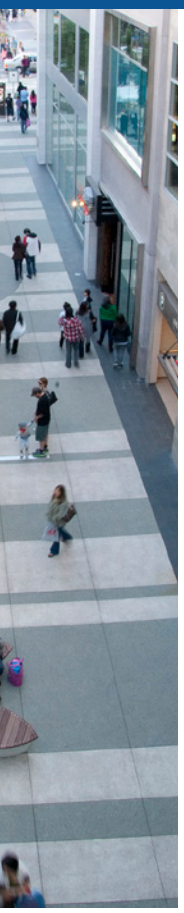
Distance to Transit: rail proximity. Close proximity to transit encourages its use, along with trip-linking and walking, and often creates accessible walking environments.

Development Scale: residents, jobs. Appropriate development scale provides critical mass, increases local opportunities, and supports transit investment.

Demographics: household size, income. Mixed use development allows self-selection by households into settings with their preferred activities and travel modes, allows businesses to locate convenient to clients, and supports a socioeconomic "fit" among residents, businesses, and activities.

Demand Management: pricing, incentives. Demand management ties incentives to the urban environment and allows alignment of auto disincentives with available alternate modes. It takes advantage of critical mass of travel resulting from density, diversity, and design.

A growing body of evidence indicates that these factors, individually or together, quantifiably explain the number of vehicle trips and vehicle-miles traveled for a development project and for a region as a whole. Each of the D factors influences traffic generation through a variety of mechanisms. There are also important interactions, both synergistic and mutually dampening, among the D factors that call for sophisticated techniques when quantifying the travel generation effects of different combinations proposed in any project or plan.



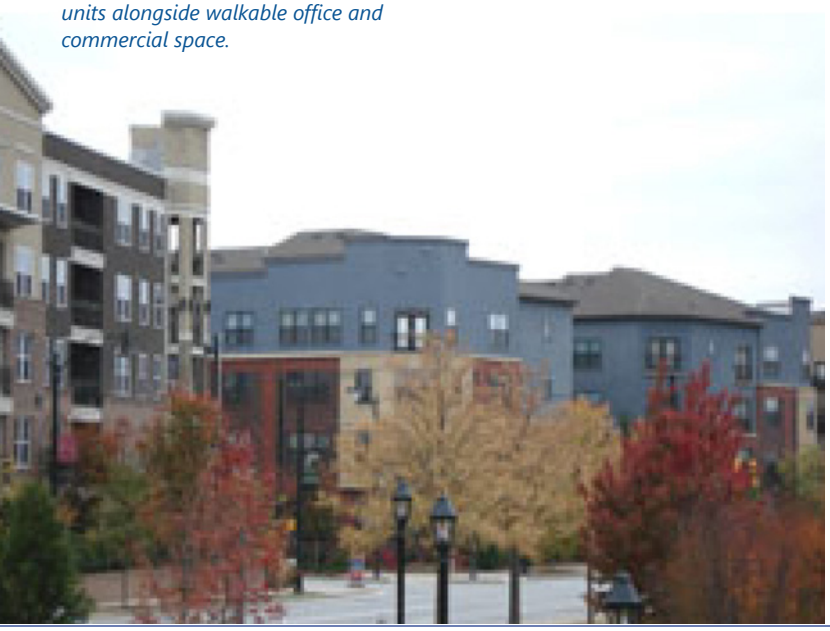
The Evidence that Conventional Methods Overstate MXD Impacts

Empirical evidence and research provides evidence that mixed-use, infill, and transit-oriented developments generate fewer external vehicle trips than equivalent stand-alone uses. A nationwide study sponsored by the U.S. EPA (Ewing et al. 2011) found statistical correlation between the D factors and increased trip internalization and increased walking and transit use. It further demonstrated, for 27 mixed-use development sites across the U.S., that:

1. On average, the sites' land uses would generate 49 percent more traffic if they were distributed among single-use sites in suburban settings, the situations to which the ITE *Trip Generation Manual* would apply.

2. The ITE *Handbook*, the current state-of-practice resource for estimating mixed use trip generation, would overestimate peak hour traffic by an average of 35 percent.

Atlantic Station offers residential units alongside walkable office and commercial space.



The following examples from recent studies demonstrate the degree by which such developments reduce traffic generation relative to what would be presumed under conventional traffic analysis methods.

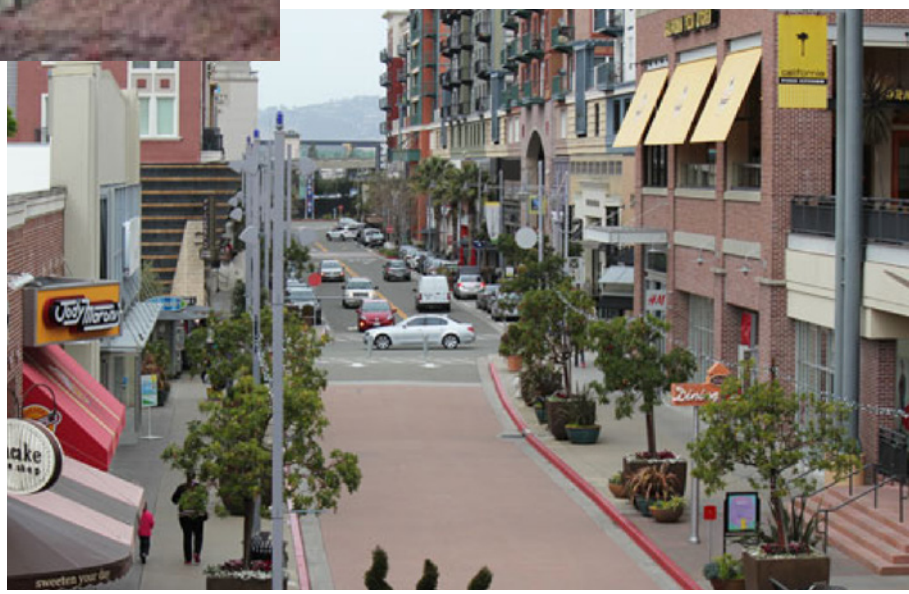
Atlantic Station in Atlanta is a major mixed-use infill development located on a 138-acre former brownfield site in midtown Atlanta, connected by nonstop shuttle service to a MARTA metro rail station about a half-mile away. At the time it was studied, the development included 798 mid- and high-rise residential units, 550,600 square feet of office space, 434,500 square feet of retail space, a 101-room hotel, a restaurant, and a cinema.

For Atlantic Station, the "internal capture rate" (proportion of generated trips that remain internal to the site) is 15 percent in the morning peak hour and about 40 percent of evening peak-hour. Of the trips entering and leaving the site, between 5 and 7 percent use transit and another 5 to 7 percent walk or bicycle.

According to standard ITE trip-generation rates, were the Atlantic Station development elements located at single-use suburban sites, they would generate 37 percent more weekday traffic and 69 percent more PM peak traffic than actually counted at the centrally located, mixed use site.

RiverPlace in Portland is an award-winning mixed use waterfront development on a former brownfield within easy walking distance of downtown Portland, Oregon. Adjacent to the Tom McCall Waterfront Park, the site contains 700 residential units (condominiums and apartments), 40,000 square feet of office space, 26,500 square feet of small retail shops and restaurants, a 300-room hotel, and a marina, cinema, and athletic club. The waterfront walking environment conveniently links all of the activities within the development site and connects the site to the Portland central business district. Transit is also available at the site; the Portland Streetcar connects RiverPlace to downtown Portland and the greater Portland area.

RiverPlace (left) offers a mix of residential, office, and commercial uses on Portland's waterfront. Photo courtesy Fehr & Peers. Bay Street's walkable urban village (below) is designed on a Main Street theme.



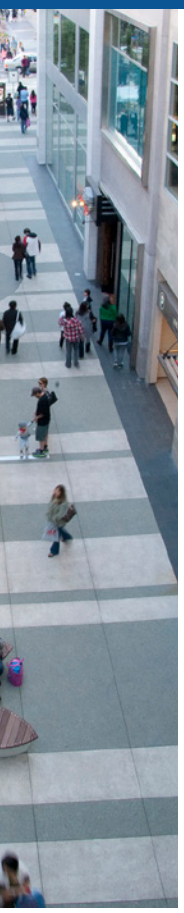
RiverPlace's internal capture rate is 36 percent. For internal and external trips combined, 40 percent are by walking and 5 percent by transit. These statistics are significantly higher than the regional averages of 15 percent of trips taken by walking and 2 percent by transit.

Bay Street in Emeryville is a vibrant, thriving recent redevelopment project in Emeryville, California, just outside San Francisco. The previously heavy-industrial area within and around Bay Street has undergone dramatic revitalization in the past two decades, and it now includes the headquarters of Pixar Studios and other businesses. Bay Street itself is a one-million-square-foot walkable urban village designed on a Main Street theme. It contains a major theater complex, hotel, and 382,000 square feet of fashionable retail shops (including an Apple Store) with 381 apartment units and offices above. The site is within walking distance of a Capitol Corridor commuter rail station and within a shuttle bus ride of BART metro rail.

Bay Street's daily traffic generation is about 41 percent less than the combined total that would be generated by similarly sized suburban shopping centers, theater complexes, residential uses, and office developments based on standard ITE trip rates for stand-alone land uses. It also generates 36 percent less daily traffic than would be estimated by traffic engineers applying the ITE *Handbook* and conventional analysis methods. In the PM peak hour, Bay Street traffic generation is 46 percent lower than would be generated by the same land uses scattered on individual suburban sites, and 41 percent lower than would be estimated by standard ITE traffic analysis.

New Models for Mixed Use Development Traffic Analysis

To address the shortcomings in conventional analysis methods, the National Cooperative Highway Research Program (NCHRP) and the U.S. EPA recently conducted significant research studies to improve quantification of the trip-reducing effects of mixed use development. Each study took a different approach: NCHRP undertook extensive visitor surveys and traffic counts at Atlantic Station and two mixed-use developments in Texas (Bochner et al. 2011), while EPA sponsored a nationwide study of more than 260 mixed use developments across the U.S. using regional travel survey data and verification traffic counts at a subset of the sites (Ewing et al. 2011). Using different analysis methods, each study developed a recommended approach to discounting traffic generation estimates to account for the mix of uses and other development characteristics. Each study represents a major advancement over conventional analysis methods.



NCHRP Report 684

National Cooperative Highway Research Program (NCHRP) Report 684, "Enhancing Internal Trip Capture Estimation for Mixed-Use Developments," analyzed internal-capture relationships of MXD sites and examined the travel interactions among six individual types of land uses: office, retail, restaurant, residential, cinema, and hotel. The study looked at three master-planned developments: Mockingbird Station, a single-block TOD in Dallas; Legacy Town C enter, a multiblock district in suburban Plano, Texas, containing fully integrated and adjacent complementary uses; and Atlantic Station (see above). It compared the survey results to those found in prior ITE studies at three Florida sites, Boca del Mar, Country Isles, and Village Commons, all containing a variety of land uses, though in single-use pods.

Based on traveler and vehicle counts and interviews, the study ascertained interactions among the six land-use types of interest and compared them with site characteristics. It then examined the percentage of visitors to each land-use type who also visited each of the other uses during the same trip. The study considered site context factors and described percentage reductions in sitewide traffic generation that might result from the availability of transit service and other factors.

Researchers then performed verification tests by comparing the analysis results to those available from ITE for three earlier studies at Florida mixed use sites. The validation confirmed that the estimated values were a reasonable match for actual counted traffic. The product of the study is a series of tables and spreadsheets that balance and apply the discovered use-to-use visitation percentages to the land uses within the project site under study. The interaction percentages are then used to discount ITE trip-generation rates and to reduce what would otherwise represent the number of trips entering and leaving the entire site.

EPA MXD

The U.S. EPA–sponsored 2011 report, "Traffic Generated by Mixed-Use Developments — A Six-Region Study Using Consistent Built Environmental Measures," investigated trip generation, mode choice, and trip length for trips produced and attracted by mixed use developments. Researchers selected six regions — Atlanta, Boston, Houston, Portland, Sacramento, and Seattle — to represent a wide range of urban scale, form, and climatic conditions. Regional travel survey data with geographic coordinates and parcel-level detail available for these areas allowed researchers to isolate trips to, from, and within MXDs and relate travel choices to fine-grained characteristics of these developments.

In each region, researchers worked with local planners and traffic engineers to identify a total of 239 MXDs that met the ITE definition of multi-use development. The MXDs ranged from compact infill sites near regional cores to low-rise freeway-oriented developments. They varied in size, population and employment densities, mixes of jobs and housing, presence or absence of transit, and locations within their regions. In total, the MXD sample for the six regions provided survey data on almost 36,000 trips.

The analysis found that one or more variables in each of seven D categories (see above) were statistically significant predictors of internal capture, external walking, external transit use, and external private vehicle trip length. Specifically, an MXD's external traffic generation was related to population and employment within the site (density); the relative balance of jobs and housing within the site and the amount of employment within 1 mile of the site (diversity); the density of intersections within the site as a measure of street connectivity (design); the presence of bus stops within a quarter mile or the presence of a rail station (distance from transit); employment within a mile of site boundaries and percentage of regional employment within 20 minutes by car, 30 minutes by car, and 30 minutes by transit (destination accessibility); the gross acreage of the development (development scale); and the average number of household members as well as

household vehicle ownership per capita(demographics). The accuracy of the EPA MXD method was verified through traffic generation comparisons at 27 mixed-use sites across the U.S.

The EPA MXD product is a series of equations and instructions captured in a spreadsheet workbook. The methodology calculates the percentage reductions in ITE trip generation resulting from the national statistical analysis of seven D effects on internal trip capture, walking, and transit use. The spreadsheets produce reduced estimates of traffic generation on a daily basis and for peak traffic hours.

Combining the Approaches

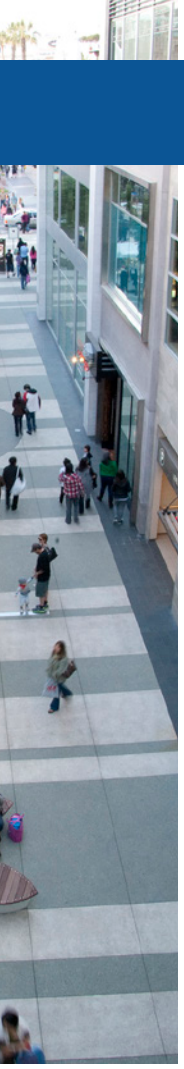
The NCHRP 684 method and EPA MXD method each derive from different research approaches and produce different methods of analyzing trip generation at mixed use developments. They focus on overlapping but not identical aspects of mixed-use development sites and their contexts and offer respective strengths and weaknesses in terms of factors considered and ease of application. Selecting which method to employ under different circumstances requires both a comparison of their capabilities as well as professional judgment of their respective strengths and weaknesses.

Report 684 includes a refined assessment of on-site land-use categories, specifically recognizing the roles of restaurants, theaters, and hotels within the site land-use mix, along with an adjustment to account for the spatial separations among individual land uses within the development site. It is directly useful for the evaluation of proposed development sites that are similar to the one or more of the three surveyed in Atlanta and Texas for the report. However, it is not responsive to factors such as regional location, transit availability, density of development, walkability factors, and the socio-demographic profile of site residents and businesses.

In contrast, the EPA MXD method accounts directly and quantitatively for these factors. However, while it accounts for the balances of retail, office, and residential development, it does not explicitly differentiate subcategories such as restaurants, theaters, and hotels. Furthermore, it requires the analyst to account for off-site development, including employment within a one-mile radius of the MXD and the number of jobs available within 30 minutes of the site.

To develop a method that captures the best of both sets of research findings, the authors of the two original studies decided to collaborate on an integrated method that recognizes the full array of on-site and context characteristics that contribute to traffic reduction and, through a focus on empirical verification, achieves greater accuracy than either method individually.

In developing the integrated approach, we compared the performances of the methods to actual traffic counts at a diverse group of mixed use developments in a variety of settings. The 27 verification sites were successful mixed-use development, exhibiting moderate to high levels of activity in terms of business sales, occupied residential units, property value, and household income, with average or above-average person trips, at the time of the survey. They included those studied for NCHRP 684, the sites used as the basis for the ITE *Trip Generation Handbook*, and others surveyed by Fehr & Peers, transportation consultants. Six of the 27 sites were located in Florida, and three were located in Atlanta and Texas. Three of these nine were nationally known examples of smart growth or transit-oriented development: Atlantic Station, Mockingbird Station, and Celebration, Florida. Six sites were located in San Diego County and were designated by local planners and traffic engineers in 2009 as representing a wide range of examples of smart growth trip generators in that region. The 12 remaining sites were MXD developments located elsewhere in California and in Utah, ranging from TOD sites (commuter rail and ferry) to conventional suburban freeway-oriented mixed use sites.



A New Approach: The MXD+ Method

The new analytical approach, the MXD+ method, combines the strengths of NCHRP 684 and EPA MXD. The authors sought to (1) address the fact that each method has strengths relative to the other, (2) create a method that is more accurate than either of the individual methods alone, and (3) reduce confusion among practitioners on which is the most appropriate method.

The proposed MXD+ method incorporates the underlying data sources and logic that the two methods share. It offers the ability to assess the effects of spatial separation of uses and recognition of more specific land-use categories and to consider the dynamic influences of local development context, regional accessibility, transit availability, development density and walkability factors, and the characteristics of residents.

To develop the preferred method, the authors experimented with different methods of integrating the two methods and arrived at a direct calibration approach. The appropriate combination of the results of the two individual methods was determined through regression analysis to identify the proportions that provided the best correlation with the traffic counted at the 27 validation sites. Table 1 presents results from the regression analysis, listing the proportions of the two methods found most effective at matching the traffic generation at the diverse set of mixed use validation sites. Weighting the results of the two individual analyses by the percentages in Table 1 and combining the results produces more accurate estimates of traffic generation and captures the effects of all of the site description variables included in the NCHRP and EPA methods.

TABLE 1 **OPTIMAL BLEND OF NCHRP 684 AND EPA MXD METHODS**

	AM PEAK TRAFFIC	PM PEAK TRAFFIC	AVERAGE DAILY TRAFFIC
NCHRP 684	10.1%	36.5%	n/a
EPA MXD	89.9%	63.5%	100%

The step-by-step method is as follows:

1. Apply the full EPA MXD methodology to predict external traffic generation as influenced by site development scale, density, accessibility, walkability and transit availability, resident demographics, and general mix of uses.

2. Apply the full NCHRP 684 method to capture the effects of detailed land-use categories, including hotel, theater, and restaurant, and the spatial separation of uses within small and medium sites.

3. Combine the results of the two methods in terms of percentages of trips remaining internal to the development site, using proportioning factors presented in the table above.

4. Apply adjustments to account for off-site walking and transit travel using the EPA MXD method.

5. Discount standard ITE traffic-generation rates by the percentages of internalization produced in step 3 and the percentage of walk and transit travel in step 4 to obtain the estimate of site- generated traffic.

TABLE 2 COMPARISON OF THREE PRINCIPAL METHODS IN TERMS OF PROJECT CHARACTERISTICS CONSIDERED			
	EPA MXD METHOD	NCHRP 684 METHOD	MXD+ METHOD
Project Characteristics Considered			
Density of Development	♦		♦
Diversity of Uses: Jobs/Housing	♦	♦	♦
Diversity of Uses: Housing/Retail		♦	♦
Diversity of Uses: Jobs/Services		♦	♦
Diversity of Uses: Entertainment, Hotel		♦	♦
Design: Connectivity, Walkability	♦	♦	♦
Design: Separation Among Uses		♦	♦
Destination Accessibility by Transit	♦		♦
Destination Accessibility by Walk/Bike	♦		♦
Distance from Transit Stop	♦		♦
Development Scale	♦		♦
Distance from Transit Stop	♦		♦
Development Scale	♦		♦
Demographic Profile	♦		♦
Data Needs (beyond Project Site Plan)			
Average Residents per Dwelling Unit	♦		♦
Average Autos Owned per Dwelling Unit	♦		♦
Nearby (1/4 mi) Bus Stops and Rail Stations	♦		♦
Jobs Within 1 Mile of Site	♦		♦
Jobs Within 30-Minute Transit Trip	♦		♦
Regional Employment	♦		♦
Located in CBD or TOD?	♦		♦
Site Development by Classification		♦	♦
Vehicle Occupancy Estimate		♦	
Mode Split Estimate		♦	

As Table 2 indicates, the MXD+ method improves traffic generation estimates by considering the full array of 12 site development and context characteristics shown to influence internal capture and mode share, while the individual methods consider only 5 to 8 factors each. Effects considered in MXD+ that are not included in the NCHRP 684 method include household size and auto ownership, site proximity to bus and rail stops, and accessibility to local and regional jobs. Effects considered in the NCHRP 684 method that do not appear in the EPA MXD method include specific land uses and proximity of interacting land uses to each other.

Table 3 presents the statistical performance of the MXD+ integrated method with the individual performance of the individual NCHRP 684 and EPA MXD methods. We compared the ability of each of the available methods to replicate the amount of traffic generated at the 27 validation sites in terms of statistical measures including percent root mean squared error, a metric used in the transportation field to evaluate model accuracy, and the coefficient of determination (or "R-squared"), which measures the ability of the analysis method to account for the variations in traffic generation among the 27 survey sites. For daily traffic generation, MXD+ is equivalent to the EPA MXD method, as the NCHRP 684 method does not address daily analysis. For peak hour traffic generation, MXD+ performs notably better than either of the individual methods.

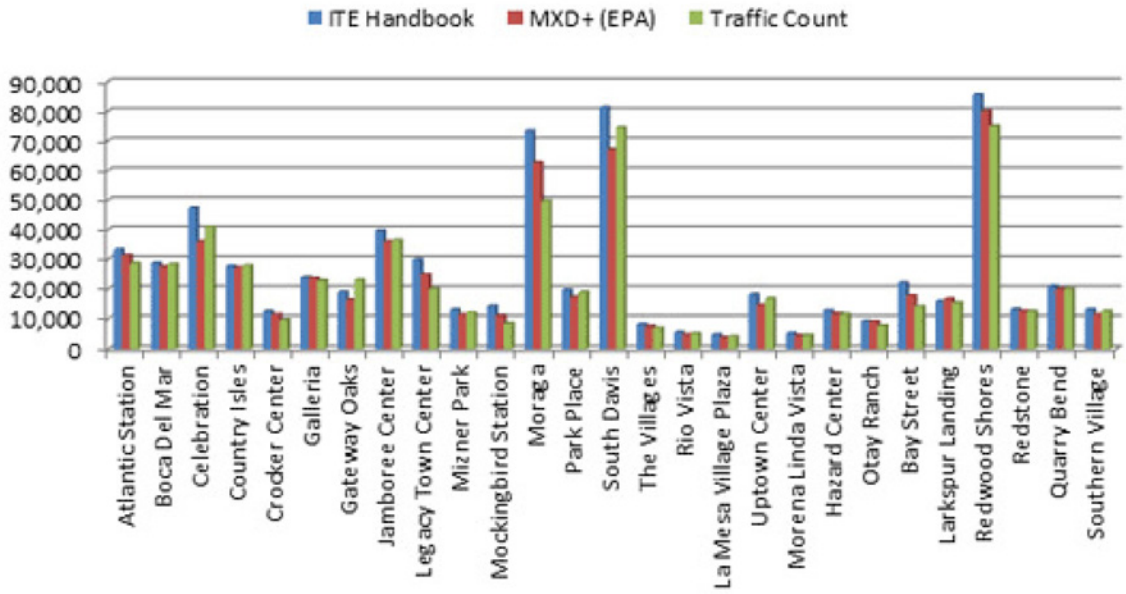
TABLE 3 **COMPARISON OF THREE PRINCIPAL METHODS IN TERMS OF PERFORMANCE AT VALIDATION SITES**

	EPA MXD METHOD	NCHRP 684 METHOD	MXD+ METHOD
Daily Traffic Generation			
R-squared	96%	89%*	**96%**
Average Error	2%	16%*	**2%**
Root Mean Square Error	17%	27%	**17%**
AM Peak Traffic Generation			
R-squared	97%	93%*	**97%**
Average Error	12%	30%	**12%**
Root Mean Square Error	21%	33%	**21%**
PM Peak Traffic Generation			
R-squared	95%	81%	**97%**
Average Error	8%	18%	**4%**
Root Mean Square Error	18%	36%	**15%**

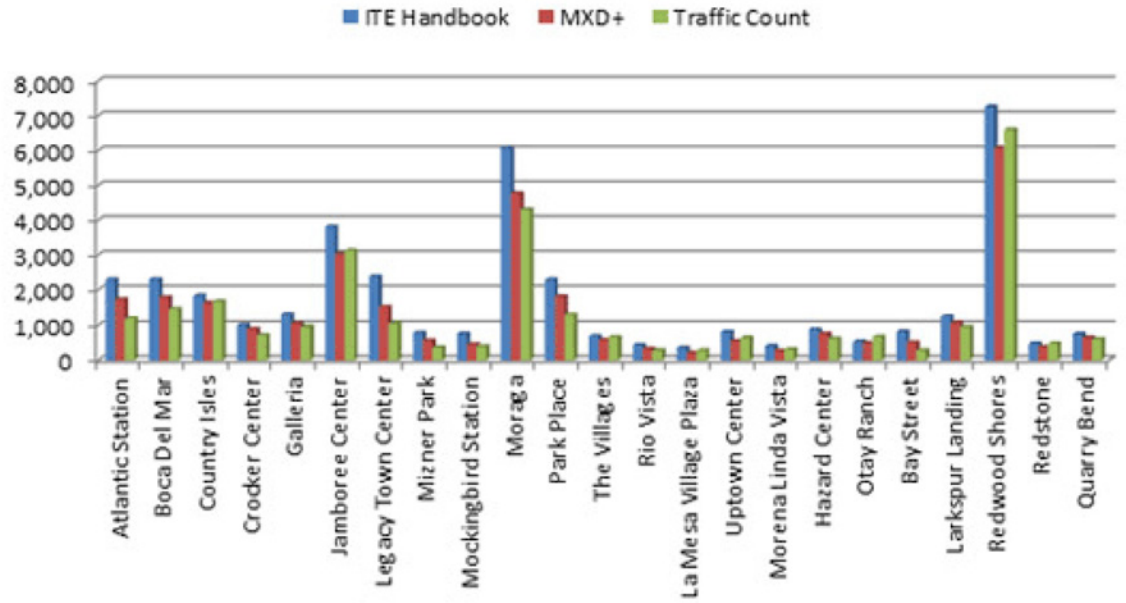
** ITE Handbook internalization statistics (NCHRP 684 method does not address daily trip generation)*

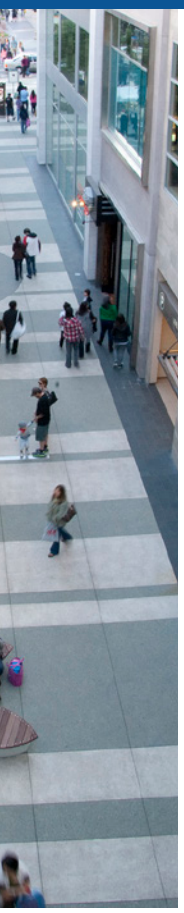
The graphs on the following page compare the performance of the MXD+ method to the ITE *Handbook* method at replicating traffic generation at the diverse group of mixed-use validation sites. Compared with the ITE *Handbook*, MXD+ method more accurately matches the amount of daily traffic actually counted at 20 of the 27 survey sites. In the AM peak hour, it is more accurate than the ITE Handbook at 21 of the 24 sites for which counts were available, and in the PM peak hour, MXD+ is more accurate than the ITE *Handbook* method at 23 of 25 sites.

DAILY TRAFFIC GENERATION COMPARISON OF ITE HANDBOOK & MXD+ METHODS

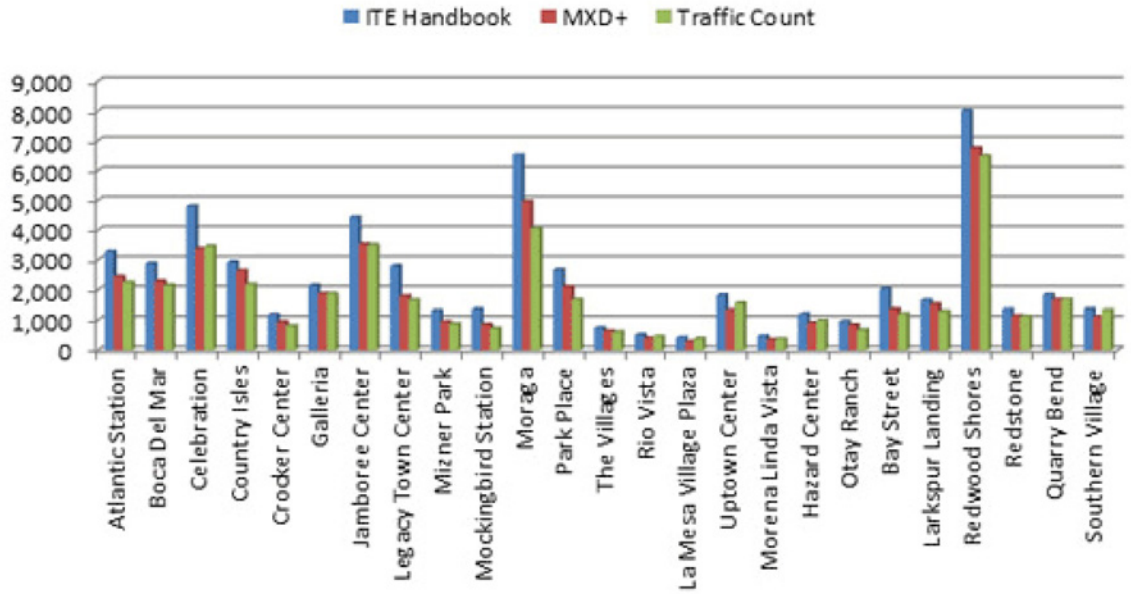


AM PEAK HOUR TRAFFIC GENERATION COMPARISON OF ITE HANDBOOK & MXD+ METHODS





PM PEAK HOUR TRAFFIC GENERATION COMPARISON OF ITE HANDBOOK & MXD+ METHODS



The MXD+ method explains 97 percent of the variation in trip generation among mixed-use developments, compared with 65 percent for the ITE *Handbook* method. On average, the *Handbook* overestimates AM peak traffic generation by 49 percent, compared with 12 percent for MXD+. For the PM peak hour, the ITE *Handbook* overestimates actual traffic by 35 percent. The MXD+ method reduces this to 4 percent, remaining slightly conservative and unlikely to understate impacts.

By combining and refining the two most advanced methodologies for estimating traffic generation for mixed-use development, the MXD+ method provides transportation planners and engineers a more accurate single approach that accounts for the most important factors that distinguish lower impact development from other forms. Doing so advances development planning and impact assessment beyond the practices that have, to date, unreasonably discouraged mixed-use development.

Recommendations for Planners

We recommend that planners adopt the latest methods for evaluating traffic generation of mixed use and other forms of smart growth, including infill and transit-oriented development. The MXD methods developed under the U.S. EPA multiregional study and the NCHRP 684 study on enhancing trip-capture estimation each represent substantial advances to the conventional practices previously available through ITE. Combining the two new methods, as described above, improves upon both individual methods. Tools for all three approaches are available for use through the references and resources listed below.

Traffic engineers are beginning to take notice of the new methods, but we expect that natural sluggishness in adopting new practices will continue to impose unfair penalties on mixed use and other forms of lower-impact development. We recommend activism on the part of all planners, development reviewers, and impact analysts on behalf of the more accurate MXD methods.

Immediate adoption of the improved methods will allow planners to account for a project's regional location, transit availability, density of development, walkability factors, and the characteristics of residents and businesses and on-site adjacencies of land uses including residential, office, retail, restaurants, theaters, and hotels. Accounting for these factors through the MXD+ method will achieve the highest levels of accuracy possible in estimating traffic impacts of mixed use development.

We recommend applying and promoting the MXD+ method for day-to-day project planning and performance-based site-plan refinement, impact analysis, and discretionary review. Doing so will eliminate what is presently a systematic bias in traffic analysis that favors single-use, isolated, suburban-style development.

Conclusion

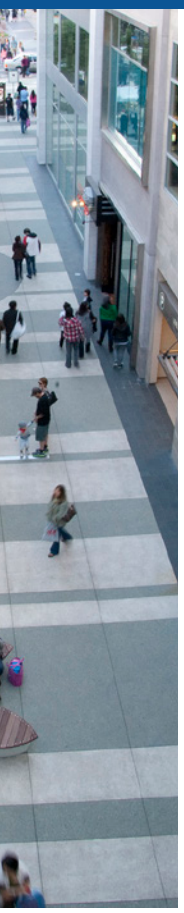
Standard traffic engineering practices are blind to the primary benefits of smart growth. A plan's development density, scale, design, accessibility, transit proximity, demographics, and mix of uses all affect traffic generation in ways unseen to prescribed methods. The Institute of Transportation Engineers (ITE) *Trip Generation Manual* and *Handbook* overestimate peak traffic generation for mixed-use development by an average of 35 percent. For conventional suburban stand-alone development, ITE rates portray the average for such sites; so hedging mixed-use analysis toward more conservative assumptions creates a systematic bias in favor of single-use suburban development.

ITE overestimation of traffic impacts reduces the likelihood of approval of mixed use and related forms of smart growth such as infill, compact, and transit-oriented development. Such overestimation escalates development costs, skews public perception, heightens community resistance, and favors isolated single-use development.

The methods of evaluating mixed use development described in this report represent a substantial improvement over conventional traffic-estimation methods. They improve accuracy and virtually eliminate overestimation bias, and they are supported by the substantial evidence of surveys and traffic counts at 266 mixed use sites across the U.S. The MXD+ analysis method explains 97 percent of the variation in trip generation among mixed use sites and all but eliminates the ITE systematic overestimation of traffic. We hope planners and other professionals will take advantage of the available spreadsheet tools listed below to help even the playing field between conventional development patterns and more sustainable, walkable, livable places.

About the Authors

Jerry Walters is a principal and sustainability practice leader with Fehr & Peers, transportation consultants. He has more than 30 years of experience in transportation planning, engineering, and travel forecasting and is a registered traffic engineer. Jerry developed project evaluation methods for the U.S. EPA study "Mixed-use Development and Vehicle Trips: Improving the Standard Estimation Methodology." He is a co-author of the book Growing Cooler – the Evidence on Urban Development and Climate Change (Urban Land Institute, 2008).



Brian S. Bochner is a senior research engineer at Texas Transportation Institute with over 40 years of experience in traffic engineering and planning. He is a certified professional traffic engineer, a professional traffic operations engineer and transportation planner, an affiliate with the Transportation Research Board, and past president and member of the International Board of Direction of the Institute of Transportation Engineers (ITE). His awards include Transportation Innovator, Texas Department of Transportation Research Program, and Transportation Engineer of the Year for the Texas Section of ITE.

Reid Ewing is a professor of city and metropolitan planning at the University of Utah, associate editor of the *Journal of the American Planning Association*, columnist for *Planning* magazine, and Fellow of the Urban Land Institute. His 2010 article, "Travel and the Built Environment: A Meta-Analysis," won the Best Article of the Year award from the American Planning Association, and his book, Best Development Practices (APA Planners Press, 1996), is listed by APA as one of the 100 essential planning books of the past 100 years.

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Additional Resources

Description, documentation, and spreadsheet tools for the NCHRP 684 method, Enhancing Internal Trip Capture Estimation for Mixed-Use Developments may be found at www.trb.org/Main/Blurbs/165014.aspx.

Description, documentation, and spreadsheet tools for the EPA MXD Trip Generation Tool for Mixed-Use Developments may be found at www.epa.gov/smartgrowth/mxd_tripgeneration.html.

Quick-response analysis tools for applying the EPA MXD method, the combined EPA /NCHRP method MXD+, and MXD in conjunction with analysis of vehicle-miles traveled, GHG emissions, and shared parking, Plan+, may be found at http://asap.fehrandpeers.com/tools/.

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WILMAPCO

Department of Transportation
Carolann Wicks, Secretary

Measuring and Accounting for Internal Trip Capture in Mixed Use Development: A Recommendation

June 2010

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Measuring and Accounting for Internal Trip Capture in Mixed Use Development: A Recommendation

Why the Interest in Mixed Use Development?

The Delaware Department of Transportation recognizes that land use decisions play a key part in the Department's ability to plan for and execute programs and projects that help in meeting its' mission to provide for the safe and smooth flow of traffic. The Department also recognizes the importance of communities designed to encourage and facilitate walking, bicycling, and the use of transit. Collectively these modes have multiple benefits which further enhance the Department's ability to provide for the safe and smooth flow of traffic, in the broadest sense. It was taken as a given that mixed use development, if planned and designed with pedestrians, bicyclists, and bus patrons in mind, can make a difference in travel behavior and demands upon the transportation system.

Mixed use development has various definitions. For purposes of this study it was defined as *a unified and functionally compatible mixture of two or more land uses including housing, employment, recreation, retail, and community facilities intended to be within walking distance, transit accessible and pedestrian friendly, in conformance with an adopted plan.*

The Mixed Use Development Working Group

To assist in accomplishing the study, it was decided to assemble a cross-section of interested stakeholders. A committee was established under the auspices of the Wilmington Area Planning Council (WILMAPCO) in cooperation with DelDOT. The committee, or Mixed Use Development Working Group (Working Group) as it was called, was given the task of trying to answer four basic questions:

- Is there a mixed use development model, ordinance, or design with enough commonalities of interest to be replicated?
- What would be the analytical method and process used to determine effectiveness?
- How can the committee facilitate the creation of a model, initially for New Castle County?
- Can and should a model be developed that can be used throughout Delaware?

Membership in the Mixed Use Development Working Group included:

- WILMAPCO
- TMA Delaware
- New Castle County Department of Land Use
- New Castle County Economic Redevelopment Office
- New Castle County Chamber of Commerce
- Delaware Department of Transportation
- Delaware Transit Corporation
- Delaware Economic Development Office
- Delaware Office of State Planning Coordination
- Department of Natural Resources and Environmental Control
- The Reybold Group

Special efforts were made to assure that the members of the Working Group were provided with progress updates and significant benchmark materials, regardless of whether they were able to attend the meetings. Also, WILMAPCO took the lead in providing meeting invitations to every member in advance of every meeting.

A Need for Consistency Using an Analytical Approach

On various occasions over the years DelDOT has had opportunities to discuss the traffic implications of proposed mixed use development with developers and their engineering consultants. It was clear that the commonly accepted procedure for predicting the internal trip capture associated with mixed use development i.e. that in the ITE Trip Generation Handbook had significant deficiencies. It has been assumed that increasing internal trip capture would result in benefits that include reduced traffic congestion, improved air quality, reduced energy consumption and enhanced non-vehicular mobility. Thus when it became time for providing credit to developers when they designed their projects as mixed use, DelDOT was at a loss as to how to do that very effectively. It was also recognized that it was important to treat all developers consistently in respect to the credit for planning, designing and constructing mixed use communities.

In addition, it is important to continue using Traffic Mitigation Agreements as another means of promoting internal trip capture. For example, when opportunities arise for keeping trips on site, whether in a mixed use community or not, if an agreement is required then it should focus not only on encouraging a mode shift to higher occupancy vehicles or a time shift to start and end work outside of peak travel hours, but also on providing on-site employee services (deli, dry cleaning, day care, etc.) in this regard.

Working Group Products

Beginning on December 17, 2008, the Working Group met a total of seven times. The meeting agendas are attached as an appendix and reflect fairly accurately the items discussed at the respective meetings. One of the more interesting meeting exercises was the administration of a Mixed Use Development Survey prepared by WILMAPCO staff members. Results from the Working Group were shared at the March 18, 2009 meeting.

Opinions were for the most part consistent in expressing the following:

- The ideal size for a mixed use development project is 50-100 acres
- The land use mix should consist of 3 or more different uses
- Between 5% and 20% of residential units should be set aside as low-income
- The location for mixed use development in New Castle County should be in the center and core investment areas
- Proximity to transit service and reducing automobile dependence were cited as the two most important considerations, although others followed closely
- Peak hour transit service headways of 10 to 20 minutes were considered important
- Other factors ranked by importance included mix of land use types, housing density, walkability and mix of housing types

Another aspect of the Working Group's discussions was an understanding of the way DelDOT addresses internal trip capture as part of the Traffic Impact Study (TIS) review process. DelDOT staff made a presentation at the February 4, 2009 meeting at which time the limitations of using the ITE Trip Generation Handbook to account for internal trip capture for "multi-use development" were illuminated in great detail. The Trip Generation and Internal Capture Summary worksheet was described and displayed.

Yet another part of the committee's efforts included an evaluation of the two primary modeling approaches being considered from a national perspective. The first is the National Cooperative Highway Research Program (NCHRP) Project 8-51, undertaken by the Transportation Research Board. The second is the Environmental Protection Agency's Six Region Study undertaken by the transportation consulting firm of Fehr and Peers. After hearing a presentation on the EPA model presented by Mr. Reid Ewing (University of Utah) on May 13, 2009 and a demonstration of that model by WILMAPCO staff on August 26, 2009, with the support of the committee DelDOT decided to undertake an evaluation of both models. DelDOT chose six current or proposed mixed use developments in Delaware to test internal trip capture. While initial study efforts were intended to focus on New Castle County it was realized that this approach would be too limiting. There was agreement that using various Delaware development sites would hopefully provide enhanced interest inherent in familiarity with the local environment.

Using the pre-release versions of the models provided by NCHRP and EPA, DelDOT applied the models to the six developments and also did a sensitivity analysis to determine the affect of changing the independent variables.

DelDOT staff observations resulting from the evaluation are summarized below.

- Both models yield PM Peak Hour results similar to the ITE procedure, except that when restaurants and hotels are identified as part of the development the NCHRP model shows much more internal capture. The proximity of the uses is also significant in the NCHRP model.
- The EPA model consistently shows less, often much less, internal capture than the ITE and NCHRP models.
- Both models tend to show more internal capture in the PM peak hour than in the AM peak hour, but the NCHRP model shows much greater differences between AM and PM. Possible explanations include the nature of the survey instrument (on-site exit interviews vs. household travel surveys) and the size of the developments considered (some of EPA's were much larger).

Based on the analysis and the observations that resulted, DelDOT arrived at the following recommended uses in respect to the two models:

NCHRP 8-51

- Site Traffic Impact Analysis (Traffic Impact Studies and Traffic Operational Analyses.)
- Environmental Impact Analyses other than emissions and energy if sensitive to intersection or peak hour operation
- Other applications where peak hour estimates are important and/or the site plan is known

EPA

- Regional travel studies
- Vehicle emissions studies
- Energy consumption studies
- Environmental Impact Analyses other than emissions and energy if analyzing large areas or corridors or on a daily basis
- Other applications where site plan is unknown but population and employment estimates are available

A copy of the entire DelDOT evaluation, in the form of a PowerPoint presentation is included in the report appendices.

Answering the Four Original Questions – What Was Learned.

- Is there a mixed use development model, ordinance, or design with enough commonalities of interest to be replicated?

The Working Group did not intend to undertake an exhaustive search of mixed use models or designs. What it did discover was that there were two major study efforts underway which were believed worthy of evaluation and limited testing. That in fact was done by DelDOT in collaboration with WILMAPCO staff and the other members of the Working Group.

- What would be the analytical method and process used to determine effectiveness?

The most efficient approach given time and staffing limitations was felt to be a comparison of the results of applying the two models to several mixed use developments in Delaware to that of utilizing the ITE procedures for determining traffic internal trip capture. That was the approach taken. The results are reported in the document entitled Evaluation of NCHRP 8-51 and EPA Mixed Use Development Internal Capture Models. A case can be made for using either model depending upon what data inputs are available and what is deemed most important: traditional site-specific traffic impact analyses or area wide or regional travel analyses (Particularly where environmental and energy aspects are in the forefront.) As might be expected both models have pros and cons so it will be interesting to see how they are received by the Institute of Traffic Engineers.

- How can the committee facilitate the creation of a model, initially for New Castle County?

The Working Group has taken the first step by investing their time in the discussion of the topic. Unfortunately, the level of interest waned as time went on and participation in the committee's efforts was reduced to a core of about eight members. This is significant because a greater emphasis on planning, designing and building mixed use development projects has great potential for addressing a multitude of travel related issues. This was evidenced in New Castle County when they began taking a closer look at mixed used development with a view toward changes in their Unified Development Code. That effort did not gain momentum and ended without a result that the Working Group was ever made aware of. Attempts to collaborate more closely with the County in this regard, using the committee as a platform for discussion were not successful.

- Can and should a model be developed that can be used throughout Delaware?

A new model is not necessarily needed. When ITE makes a determination of how mixed use development will be addressed in the next changes to the Trip Generation Handbook, this should be used as an opportunity to garner support for the design of communities that incorporate mixed use development elements. Until that occurs, DelDOT has determined based upon the committee's study, that future reviews of mixed use development proposals will utilize the NCHRP model in completing its evaluation. The rationale, as stated earlier in this summary report, is that this model lends itself more readily to site generated traffic impact analysis, where peak hour

traffic information can be derived. This approach will be shared with DelDOT's customers so that developers and engineers, in particular, will be cognizant of this.

Next Steps

Recognizing that much has been learned by undertaking this mixed use development study, does not suggest that there has been complete closure. Challenging issues still remain which should be addressed. Among those that the Working Group believes require additional high level consideration are:

1. *How can state and local government work cooperatively to bring about a greater emphasis on and impetus for mixed use development so that its' use will bring benefits to all Delawareans?*
2. *How will it be determined what qualify as optimum mixed use development designs versus minimal designs?*
3. *How can the private sector be further engaged in the process of establishing design parameters without triggering a conflict of interest, either real or imagined?*
4. *How can information and a consistent terminology pertaining to mixed use development be provided so that misinformation is eliminated, or at least minimized?*
5. *How can credits be applied in a manner that will encourage mixed use development designs?*

Appendix A: 12/17/08 meeting materials

- **Meeting Agenda**
- **Meeting Notes**
- **Presentation: *"Review of Recent Mixed-Use/TOD Development Traffic Research"* Dan Blevins-WILMAPCO**

Wilmington Area Planning Council

850 Library Avenue, Suite 100
Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

WILMAPCO Council:

Stephen Kingsberry, Chair
Delaware Transit Corporation Director

Joseph L. Fisona, Vice Chair
Mayor of Elkton

James M. Baker
Mayor of Wilmington

Christopher A. Coons
New Castle County County Executive

John F. Klingmeyer
Mayor of New Castle

Brian Lockhart
Cecil County Commissioner

Samuel F. Minnitte, Jr.
Maryland Dept. of Transportation Director, Office of Planning

Lee Ann Walling
Delaware Office of the Governor Policy Advisor for Environment and Quality of Life Policy

Carolann Wicks
Delaware Dept. of Transportation Secretary

WILMAPCO Executive Director
Tigist Zegeye

Memorandum

Date: May 26, 2010

Re: 12/17/08 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, December 17th, 2008 9-11am

Agenda

1. **Goals and Objectives of Working Group**

2. **Discussion: Defining mixed-use development**
   - What is mixed use development?
   - Why consider mixed used development?
   - What are some examples of "good" mixed use developments?
   - What do these examples have in common?

3. **Presentation on current research on measuring the impacts and benefits of mixed-use development *(D. Blevins)***
   - Problems/Issues with current ITE measurement practices
   - Internal trip capture benefits of mixed use developments
   - Literature review of recent ITE/TRB publications

4. **Discussion on future steps for the working group**
   - Is there a model design, ordinance or structure with enough commonalities to be replicated?
   - What would be the analytical method and process?
   - Can and should a model be constructed that can be used throughout Delaware?
   - How can the committee facilitate the creation of a model (first for New Castle County)?

5. **Next meeting date**

12/17/08 Mixed-Use/TMA meeting notes

Attendees:
George Timko – NCC Economic Redevelopment
Dan LaCombe- DelDOT
Angelina Micheva – New Castle County Chamber of Commerce
Wayne Henderson – Delaware Transit Corporation
Jeff Stone – Delaware Economic Development Office
Ted Bishop – DelDOT
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Dan Blevins – WILMAPCO

Meeting Notes:

Goals and Objectives of Working Group

After introductions, the purpose for the formation of this group was presented. The overall goal is to create a fair and consistent procedure to assess (through Traffic Mitigation Agreements) the benefits and net impacts of mixed-use development. With several mixed use development plans located in New Castle County, DelDOT would like to use New Castle as a model for the entire state on how to properly assess the land use types.

The group participated in an open discussion on what the term “mixed-use” mean to everyone. In general, the term is loosely based on development that contains two or more land use types. The mix of what constitutes a good blend of uses (residential vs. non-residential) was discussed as well.

The question was asked as to exactly how the DOT currently approaches the analysis of mixed use development plans. It was requested that this be a discussion at a future meeting. It was mentioned that the Institute of Transportation Engineers (ITE) was currently reviewing the state of the practice of measuring the trip generation of new mixed use development across the country. Findings from TCRP Report #128: Effects on TOD and Housing, Parking and Travel (August, 2008) are that the current ITE manual assumptions do not capture internal trips very well and that good mixed use developments generated 44 percent fewer daily trips than the 7th edition of the ITE manual suggests.

More details on the findings another study, NCHRP 08-51: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments has been requested once it has been completed which is scheduled for 1/31/09 which is recommending new trip generation assumptions for mixed-use developments for the next ITE manual.

From the perspective of the developer, it was discussed that any mixed use agreement should have the burden placed on the developer, not the public. If the development fails, then the costs will be absorbed by the developer.

Next steps/future meetings:

- Review the current traffic assumptions made by DelDOT uses for modeling mixed use developments
- Review local/regional examples of “good” and “bad” mixed use development
- Addition of a representative from DNREC added to the core group.
- Additional details on the NCHRP 08-51: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments (due to be completed Jan. 2009 draft final report is expected in November 2008)
- Invitation of a guest speaker (TBA) to discuss benefits of mixed use development and what is the ideal mixture of uses to prove beneficial.

Review of Recent Mixed-Use/TOD Development Traffic Research

Prepared for the Mixed-Use and Traffic Mitigation Agreement Working Group

February 4th 2009

Agenda

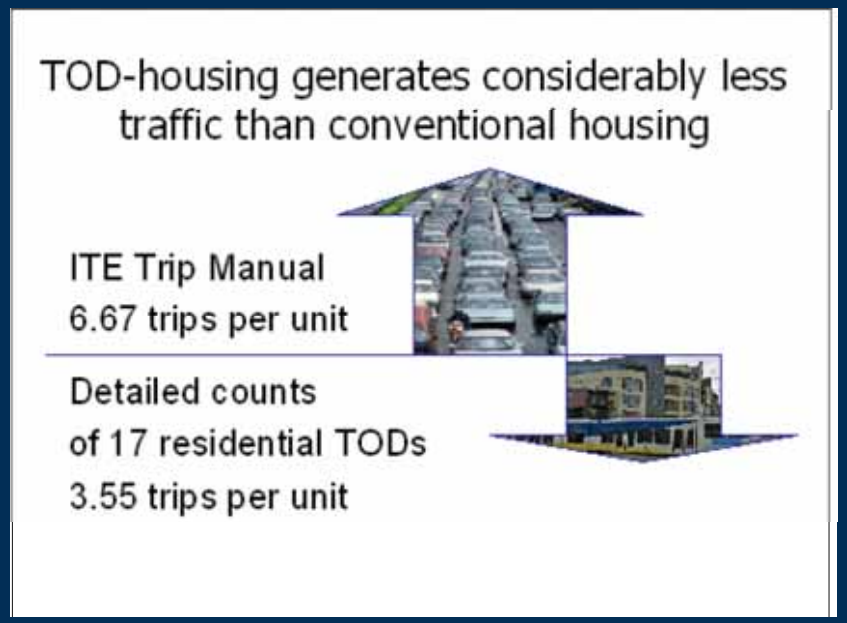
- Current issues with “traditional” traffic impact measurements of mixed-use development
- Traffic benefits of mixed-use development
- Recent TRB/ITE research

Current issues

- Current ITE Trip manual over-estimates automobile trip generations for mixed use development
- Current ITE book studied 6 sites in FL to generate figures for mixed use assumptions
- Listed as “special land uses” in ITE manual
- Misses Internal trip capture: 17.8% trips ending in development originated in same development (TCRP 128)
- Overcharging of developers; hinders attempting mixed-use development

Mixed-Use Benefits

- Internal trip capture: 17.8% trips originating and ending in same development (TCRP 128)
- Fewer daily trips generated per unit



- The weighted average differentials were even larger during peak periods – 49% lower rates during the A.M. peak and 48% lower rates during the P.M. peak.

Why focus on ITE manual?

- All TIS/TOA's base traffic impacts on latest version of ITE trip generation manual (7th edition)

Why focus on ITE manual?

- TIS/TOA's base traffic impacts on latest version of ITE trip generation manual (7th edition)

- Recent research updates will:
  - give more options for traffic engineers to choose from
  - give better trip generation rates

- Results from recent TCRP/NCHRP research will be used to revise this section

Recent Research

TCRP 128: Effects of TOD on Housing, Parking, and Travel (Completed Sept. 2008)

- Research studied actual transportation performance of 17 built TOD projects.
- Collected data using tubes stretched across the driveways and visual counts and surveys of other modes
- 4 urbanized areas of the country: Philadelphia/N.E. New Jersey; Portland, Oregon; metropolitan Washington D.C.; and the East Bay of the San Francisco Bay Area
- Over a typical weekday period, the 17 surveyed TOD-housing projects averaged 44% fewer vehicle trips than that estimated by the ITE manual (3.7 versus 6.7 daily trips per unit).
- The weighted average differentials were even larger during peak periods –
  - 49% lower rates during the A.M. peak and
  - 48% lower rates during the P.M. peak.

Recent Research

NCHRP 08-51: Enhancing Internal Trip Capture Estimation for Mixed-Use Developments (Due: January 2009)

- Acknowledges shortcomings of current versions
- Designed to address this need by providing a classification system of mixed-used developments and a data-collection framework to enhance estimates of internal capture for mixed-use developments.
- ITE advises those estimating transportation impacts of mixed-use developments to "collect additional data if possible" (TMA?)
- Since the internal capture rate used for a given mixed-use development can be politically contentious, empirical observations are needed to provide professional guidance for better estimating these impacts. By improving the methods for estimating internal capture, the process of determining developers' responsibilities for mitigating transportation impacts of mixed-use development will become more equitable, transparent, and open.

Recent Research

NCHRP 08-66 Trip-Generation Rates for Transportation Impact Analyses of Infill Developments (In progress)

- Addressing similar issues as NCHRP 08-51
- Directed at dealing with development in existing urban/suburban areas with existing major infrastructure
- Addresses understanding that rates are used during local land use review and development permitting processes
- Deals with over-estimating vehicle trips can lead to excessive traffic mitigation fees and infrastructure improvements, leading to possible neighborhood opposition (and sometimes costly and time-consuming lawsuits). This process can also result in demand for more parking spaces than may actually be needed to support the proposed development. Over-estimating can create higher development costs as well as delay and even cancellation of otherwise beneficial infill projects—impacts that can stall economic development and the provision of needed housing and job growth within existing urban and suburban redevelopment areas.

Recent Research

NCHRP 3-70 Multimodal LOS Analysis for Urban Streets (Completed Feb. 2008)

- Developed and tested methods to determine LOS on urban streets for:
  - Automobile
  - Transit
  - Bicycle
  - Pedestrian

- Consists of a set of recommended procedures for predicting traveler perceptions of quality of service and performance measures

- Level of service is a quantitative stratification of quality of service into six letter grades with letter grade “A” representing the best quality of service, and letter grade “F” representing the worst quality of service.

Recent Research

NCHRP REPORT 616: Multimodal Level of Service Analysis for Urban Streets (Completed Feb. 2008)

- Multimodal level of service (MMLOS) method is designed for evaluating "complete streets," context-sensitive design alternatives, and smart growth from the perspective of all users of the street.

- Use the MMLOS method to evaluate the tradeoffs of:
  the auto driver's, transit passenger's, bicyclist's, and pedestrian's perceptions of the quality of service provided by the street.

- Can be implemented in a simple spreadsheet.

- Makes use of a combination of readily available data and data normally gathered to assess auto and transit level of service. The data requirements of the MMLOS method include geometric cross-section, signal timing, the posted speed limit, bus headways, traffic volumes, transit patronage, and pedestrian volumes.

- Enables agencies to balance the LOS needs of auto drivers, transit riders, bicycle riders, and pedestrians in their street designs by providing agencies with a tool for testing different allocations of scarce street right-of-way to the different modes using the street.

Questions?

Appendix B: 2/4/09 meeting materials

- **Meeting Agenda**
- **Meeting Notes**
- **Presentation: *Mixed Use Development Trip Generation*—Todd Sammons, DelDOT**

Wilmington Area Planning Council

850 Library Avenue, Suite 100
Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

WILMAPCO Council:

Stephen Kingsberry, Chair
Delaware Transit Corporation Director

Joseph L. Fisona, Vice Chair
Mayor of Elkton

James M. Baker
Mayor of Wilmington

Christopher A. Coons
New Castle County County Executive

John F. Klingmeyer
Mayor of New Castle

Brian Lockhart
Cecil County Commissioner

Samuel F. Minnitte, Jr.
Maryland Dept. of Transportation Director, Office of Planning

Lee Ann Walling
Delaware Office of the Governor Policy Advisor for Environment and Quality of Life Policy

Carolann Wicks
Delaware Dept. of Transportation Secretary

WILMAPCO Executive Director
Tigist Zegeye

Memorandum

Date: January 30, 2009

Re: 2/4/09 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, February 4th, 2009 9-11am

Agenda

1. **Presentation: Current DelDOT practice of assessing impact of development – *Todd Sammons (DelDOT)***
   Todd will present DelDOT current methods on how they assess the traffic impacts of development plans citing examples from the state.

2. **Presentation: TIPS Trip Generation Software – *Todd Sammons (DelDOT)***
   Developed by the Florida Department of Transportation, a trip generation calculation tool called TIPS (Trip generation, Internal capture, and Pass-by Software) estimates the number of trips generated by specific land uses of a proposed land development. A presentation on the software and its possible application to Delaware will be discussed.

3. **Current perspective of the development process from the developer community – *Jerry Heisler (The Reybold Group)***

4. **Presentation on current research on measuring the impacts and benefits of mixed-use development *(D. Blevins)***
   - Problems/Issues with current ITE measurement practices
   - Internal trip capture benefits of mixed use developments
   - Literature review of recent ITE/TRB publications

5. **Open Discussion: Defining mixed-use development**
   - What is mixed use development?
   - What are some examples of “good” mixed use developments?
   - What do these examples have in common?

6. **Next meeting date and future objectives**

2/4/09 Mixed-Use/TMA meeting notes

Attendees:
George Timko – NCC Economic Redevelopment
Dan LaCombe - DelDOT
Jerry Heisler - The Reybold Group
Wayne Henderson – Delaware Transit Corporation
Jeff Stone – Delaware Economic Development Office
Ted Bishop – DelDOT
Todd Sammons - DelDOT
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Dan Blevins – WILMAPCO

Meeting Notes:

Agenda Item #1: Current DelDOT practice of assessing development impacts:
Todd Sammons (DelDOT) gave a presentation titled "Mixed Use Development Trip Generation". Todd presented the current TIS (Traffic Impact Study) process in which DelDOT follows to measure the impacts of developments.

Comments regarding the presentation:

- Generally there is a dis-incentive in calculating mixed use development impacts due to lack of internal trip capture benefits in current methods. However, there is currently not enough historical data collected on trip generation in existing mixed-use developments. There is a need more of these type projects to get better readings on internal capture.

- It was mentioned that smallest component of a mixed use should be retail for it to be truly effective. Plans should also have incentives that help facilitate people to live and work on same site.

- LOS E in high density areas is needed to foster true mixed use developments

- A problem that exists with mixed-used development is that you must lay out more infrastructure up front to accommodate the entire parcel rather than incrementally with more single-use developments. This makes developers shy away from these types of developments. In addition, it is tough to obtain financing for mixed use due to national trends.

Agenda Item #2: Current perspective of the development process:

- There is a need to get transportation agencies involved early in the development process rather than later. Should be involved earlier in TIS process. Developments are easier to alter to suit earlier in the process. (DelDOT to follow up on recommendation).

- Additionally to help make mixed use development work, amenities such as bike/ped and transit facilities need to be part of the mix.

- Zoning seems to be lagging behind this type of development at the state/county level. No encouragement beyond verbal support. More concrete policy needs to be part of this process. Also, it is tough to get developers to move toward doing mixed use development.

- Starting to look at plan review process to review approach. Can't control changes to a plan, only use. First order of business is to work more closely with counties on their comp plans to point out areas which could be feasible for mixed use and the prospect of LOS E designations.

- Got to be a guide to the process with the full range of groups/agencies that need to be part of it. (i.e. Ag, DOT, transit, AQ, bike/ped), but consequences of adding more players to the process may further drive developers away from coming up with more of these developments.

- The question was raised about where the The PLUS process (Preliminary Land Use Service) fit into this equation. – 2 things; Too late in the process and it has gone beyond concept plan and have even spent funds on engineering efforts which makes it difficult to get any changes made to the plan. It functions as an advisory group that give comments, but not the ability mandate changes to a plan based on comments from the PLUS members. Mostly a process used by Kent and Sussex counties.

Agenda Item #3: Open Discussion – Defining Mixed Use Development

- No real consensus form group on what exactly mixed use development that can be promoted collectively. Suggestion was made that for next meeting all members prepare a list of what they feel represents a mixed use development. At the next meeting these would be compared.

- From the developer's perspective, LOS E is needed for mixed use development to work. Other wise is becomes cost-prohibitive. The question was raised on how can LOS E be sold to the general population? If there are certain conditions that exist, including locals and the local government.

- Transportation Investment Districts- does this need to be worked on now? For purposes of TIS waivers, used to create mechanisms that can match the infrastructure with the plan for that area. But decision must come from local government, not the DOT. Can be based on county, municipal or sub-regional plan/study.

- The thought of scheduling a speaking was brought up. It was suggested that this would be a good time in tandem with the members putting down on paper as to their thoughts and discuss at the next meeting. Once we have a consensus on what the working group believes that should be part of mixed use development for our area, then it would be compared to the NCHRP research. Once this has been competed, then the scheduling of an outside expert on the topic should be arranged.

- Update on NCHRP reports. 08-51 will be available soon.

Next steps/future meetings:

- Ask each member to write down what they consider as “mixed-use” development. Will be compiled prior to the next meeting
- Compare workgroup thoughts to recently released NCHRP efforts
- Select Speaker(s) for future meeting to give more details on possibilities for mixed use development for DE.

Mixed Use Development Trip Generation

- Todd Sammons
- TIS Group
- Division of Planning
- February 4, 2009

State of Delaware
Department of Transportation
Carolann Wicks, Secretary

A Traffic Impact Study (TIS) is:

According to DelDOT's Standards and Regulations for Subdivision Streets and State Highway Access, a TIS is:

"A study conducted during the development approval process to determine the impacts that traffic generated by the proposed development will have on the surrounding street network and the improvements needed to the transportation system in order to mitigate those impacts."

What are the applicable regulations?

1) Chapter 2 of DelDOT 's Standards and Regulations for Subdivision Streets and State Highway Access

2) Chapter 11 of New Castle County's Unified Development Code

UNIFIED DEVELOPMENT CODE
New Castle County

A Traffic Operational Analysis (TOA) is:

According to DelDOT's Standards and Regulations for Subdivision Streets and State Highway Access, an Operational Analysis is:

An evaluation or series of evaluations conducted during the TIS and site entrance reviews that is used to determine the ability of a proposed development project to operate safely and with adequate access. Analyses conducted during the heading of "Operational Analysis" may include Queueing Analysis, Highway Capacity Analyses, and Accident Analyses.

What are the applicable regulations?

1) Chapter 2 of DelDOT 's Standards and Regulations for Subdivision Streets and State Highway Access

2) Chapter 11 of New Castle County's Unified Development Code

UNIFIED DEVELOPMENT CODE
New Castle County

When to use a TIS or a TOA

- DelDOT and County regulations are specific as to when a TIS may and may not be required and when the requirement can be waived.
- DelDOT regulations grant the authority to require a TOA as necessary to review a plan.
- Examples of when DelDOT might require a TOA:
  - TIS not warranted
  - TIS cannot be required by County Code
  - TIS warranted but waived
  - TIS left a relevant question unanswered

Examples

AstraZeneca = TIS

WAWA = TOA

TRAFFIC IMPACT STUDY (TIS) PROCESS

- DelDOT and Developer's Consultant have Scoping Meeting
- Developer's Consultant performs Traffic Counts
- DelDOT reviews Traffic Counts
- Developer's Consultant prepares Preliminary TIS
- DelDOT reviews Preliminary TIS
- Developer's Consultant prepares Final TIS
- DelDOT provides Final TIS to DelDOT's Consultant for review
- DelDOT's Consultant prepares Final letter/recommendations
- DelDOT reviews Final letter
- DelDOT transmits Final letter to Developer and local government

Analysis Tools used to determine Final TIS Results

- Highway Capacity Software (HCS) for estimating capacity and determining Level of Service (LOS) A through F
- SYNCHRO is used for advanced modeling techniques or instead of HCS
- aaSIDRA utilized for roundabout analysis

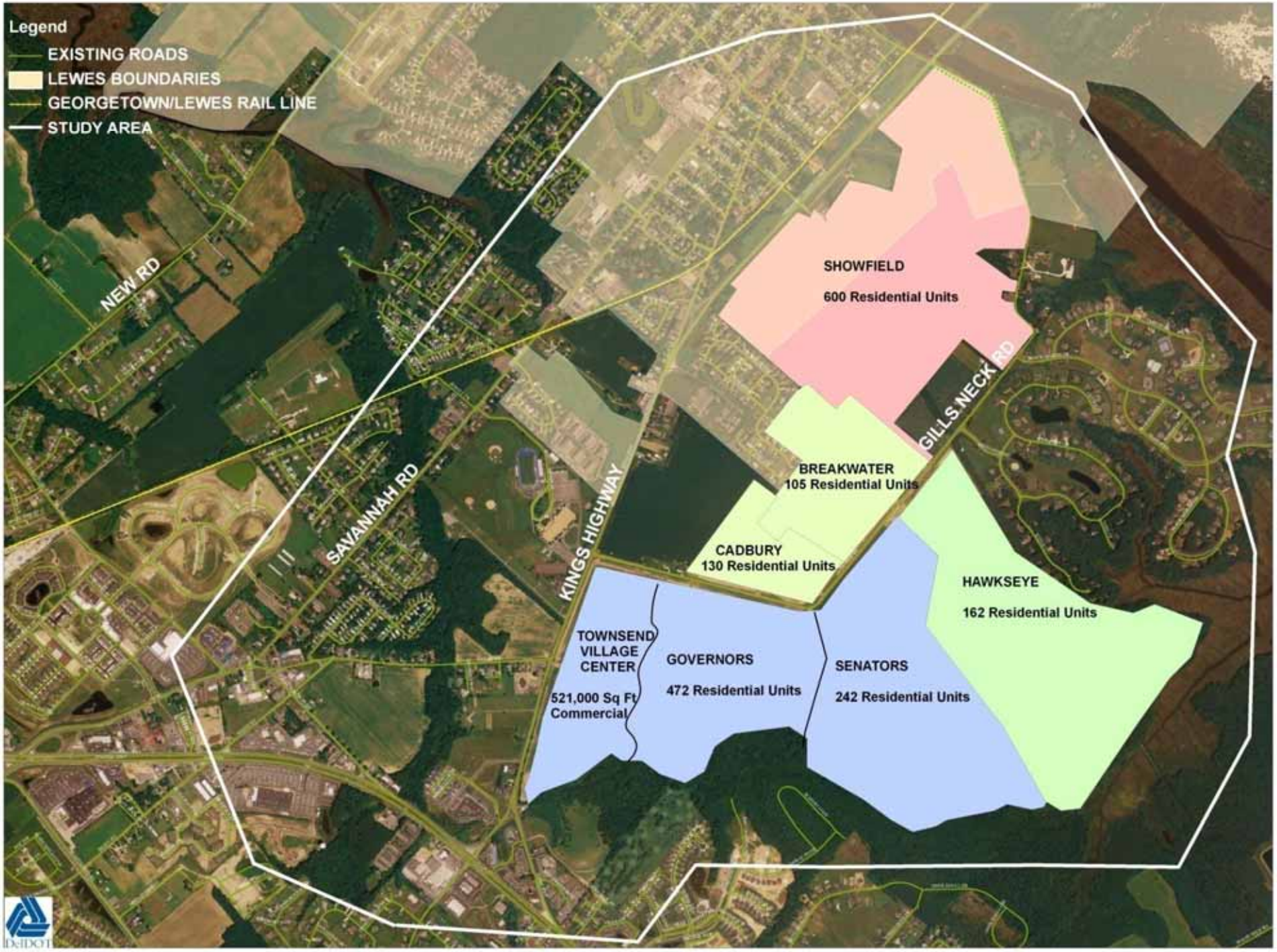
LEWES AREA
DEVELOPMENT & INFRASTRUCTURE IMPROVEMENTS

DELAWARE DEPARTMENT OF TRANSPORTATION

DIVISION OF PLANNING

P.O BOX 778

Dover, DE 19903


Legend
EXISTING ROADS
LEWES BOUNDARIES
GEORGETOWN/LEWES RAIL LINE
STUDY AREA
NEW RD
SAVANNAH RD
KINGS HIGHWAY
GILLS NECK RD
SHOWFIELD
600 Residential Units
BREAKWATER
105 Residential Units
CADBURY
130 Residential Units
HAWKSEYE
162 Residential Units
TOWNSEND
VILLAGE
CENTER
521,000 Sq Ft
Commercial
GOVERNORS
472 Residential Units
SENATORS
242 Residential Units
DelDOT

CHAPTER 7

Multi-Use Development

7.1 Background

A basic premise behind the data presented in *Trip Generation* is that data were collected at single-use, free-standing sites. However, the development of mixed-use or multi-use sites is increasingly popular. While the trip generation rates for individual uses on such sites may be the same or similar to what they are for free-standing sites, there is potential for interaction among those uses within the multi-use site, particularly where the trip can be made by walking. As a result, the total generation of vehicle trips entering and exiting the multi-use site may be reduced from simply a sum of the individual, discrete trips generated by each land use.

A common example of this internal trip-making occurs at a multi-use development containing offices and a shopping/service area. Some of the trips made by office workers to shops, restaurants, or banks may occur on site. These types of trips are defined as internal to (i.e., "captured" within) the multi-use site.

7.2 What Is a Multi-Use Development?

For purposes of this handbook, a ***multi-use development is typically a single real-estate project that consists of two or more ITE land use classifications between which trips can be made without using the off-site road system.*** Because of the nature of these land uses, the trip-making characteristics are interrelated, and some trips are made among the on-site uses. This capture of trips internal to the site has the net effect of reducing vehicle trip generation between the overall development site and the external street system (compared to the total number of trips generated by comparable, stand-alone sites).

Multi-use developments are commonly found ***ranging in size from 100,000 sq. ft. to 2 million sq. ft.*** The data presented in this chapter correspond to multi-use developments in this size range. The recommended procedures for estimating trip generation at multi-use developments are likely applicable at even larger sites, but the analyst is encouraged to collect additional data.

A key characteristic of a multi-use development is that trips among the various land uses can be made on site and these ***internal trips are not made on the major street system.*** In some multi-use developments, these internal trips can be made either by walking or by vehicles using internal roadways without using external streets.

An ***internal capture rate*** can generally be defined as a percentage reduction that can be applied to the trip generation estimates for individual land uses to account for trips internal to the site. It is important to note that these reductions are applied externally to the site (i.e., at entrances, adjacent intersections and adjacent roadways). The trip reduction for internally captured trips is separate from the reduction for ***pass-by trips.*** These are two distinct phenomena and both could be applicable for a proposed development. The internal trips, if present, should be subtracted out ***before*** pass-by trip reductions are applied (refer to Chapter 5 for a complete discussion of pass-by trip estimation).

Multi-Use Development

- **Typically planned as a single real-estate project,**
- **Typically between 100,000 and 2 million sq. ft. in size,**
- **Contains two or more land uses,**
- **Some trips are between on-site land uses, and**
- **Trips between land uses do not travel on major street system.**

Not a(n)

- **Central business district,**
- **Suburban activity center, or**
- **Existing ITE land use classification with potential for a mix of land uses, such as**
  - **Shopping center,**
  - **Office park with retail,**
  - **Office building with retail, or**
  - **Hotel with limited retail and restaurant space.**

Single-Family Detached Housing
(210)

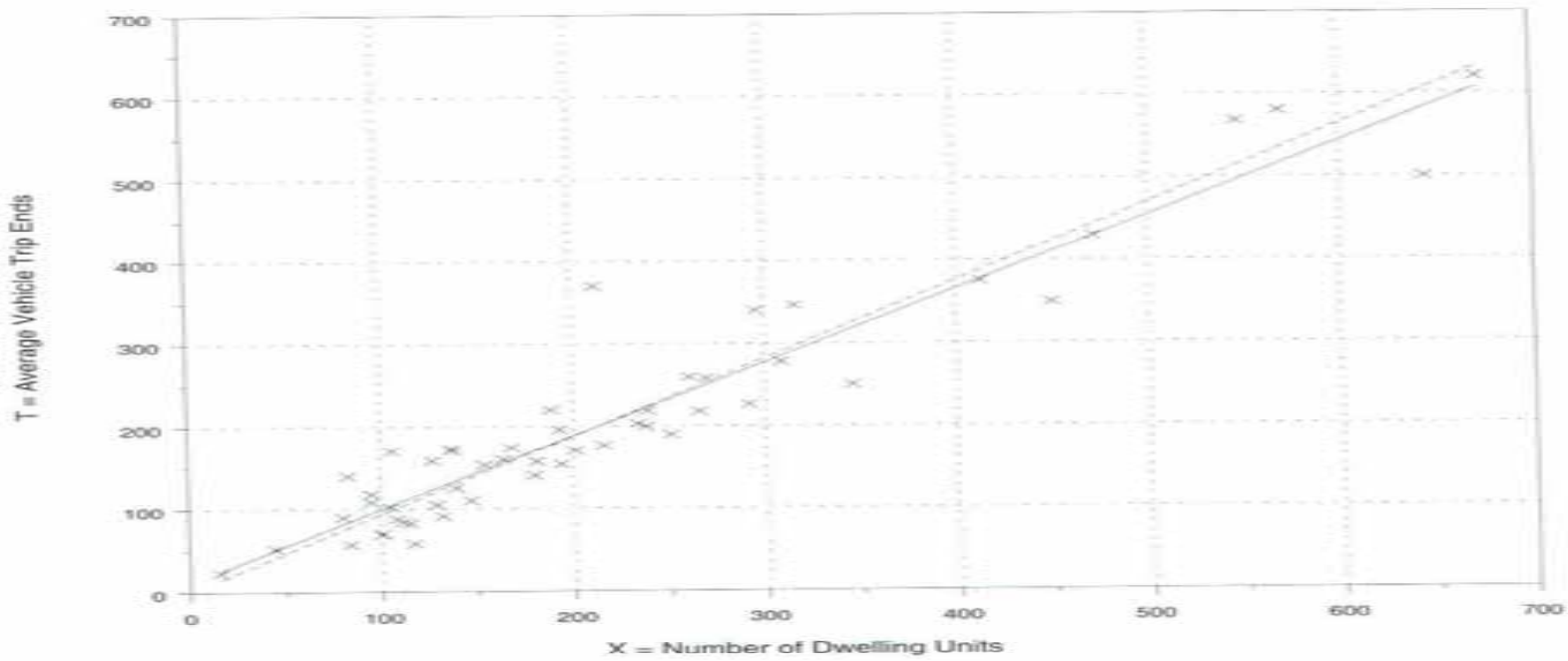
Average Vehicle Trip Ends vs: Dwelling Units
On a: Saturday,
Peak Hour of Generator

Number of Studies: 52
Avg. Number of Dwelling Units: 220
Directional Distribution: 54% entering, 46% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.94	0.50 - 1.75	0.99

Data Plot and Equation



Fitted Curve Equation: T = 0.89(X) + 10.93

R^2 = 0.90

Residential Condominium/Townhouse
(230)

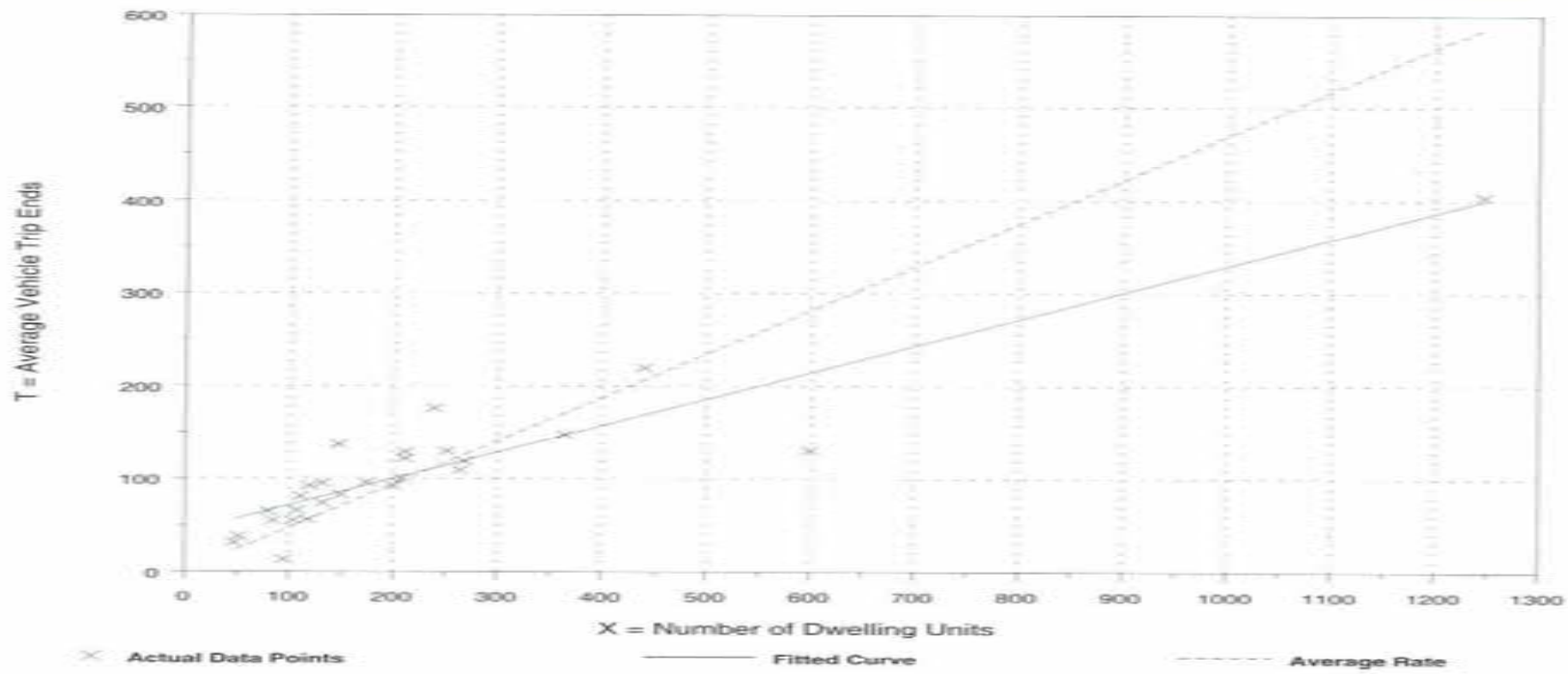
Average Vehicle Trip Ends vs: Dwelling Units
On a: Saturday,
Peak Hour of Generator

Number of Studies: 27
Avg. Number of Dwelling Units: 228
Directional Distribution: 54% entering, 46% exiting

Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.47	0.14 - 0.93	0.71

Data Plot and Equation



Fitted Curve Equation: T = 0.29(X) + 42.63

R^2 = 0.84

Shopping Center
(820)

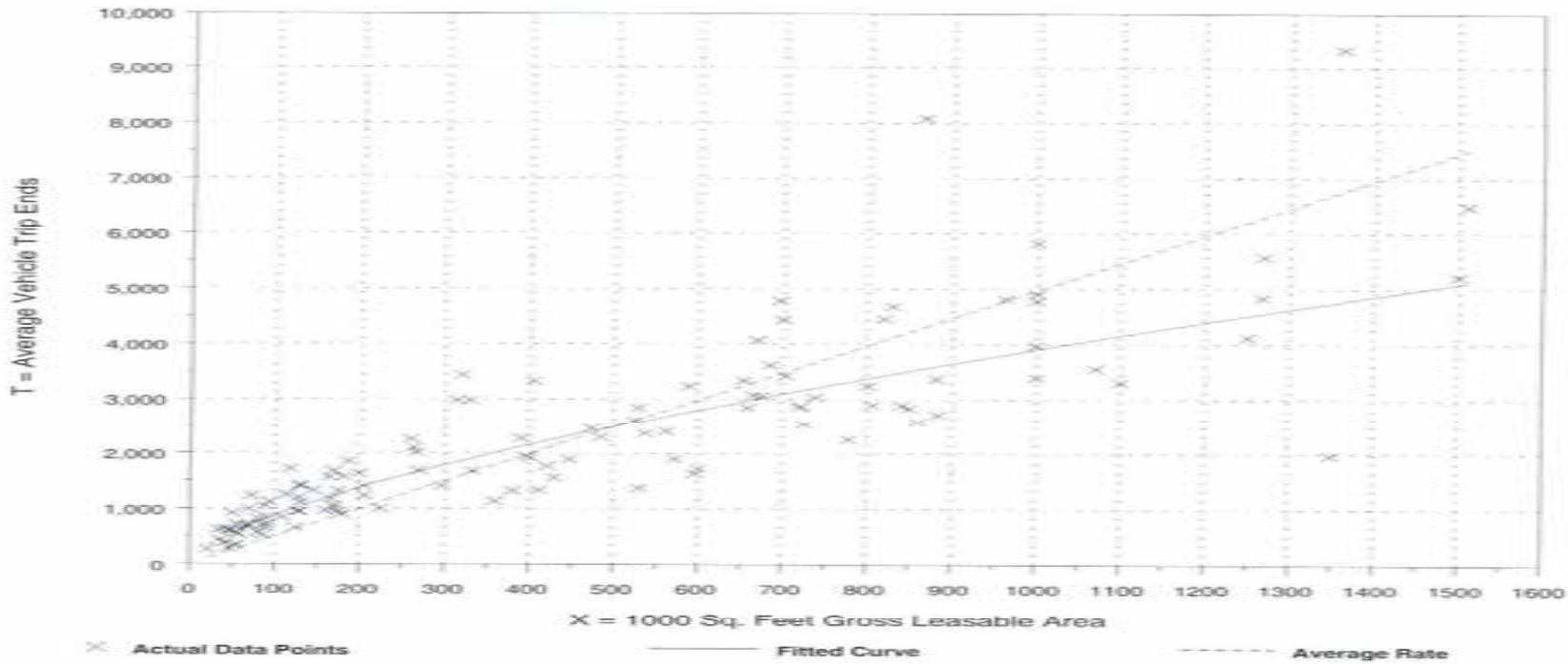
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Leasable Area
On a: Saturday,
Peak Hour of Generator

Number of Studies: 124
Average 1000 Sq. Feet GLA: 447
Directional Distribution: 52% entering, 48% exiting

Trip Generation per 1000 Sq. Feet Gross Leasable Area

Average Rate	Range of Rates	Standard Deviation
4.97	1.46 - 18.32	3.11

Data Plot and Equation



Fitted Curve Equation: Ln(T) = 0.65 Ln(X) + 3.77 $R^2 = 0.84$

Analyst RAM
Date 2/14/06

MULTI-USE DEVELOPMENT TRIP GENERATION AND INTERNAL CAPTURE SUMMARY

Name of Dvlpt GILLS NECK
Time Period SATURDAY PEAK HOUR

LAND USE A RESIDENTIAL

ITE LU Code 210, 230
Size 138 DU, 318 DU

Exit to External: 82
Enter from External: 91

	Total	Internal	External
Enter	145	54	91
Exit	124	42	82
Total	269	96	173
%	100%	36%	64%

34% 42 Demand
42 Balanced
5% 49 Demand

37% 54 Demand
54 Balanced
7% 63 Demand

% Demand
Balanced
% Demand

% Demand
Balanced
% Demand

LAND USE B RETAIL

ITE LU Code 820
Size 330,000 SF

Exit to External: 849
Enter from External: 936

	Total	Internal	External
Enter	978	42	936
Exit	903	54	849
Total	1881	96	1785
%	100%	5%	95%

Demand % Balanced Demand %

% Demand Balanced % Demand

LAND USE C

ITE LU Code
Size

Enter from External
Exit to External

	Total	Internal	External
Enter			
Exit			
Total			
%			

Net External Trips for Multi-Use Development

	LAND USE A	LAND USE B	LAND USE C	TOTAL
Enter	91	936	—	1027
Exit	82	849	—	931
Total	173	1785	—	1958
Single-Use Trip Gen. Est.	269	1881	—	2150

Source: Kaku Associates, Inc.

INTERNAL CAPTURE: 9%

Table 7.2 Unconstrained Internal Capture Rates for Trip Destinations Within a Multi-Use Development

		WEEKDAY		
		MIDDAY PEAK HOUR	p.m. PEAK HOUR OF ADJACENT STREET TRAFFIC	DAILY
to OFFICE	from Office	6%	6%	2%
	from Retail	38%	31%	15%
	from Residential	0%	0%	N/A
to RETAIL	from Office	4%	2%	4%
	from Retail	31%	20%	28%
	from Residential	5%	9%	9%
to RESIDENTIAL	from Office	0%	2%	3%
	from Retail	37%	31%	33%
	from Residential	N/A	N/A	N/A

Caution: The estimated typical internal capture rates presented in this table rely directly on data collected at a limited number of multi-use sites in Florida. While ITE recognizes the limitations of these data, they represent the only known credible data on multi-use internal capture rates and are provided as illustrative of typical rates. ***If local data on internal capture rates by paired land uses can be obtained, the local data may be given preference.***

N/A—Not Available; logic indicates there is some interaction between these two land uses; however, the limited data sample on which this table is based did not record any interaction.

Table 7.1 Unconstrained Internal Capture Rates for Trip Origins within a Multi-Use Development

		WEEKDAY		
		MIDDAY PEAK HOUR	p.m. PEAK HOUR OF ADJACENT STREET TRAFFIC	DAILY
from OFFICE	to Office	2%	1%	2%
	to Retail	20%	23%	22%
	to Residential	0%	2%	2%
from RETAIL	to Office	3%	3%	3%
	to Retail	29%	20%	30%
	to Residential	7%	12%	11%
from RESIDENTIAL	to Office	N/A	N/A	N/A
	to Retail	34%	53%	38%
	to Residential	N/A	N/A	N/A

Caution: The estimated typical internal capture rates presented in this table rely directly on data collected at a limited number of multi-use sites in Florida. While ITE recognizes the limitations of these data, they represent the only known credible data on multi-use internal capture rates and are provided as illustrative of typical rates. ***If local data on internal capture rates by paired land uses can be obtained, the local data may be given preference.***

N/A—Not Available; logic indicates there is some interaction between these two land uses; however, the limited data sample on which this table is based did not record any interaction.

Figure 5.1 Types of Trips

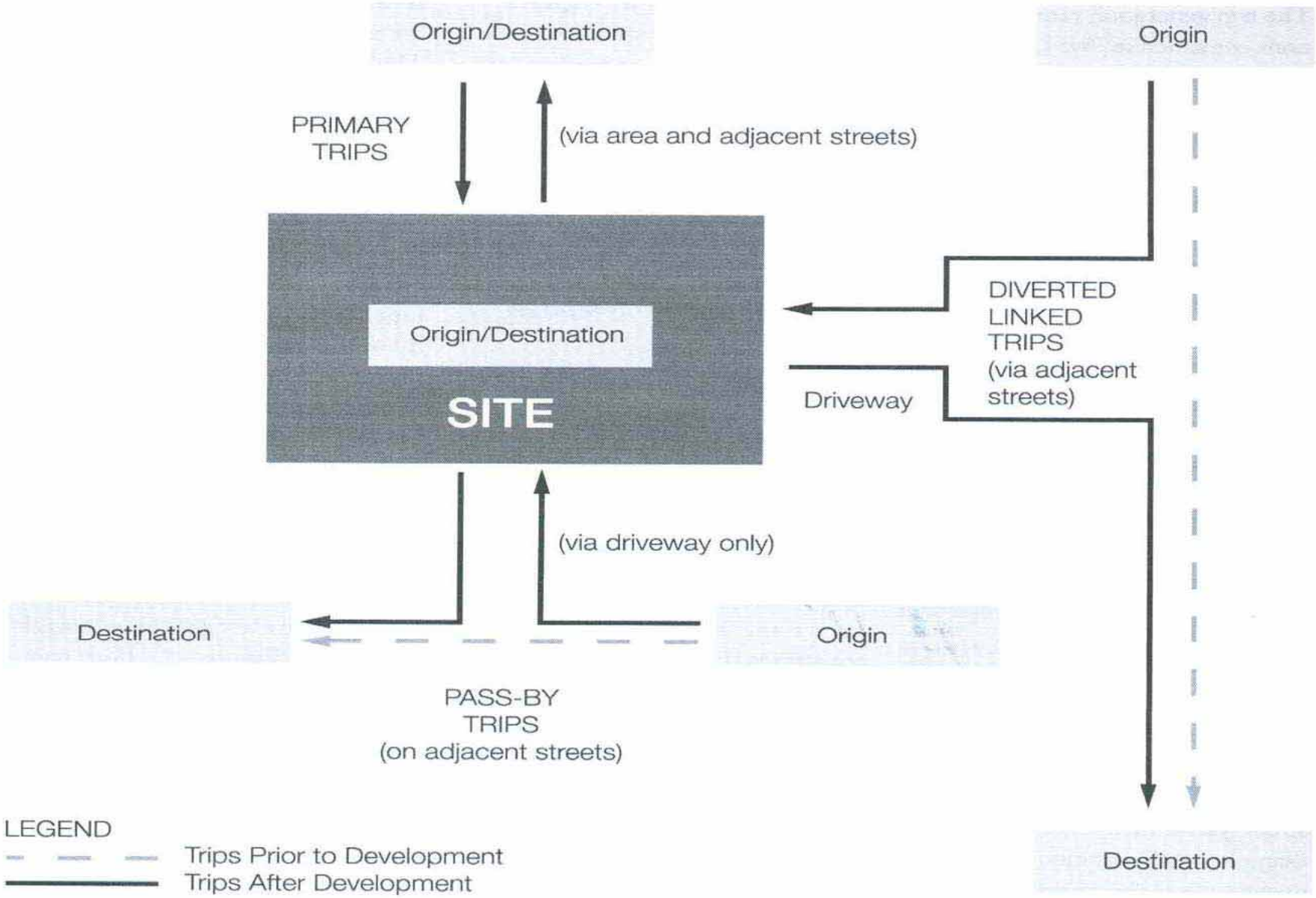
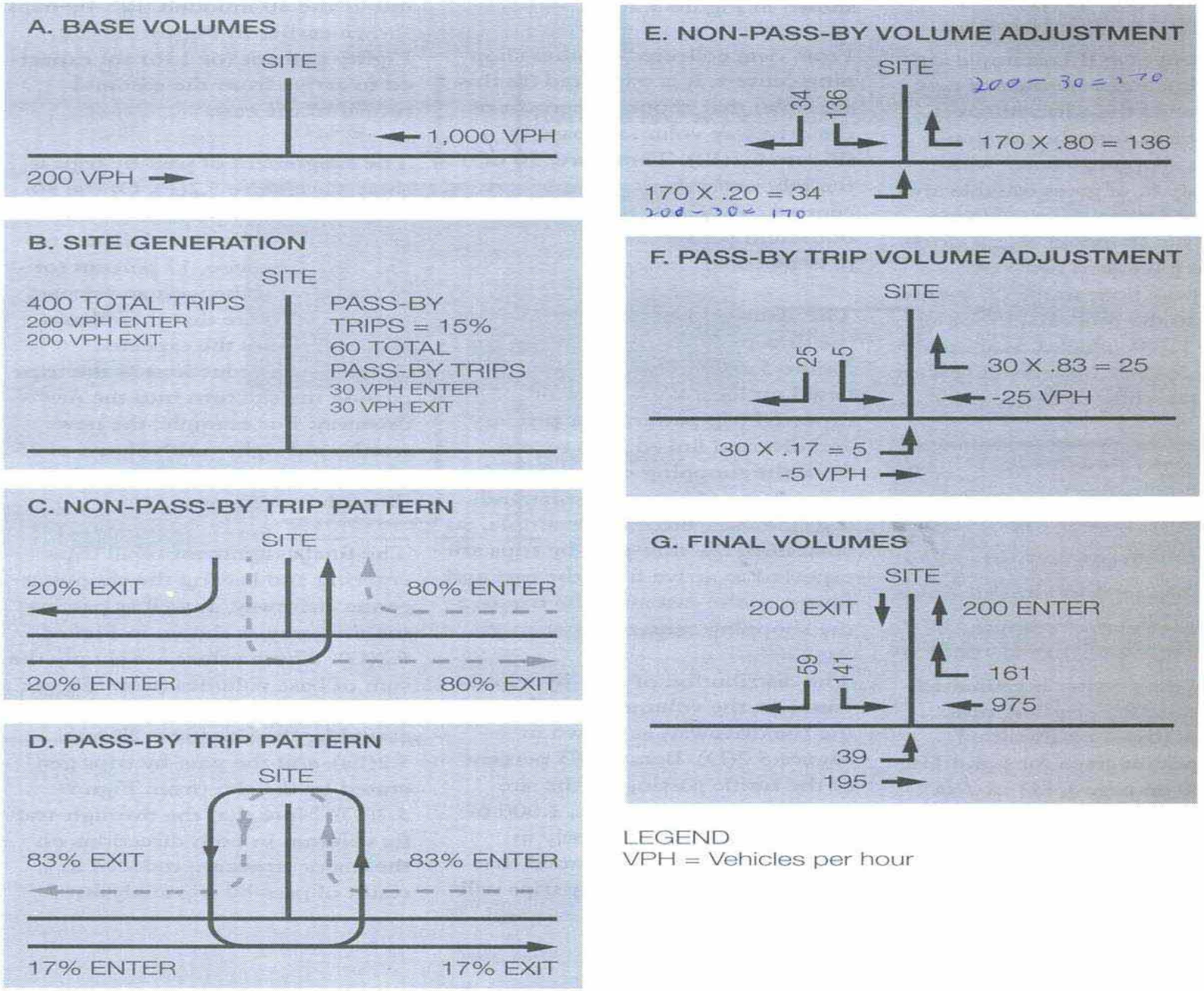


Figure 5.2 Application of Pass-By Trips



LEGEND
VPH = Vehicles per hour

Subtract out pass-by from primary

Subtract out pass-by from through and patio/side entrance

add entrance pass-by to primary entrance

Table 5.1 Land Uses and Time Periods with Pass-By Data

Land Use Code and Description	Time Period	Table	Figure
813 Free-Standing Discount Superstore	Weekday, p.m. Peak Period	5.2	—
815 Free-Standing Discount Store	Weekday, p.m. Peak Period	5.3	5.3
	Saturday, Midday Peak Period	5.4	5.4
816 Hardware/Paint Store	Weekday, p.m. Peak Period	5.5	—
820 Shopping Center	Weekday, p.m. Peak Period	5.6	5.5/5.6
	Saturday, Midday Peak Period	5.7	5.7
843 Automobile Parts Sales	Weekday, p.m. Peak Period	5.8	—
848 Tire Store	Weekday, p.m. Peak Period	5.9	—
850 Supermarket	Weekday, p.m. Peak Period	5.10	5.8
851 Convenience Market (Open 24 Hours)	Weekday, p.m. Peak Period	5.11	5.9
853 Convenience Market with Gasoline Pumps	Weekday, a.m. Peak Period	5.12	5.10
	Weekday, p.m. Peak Period	5.13	5.11
854 Discount Supermarket	Weekday, p.m. Peak Period	5.14	5.12
862 Home Improvement Superstore	Weekday, p.m. Peak Period	5.15	—
863 Electronics Superstore	Weekday, p.m. Peak Period	5.16	—
880 Pharmacy/Drugstore without Drive-Through Window	Weekday, p.m. Peak Period	5.17	—
881 Pharmacy/Drugstore with Drive-Through Window	Weekday, p.m. Peak Period	5.18	—
890 Furniture Store	Weekday, p.m. Peak Period	5.19	—
912 Drive-In Bank	Weekday, p.m. Peak Period	5.20	—
931 Quality Restaurant	Weekday, p.m. Peak Period	5.21	—
932 High-Turnover (Sit-Down) Restaurant	Weekday, p.m. Peak Period	5.22	5.13
934 Fast-Food Restaurant with Drive-Through Window	Weekday, a.m. Peak Period	5.23	—
	Weekday, p.m. Peak Period	5.24	5.14
935 Fast-Food Restaurant without Drive-Through Window and No Indoor Seating (*Specialized Land Use: Coffee/ Espresso Stand*)	Weekday	5.25/5.26	—
944 Gasoline/Service Station	Weekday, a.m. Peak Period	5.27	—
	Weekday, p.m. Peak Period	5.28	—
945 Gasoline/Service Station with Convenience Market	Weekday, a.m. Peak Period	5.29	5.15
	Weekday, p.m. Peak Period	5.30	5.16

Ott - Rodgers & Associates, Inc.
TRANSPORTATION ENGINEERS and PLANNERS

FIGURE 58

Gills Neck Saturday Peak Hour Traffic Volumes (Total)
Scenario 1
Gills Neck
LEWES, SUSSEX COUNTY, DE

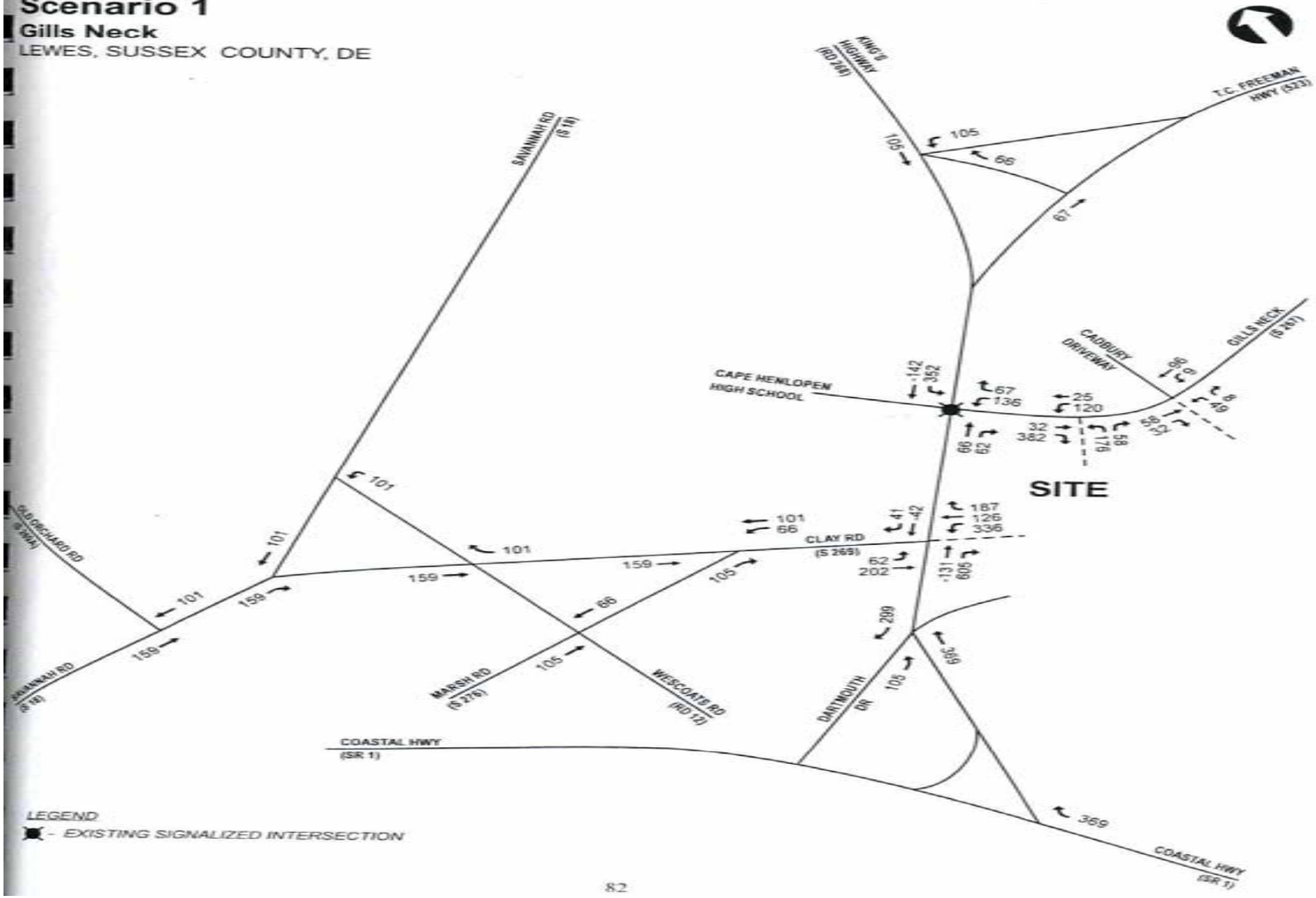


Table VI.

Gills Neck Road Subdivision – PM Peak Hour Trip Generation

Land use	ITE Code	PM peak hour			External trips			Pass-by %	Internal Trip %
		Enter	Exit	Total	Enter	Exit	Total		
138 single-family homes	210	90	53	143	62	25	87	0%	39%
318 multi-family units	230	104	51	155	72	24	96	0%	39%
1,000 seat performing arts center	441	10	10	20	10	10	20	0%	0%
330,000 SF shopping center	820	661	716	1377	439	475	914	27.6%	8%
TOTAL PM peak hour trips	-	**865**	**830**	**1695**	**583**	**534**	**1117**	-	-

Table VII.

Gills Neck Road Subdivision – Saturday Peak Hour Trip Generation

Land use	ITE Code	Saturday peak hour			External trips			Pass-by %	Internal Trip %
		Enter	Exit	Total	Enter	Exit	Total		
138 single-family homes	210	72	62	134	45	41	86	0%	36%
318 multi-family units	230	73	62	135	46	41	87	0%	36%
1,000 seat performing arts center*		330	0	330	330	0	330	0%	0%
330,000 SF shopping center	820	978	903	1881	632	583	1215	32%	5%
TOTAL Saturday peak hour trips	-	**1453**	**1027**	**2480**	**1053**	**665**	**1718**	-	-

Note: As per DelDOT's procedures, internal trip capture for Saturday was calculated using ITE's Weekday Mid-Day data.

**For the performing arts center, a rate of 0.33vehicles per seat was used to generate Saturday trips. This rate was obtained from ITE's* Parking Generation Manual, *3rd Edition.*

Trip Distribution

The distribution of the site-generated traffic was based on the type of land use and the existing traffic patterns in the study area in relation to the proposed site access point. This distribution was used to assign the site-generated traffic to the roadway network for weekday (a.m. and p.m.) and Saturday peaks. For the weekday and Saturday peaks, this report assumes the following:

- 35 percent of the site traffic will enter/exit via Delaware Route 1 from the south,
- 15 percent will enter/exit via Savannah Road (Rd 18) from the west,
- 10 percent will enter/exit via Marsh Rd (Rd 276) from the west,
- 10 percent will enter/exit via Dartmouth Road from the west,
- 10 percent will enter/exit via Kings Highway (Rd 268) from the east,
- 10 percent will enter/exit via Theodore C. Freeman Highway (Road 23) from the east, and
- 10 percent will enter/exit via Gills Neck Rd (Rd 267) from the east.

The proposed trip distribution percentage for the residential portion of the site is illustrated in Figure 36 while the trip distribution percentage for the commercial portion of the site is shown in Figure 37 and the pass-by trip distribution percentage for the retail is shown in Figure 38.

FDOT Systems Planning Office - TIPS Download - Windows Internet Explorer

http://www.dot.state.fl.us/planning/systems/sm/siteimp/tips.shtm

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FDOT Systems Planning Office - TIPS Download

Page Tools

TIPS: Trip Generation, Internal Capture, and Pass-by Software Download and Instructions Page

***Print this page for reference ***

The Florida Department of Transportation has developed a trip generation calculation tool called TIPS (Trip generation, Internal capture, and Pass-by Software) to estimate the number of trips generated by specific land uses of a proposed land development. This application uses rates and equations from the Institute of Transportation Engineers *Trip Generation*, 7th Edition. TIPS provides a database of over 140 land-use types as well as step-by-step guidance in performing the necessary calculations.

Download and Installation Instructions (updated 10/09/07):

- Sign up for product updates and download program
- A dialog box will appear asking you if you want to run (or open) the file from its current location or to save it to disk: Choose save to disk
- Save the file "**TIP_1.40.zip**" to any temporary directory or your desktop
- Close all programs except for those used in installation
- Double-click on the "**TIP_1.40.zip**" file

Internet 100%

NCHRP 08-51 [Active]

Enhancing Internal Trip Capture Estimation for Mixed-Use Developments

Project Data	
Funds:	$250,000
The preliminary draft final report is expected in November 2008.	
Staff Responsibility:	Christopher Hedges
Research Agency:	Texas A&M University
Principal Investigator:	Brian Bochner
Effective Date:	7/5/2005
Completion Date:	1/31/2009

BACKGROUND

As new development places increasing demands on the transportation system, community leaders, land-use planners, developers, and transportation agency administrators need techniques to enable them to reliably predict the number of net vehicle and person trips that will be generated by new or infill mixed-use development.

For site impact analysis purposes, an internal capture rate that is set too low may unfairly penalize developers by making them pay more than their fair share of costs for transportation mitigation measures. Conversely, an internal capture rate that is set too high may unfairly place this burden on the public. Both cases may result in sub-optimal build-out, particularly in urban areas.

Since the internal capture rate used for a given mixed-use development can be politically contentious, empirical observations are needed to provide professional guidance for better estimating these impacts. By improving the methods for estimating internal capture, the process of determining developers' responsibilities for mitigating transportation impacts of mixed-use development will become more equitable, transparent, and open.

The Institute of Transportation Engineers' (ITE's) report titled: *Trip Generation* (7th edition, 2003, ISBN 0-935403-79-5) provides vehicle trip generation rates for various residential, commercial, and industrial developments. ITE recently conducted a survey of its members that provides further insight on estimating internal capture for mixed-use developments The information is available on-line at: http://www.zoomerang.com/reports/public_report.zgi?ID=L2263NJNHL4U. Because ITE's rates are predominantly based on "single-use, free-standing sites," the potential exists for multi-use sites to exhibit fewer vehicle trips than would be estimated using the stand-alone rates. For example, a proposed mixed-use development that includes residential, retail, and office use may, in reality, exhibit significant internal capture and consequently lower external trip generation than would have otherwise been predicted. In addition, it has been suggested that behavioral response to contextual factors such as density, diversity, design, and regional accessibility influence travelers' trip-making decisions (Ewing, R. and R. Cervero, 2001, *Transportation Research Record: Journal of the Transportation Research Board, No. 1780*, pp. 87-113).

ITE advises those estimating transportation impacts of mixed-use developments to "collect additional data if possible." ITE's *Trip Generation Handbook* (2nd edition, 2004, ISBN 0-935403-86-8), has established a data-collection procedure for estimating multi-use trip generation; however the existing framework is based on a limited set of data that does not adequately capture elements of mixed-use development. Consequently, when considering potential transportation impacts of proposed mixed-use developments, local and state transportation planners lack a comprehensive, credible data set that can be used to confirm or deny the soundness of proposed internal capture estimates. Currently, "...so little information is available about internal capture rates that traffic impact studies for mixed-use developments become little more than exercises in speculation." (Ewing, R., M. Deanna, and S.C. Li, *Transportation Research Record 1518*, pp. 1-6). This NCHRP study will address this need by providing a classification system of mixed-used developments and a data-collection framework to enhance estimates of internal capture for mixed-use developments.

OBJECTIVE

The objective of this two-phase project is to produce a methodology for enhancing internal trip capture estimates that includes (1) a classification system of mixed-use developments that identifies the site characteristics, features, and context that are likely to influence internally captured trips and (2) a data-collection framework for quantifying the magnitude of internal travel to and around mixed-use developments to determine the appropriate reduction rates.

Accomplishment of the project objective will require at least the following tasks.

Appendix C: 3/18/09 meeting materials

- **Meeting Agenda**
- **Meeting Notes**
- **Presentation: *Results from Mixed-Use Survey-* Dan Blevins, WILMAPCO**
- **Mixed-Use Survey Questionnaire template**

Wilmington Area Planning Council

850 Library Avenue, Suite 100
Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

WILMAPCO Council:

Stephen Kingsberry, Chair
Delaware Transit Corporation Director

Joseph L. Fisona, Vice Chair
Mayor of Elkton

James M. Baker
Mayor of Wilmington

Christopher A. Coons
New Castle County County Executive

John F. Klingmeyer
Mayor of New Castle

Brian Lockhart
Cecil County Commissioner

Samuel F. Minnitte, Jr.
Maryland Dept. of Transportation Director, Office of Planning

Lee Ann Walling
Delaware Office of the Governor Policy Advisor for Environment and Quality of Life Policy

Carolann Wicks
Delaware Dept. of Transportation Secretary

WILMAPCO Executive Director
Tigist Zegeye

Memorandum

Date: May 21, 2009

Re: 3/18/09 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, March 18th, 2009 9-11am

Agenda

1. **Presentation: Results from Mixed-Use Survey – Dan Blevins**
   WILMAPCO staff will present the results from the completed surveys on mixed use development.

2. **Conclusions on local perspective of mixed-use development**

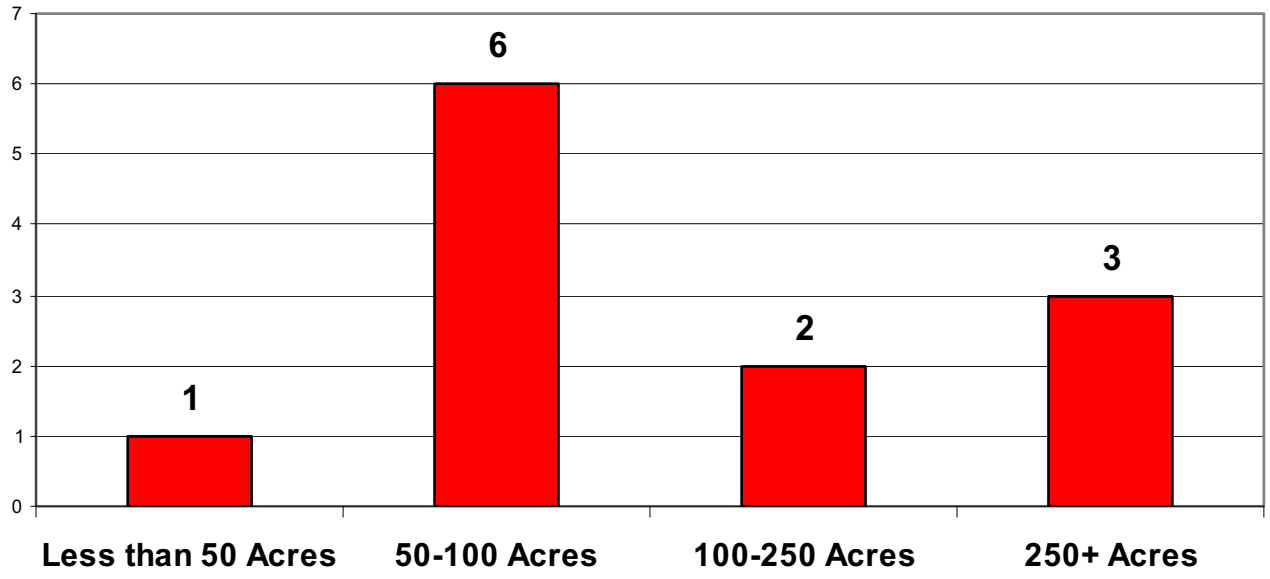
3. **Possibilities for a National Speaker to discuss national trends in mixed-use development**

4. **Next meeting date and future objectives**

Summary of Results from the Local Perception of Mixed Use Development

Presented to the Mixed-Use and Traffic Mitigation Agreement Working Group 3/18/2008

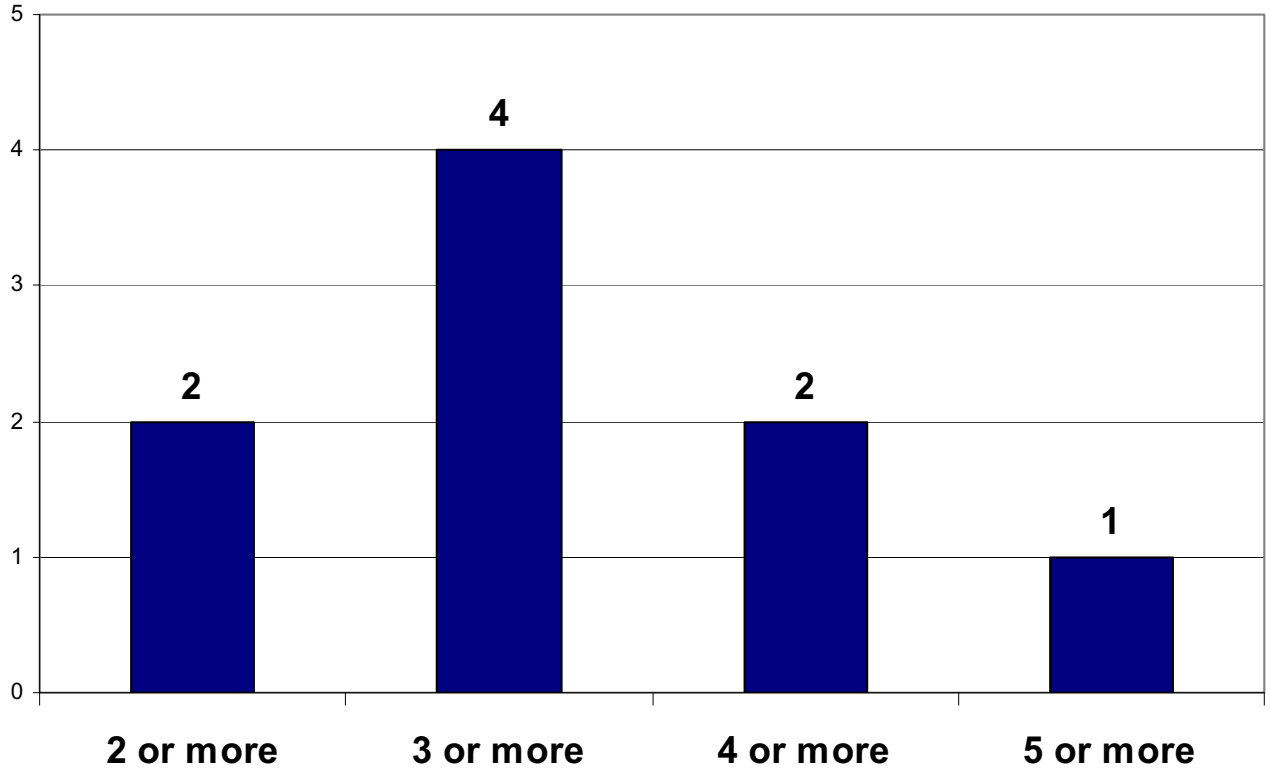
Development Size: In your opinion, what do you feel is the ideal size of a mixed-use development?



Local examples:

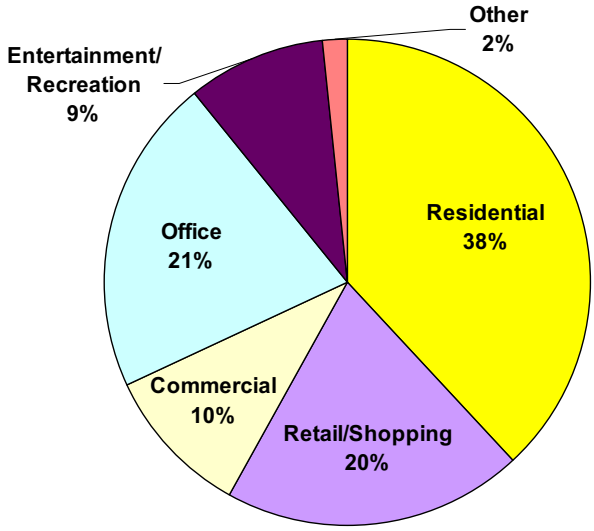
- **Lincoln Center: 56ac.**
- **Renaissance Village 51 ac.**
- **Westown 2,500 ac.**
- **Barley Mill Plaza (111ac.)**

Land Use mix: How many land uses (i.e. residential, office, retail, commercial, etc…) do you feel constitutes a good mixed use development?



In your opinion, please write the percentages of the land use types that would constitute your "ideal blend" of a mixed use development. Total should be 100%

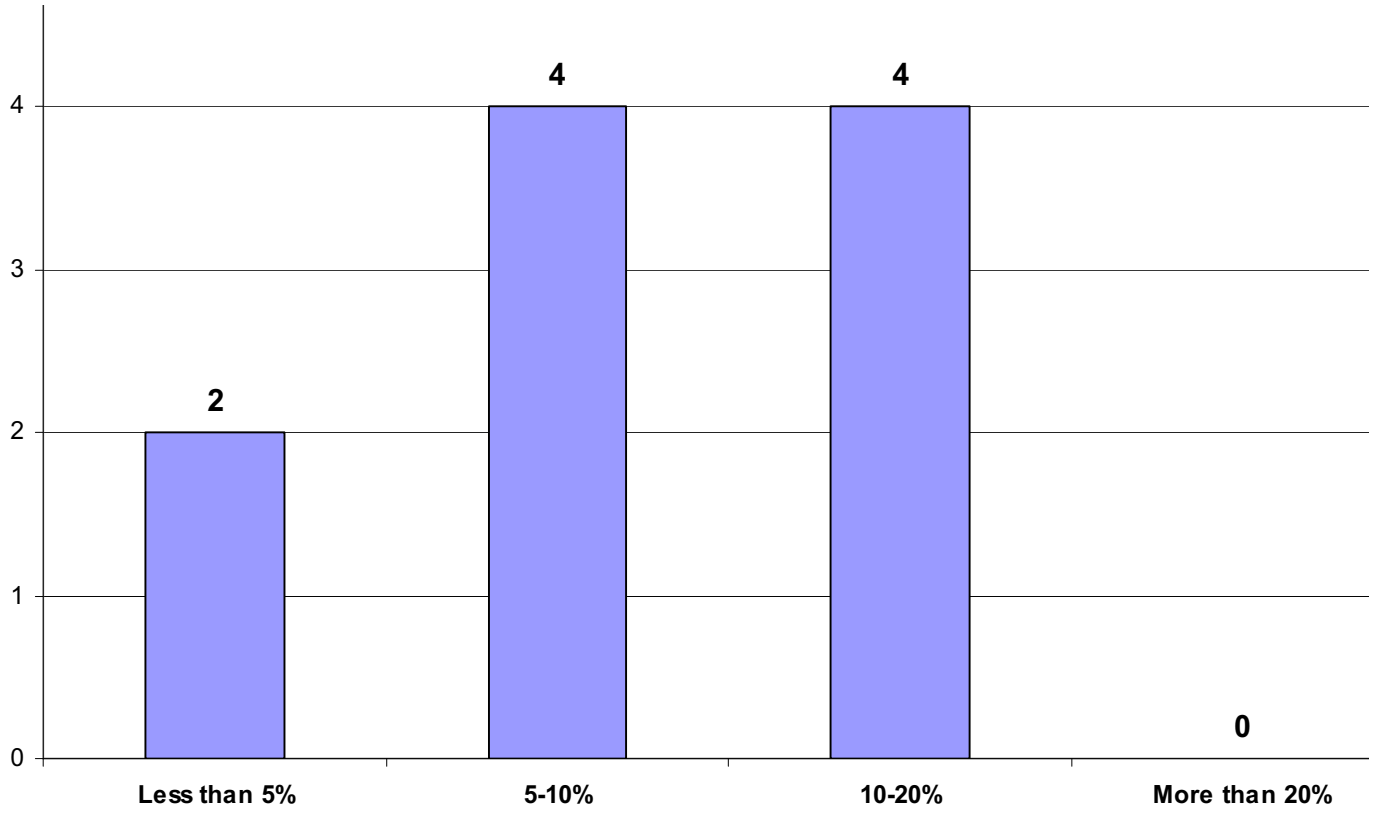
Total Survey Avg.



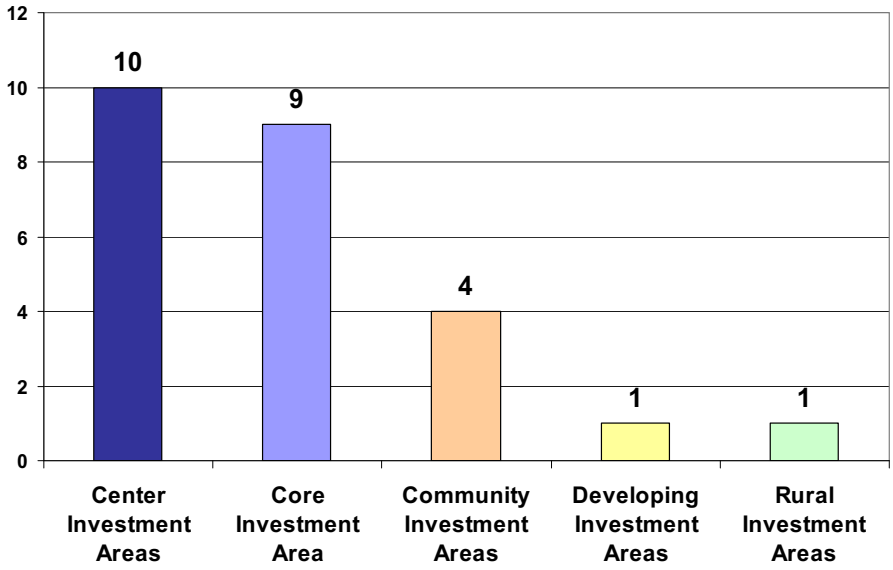
Breakdown of Individual Responses

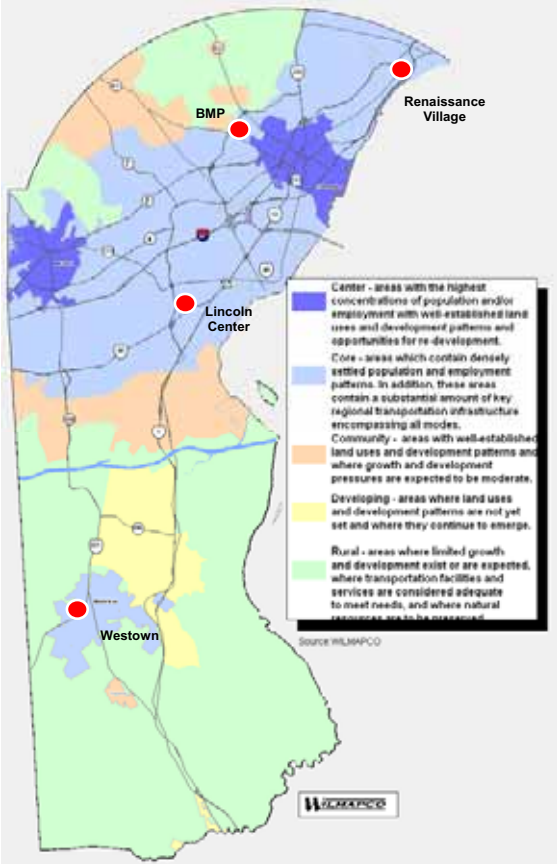
Type	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	AVG
Residential	15%	60%	35%	30%	23%	45%	65%	25%	50%	30%	38%
Retail/Shopping	30%	15%	15%	20%	19%	20%	10%	40%	15%	20%	20%
Commercial	15%	5%	15%	20%	10%	10%	8%	10%	0%	10%	10%
Office	35%	5%	20%	20%	38%	10%	10%	15%	30%	30%	21%
Ent./Rec.	5%	15%	10%	10%	5%	15%	7%	10%	5%	5%	9%
Other	0%	0%	5%	0%	5%	0%	0%	0%	0%	5%	2%

What percentage of the residential units should be set aside for low-income buyers in a mixed-use development?



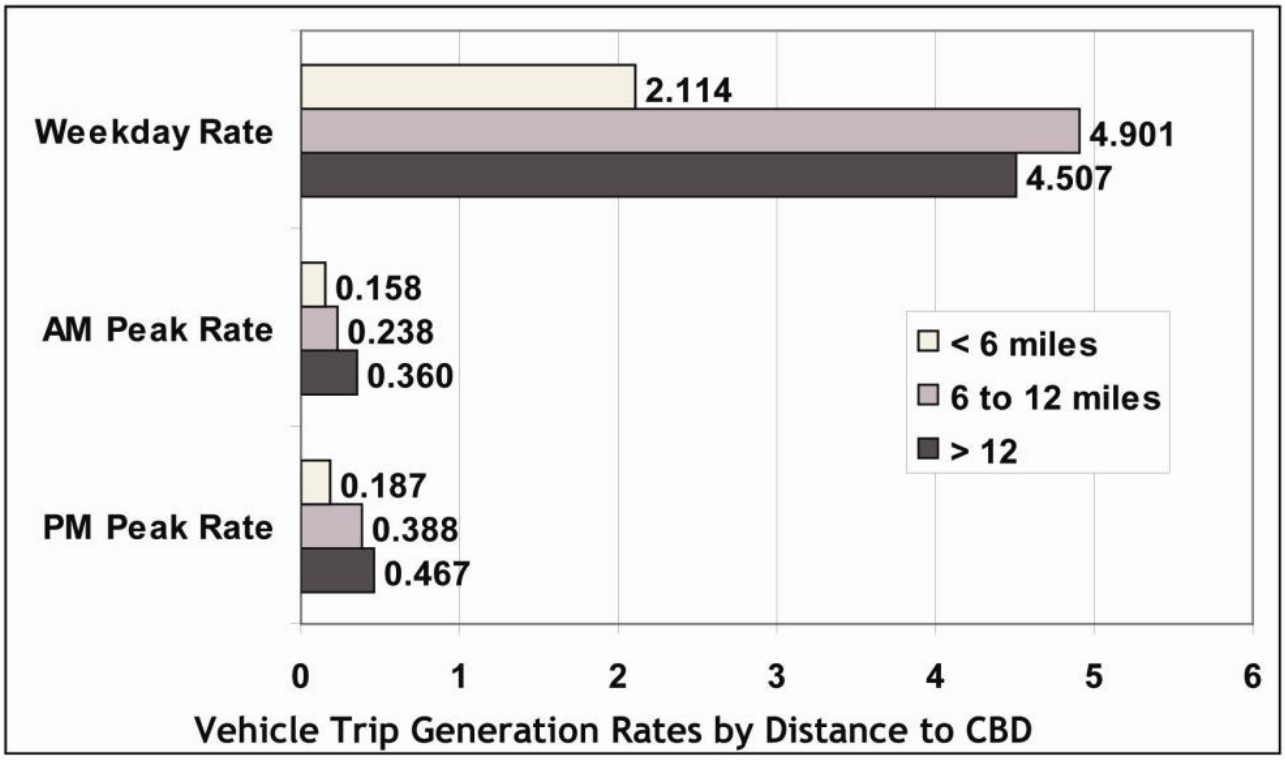
Location: Based on the WILMAPCO Transportation Investment Area map, where should higher-density mixed use developments should be allowed to occur?





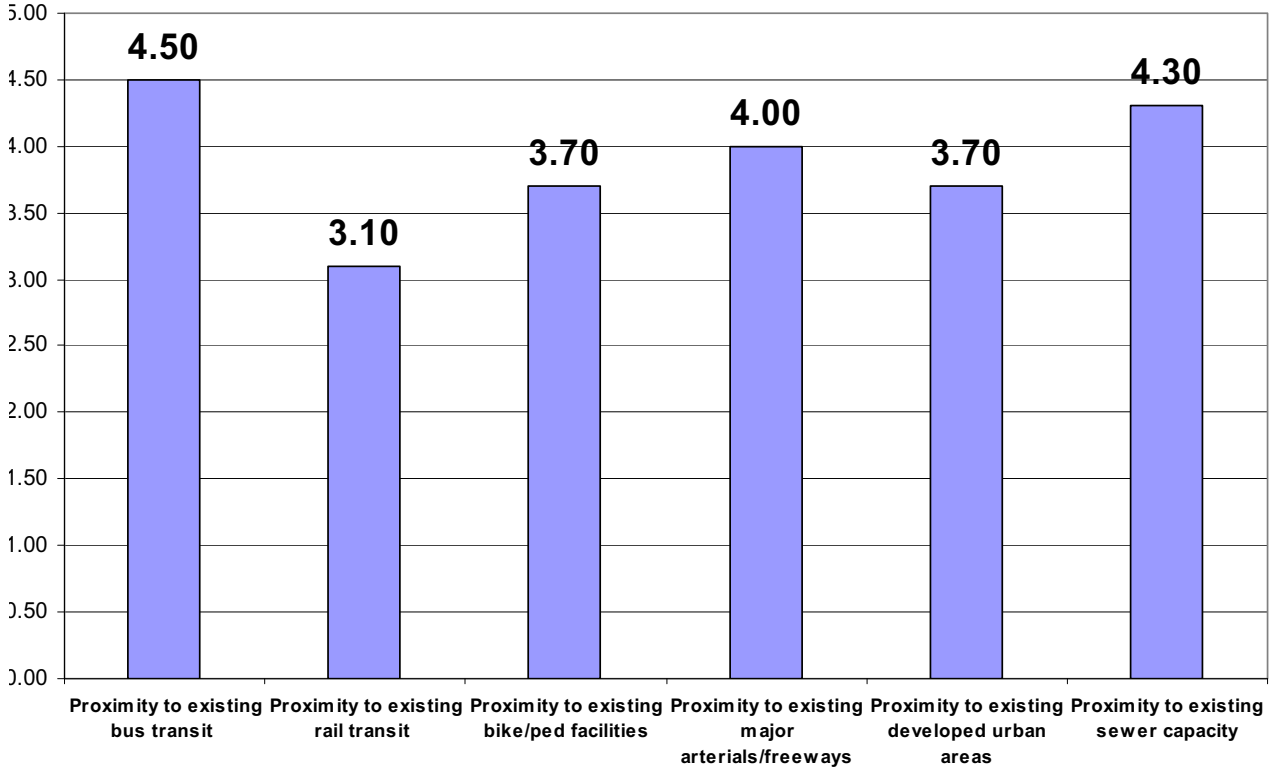
From the experts……

"Vehicle trip generation rates tend to rise as one goes farther away from the urban core."

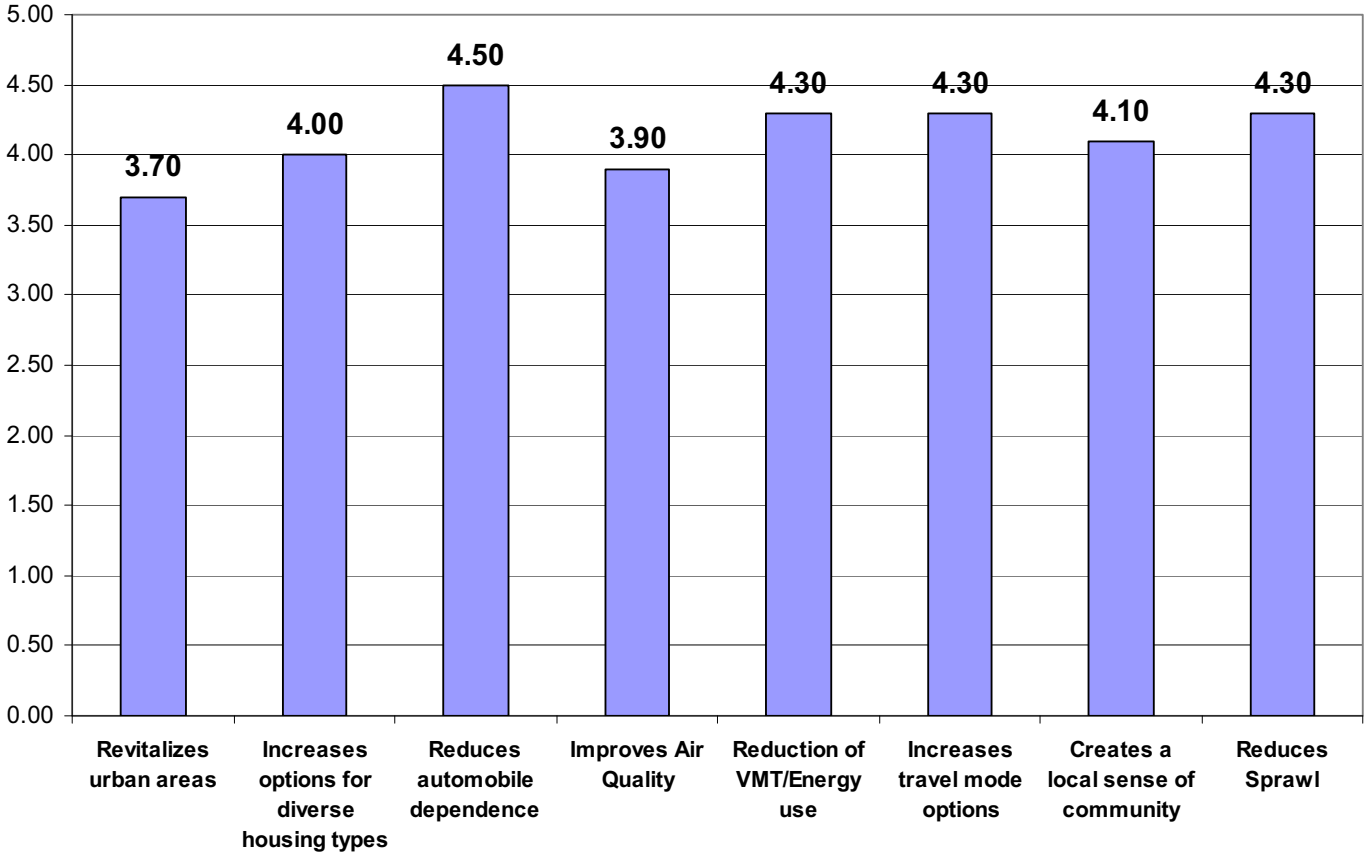


From TCRP 128: Effects of TOD on Housing, Parking and Travel

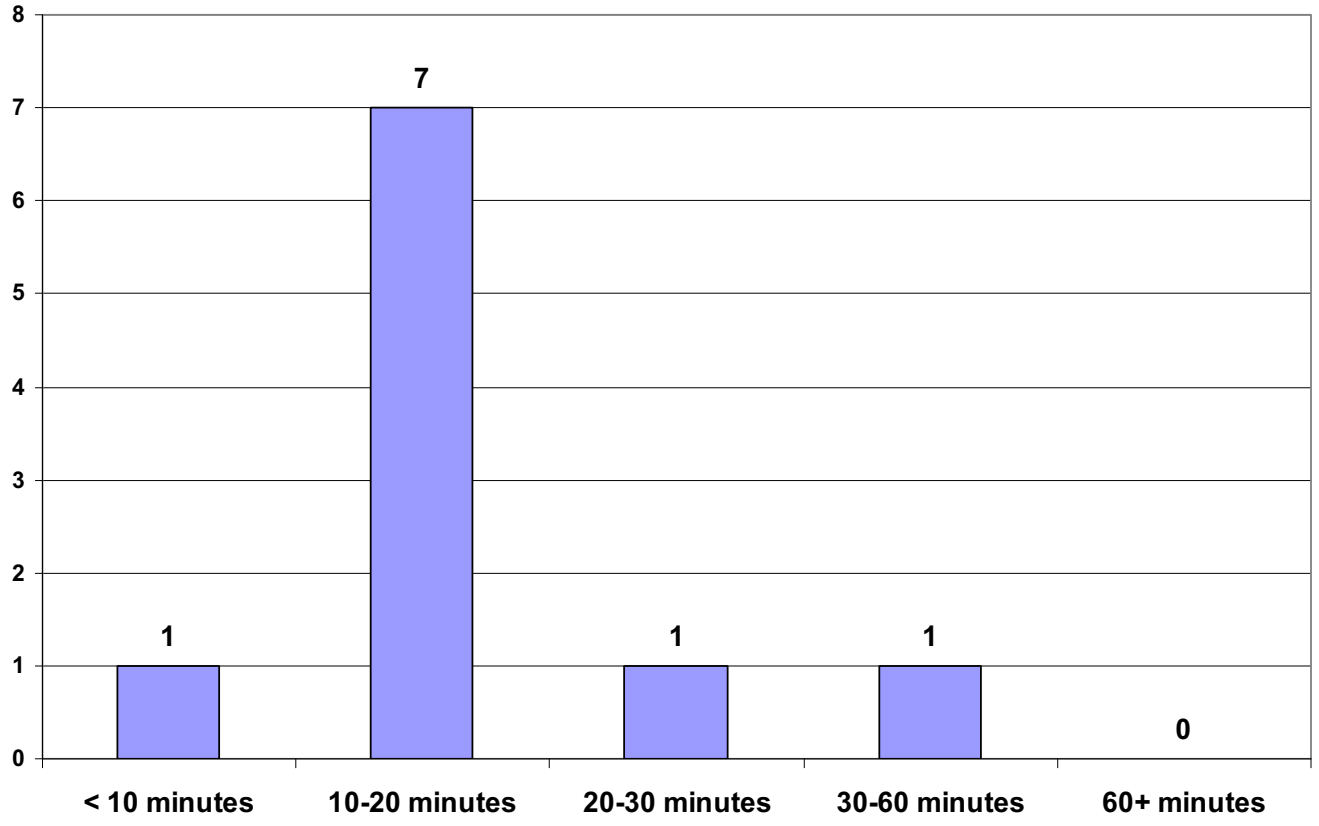
Please rate the importance of the following items in relation to infrastructure / transportation and the location of mixed-use developments:



Please rate the importance of the following items in relation to the perceived benefits of mixed-use development:



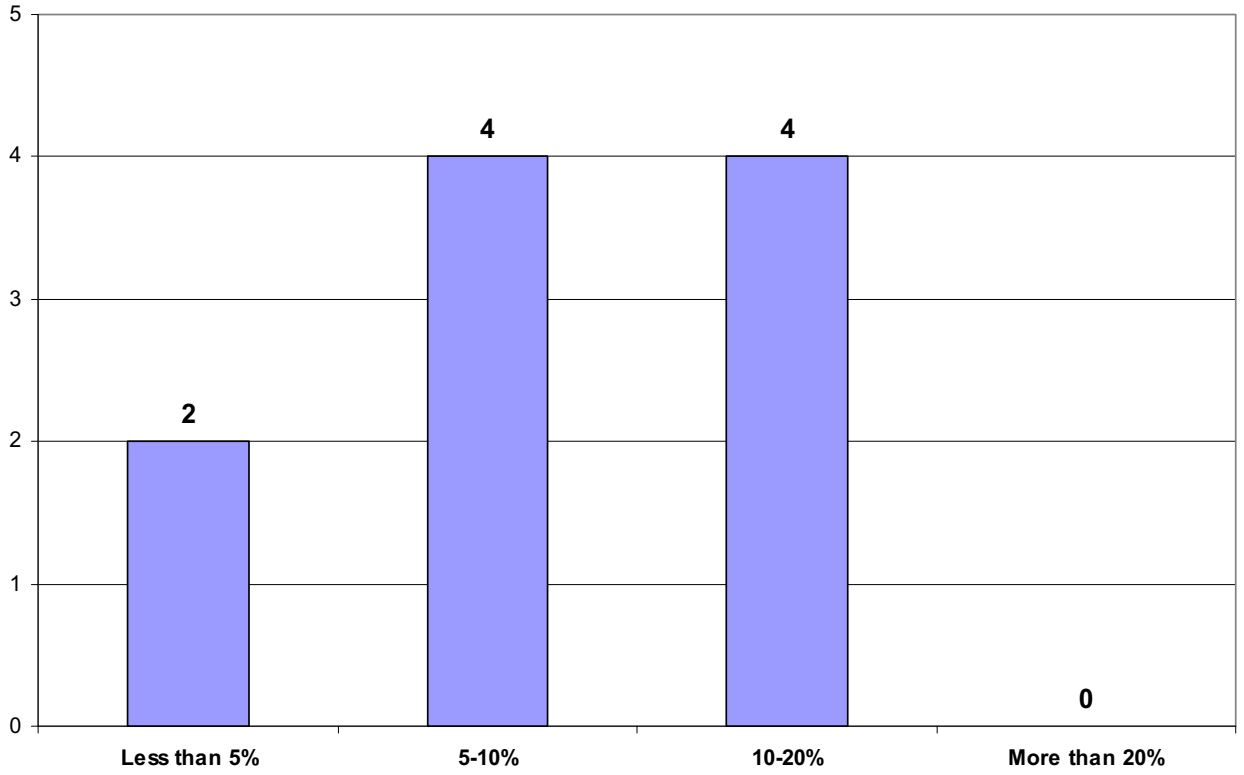
Transit: What should the peak hour transit headway threshold be for servicing a mixed-use development ?



Please rate these factors in order of importance (1 thru 8) in the consideration of planning a mixed use development:

Overall Rank	Avg. Score
1. Mix of land use types:	1.80
2. Housing Density:	2.70
3. Walkability:	3.80
4. Mix of Housing Types:	3.90
5. Transit Access:	4.20
6. Other (Design):	4.70
7. Env. & Open Space:	6.10
8. Parking:	6.80

What percentage of the residential units should be set aside for low-income buyers in a mixed-use development?



1. Level of Service (LOS) threshold: Is LOS E an acceptable LOS to allow around mixed-use development?

- Yes, internal capture computations can justify it.

- Yes, if the density is high and there are alternatives to SOV travel.

- Yes, if only during peaks.

- Yes, this might be the expectation of increased uses and density and therefore requires a different treatment than other land use

- Yes, if we can leverage LOS E with more viable mixed use, transit, affordability and density. I know that viewpoint probably does not jibe with the citizenry of New Castle County, especially after Workforce Housing.

2. Land use plan approval process: The current method is fragmented between state, county and city planning and zoning groups. What changes should be made to the current process and which agencies should be involved?

•Give 100% of the real estate transfer fee to the State if any development is outside agreed upon growth areas. Force those political jurisdictions that benefit from this source of revenue to share in the costs. Standardize the approval process and expedite it for mixed use developments. At a minimum, involve DelDOT, DNREC, Housing and Agriculture in all the major decisions on land use. Add to that core the local government with current jurisdiction such as the County or the city.

• Municipal and county governments have the most to say about land use decisions while the state basically does permitting and provides the bulk of infrastructure and services.

•Greater opportunities for collaboration and decision-making, but land use decisions must always remain at the local level.

• Consistency to encourage and support mixed use development

•The process should be web-based. An interagency working group approach would yield better comprehensive and coordinated

• There is more of a disconnect between the state and New Castle County than with the state and the other two counties because of PLUS Memoranda of Understanding. The state reviews virtually no projects (or ordinances) in New Castle vs. most projects in Kent and Sussex. DelDOT may be involved early, but State Planning, DNREC and other agencies are not. PLUS should be involved at the exploratory stage in order to provide the most meaningful suggestions that can be addressed before plans have solidified.

•There should be a blue print at the state level that carries incentive/disincentive and even enforcement. Call it smart growth, livable Delaware, walkable communities, growth boundaries, or whatever. The idea is for the state to figure out what it wants to be “when it grows up” with input from the locals. Once that is established and has real “hammer” attached to it, then locals can implement the blue print thru their process.

3. Would it be a worthwhile effort to attempt to create a greater number of Transportation Investment Districts throughout the state where they currently do not exist?

- I do not know.

- Yes. They provide opportunities for greater efficiency in the use of fiscal and protection of natural resources.

- I think so

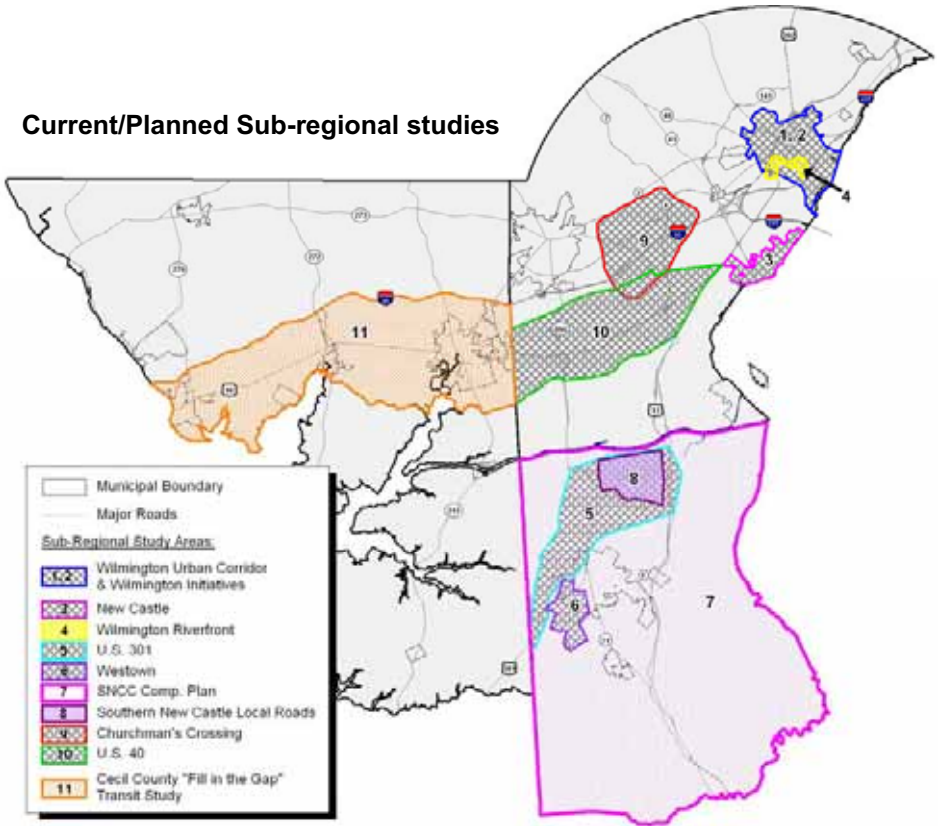
- Yes, this would help mid-range and long term agency planning. Also, developers would have a better understanding of what might be required of them to leverage agency resources.

- Yes, but can DelDOT afford the additional investment in time and dollars? Also, from the DNREC perspective, when you are planning more intense growth and investment in a particular area, you need to consider the effect on the entire watershed and try to mitigate the effects of increasing impervious cover.

- Yes

- No

- No



4. What are the biggest hurdles that exists for having more mixed use development activity in the state?

•NIMBY, permit approval process is too complex, misinformation about the impact that mixed use has on an area. The inherent limitations on perspective people have. Compared to what?

• local land use regulations. Generally there are too many hoops to jump through as opposed to typical trend patterns.

• It is an unknown quantity often equated with higher density, more traffic, more congestion, degraded air quality and overall uncertainty. Few people know of the sucessful examples.

•Public Perception

•Zoning and people's ignorance.

•1)Community and elected officials not accepting/wanting/understanding “density”
2)Unpredictable development decisions

•Getting something on the ground that actually is truly mixed use and builds out according to the original vision. Too often, a projects gets adulterated or dumbed-down by cost considerations and/or NIMBY activism. We know it works and is popular in other areas. That means getting over the density hurdle -- even with the density bonus of 50% for workforce housing in New Castle, density would still be less than the Sussex's base density of 2 units per acre. Why is base density higher in a rural county than in a metropolitan county? People need to understand the relationship between sprawl, VMT, air quality and their health.

• Too many laws

5. Please use the remaining space to add any additional comments not covered in this survey:

•There needs to be political will at all levels of government in Delaware to make improvements that will benefit the common good. Too many organizations (some Departments, Divisions, elected officials) see this from the perspective of their own "silo" and not in the broader context required for projects of this magnitude. We need to start with a blank sheet of paper rather than tweak the existing, failed process.

•we need to discuss what percents of uses constitutes mixed-use, the type of mixed-use we want to recognize as good and want to support. Then, of course, we need to develop a framework for realistically estimating the traffic impact of these developments, recognizing the internal trips.

•Measuring success will be a key element in any efforts to increase the use of mixed use developments.

Appendix D: 5/13/09 meeting materials

- **Meeting Notes**
- **Presentation: *"Traffic Generated by Mixed-Use Developments – A Six-Region Study Using Consistent Built Environmental Measures"*- Reid Ewing (Univ. of Utah)**

5/13/09 Mixed-Use/TMA meeting notes

Attendees:
Antoni Sekowski – NCC Land Use
Jerry Heisler - The Reybold Group
Ted Bishop – DelDOT
Reid Ewing – Univ. of Utah
Angelina Micheva – NCCCC
Herb Inden - DE Office of State Planning Coordination
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Dan Blevins – WILMAPCO

Meeting Notes:

Agenda Item #1: Reid Ewing Presentation: Reid Ewing (Univ. of Utah) gave a presentation titled "*Traffic Generated by Mixed-Use Developments – A Six-Region Study Using Consistent Built Environmental Measures*". The presentation covered material that is part of an effort to refine the methodology for estimating internal trip capture in mixed use developments. The final product will be a spreadsheet based application to allow planners, developers and transportation departments to calculate expected internal trip capture of mixed use developments. This is in tandem with another effort by the NCHRP that is looking to do the same. He discussed some of the current shortcomings of the current ITE methodology (Chapter 7 of Trip Generation Handbook):

- Based on only three sites in Florida
- Covers only three land use types
- Scale of development disregarded
- Land use context disregarded
- Possibility of mode shifts disregarded
- Length of external trips disregarded

The effort that Mr. Ewing has developed performed an analysis of recent research (more than 150 studies). These were taken from 6 different areas across the country (Atlanta, Boston, Houston, Portland, Sacramento, Seattle) and has created "7D" analysis of regional travel survey data which are:

- Density
- Diversity
- Design
- Destination Accessibility
- Distance to Transit
- Development Scale
- Demographics

The approach includes a hierarchial model methodology which takes in to account the local household characteristics (i.e. household size, avg. vehicle ownership), development design including proposed transportation infrastructure

(such as intersection and sidewalks densities) and regional data such as total employment within 30 minutes of the development and street connectivity.

The model was validated against 16 existing sites and the results were compared to the results of the current ITE method. On average, the model was roughly twice as accurate in estimating the internal trip capture compared to current ITE methods.

Other Discussions:
Antoni Sekowski gave a brief description of county efforts to enhance the UDC to allow for more mixed-use development. On a grant received through BRAC, the Land Use department has hired a consultant to survey several groups in the county. The groups gave input on what is lacking and what changes might be made that would help incorporate some of the goals of the Comprehensive Plan. A priority is to help incentivize small business as much as possible as they make up the majority of established businesses in the county. The final product will be a draft of UDC ordinances to be proposed for inclusion into an expanded section dealing with mixed-use. Stipulations will be placed on location, square footage and density. The draft is looking at regulations for roughly 3 types of mixed use based on size:

- Small <5 acres. Infill up to 2 uses
- Medium 5-20 acres
- Large 20+ acres

A follow up will be given once more details are available at a future meeting. It was asked that the mixed use steering committee and the Mixed-Use working group meet to discuss jointly.

Mr. Ewing extended an offer to allow WILMAPCO to serve as a test site for the newly developed model. A meeting will set up in late May to discuss the details with the model developers in order to get WILMAPCO staff up to speed on how to use the model.

Next steps/future meetings:

- Meet with EPA to discuss receiving the model
- Begin testing local examples of mixed use development, comparing trip capture vs. current estimates. Present findings to committee
- Invite members of NCCLU mixed use steering committee to future meeting(s)

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Traffic Generated by Mixed-Use Developments – A Six-Region Study Using Consistent Built Environmental Measures

Reid Ewing
Michael Greenwald
Ming Zhang
Larry Frank
Mark Feldman
Jerry Walters
Robert Cervero
Senait Kassa
John Thomas

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Criteria	ITE Trip Gen.	ITE Multi-Use	Proposed MXD
Intuitively reasonable, logically correct	√	√	√
Scientifically proven for wide range of cases	√		√
Conceptual, empirical support from independent research	√		√
Transparent, understandable, easy to apply	√	√	√
Accounts for the effect of built environmental variables		√	√
Validated through independent field testing			√

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Current ITE Multi-Use Development Method (Chapter 7 of Trip Generation Handbook)

- The analyst determines the amounts of different land use types (residential, retail, and office) contained within the development.
- These amounts are multiplied by ITE's per-unit trip generation rates to obtain a preliminary estimate of the number of vehicle trips generated by the site. This preliminary estimate is what the site would be expected to generate if there were no interactions among the on-site uses.
- The generated trips are then reduced by a certain percentage to account for internal-capture of trips within MXDs. The reductions are based on look-up tables. The share of internal trips from the appropriate look-up table is multiplied by total numbers of trips generated by a given use to obtain an initial estimate of internal trips for each producing use and attracting use.
- For each pair of land uses, productions and attractions are reconciled such that the number of internal trips produced by one use just equals the number attracted by the other use. The lesser of the two estimates of internal trips constrains the number of internal trips generated by the other use.

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Look-Up Tables

Table 7.1 Unconstrained Internal Capture Rates for Trip Origins within a Multi-Use Development

		WEEKDAY		
		MIDDAY PEAK HOUR	p.m. PEAK HOUR OF ADJACENT STREET TRAFFIC	DAILY
from OFFICE	to Office	2%	1%	2%
	to Retail	20%	23%	22%
	to Residential	0%	2%	2%
from RETAIL	to Office	3%	3%	3%
	to Retail	29%	20%	30%
	to Residential	7%	12%	11%
from RESIDENTIAL	to Office	N/A	N/A	N/A
	to Retail	34%	53%	38%
	to Residential	N/A	N/A	N/A

Caution: The estimated typical internal capture rates presented in this table rely directly on data collected at a limited number of multi-use sites in Florida. While ITE recognizes the limitations of these data, they represent the only known credible data on multi-use internal capture rates and are provided as illustrative of typical rates. ***If local data on internal capture rates by paired land uses can be obtained, the local data may be given preference.***

N/A—Not Available; logic indicates there is some interaction between these two land uses; however, the limited data sample on which this table is based did not record any interaction.

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Limitations of Current ITE Method

- Based on only three sites in Florida
- Covers only three land use types
- Scale of development disregarded
- Land use context disregarded
- Possibility of mode shifts disregarded
- Length of external trips disregarded

Approach of EPA

- Meta-analysis of recent research (more than 150 studies)
- 7D analysis of regional travel survey data

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7D Analysis - Innovations

- Pooled household travel data for MXDs in six diverse regions
- Identified 239 MXDs through a bottom-up survey process
- Included internal capture, mode choice for external trips, and trip length as travel outcome measures

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Additional Innovations

- Estimated large number of 7D variables consistently across regions
- Modeled travel relationships hierarchically
- Validated results through comparison to traffic generation counts at an independent set of mixed use sites in various parts of the U.S., and
- Feeding directly into traffic engineering practice ITE

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Six Diverse Regions

- Atlanta
- Boston
- Houston
- Portland
- Sacramento
- Seattle

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Choice of Regions Based on Data Availability

Provide XY coordinates for trip ends, so we could zero in on individual sites when studying travel patterns to, from, and within MXDs

Provide individual parcel data, so we could study land-use mix down to the parcel level

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Identifying MXDs

Top-Down GIS-Based Approach

vs.

Bottom-Up Expert-Based Approach

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ITE Definition

"…a multi-use development is typically a single real-estate project that consists of two or more ITE land use classification between which trips can be made without using the off-site road system."

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ULI Definition

…three or more significant revenue producing uses; significant functional and physical integration of the different uses; and conformance to a coherent plan.

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New Definition

…A mixed-use development or district consists of two or more land uses between which trips can be made using local streets, without having to use major streets. The uses may include residential, retail, office, and/or entertainment. There may be walk trips between the uses.

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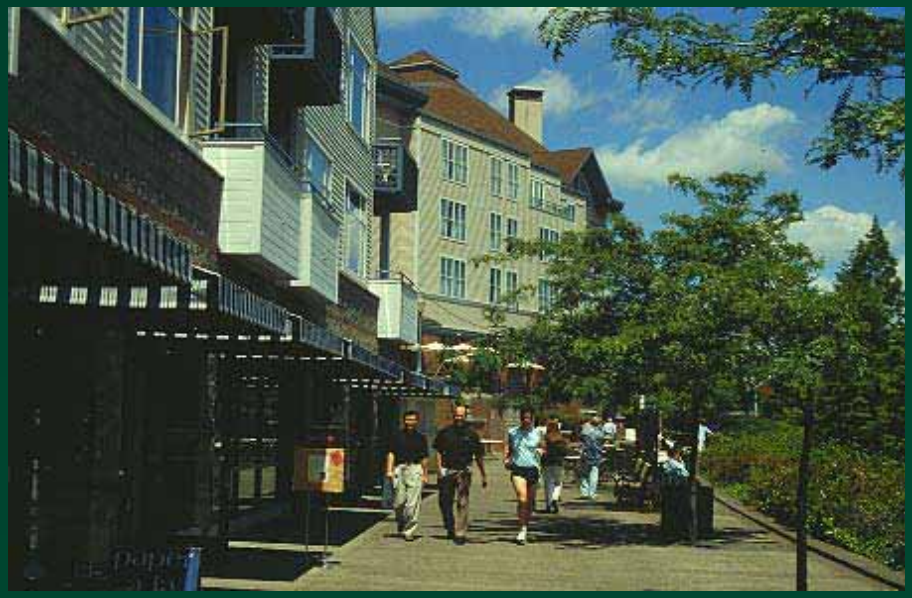
Example

internal capture – 36%
walking – 14%
transit – 9%



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239 MXDs

	Survey Year	MXDs	Mean Acreage per MXD	Total Trip Ends	Mean Trip Ends per MXD
Atlanta	2001	24	287	6,167	257
Boston	1991	59	175	3,578	61
Houston	1995	34	401	1,584	47
Portland	1994	53	116	6,146	116
Sacramento	2000	25	179	2,487	99
Seattle	1999	44	207	15,915	362
Total		239	211	35,877	150

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Multiple Outcome Measures

INTERNAL – Dummy variable indicating that a trip remains internal to the MXD (1=internal, 0=external)

WALK – Dummy variable indicating that the travel mode on an external trip is walking (1=walk mode, 0=other)

TRANSIT - Dummy variable indicating that the travel mode on an external trip is public bus or rail (1=transit, 0=other)

TDIST - Network trip distance between origin and destination locations for an external private vehicle trip, in miles

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Understudied

Transportation Research Record 1780 115
Paper No. 01-3524

Internalizing Travel by Mixing Land Uses

Study of Master-Planned Communities in South Florida

Reid Ewing, Eric Dumbaugh, and Mike Brown

Planners, public officials, and large-scale land developers increasingly promote mixed-use developments as an alternative to sprawl. They list among the benefits of such developments the "internal capture" of trips; that is, trips that would otherwise have filtered onto the regional road network will remain on site. Yet, so little information is available about internal capture rates that traffic impact studies for mixed-use developments become little more than exercises in speculation. In an attempt to advance basic knowledge of the subject and move toward better prediction methods, 20 mixed-use communities in south Florida were studied to determine the effect of land use mix on internal capture rates. The sample of communities studied had internal capture rates ranging from 0 to 57 percent of all trip ends generated. When modeled in terms of land use and accessibility variables, both the scale of a development and regional accessibility proved significant, with the former directly related to internal capture and the latter inversely related to internal capture. The best-fit model explained just under half of the variance in internal capture rates. Controlling for scale and regional accessibility, land use mix and

In an attempt to advance basic knowledge of the subject and move toward better prediction methods, 20 mixed-use communities in south Florida were selected for study. All were built within the last 40 years and include housing, shopping, services, and recreational facilities. Some have basic employment as well. They vary sufficiently in location, size, and land use mix as to promise significant variation in internal capture rates, which, in turn, should allow internal capture rates to be modeled in terms of the same variables.

SELECTING COMMUNITIES

To identify developments appropriate for study, metropolitan and municipal planners in Dade, Broward, and Palm Beach Counties in Florida were interviewed. They were asked for lists of master-planned communities with a mix of housing, shopping, services, and recreational facilities. The interview process produced a list of 26 commu-

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Substantial Variance

	Internal Capture
Atlanta	16.7%
Boston	16.9%
Houston	31.1%
Portland	15.9%
Sacramento	16.4%
Seattle	18.0%

	Walk Share	Transit Share
Atlanta	5.1%	3.1%
Boston	20.6%	7.8%
Houston	3.1%	6.1%
Portland	7.3%	4.6%
Sacramento	2.9%	0.4%
Seattle	5.8%	9.9%

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7D variables consistently defined

- Density
- Diversity
- Design
- Destination Accessibility
- Distance to Transit
- Development Scale
- Demographics

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Individual Level Variables

CHILD – Dummy variable indicating that the traveler is under 16 years of age (1=child, 0=adult)

WHITE – Dummy variable indicating that a traveler is a white Caucasian (1=white, 0=other)

HHSIZE – Number of members of the household

VEHCAP – Number of motorized vehicles per person in the household

BUSSTOP – Dummy variable indicating that the household lives within ¼ mile of a bus stop (1=yes, 0=no)

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MXD Level Variables

POPDEN – Net population density per square mile

EMPMILE – Total employment within one mile of the traffic analysis zones intersecting the MXD

EMP30T – Total employment within 30 minutes by transit of traffic analysis zones intersecting the MXD

LANDMIX – Entropy index that captures the variety of land uses based on acreage

INTDEN - Number of intersections within the MXD per square mile of gross area

SIDEWALK – Mileage of sidewalks within the MXD per centerline mile of streets

STOPDEN – Number of bus stops within the MXD per square mile of gross area

RAIL – Rail station located within the MXD (1 = yes, 0=no)

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	N	Mean	S.D.
AREA	239	0.33	0.32
POP	239	2,271	3,261
EMP	239	2,696	5,572
ACTIVITY	239	4,967	6,945
POPDEN	205	21,600	35,147
EMPDEN	204	30,269	51,360
ACTDEN	239	19,780	30,669
FAR	121	0.40	0.54
DEVLAND	239	0.82	0.22
JOBPOP	239	0.46	0.31
RETPOP	205	0.46	0.31
JOBMIX	180	0.70	0.17
BUILDMIX	64	0.55	0.33
LANDMIX	239	0.52	0.20
STRDEN	239	25.4	10.5
INTDEN	239	257	203
SIDEWALK	74	0.91	0.67
EMPMILE	239	30,510	50,914
EMP10A	239	69,813	111,192
EMP20A	239	276,127	377,056
EMP30A	239	505,003	630,585
EMP30T	239	86,143	147,873
STOPDEN	239	70.75	83.63
RAILSTOP	239	0.08	0.28

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Region Level Variables

REGPOP – Population within the region

REGEMP – Employment within the region

REGACT – Activity within the region (population + employment)

REGDEN – Measure of regional density developed by Ewing et al. (2002, 2003)

REGMIX – Measure of regional land use mix from same source

REGCEN – Measure of regional centering from same source

REGSTS – Measure of regional street accessibility from same source

SPRAWL – Measure of overall regional sprawl from same source

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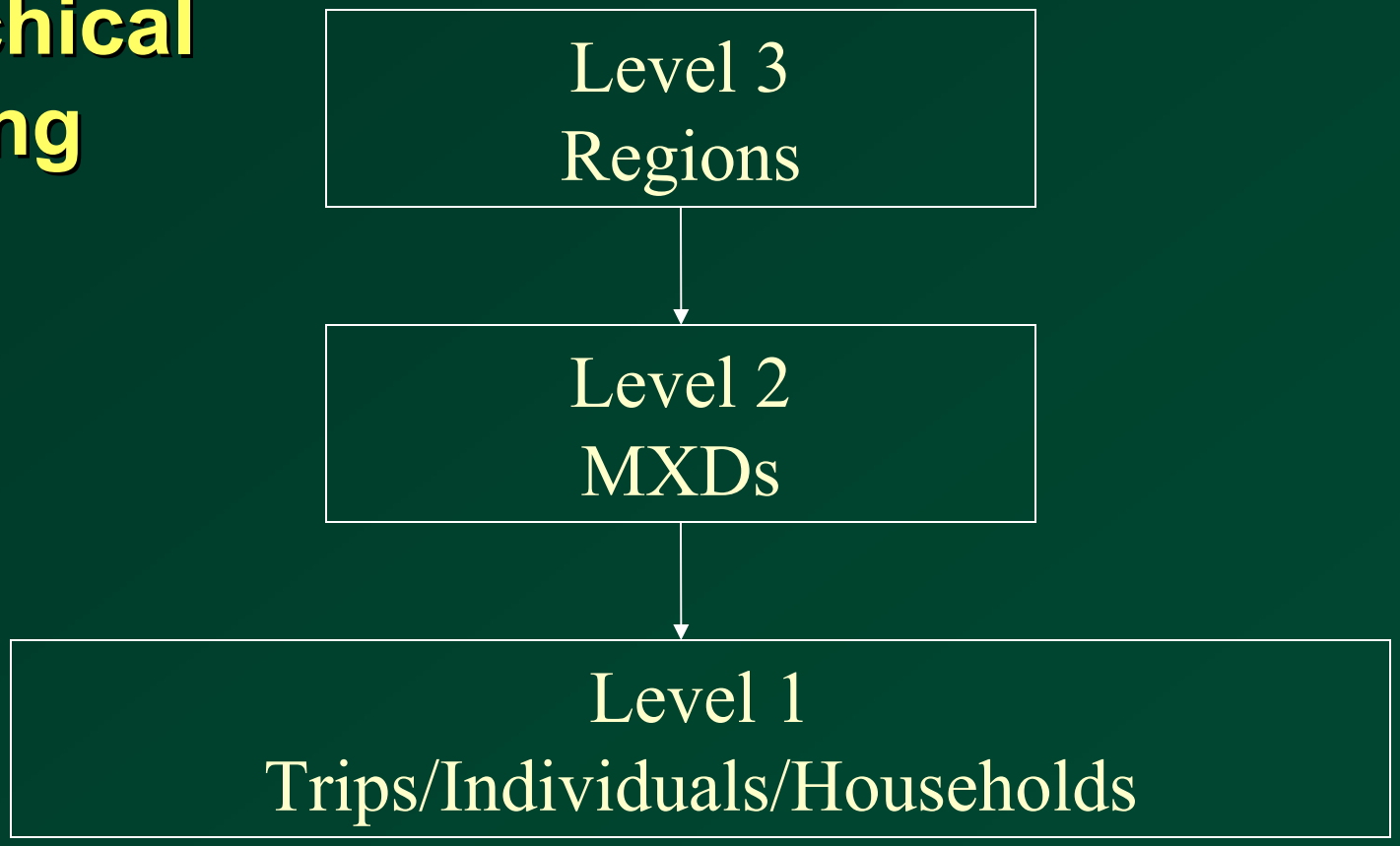
Hierarchical Modeling



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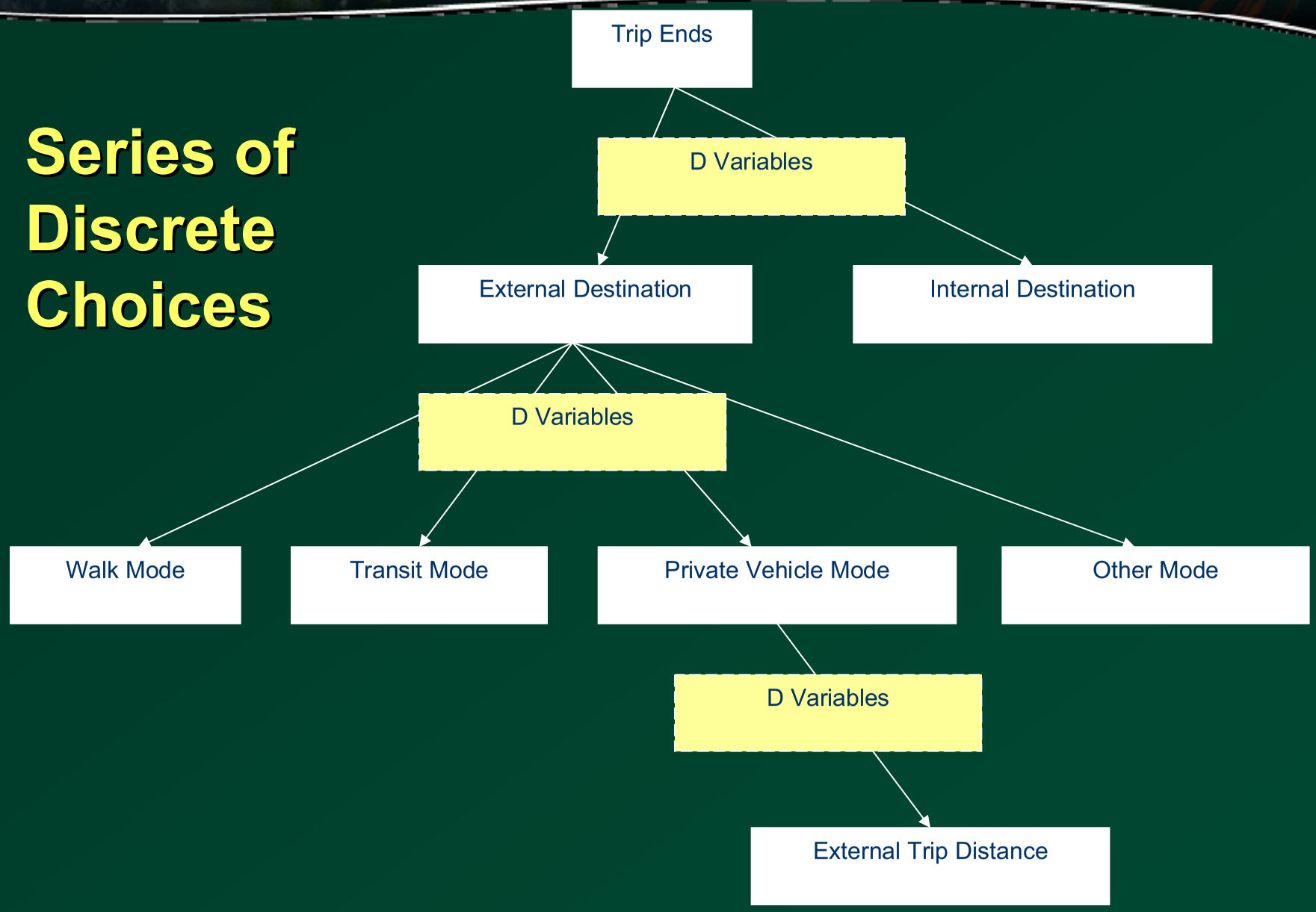
Series of Discrete Choices



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Log odds of internal capture

	Home-Based Work			Home-Based Other			Non-Home Based		
	coeff	t-ratio	p-value	coeff	t-ratio	p-value	coeff	t-ratio	p-value
constant	-3.62			-2.68			-1.87		
EMP							0.208	3.28	0.002
AREA				0.486	3.61	0.001	0.468	4.58	<0.001
JOBPOP	0.389	2.62	0.010	0.399	4.55	<0.001			
INTDEN				0.385	1.92	0.055	0.638	4.95	<0.001
HHSIZE	-1.33	-6.03	<0.001	-0.867	-13.0	<0.001	-0.237	-4.54	<0.001
VEHCAP	-0.990	-4.15	<0.001	-0.590	-8.19	<0.001	-0.163	-3.00	0.003
pseudo-R2	0.09			0.25			0.27		

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Log odds of walking on external trips

	Home-Based Work			Home-Based Other			Non-Home Based		
	coeff	t-ratio	p-value	coeff	t-ratio	p-value	coeff	t-ratio	p-value
constant	-3.98			-3.41			-3.63		
AREA				-0.415	-4.27	<0.001			
ACTDEN				0.370	2.74	0.007	0.377	3.12	0.003
JOBPOP	0.226	2.46	0.015	0.219	3.83	<0.001			
INTDEN							0.803	5.05	<0.001
EMPMILE	0.385	3.12	0.002	0.450	5.05	<0.001	0.440	5.09	<0.001
HHSIZE	-1.57	-6.29	<0.001	-0.486	-5.05	<0.001	-0.281	-2.59	0.010
VEHCAP	-1.84	-7.00	<0.001	-0.768	-7.62	<0.001	-0.242	-2.13	0.033
pseudo-R2	0.11			0.58			0.69		

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Log odds of using transit on external trips

	Home-Based Work			Home-Based Other			Non-Home Based		
	coeff	t-ratio	p-value	coeff	t-ratio	p-value	coeff	t-ratio	p-value
constant	-4.32			-5.20			-4.40		
INTDEN	1.12	4.55	<0.001						
EMP30T	0.238	3.84	0.043	0.266	3.80	<0.001	0.249	4.29	<0.001
HHSIZE	-1.14	-6.30	<0.001	-1.00	-8.45	<0.001			
VEHCAP	-1.67	-8.56	<0.001	-1.06	-8.24	<0.001	-0.276	-2.90	0.004
BUSSTOP	0.336	1.99	0.046	0.510	4.31	<0.001			
pseudo-R2	0.17			0.15			0.05		

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Log distance of external automobile trips

	Home-Based Work			Home-Based Other			Non-Home Based		
	coeff	t-ratio	p-value	coeff	t-ratio	p-value	coeff	t-ratio	p-value
constant	1.77			1.37			1.43		
AREA	0.104	2.15	0.032						
JOBPOP	-0.0533	-2.55	0.012	-0.050	-2.74	0.007	-.0302	-1.94	0.053
INTDEN				-0.112	-2.13	0.034	-0.209	-4.48	<0.001
EMP10A							-0.0802	-5.13	<0.001
EMP20A				-0.0723	-3.93	<0.001			
EMP30A	-0.108	-4.20	<0.001						
HHSIZE	0.257	5.98	<0.001	0.115	4.93	<0.001	0.0931	3.20	0.002
VEHCAP	0.350	7.31	<0.001	0.270	11.0	<0.001	0.148	4.96	<0.001
pseudo-R2	0.04			0.05			0.05		

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16 Nationwide Validation Sites

6 Florida sites from ITE *Trip Generation Handbook*

1 Central Florida site

1 Georgia site

6 California sites

2 Texas sites

Prelim data from 3 sites in Texas and Georgia from NCHRP 8-51

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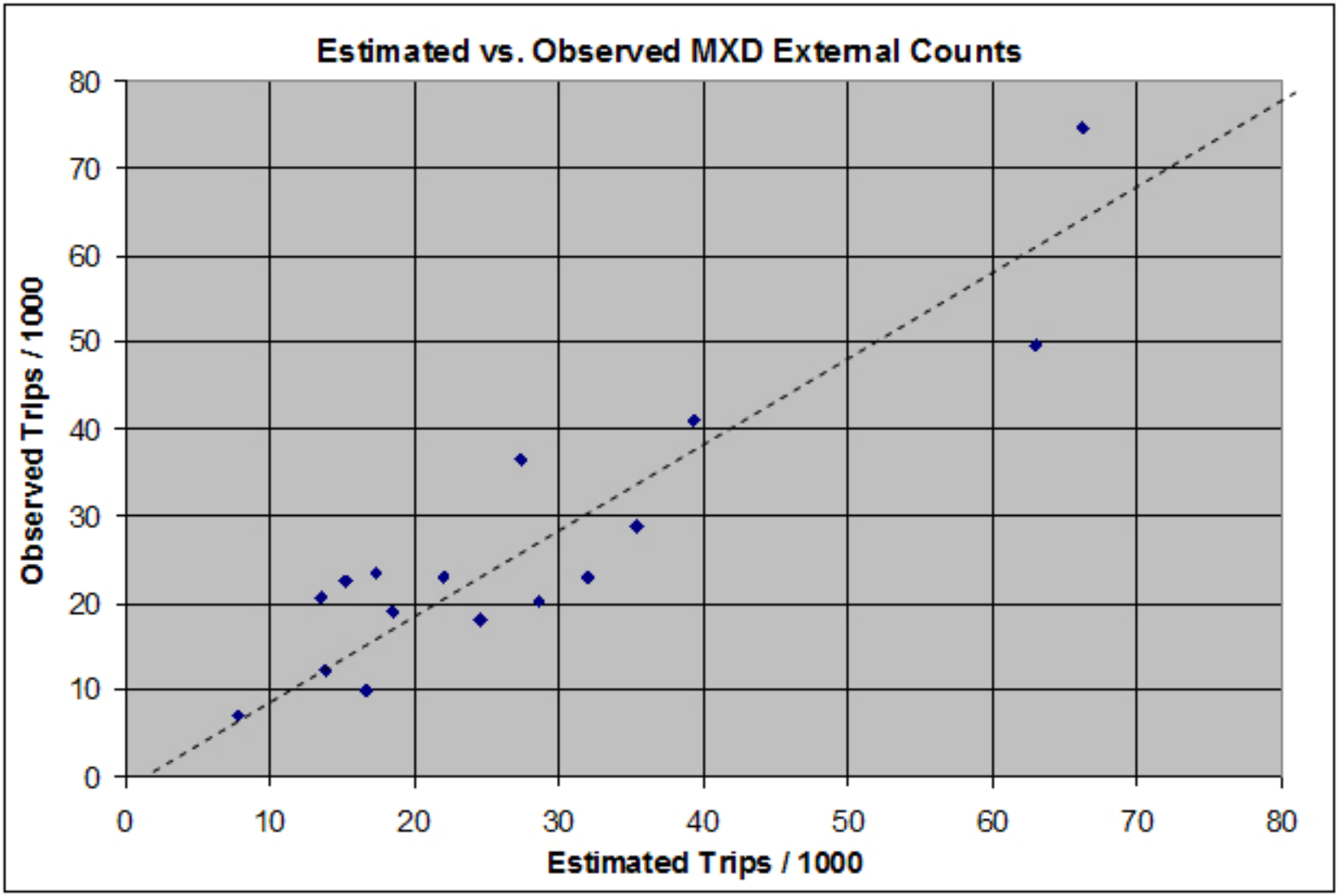

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Site	ITE Gross	ITE Net	MXD Models
1	42%	25%	23%
2	7%	-4%	-4%
3	-27%	-38%	-32%
4	92%	82%	70%
5	54%	35%	39%
6	-16%	-19%	-26%
7	-14%	-22%	-25%
8	77%	50%	42%
9	31%	20%	14%
10	-19%	-26%	-35%
11	60%	49%	27%
12	10%	4%	-3%
13	10%	-5%	-11%
14	22%	17%	9%
15	45%	31%	35%
16	21%	17%	-4%
RMSE	40%	32%	26%
R^2	0.58	0.73	0.82

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Primary Determinants of Reduction in External Auto Trips

- The total and the relative amounts of population and employment on the site
- The site size and activity density
- The size of households and their auto ownership
- The amount of employment within walking distance of the site
- The pedestrian-friendliness of the site (small block size)
- The access to employment within a 30 minute transit ride of the site.

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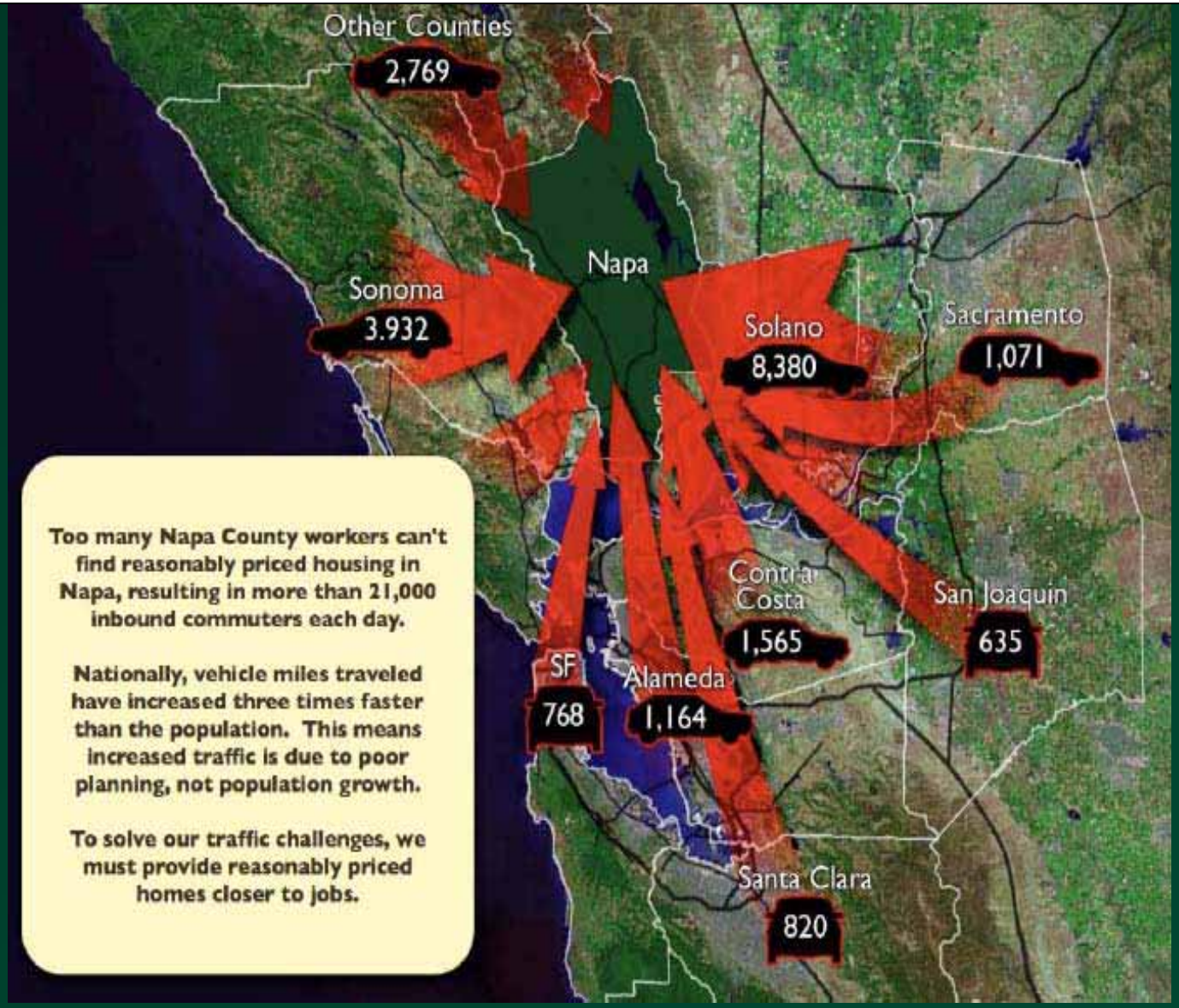
Napa Pipe Development Project

Affordable Housing in Job Rich Napa County

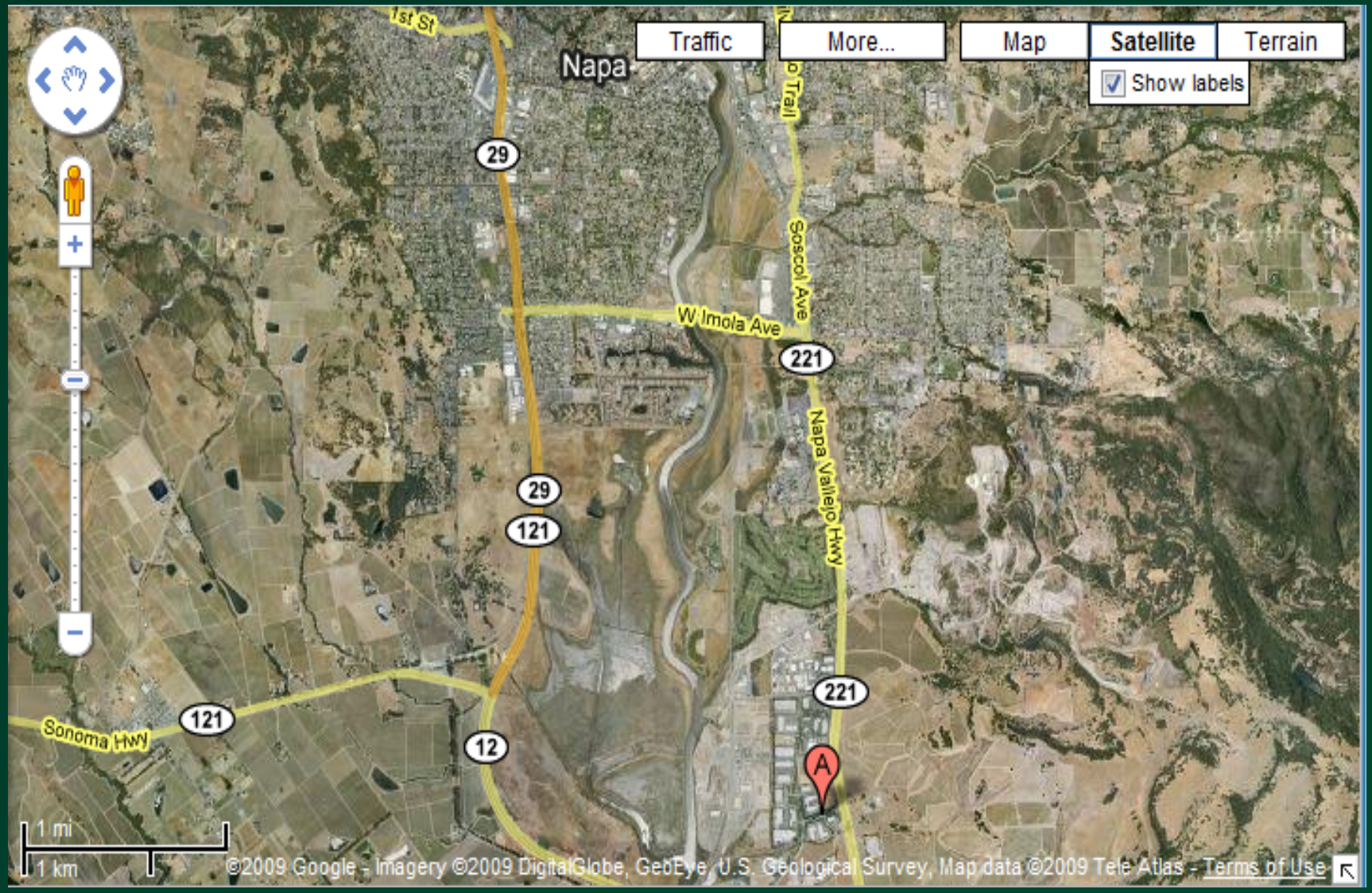


Too many Napa County workers can't find reasonably priced housing in Napa, resulting in more than 21,000 inbound commuters each day.

Nationally, vehicle miles traveled have increased three times faster than the population. This means increased traffic is due to poor planning, not population growth.

To solve our traffic challenges, we must provide reasonably priced homes closer to jobs.

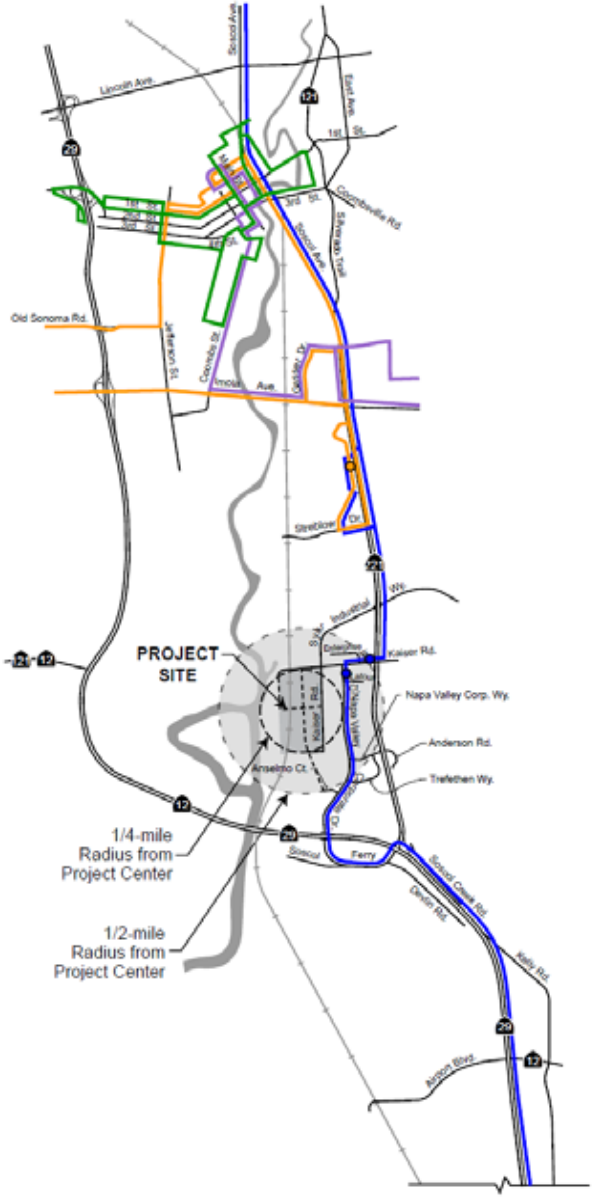
Local Context



Existing Conditions

Site Plan

Transit Service



FEHR & PEERS
TRANSPORTATION CONSULTANTS

Trip Reduction Comparison

3.6% vs. 6.9%

Next Steps

Appendix E: 8/26/09 meeting materials

- **Meeting Agenda**
- **Meeting Attendance**
- **Presentation: *Demonstration of the Mixed Use "MXD" model-* Dan Blevins, WILMAPCO**

Wilmington Area Planning Council

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Newark, Delaware 19711
302-737-6205; Fax 302-737-9584
From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
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WILMAPCO Council:

Stephen Kingsberry, Chair
Delaware Transit Corporation Director

Joseph L. Fisona, Vice Chair
Mayor of Elkton

James M. Baker
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Brian Lockhart
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Samuel F. Minnitte, Jr.
Maryland Dept. of Transportation Director, Office of Planning

Lee Ann Walling
Delaware Office of the Governor Policy Advisor for Environment and Quality of Life Policy

Carolann Wicks
Delaware Dept. of Transportation Secretary

WILMAPCO Executive Director
Tigist Zegeye

Memorandum

Date: August 24, 2009

Re: 8/26/09 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, August 26th, 2009 9-11am

Agenda

1. **Presentation and demonstration of the mixed use "MXD" model:** WILMAPCO staff will present the beta-version of the MXD model developed by Fehr & Peers. Staff will also give a demonstration on how the model operates.

2. **Update on effort by New Castle County to enhance mixed-use development though the UDC**

3. **General discussion on next steps of TMA/Mixed-Use working group**

4. **Next meeting date**

8/26/09 Mixed-Use/TMA meeting attendance

Attendees:
Jerry Heisler - The Reybold Group
Ted Bishop – DelDOT
Dan Lacombe - DelDOT
Angelina Micheva – NCCCC
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Wayne Henderson - DTC
Dan Blevins – WILMAPCO

Preliminary Results
MXD Model
6.10.2009

Agenda

- Summary of Model
- Model Inputs
- Data Needs
- Outputs
- Comparison to TIS/TOA counts

Background

Effort to create a more detailed analysis of the impacts of Mixed Use Developments

Background

Effort to create a more detailed analysis of the impacts of Mixed Use Developments

Limitations of Current ITE Multi-Use Development Method (Chapter 7 of Trip Generation Handbook)

- Based on only three sites in Florida
- Covers only three land use types
- Scale of development disregarded
- Land use context disregarded
- Possibility of mode shifts disregarded
- Length of external trips disregarded

Background

Approach of EPA MXD Model

- Meta-analysis of recent research (more than 150 studies)
- 7D analysis of regional travel survey data
- Pooled household travel data for MXDs in six diverse regions
- Identified 239 MXDs through a bottom-up survey process
- Included internal capture, mode choice for external trips, and trip length as travel outcome measures
- Estimated large number of 7D variables consistently across regions
- Modeled travel relationships hierarchically

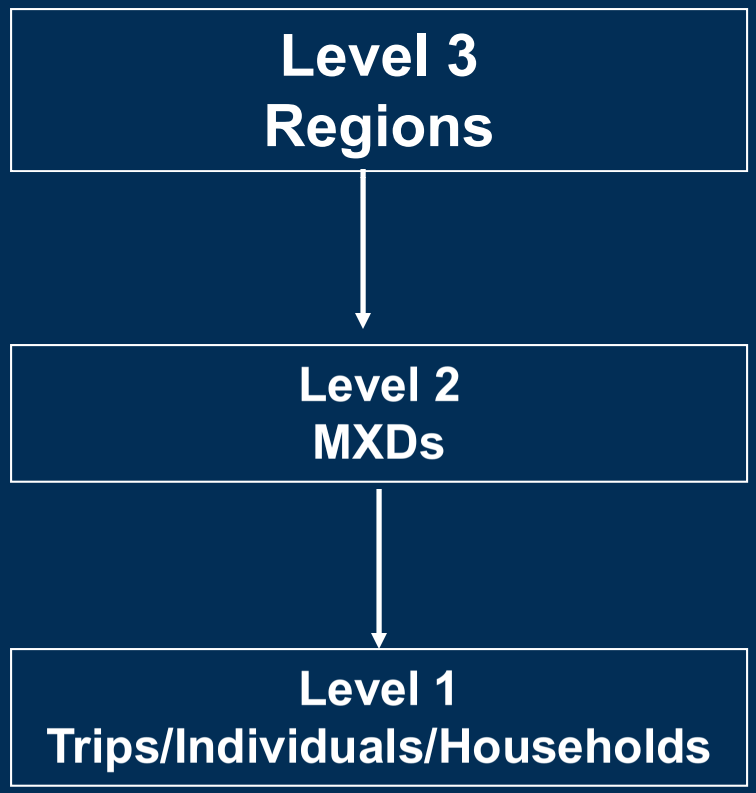
Background

7D variables consistently defined

Density
Diversity
Design
Destination Accessibility
Distance to Transit
Development Scale
Demographics

Background

Uses Hierarchical Modeling



Background

Data Validated from 16 Nationwide Sites
6 Florida sites from ITE *Trip Generation Handbook*
1 Central Florida site
1 Georgia site
6 California sites
2 Texas sites
Prelim data from 3 sites in TX and GA from NCHRP 8-51

On average, for the 16 validation sites Percent Difference in **Daily** Trip Generation Comparing Each Estimation Method with Actual Traffic Counts

Calculation Method	Avg. Deviation
ITE *Trip Generation* Manual (8th Edition) Unadjusted	25%
Trip Generation (8th) Adjusted Using Method *From Trip Generation Handbook* (2004)	14%
Trip Generation (8th) Adjusted Using MXD Models	7%

Background

The MXD method is recommended for sites ranging from about 5 acres to sites about 2000 acres.

The results indicate that the external traffic generation of an MXD is directly related to the following development characteristics:

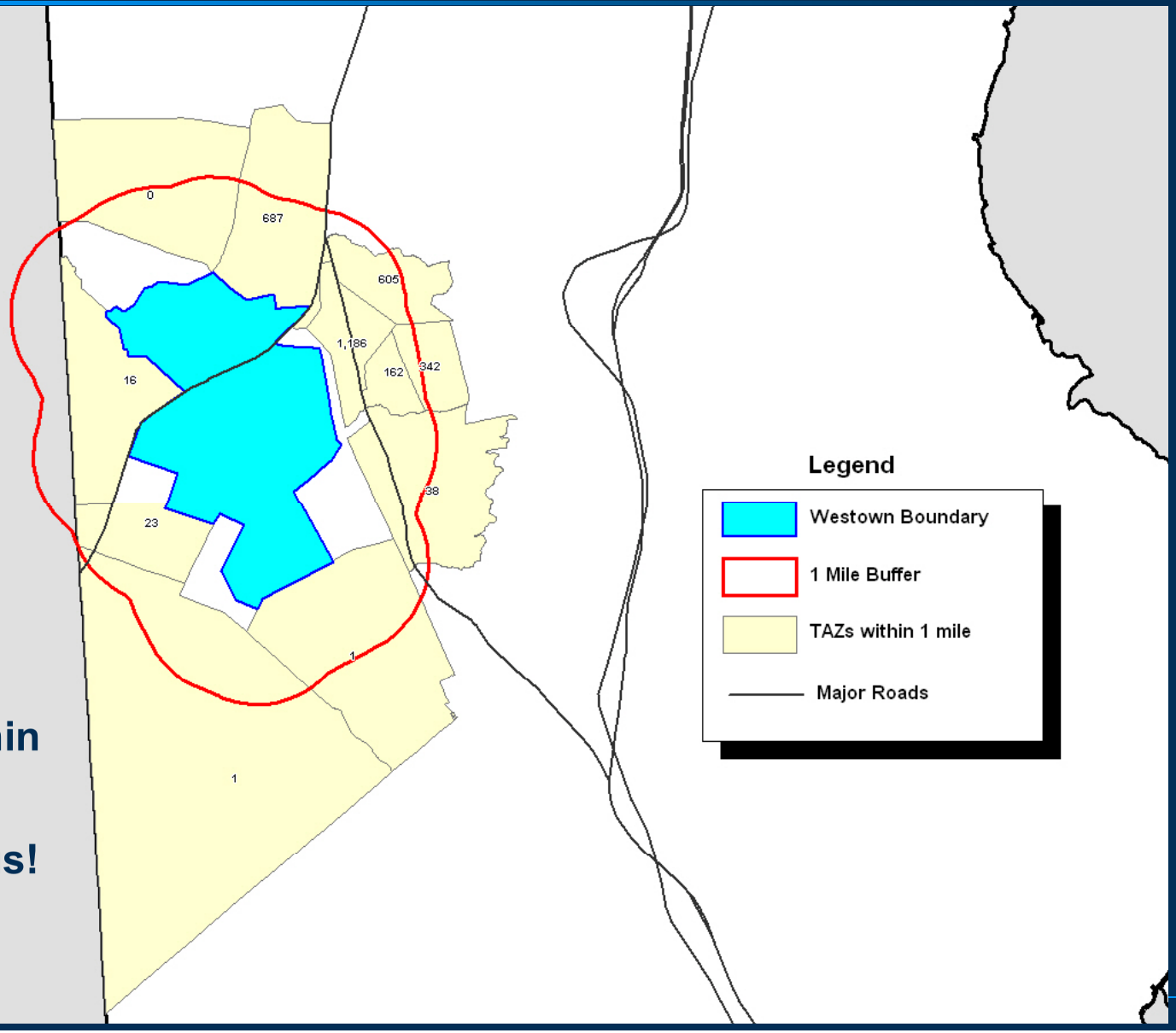
- The size of the site and its total employment
- The jobs / housing balance within the site
- The balance between housing and supporting retail within the site
- The density of development on the site
- The size of households and their auto ownership characteristics
- The amount of employment within walking distance of the site
- The pedestrian-friendliness of the site (small blocks and sidewalks)
- The level of transit service, measured as the employment within a 30 minute transit ride of the site

Site/Local/Regional Demographics

MIXED USE TRIP GENERATION MODEL		Notes / Instructions
Site Name	Average Site	
Geographic		
Area (in acres)	2500	
Number of Intersections	33	Count intersections either within or on the perimeter of the MXD. Do not count driveways.
Number of bus stops	1	Count bus stops either within or on the perimeter of the MXD
Number of rail stops	0	Count rail stops either within or on the perimeter of the MXD
		Note: Bus Stops and rail stops are not in the models, but zero out transit probability if they
Land Use - Surrounding Area		
MPO Type	3	Enter 1 if the MPO has a population of < 200K, 2 if 200-500K, 3 if 500-1000K, 4 if >1000K
Is the site in a Central Business District?	No	
Employment within one mile of the MXD	3,061	Do not include employment within the MXD itself
Employment within a 30 minute Transit Trip	4,598	If deriving from a model, can either include or not include employment within the MXD itse
Site Demographics		
Enter Population Directly?	Yes	If "No", will apply average HH size factors (on global input tab) to dwelling units below
Population	8300	Enter Population Here. You still need to enter dwelling units below.
Retail / Office / Industrial Data in Terms of Jobs or 1000 Square Feet (ksf)?	ksf	If "ksf", will apply average jobs per ksf factors (on global input tab) to ksf below
Average Vehicles Owned per Dwelling Unit	2.15	For guidance, one can look up Census 2000 Summary File 3 block group data for the closest block group to the site, at the URL indicated to the right, choosing table H44 when it prompts you for a table:
Enter Average Household Size Directly?	Yes	If "No", will apply average HH size factors (on global input tab) to dwelling units below
Average Household Size	2.93	Enter Average Household Size Here. You still need to enter dwelling units below.

Areas in YELLOW are user inputs!

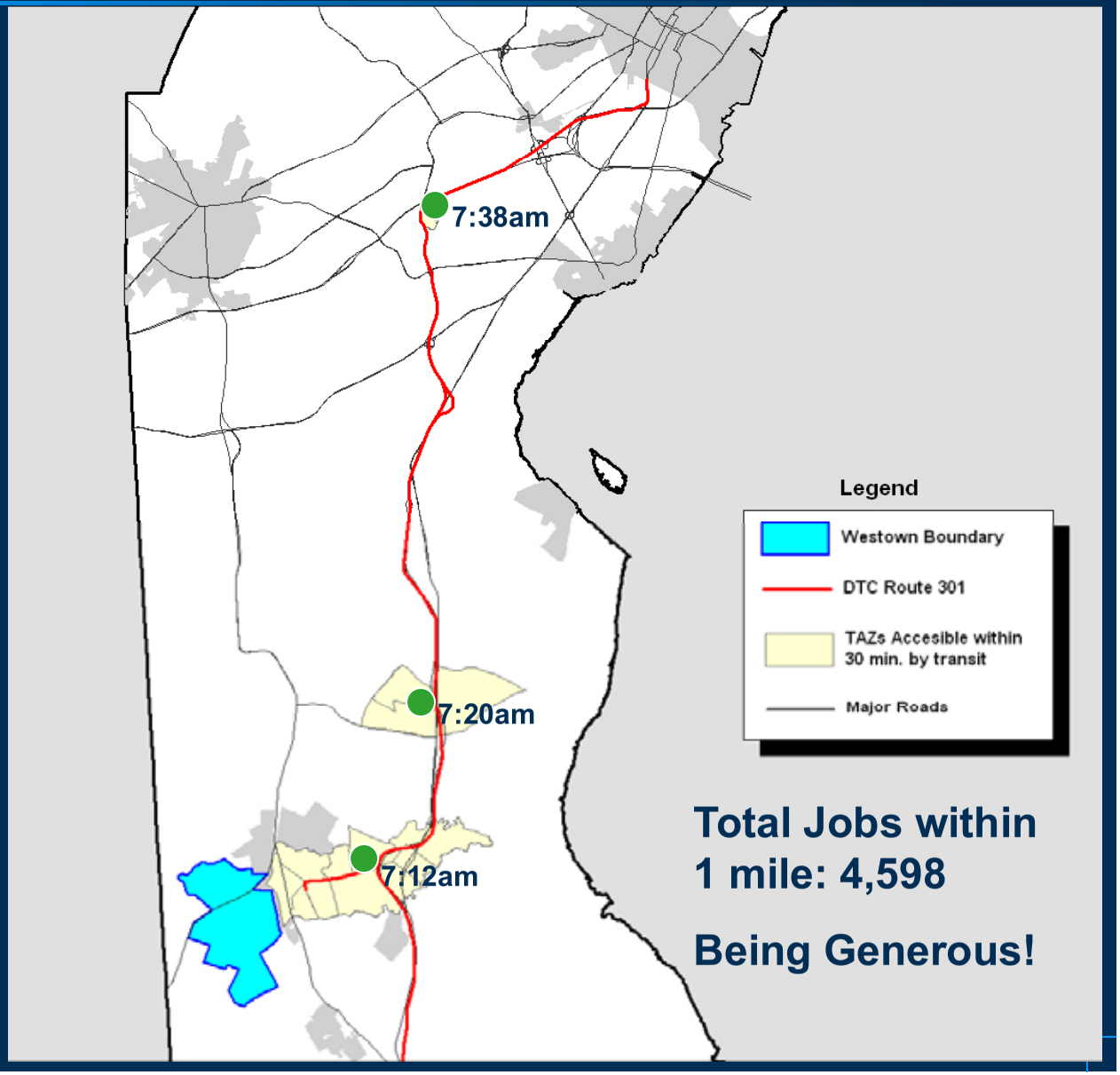
Site/Local/Regional Demographics



Total Jobs within 1 mile: 3,061

Being Generous!

Site/Local/Regional Demographics



Total Jobs within 1 mile: 4,598

Being Generous!

Trip Generation Inputs by site

Land Use - for site ITE Calcs			Trip Equation Method	Total Trips	Code	Average Rate	Linear Multiplier	Linear Constant	Log Multipler	Log Constant
					ITE Daily Parameters - rates for retail / office / industrial are per ksf					
Number of Dwelling Units	Total Units									
Single Family	2,537		3	20,366	210	9.57			0.92	2.71
Multi-Family	700		2	4,357	220	6.72	6.01	150.35		
High Rise Condo	0		2	0	232	4.18	3.77	223.66		
Retail Floor Space (ksf)	Sq. Ft									
General Retail other than those listed below	2,615		3	56,662	820	42.94			0.65	5.83
Supermarket	0		2	0	850	102.24	66.95	1391.56		
Bank	17		2	3,320	912	246.49	182.34	256.87		
Health Club	0		1	0	492	32.93				
Restaurant (non-fast food)	63		1	7,998	932	127.15				
Fast-Food Restaurant	21		1	10,220	934	496.12				
Gas Station	0		1	0	945	162.78				
Auto Repair	0		1	0	942	31.6				
Office Floor Space (ksf)	Sq. Ft									
Non-Medical	1,031		3	8,042	710	11.01			0.77	3.65
Medical	153		1	5,528	720	36.13				
Industrial Floor Space (ksf)	Sq. Ft									
Light Industrial	1,247		2	9,213	110	6.97	7.47	-101.92		
Manufacturing	20		2	56	140	3.82	3.88	-20.7		
Warehousing	724		3	1,756	151	2.5			1.01	0.82
Other										
Hotel Rooms	225		2	1,641	310	8.17	8.95	-373.16		
Movie Screens	2		1	585	445	292.5				
School Enrollment										
Grade School	400		1	516	520	1.29				
High School	700		3	1,295	530	1.71			0.81	1.86
College	400		2	1,332	550	2.38	2.23	440		
	Amount	Units		Trips						
Land uses not covered above ==>		Jobs		0						

Areas in YELLOW are user inputs!

Trip Distribution Calculations

Land Use % Trips by Purpose										
Residential Production Rate	8.7									
		Productions			Attractions			Total		
	Amount	HBW	HBO	NHB	HBW	HBO	NHB	HBW	HBO	NHB
Dwelling Units	3,237	6,196	15,771		0	2,913	1,619	6,196	18,684	1,619
Retail Emp CBD	0	0	0	0	0	0	0	0	0	0
Retail Emp Non-CBD	5,431	0	0	11,133	7,874	48,875	11,133	7,874	48,875	22,265
Service Emp (Office)	3,552	0	0	2,131	5,150	6,038	2,131	5,150	6,038	4,262
Other Emp (Incl. Industrial)	4,657	0	0	1,164	6,752	2,328	1,164	6,752	2,328	2,328
Total		6,196	15,771	14,428	19,777	60,155	16,047	25,972	75,926	30,475
MXD Total Population	8,300									
MXD Total Employment	5,000									
Trip Purpose Distribution for Project Site	**Number of Raw ITE Trips**						**Percentages**			
	All Purposes		**HBW**	**HBO**	**NHB**		**HBW**	**HBO**	**NHB**	
Daily	132,888		26,073	76,221	30,593		19.6%	57.4%	23.0%	
AM Peak Hour	8,504		3,966	3,979	560		46.6%	46.8%	6.6%	
PM Peak Hour	11,519		2,912	5,496	3,111		25.3%	47.7%	27.0%	

RK&K Current Estimate: 136,000

“Adjustable” Global Inputs

Average HH Sizes		
	Single Family	3.0
	Multi-Family	2.2
	High Rise Condo	2.2
Jobs per ksf		
	Retail	2.0
	Office	3.0
	Light Industrial	2.3
	Manufacturing	0.5
	Warehousing	2.0
	Misc. Uses	2.0
Jobs from ITE rates per other unit		
Jobs per Hotel Room		0.50
Jobs per Movie Screen		4.00
Grade School Jobs per student		0.10
High School Jobs per Student		0.10
College Jobs per student		0.25

Edited to match Census Data (2000)

Model Defaults

Results Page

Trip Reduction By Purpose	Daily			AM Peak Hour			PM Peak Hour		
	HBW	HBO	NHB	HBW	HBO	NHB	HBW	HBO	NHB
Number of "Raw" ITE Trips	26,547	79,793	26,548	4,038	4,165	486	2,965	5,753	2,700
Predicted Probabilities:									
Internal Capture	2.51%	8.24%	10.49%	2.51%	8.24%	10.49%	2.51%	8.24%	10.49%
Walking External	0.94%	0.39%	0.07%	0.94%	0.39%	0.07%	0.94%	0.39%	0.07%
Transit External	0.03%	0.57%	1.23%	0.03%	0.57%	1.23%	0.03%	0.57%	1.23%
Number of Trips:									
Internal Capture	666	6,578	2,785	101	343	51	74	474	283
Walking External	244	284	17	37	15	0	27	20	2
Transit External	7	415	292	1	22	5	1	30	30
Net Number of External Vehicle Trips	**25,630**	**72,515**	**23,453**	**3,898**	**3,785**	**429**	**2,863**	**5,228**	**2,385**
Results	**Raw Trips**	**Net Trips**	**Reduction %**		**Internal**	**Walk**	**Transit**		
Daily	**132,888**	**121,599**	**8.5%**		**7.5%**	**0.4%**	**0.5%**		
AM Peak Hour	**8,689**	**8,113**	**6.6%**		**5.7%**	**0.6%**	**0.3%**		
PM Peak Hour	**11,418**	**10,476**	**8.2%**		**7.3%**	**0.4%**	**0.5%**		

Comparison to 2005 McCormick-Taylor Report:

McCormick Taylor:
AM – 0??? out of 8,561 AM trips

PM – 1,192 (8% of PM trips)
out of 14,895 PM trips

MXD Model:
AM – 576 (6.6% of AM trips)
out of 8,689 PM trips

PM – 942 (8.2% of AM trips)
out of 11,418 PM trips

Appendix F: 2/17/10 meeting materials

- **Meeting Agenda**
- **Meeting attendance**
- **Presentation: *"Evaluation of NCHRP 8-51 and EPA Mixed Use Development Internal Trip Capture Models"* - Bill Brockenbrough/Troy Brestel, DelDOT**

Wilmington Area Planning Council

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From Cecil County: 888-808-7088
e-mail: wilmapco@wilmapco.org
web site: www.wilmapco.org

WILMAPCO Council:

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Maryland Dept. of Transportation Director, Office of Planning

Lee Ann Walling
Delaware Office of the Governor Policy Advisor for Environment and Quality of Life Policy

Carolann Wicks
Delaware Dept. of Transportation Secretary

WILMAPCO Executive Director
Tigist Zegeye

Memorandum

Date: May 26, 2010

Re: 2/17/10 TMA/Mixed Use Meeting Agenda

Traffic Mitigation Agreements for Mixed Use Development Working Group Meeting

Where: WILMAPCO Conference Room

When: Wednesday, February 17th, 2010 9-11am

Agenda

1. **Presentation and comparison of the MXD & ITE models for assessing impacts of mixed-use development:**
   DelDOT staff will present their findings of comparing the MXD model developed by Fehr & Peers vs. the model developed through ITE study 08-51.

2. **General discussion on next steps of TMA/Mixed-Use working group**

3. **Next meeting date (March/April?)**

2/17/10 Mixed-Use/TMA meeting attendance

Attendees:
Ted Bishop – DelDOT
Angelina Micheva – NCCCC
Bill Osborne – TMA Delaware
Tigist Zegeye – WILMAPCO
Wayne Henderson - DTC
Dan Blevins – WILMAPCO

EVALUATION OF NCHRP 8-51 AND EPA MIXED USE DEVELOPMENT INTERNAL CAPTURE MODELS

April 6, 2010

DelDOT Division of Planning
Bill Brockenbrough
Troy Brestel

Introduction

- What is a Mixed Use Development?

  As discussed later, definitions vary even between the two models, but essentially a mixed use development combines two or more land uses, such as residential, office and commercial space.
- What is Internal Capture?

  Internal capture is what occurs when someone in a mixed use development makes a trip within the development instead of going to a similar place outside the development.
- Why does Internal Capture matter?

  Internal Capture reduces a development's impact on congestion, air quality and energy consumption.

Introduction

- Why are there two models?
  - Actually there are three: the ITE Trip Generation Handbook contains the only currently accepted model for estimating internal capture.
  - The ITE model has some limitations:
    - Based on a study of three developments in and near Boca Raton, FL
    - Addresses only midday and PM peak hours
    - Addresses only office, residential and retail land uses
    - No adjustments for site characteristics such as walkability or connectivity

Introduction

- TRB, through the NCHRP, created Project 8-51 to improve on the ITE model. They received two good proposals for how to do that. Their Project Panel selected the proposal from the Texas Transportation Institute, which has since developed the NCHRP 8-51 model discussed here.
- EPA, which is represented on the NCHRP Project Panel, found merit in the other proposal, this one from the consulting firm Fehr & Peers. They paid for its development as the EPA model discussed here.

Current Status of the Models

- The ITE Model remains the only one currently adopted.
- The NCHRP 8-51 report is largely complete but does not have final approval from its Project Panel.
- The EPA model is in beta testing but has not been approved for use in air quality modeling. The version addressed in this presentation is Version 4.

How the Models Were Developed

NCHRP 8-51

- Peak period travel surveys at 6 mixed-use developments (MXD), 3 in FL, 2 in TX, 1 in GA
- Model begins with the use of ITE-based peak hour traffic
- Model previously developed for ITE Trip Generation Handbook expanded to include new data (from TX and GA), from 3 land uses to 6 land uses, to include adjustments for proximity of uses within the development, and to address both AM and PM Peak Hours (Daily and Midday traffic not addressed)
- Mode split (auto, walk, transit) of external trips is not addressed
- Model validated using data from 7 sites

EPA

- Household travel survey data from 239 multi-use developments (MXD)
- Model begins with the use of ITE-based daily and peak hour traffic.
- Model sums the ITE results and factors those sums to get trips by purpose (HBW, HBO, NHB)
- Model estimates the probabilities of trips remaining internal to the site, being on foot, or being on transit for each trip purpose (Note that external walking and transit trips are different from internal capture.)
- Model validated using data from 16 sites. Validation was done only for daily traffic trips and only for overall trip reduction, not separately for internal trip capture, walking and transit.

Applicable Developments

NCHRP 8-51

- Land Use Mix – combination of at least three of the following uses: retail, restaurant, office, residential, hotel, and cinema
- Development Type - a single, physically and functionally integrated development on a single block or a group of contiguous blocks: with internal pedestrian and vehicular connectivity; and with shared parking among some or all uses.
- Parking supply is sufficient to meet demand
- Development Location - midtown or suburban; not in or adjacent to a CBD.
- Development Size –between 100,000 and 5 million square feet of building space within an overall acreage of up to about 300 acres; use caution if less than 500,000 square feet or 7 acres or more than 3 million square feet or 250 acres

EPA

- Land Use Mix - two or more land uses, possibly including residential, retail, office, and/or entertainment.
- Development Type – trips between land uses can be made using local streets, without having to use major streets. There may be walk trips between the uses.
- Parking supply is not addressed.
- Development Location is not addressed.
- Development Size – between 5 acres and 2,000 acres; less than 5,000 dwellings and less than 3 million square feet of commercial space.

Inputs

NCHRP 8-51

- Site plan of sufficient detail to quantify development for use of ITE Trip Generation report and to estimate walking distances between uses
- Peak hour vehicle occupancy rates
- Mode splits by land use

EPA

- Required: developed acreage; number of intersections within and along the development edge; presence of transit; location within a CBD or transit-oriented development; number of jobs within one mile of edge of site; number of jobs within a 30-minute transit commute; numbers of single-family, multi-family and high-rise condominium dwelling units; trip generation variables (most commonly floor area) for 8 types of commercial use, 2 types of office use, 3 types of industrial use, hotels, motels, movie theaters, and 4 types of schools; average auto ownership;
- Optional (defaults available if data is not available): average household size for each housing type; numbers of employees per trip generation variable on the above land uses; average internal and external trip lengths; trip purpose splits (HBW,HBO, NHB) by land use; and site-specific internalization percentages

Outputs

NCHRP 8-51

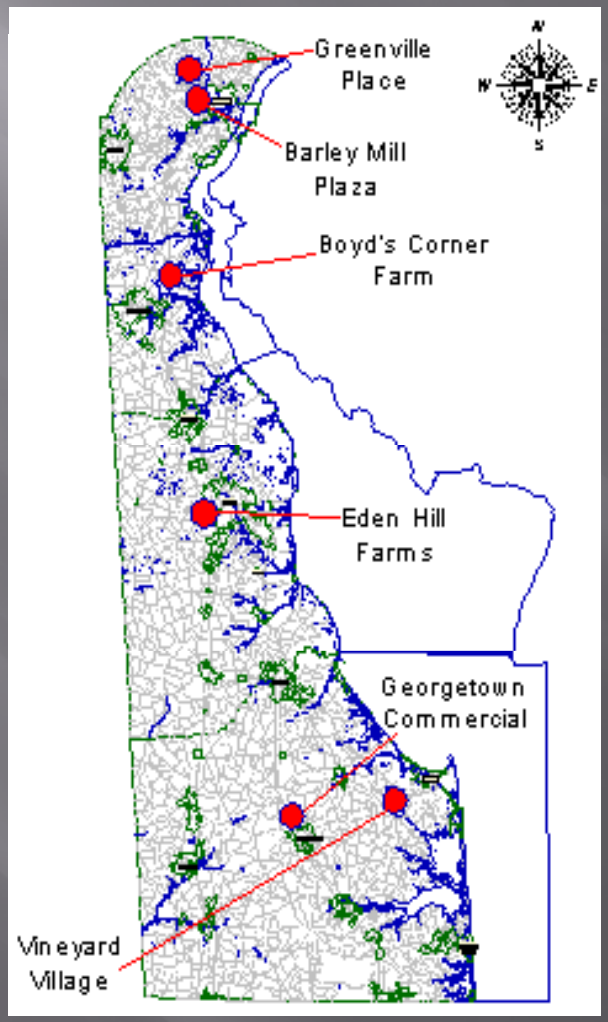
- AM peak hour and PM peak hour internal and external vehicle trips in and out of each land use in the development.
- If there are pedestrian facilities and destinations within walking distance or if transit is available, it may be appropriate to further reduce the external vehicle trips. The EPA model may be helpful in these regards. NCHRP 8-51 provides no guidance in this area.

EPA

- Daily, AM peak hour and PM peak hour internal trips, and external walking trips, transit trips and vehicle trips in and out of the development, classified by trip purpose (home-based work, home-based other and non-home-based).
- The external walking and transit trips reported are the <u>increases</u> over those that a comparable conventional development would generate.

Delaware Examples

Six Current and Proposed Mixed Use Developments



Delaware Examples

Comparison of Internal Capture Percentages*

Development	Status	Description	ITE Trip Generation Handbook			NCHRP 8-51				EPA			
			Daily	AM	PM	Daily	AM	PM	PM Δ from ITE	Daily	AM	PM	PM Δ from ITE
Vineyards at Nassau Valley	Partially Built	927 condominiums, 150-room hotel, 75,000 SF office, 317,000 SF retail, 33,000 SF restaurant	N/A	N/A	15.7	N/A	20.9	31.0	+15.3	5.1	4.7	5.1	-10.6
Greenville Place	Partially Built	27 multi-family DUs, 62,256 SF office, 94,703 SF retail	N/A	N/A	5.2	N/A	15.7	19.5	+14.3	1.8	1.4	1.9	-3.3
Boyds Corner Farm	Proposed	400 multi-family DUs, 40,000 SF office, 175,000 SF retail	N/A	N/A	16.6	N/A	4.4	20.0	+3.4	4.8	4.1	4.7	-11.9
Barley Mill Plaza	Proposed	700 multi-family DUs, 1,434,638 SF office, 488,000 SF retail, 200-room hotel	N/A	N/A	11.4	N/A	12.1	17.5	+6.1	2.4	1.9	2.4	-9.0
Georgetown Commercial	Proposed	105 single-family DUs, 317 multi-family DUs, 50,800 SF office, 64,496 SF retail, 10,800 SF restaurant, 72 hotel rooms	N/A	N/A	17.0	N/A	21.8	40.7	+23.7	7.7	6.6	7.5	-9.5
Eden Hill Farms	Partially Built	291 single-family DUs, 355 townhouses, 230,441 SF office, 154,500 SF retail	N/A	N/A	11.8	N/A	7.6	24.5	+12.7	9.7	6.4	9.4	-2.4

*Does not include external walk or transit trips.

Observations

- Both models yield PM Peak Hour results similar to the ITE procedure, except that when restaurants and hotels are identified as part of the development the NCHRP model shows much more internal capture. The proximity of the uses is also significant in the NCHRP model. Therefore it is important for the analyst using this model know the site layout and to identify these components of proposed commercial areas if they are planned.
- The EPA model consistently shows less, often much less, internal capture than the ITE and NCHRP models.
- Both models tend to show more internal capture in the PM peak hour than in the AM peak hour, but the NCHRP 8-51 model shows much greater differences between AM and PM. Possible explanations include the nature of the survey instrument (on-site exit interviews vs. household travel surveys) and the size of the developments considered (some of EPA's were much larger).

Sensitivity Analysis

- Sensitivity analyses have been done for both the NCHRP and EPA models to determine which variables have the most influence on model results.
- For each of the six example developments, each of the variables was increased in three to four increments of increasing magnitude. For example, in evaluating the EPA model, the number of single-family detached houses was increased first by 50, then by 100, then by 200.

Sensitivity Analysis Results
NCHRP 8-51

Input / Increments	Vineyards		Greenville Place		Boyds Corner Farm		Barley Mill Plaza		Georgetown Commercial		Eden Hill Farms	
	AM Change	PM Change	AM Change	PM Change	AM Change	PM Change	AM Change	PM Change	AM Change	PM Change	AM Change	PM Change
Residential Size												
Increase of 50 units	-0.6	1.9	-0.8	6.3	-0.1	3.1	-0.2	1.2	-0.9	-0.8	-0.1	-0.7
Increase of 100 units	-1	3	-1.4	11	-0.3	4.5	-0.3	2.1	-1.3	-2.1	-0.2	-1.3
Increase of 200 units	-1.6	4.9	-2.4	17.2	-0.5	5.9	-0.5	3.9	-2.6	-4.3	-0.3	-2.3
Retail Size												
100,000 SF	-0.6	-5.7	-3	-2.7	-1.1	-6.6	0.2	-2.1	-0.3	-12.1	-1.1	-2.3
200,000 SF	-1.1	-8.3	-4.4	-3.5	-1.4	-8.8	-0.2	-3	-0.6	-16.6	-1.5	-5.2
400,000 SF	-1.8	-11.3	-6.1	-4.2	-1.9	-11.1	-0.7	-4.3	-1.8	-21.4	-2.1	-8.7
Office Size												
100,000 SF	4.6	-0.1	-2.4	1.7	2.8	0.2	-0.4	-0.1	7.1	-2.8	1.1	-0.6
200,000 SF	7.2	-0.6	-4.1	2.4	3.8	-0.1	-0.6	-0.2	8.1	-4.2	1.3	-0.9
400,000 SF	7.2	-1.5	-6.8	3.5	5.1	-0.7	-1	-0.3	5	-6.8	1	-1.8
Cinema Size												
10 screens	0	2.8	0	4.8	0	3.6	0	1.4	0	2.9	0	2.6
14 screens	0	3.2	0	4.2	0	3.4	0	1.9	0	0.9	0	2.3
18 screens	0	3.6	0	3.6	0	2.5	0	2.3	0	-0.5	0	1.9
Hotel Size												
50 rooms	-0.2	0	0.9	0.8	0.8	0.4	0	0.1	-0.1	-0.1	0.6	0.2
100 rooms	-0.4	0	0.9	1.7	0.5	0.9	-0.1	0.3	-0.6	-0.4	1.6	0.7
200 rooms	-0.8	0.3	-1.1	2.8	-0.1	1.3	-0.4	0.4	-1.3	-1.6	1	1
Restaurant Size												
5,000 SF	-2.1	4.6	15.1	13.1	16.5	10.4	9.8	4.2	-4.5	7.5	18.4	7.9
10,000 SF	-4.7	7.3	13.2	21.7	11.7	16.9	14.4	8	-7.9	10.7	18.9	14.3
20,000 SF	-8.2	11.6	4.6	30.2	6.2	22.8	18.3	13	-11.9	8.6	15.6	21.7
Distance to Residential												
1,000 Feet	-1.6	-1.9	0	-0.3	-0.2	-2.1	0	-1.1	-1.9	-2.9	-0.1	-2.2
2,000 Feet	-4.4	-7.7	0	-0.9	-0.5	-8	-0.2	-4.1	-5.5	-10.7	-0.5	-8.8
3,000 Feet	-5.9	-12.2	0	-1.4	-0.8	-12.6	-0.2	-6.5	-7.4	-16.9	-0.7	-14.3
Distance to Retail												
1,000 Feet	-0.4	-1.6	-2.9	-0.9	-0.5	-2.5	-1.1	-2.5	-0.4	-2.4	-0.8	-2.9
2,000 Feet	-0.9	-6.3	-8.3	-2.8	-1.4	-8.8	-3.2	-8.2	-1	-9	-2.3	-10.6
3,000 Feet	-1.2	-9.9	-11	-3.9	-1.9	-13.7	-4.2	-11.8	-1.4	-14.2	-3.1	-16.6
Distance to Office												
1,000 Feet	-0.7	-0.1	-2.9	-0.7	-0.3	-0.4	-1	-1.5	-0.7	-0.5	-0.6	-0.7
2,000 Feet	-1.7	-0.7	-8.2	-2	-0.9	-1.1	-3	-4.4	-2	-1.4	-1.8	-2.3
3,000 Feet	-2.2	-1.1	-10.9	-2.6	-1.1	-1.6	-3.9	-5.9	-2.7	-2	-2.4	-3.2
Distance to Cinema												
1,000 Feet	0	0	0	0	0	0	0	0	0	0	0	0
2,000 Feet	0	0	0	0	0	0	0	0	0	0	0	0
3,000 Feet	0	0	0	0	0	0	0	0	0	0	0	0
Distance to Hotel												
1,000 Feet	0	0	0	0	0	0	0	0	0	0	0	0
2,000 Feet	0	0	0	0	0	0	0	0	0	0	0	0
3,000 Feet	0	0	0	0	0	0	0	0	0	0	0	0
Distance to Restaurant												
1,000 Feet	-1.9	-0.5	0	-0.2	0	0	0	0	-2.3	-0.9	0	0
2,000 Feet	-5.2	-2	0	-0.5	0	0	0	0	-6.5	-2.9	0	0
3,000 Feet	-7	-3.1	0	-0.8	0	0	0	0	-8.7	-4.8	0	0

Sensitivity Analysis Results EPA (page 1 of 2)

Input / Increments	Vineyards			Greenville Place			Boyds Corner Farm			Barley Mill Plaza			Georgetown Commerical			Eden Hill Farms		
	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change
SFDU																		
Increase of 50 SFDU	0	0.1	0	0.4	0.5	0.4	0	0.1	0.1	0	0	0	0.2	0.2	0.1	0.1	0.1	0.1
Increase of 100 SFDU	0.1	0.1	0	0.6	0.8	0.6	0.1	0.2	0.1	0	0.1	0.1	0.3	0.3	0.2	0.1	0.2	0.2
Increase of 200 SFDU	0.2	0.2	0.1	0.9	1.2	0.8	0.3	0.4	0.3	0.1	0.1	0.1	0.2	0.2	0.1	0.3	0.4	0.3
MFDU																		
Increase of 50 MFDU	0	0.1	0	0.4	0.5	0.4	0.1	0.1	0.1	0	0	0	0.2	0.2	0.1	0.1	0.1	0.1
Increase of 100 MFDU	0.1	0.1	0.1	0.6	0.8	0.6	0.1	0.2	0.2	0	0.1	0.1	0.3	0.3	0.2	0.2	0.2	0.2
Increase of 200 MFDU	0.2	0.2	0.1	0.9	1.2	0.9	0.3	0.4	0.3	0.1	0.1	0.1	0.4	0.4	0.3	0.3	0.4	0.3
High-Rise Condo																		
Increase of 50 Units	0.1	0.1	0	0.4	0.5	0.4	0	0.1	0.1	0	0	0.1	0.2	0.2	0.1	0.1	0.1	0.1
Increase of 100 Units	0.1	0.1	0.1	0.6	0.9	0.6	0.1	0.2	0.2	0	0.1	0.1	0.3	0.3	0.2	0.2	0.2	0.2
Increase of 200 Units	0.2	0.2	0.1	0.9	1.2	0.9	0.3	0.4	0.3	0.1	0.1	0.1	0.4	0.4	0.3	0.3	0.4	0.4
General Retail SF																		
100,000 SF	-0.1	-0.2	-0.1	0	-0.1	0	-0.2	-0.3	-0.1	-0.1	0	0	-0.2	-0.6	-0.2	-0.1	-0.2	0.1
200,000 SF	-0.2	-0.3	-0.2	0	-0.2	0	-0.4	-0.5	-0.2	-0.1	-0.1	0	-0.4	-1	-0.3	-0.1	-0.3	0.1
400,000 SF	-0.4	-0.6	-0.3	0	-0.3	0	-0.5	-0.8	-0.4	-0.1	-0.1	0	-0.7	-1.5	-0.5	-0.2	-0.5	0.1
Supermarket SF																		
25,000 SF	0	0	-0.1	0	0	0	-0.1	0	0	0	0	0	0	-0.1	0	0	0	0.1
50,000 SF	-0.1	-0.1	-0.1	0	-0.1	0	-0.1	-0.1	-0.1	0	0	0	0	-0.2	0	0.1	0.1	0.2
75,000 SF	-0.1	-0.1	-0.1	0	-0.1	0	-0.2	-0.2	-0.1	0	0	0	-0.1	-0.3	0	0.1	0.1	0.2
Turk SF																		
2,000 SF	0	0	0	0	0	0	-0.1	0	0	0	0	0	0	0	0	0	0	0
4,000 SF	0	0	0	0	0	0	-0.1	0	0	0	0	0	0.1	0	0	0	0	0.1
6,000 SF	0	0	0	0	0	0	-0.1	0	0	0	0	0	0.1	0	0	0	0.1	0.1
Health Club SF																		
2,000 SF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4,000 SF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6,000 SF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HTSD Restaurant SF																		
2,000 SF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4,000 SF	0	0	0	0	0	0	-0.1	0	0	0	0	0	0	0	0	0	0	0
6,000 SF	0	0	0	0	0	0	-0.1	0	0	0	0	0	0	0	0	0	0.1	0.1
FF Restaurant SF																		
2,000 SF	0	0	0	0	0	0	0	0.1	0	0	0	0	0.1	0.1	0	0	0.1	0.1
4,000 SF	0	0	0	0	0	0	0	0.1	0	0	0	0	0.1	0.1	0	0	0.2	0.1
6,000 SF	0	0	0	0	0	0	0	0.1	0	0	0	0	0.1	0.2	0	0.1	0.3	0.1
Gas Station SF																		
2,000 SF	0	0	0	0	0	0	0	0.1	0	0	0	0	0.1	0.1	0.1	0.1	0.2	0.1
4,000 SF	0	0	0	0	0	0	0	0.1	0	0	0	0	0.2	0.2	0.1	0.1	0.3	0.2
6,000 SF	0	0	0	0	0	0	0	0.1	0	0	0	0	0.2	0.2	0.2	0.2	0.5	0.3
Auto Repair SF																		
2,000 SF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4,000 SF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6,000 SF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Office SF																		
100,000 SF	-0.2	-0.3	-0.2	0	-0.2	0	-0.3	-0.5	-0.3	-0.1	-0.1	0	-0.6	-1	-0.6	-0.3	-0.5	-0.2
200,000 SF	-0.3	-0.5	-0.3	0	-0.3	0	-0.5	-0.8	-0.4	-0.1	-0.1	0	-0.9	-1.6	-0.9	-0.5	-0.8	-0.4
400,000 SF	-0.5	-0.8	-0.5	0	-0.4	0	-0.7	-1.2	-0.6	-0.1	-0.1	0	-1.3	-2.3	-1.2	-0.7	-1.3	-0.6
Med Office SF																		
20,000 SF	0	0	-0.1	0	0	0	-0.1	-0.1	-0.1	0	0	0	-0.1	-0.3	-0.2	-0.1	-0.1	-0.1
40,000 SF	-0.1	-0.1	-0.1	0	-0.1	0	-0.2	-0.2	-0.1	0	0	0	-0.3	-0.5	-0.3	-0.2	-0.2	-0.1
60,000 SF	-0.1	-0.2	-0.1	0	-0.1	0	-0.3	-0.3	-0.2	0	0	0	-0.4	-0.7	-0.4	-0.3	-0.3	-0.2
Light Industrial Jobs																		
50	0	0	-0.1	0	0	0	-0.1	-0.1	-0.1	0	0	0	-0.1	-0.2	-0.2	-0.1	-0.1	0
100	-0.1	-0.1	-0.1	0	0	0	-0.2	-0.2	-0.1	0	0	0	-0.2	-0.4	-0.3	-0.2	-0.2	-0.1
150	-0.1	-0.1	-0.1	0	0	0	-0.2	-0.3	-0.2	0	0	0	-0.4	-0.6	-0.4	-0.2	-0.3	-0.2
Manufacturing SF																		
50,000 SF	0	0	0	0	0	0	-0.1	-0.1	0	0	0	0	0	-0.2	-0.1	-0.1	-0.1	-0.1
100,000 SF	0	0	-0.1	0	0	0	-0.1	-0.2	-0.1	0	0	0	-0.1	-0.3	-0.2	-0.1	-0.2	-0.1
150,000 SF	-0.1	-0.1	-0.1	0	0	0	-0.2	-0.2	-0.1	0	0	0	-0.2	-0.5	-0.3	-0.2	-0.3	-0.2
Warehousing SF																		
50,000 SF	-0.1	0.2	-0.1	0	-0.1	0	-0.2	-0.2	-0.1	0	0	0	-0.2	-0.4	-0.2	-0.1	-0.2	-0.1
100,000 SF	-0.1	-0.2	-0.1	0	-0.1	0	-0.3	-0.3	-0.2	-0.1	0	0	-0.4	-0.7	-0.4	-0.2	-0.3	-0.1
150,000 SF	-0.2	-0.2	-0.2	0	-0.2	0	-0.3	-0.5	-0.3	-0.1	-0.1	0	-0.6	-0.9	-0.6	-0.3	-0.4	-0.2
Hotel Rooms																		
50	0	0	0	0	0	0	-0.1	-0.1	0	0	0	0	-0.1	-0.1	-0.1	-0.1	-0.1	0
100	0	0	-0.1	0	0	0	-0.1	-0.1	-0.1	0	0	0	-0.2	-0.3	-0.2	-0.2	-0.2	-0.1
150	-0.1	-0.1	-0.1	0	0	0	-0.2	-0.2	-0.1	0	0	0	-0.3	-0.4	-0.3	-0.3	-0.3	-0.2
Motel Rooms																		
50	0	0	0	0	0	0	-0.1	-0.1	0	0	0	0	-0.1	-0.1	-0.1	-0.1	-0.1	0
100	0	0	0	0	0	0	-0.1	-0.1	-0.1	0	0	0	-0.2	-0.3	-0.2	-0.2	-0.2	-0.1
150	0	0	0	0	0	0	-0.2	-0.2	-0.1	0	0	0	-0.3	-0.4	-0.3	-0.2	-0.3	-0.1
Movie Screens																		
8	0	0.1	0	0	0	0	-0.2	0	-0.1	-0.1	0	0	-0.2	-0.1	-0.3	-0.3	-0.1	-0.2
12	0	0.1	0	0	0	0	-0.2	-0.1	-0.1	-0.1	0	0	-0.3	-0.2	-0.4	-0.4	-0.1	-0.3
16	0	0.1	0	0	0	0	-0.2	-0.1	-0.2	-0.1	0	0	-0.4	-0.2	-0.5	-0.5	-0.1	-0.4

SENSITIVITY ANALYSIS RESULTS EPA (PAGE 2 OF 2)

Input / Increments	Vineyards			Greenville Place			Boyds Corner Farm			Barley Mill Plaza			Georgetown Commercial			Eden Hill Farms		
	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change	Daily Change	AM Change	PM Change
SFDU																		
University Students																		
2,000	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.7	-0.6	-0.5	-0.1	-0.1	-0.1	-2.1	-2	-1.9	-1	-0.3	-0.8
6,000	-0.7	-0.9	-0.7	-0.6	-0.5	-0.6	-1.4	-1.2	-1.2	-0.3	-0.2	-0.2	-2.6	-2.3	-2.4	-2.2	-0.8	-1.8
10,000	-1.1	-1.2	-1.1	-0.7	-0.6	-0.8	-1.8	-1.5	-1.6	-0.4	-0.2	-0.3	-3	-2.6	-2.7	-3	-1.2	-2.5
High School Students																		
500	0	0.1	0	-0.1	-0.1	-0.1	-0.1	0	-0.1	-0.1	0	0	-0.1	-0.1	-0.2	-0.2	0.1	-0.1
1,000	0	0	0	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	0	0	-0.3	-0.2	-0.3	-0.4	0.1	-0.2
1,500	-0.1	0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.1	0	0	-0.5	-0.4	-0.4	-0.5	0.1	-0.3
Middle School Students																		
500	0	0.1	0	-0.1	-0.1	-0.1	-0.1	0	-0.1	-0.1	0	0	-0.1	-0.1	-0.2	-0.2	0.1	-0.1
1,000	0	0	0	-0.1	-0.1	-0.1	-0.2	-0.1	-0.2	-0.1	0	0	-0.3	-0.2	-0.3	-0.3	0.1	-0.2
1,500	-0.1	0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.1	0	0	-0.5	-0.4	-0.4	-0.5	0.1	-0.4
Elementary Students																		
500	0	0.1	0	-0.1	-0.1	-0.1	-0.1	0	-0.1	-0.1	0	0	-0.1	-0.1	-0.2	-0.2	0.1	-0.1
1,000	0	0	0	-0.1	-0.1	-0.1	-0.2	-0.1	-0.2	-0.1	0	0	-0.3	-0.2	-0.3	-0.3	0.1	-0.2
1,500	-0.1	0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.2	-0.2	-0.1	0	0	-0.5	-0.4	-0.4	-0.4	0.1	-0.3
Site Acreage																		
20	0.1	0.2	0	-0.1	0	-0.1	0	0.1	0	-0.1	0	0	0.1	0.1	0	0	0	0
40	0.1	0.2	0	-0.1	0	-0.2	0	0.1	0	-0.1	0	0	0.1	0.1	0	0	0	0
60	0.1	0.3	0	-0.1	0	-0.2	0	0.2	0	-0.1	0	0	0.1	0.1	0	0	0	0
Intersections																		
10	2.1	1.4	2	1.9	0.7	1.9	1.5	0.9	1.5	2.1	0.8	2.2	0.9	0.6	0.8	0.6	0.3	0.6
20	3.5	2.3	3.4	3	1.2	3.2	2.7	1.5	2.7	3.5	1.2	3.6	1.7	1.1	1.6	1.2	0.6	1.2
30	4.6	3	4.5	4	1.5	4.1	3.6	2	3.6	4.6	1.6	4.6	2.4	1.5	2.2	1.7	0.8	1.7
Transit?																		
Yes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CBD?																		
Yes	-0.2	-0.2	-0.2	0.1	0	0	-0.3	-0.2	-0.3	0	0	0	-0.5	-0.8	-0.6	-0.8	-0.7	-0.9
No	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EMP 1 Mile																		
1,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EMP 30 min transit																		
5,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vehicles Owned																		
1	-1	-1.1	-1	-0.2	-0.3	-0.3	-0.9	-0.9	-0.8	-0.4	-0.5	-0.4	-1.4	-1.5	-1.4	-1.4	-1.3	-1.3
2	-1.5	-1.8	-1.6	-0.4	-0.5	-0.4	-1.3	-1.5	-1.3	-0.6	-0.7	-0.6	-2.2	-2.4	-2.2	-2.3	-2.1	-2.1
3	-1.9	-2.2	-1.9	-0.5	-0.6	-0.5	-1.6	-1.8	-1.6	-0.8	-0.9	-0.7	-2.7	-2.9	-2.7	-2.9	-2.6	-2.7

Sensitivity Analysis
Variables Ranked by Sensitivity

NCHRP 8-51

- Size of restaurant use
- Proximity of retail use
- Sizes of retail, office and residential uses, and proximity of office and residential uses
- Sizes of cinema and hotel uses
- Proximity of restaurant, hotel and cinema uses

EPA

- Number of Internal intersections
- Auto ownership
- Size of university (if any)
- Acreage, location within a CBD or TOD, numbers of dwellings and sizes of non-residential uses other than university
- Presence of transit, jobs within one mile of the site and jobs within a 30-minute transit trip

Sensitivity Analysis Findings

NCHRP 8-51

- Of 12 independent variables, the size of the restaurant use has by far the greatest effect. The proximity of the retail use is also significant.
- The sizes of the of retail, office and residential uses, and the proximity of office and residential uses all had lesser effects.
- The sizes of the cinema and hotel uses and the proximity of the restaurant, cinema and hotel uses had relatively small effects .
- The size of any one land use can be optimized relative to the others.
- The optimum land use mix for internal capture differs with the peak hour.
- The proximity of the uses relative to each other is a complex set of variables in that of 30 possible origin-destination pairs, there are proximity adjustments for nine of them. For this analysis, we assumed all uses were contiguous and moved one use away from the rest at a time. In reality, moving one use changes between one and seven proximity adjustments.

EPA

- Of 30 independent variables, only 27 affected the internal capture percentage.
- Of the 27, the number of internal intersections has by far the greatest effect. Two other variables, automobile ownership and university size, if a university is present, were also particularly significant.
- The total acreage, location within a CBD or TOD, and the sizes of the other land uses all had lesser effects. Two uses, health clubs and auto repair facilities, never changed internal capture by as much as 0.05 percent in this analysis.
- The presence of transit, employment within one mile of the site and employment within a 30-minute transit trip affect other model outputs but not the internal capture percentage.
- The relative sensitivity of the site characteristic variables varied from site to site, apparently due to the starting values of those variables. For example, for Greenville Center, site acreage and the numbers of dwellings were particularly significant but the site is relatively small compared to the other examples and has only 27 dwellings.

Recommended Uses

NCHRP 8-51

- Site Traffic Impact Analysis (TIS, TOA, etc.)
- Environmental Impact Analyses other than emissions and energy if sensitive to intersection or peak hour operation
- Other applications where peak hour estimates are important and/or the site plan is known

EPA

- Regional travel model
- Vehicle emissions
- Energy consumption
- Environmental Impact Analyses other than emissions and energy if analyzing large areas or corridors or on a daily basis
- Other applications where site plan is unknown but population and employment estimates are available

THANK YOU!

Please direct questions or comments to :

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Appendix G: Other Material and misc. Reports

- **TCRP Report 128, "Effects of TOD on Housing, Parking and Travel**
- **Paper: "*Vehicle Trip Reduction Impacts of Transit-Oriented Housing:-* Robert Cervero, University of California, Berkeley**
- **TCRP Report 95: *"Transit Oriented DevelopmentTraveler Response to Transportation System Changes"***

In the interest of reducing document size, below are the links to documents that were part of the literature review for this project.

TCRP Report 128, *"Effects of TOD on Housing, Parking and Travel"*
www.gulliver.trb.org/publications/tcrp/tcrp_rpt_128.pdf

Paper: *"Vehicle Trip Reduction Impacts of Transit-Oriented Housing"-* Robert Cervero, University of California, Berkeley
www.nctr.usf.edu/jpt/pdf/JPT11-3Cervero.pdf

TCRP Report 95: *"Transit Oriented Development Traveler Response to Transportation System Changes"*
www.gulliver.trb.org/publications/tcrp/tcrp_rpt_95c17.pdf

Community Capture Methodology

Accepted by the FDOT Executive Board February 18, 2009

The Florida Department of Transportation (FDOT), in partnership with the Florida Department of Community Affairs (DCA), Regional Planning Councils (RPCs), local governments, transportation and land use professionals, and representatives of the development community, has initiated the process of identifying unique trip making characteristics of large, self-standing development with a balanced mix of uses, such as a new community or town. . These communities will be subject to regulation under F.S. 380.06 – Developments of Regional Impact (DRI). Most DRIs will not need to utilize the Community Capture methods because they will not meet the identified community criteria. To recognize the unique characteristics of the developments meeting this type of scenario, we have introduced the term "**Community Capture**".

Recommendations for Estimating Community Capture

A Definition of Community Capture

Community Capture is the reduction in the number of external vehicle trips generated by a large, mixed-use development reducing the overall impact of the proposed community on the transportation system outside of the development. Community Capture occurs due to the combined land-use, location, design, and multimodal characteristics of the development. Internal Capture, as accepted by the professional transportation community, recognizes that a portion of the total trips for a multi-use development may be satisfied within the development. The concept of Community Capture extends the application of internal capture to include potential trip interactions and reductions within the boundaries of large scale, multi-use developments. In these large-scale cases, internal capture trips would be a wholly contained subset of community capture trips. While "Community Capture" and "Internal Capture" are somewhat different, some of the research and applications associated with Internal Capture can apply to Community Capture.

Where May Community Capture be Applied?

Community Capture can be applied to a large, self-standing development, such as a new community or town, with a balanced mix of uses that may fulfill a significant portion of the community's needs within the development. These communities may be separated by travel-time, design, or distance from other major land use concentrations. They provide a wide range of internal services, which may satisfy a significant portion of their needs within the community.

The community would make many off-site trips unnecessary by being of sufficient size to provide a balance of land uses, including a range of housing types and values, neighborhood and community retail centers, entertainment facilities, offices, and employment. The community would also provide a range of support services such as schools, civic institutions, houses of worship, public parks, and government facilities. Larger communities may have several town centers or villages, which embrace connectivity

within, and between, each center and village with a transportation system of all modes, including pedestrian paths, bicycle facilities, and shuttles.

Numerical Factors for Community Capture

Because each site will have unique characteristics, no minimum or maximum values for Community Capture will be recommended by FDOT. Reasonable analysis of proposed developments will be used and will be verified by substantial and ongoing monitoring programs. Ideally, over time, agreement may occur on some ranges and measurement criteria. However, because this is an emerging topic, many of the early estimates will be negotiated, based on best professional judgment and verified with monitoring agreements.

Justification of Community Capture Values

The justification will need to include summaries showing the numbers and percentages of trips served within the proposed development. For example, depending on the development, it might look like this,

> ***"X % of the entering shopping trips expected in the PM peak hour makes up Y% of the total exiting shopping trips from homes within the community".***

As a Development of Regional Impact (DRI), the proposed community will include the standard "Map H", development program summary, and build-out schedule. Additionally, there must be information provided in sufficient detail to clearly support and explain the process used to determine a proposed Community Capture value.

This analysis should be done for each phase, with an agreed upon monitoring program.

Using the Right Tools for Determining Community Capture

No single tool for determining Community Capture currently exists. While refinements to existing tools, such as the modeling methodology described below, are currently under development, no one procedure has been demonstrated to provide a final Community Capture value. Until there is more experience and knowledge regarding Community Capture, reasonable analysis and negotiations, supported by substantial and detailed monitoring requirements will be used.

Commitment to Traffic Monitoring

Expanded traffic monitoring beyond the current basic requirements of the DRI annual/biennial report will be a required provision in accepting Community Capture rates. While the detailed needs of the traffic monitoring program will be determined through the traffic study process, elements such as origin and destination studies, trip generation studies, and an evaluation of land use mixes in the community and surrounding the community will usually be included in the monitoring program. At a minimum, monitoring will be necessary before the development enters a new phase. If appropriate, trip characteristic assumptions and impact mitigation requirements will be revised, based on the monitoring.

Traffic monitoring at a frequency greater than by phase may be required for more aggressive development programs or if significant changes are made to the planned development program.

The Role of Pre-Application and Methodology Meetings

During the pre-application and transportation methodology meetings it will be important to have discussions among the experts in development and transportation (DCA, FDOT, RPCs, local governments, transportation professionals and representatives of the development community), to agree on factors needed to determine Community Capture and external impacts. All requests for utilizing Community Capture rates require more detailed information and specific commitments for justification. If sufficient information is not available at the time of the methodology meeting to make the commitments necessary to justify a Community Capture rate, final agreements on a rate will not be made until such information is available.

The Factors Impacting Community Capture

Community Capture will go beyond Internal Capture, accounting for the unique trip making aspects of a large, self-standing development with a balanced mix of uses such as a new community or town. The Community Capture concept focuses on:

Land Use Characteristics: A balance of land uses where form and function result in trips being satisfied within the development must exist for significant Community Capture to occur. Some of these factors are:

- "**Income Compatible" Uses**: Residence and employment centers should be "income compatible" so residents have ample employment opportunities in the community. Employment centers should attract a reasonable amount of the workforce from within the community.

- **Type of Community:** Is this a community planned for all age groups with job opportunities, or is it a retirement community? Is the new community primarily recreational? These issues can have an important impact on Community Capture.

- **Community Design:** The design features of the community can affect both the number of external vehicle trips, as well as the internal trips using major roadways. For example, a well-designed development with good internal connectivity will make it more convenient for trips to stay on site. By providing alternative connections internal to the site, the number of vehicle trips needing to use a major roadway to traverse the site can be reduced. Internal capture is facilitated by a high level of connectivity and short travel distances between complimentary land uses.

- **Development Maturity**: The project's fullest Community Capture may not occur until the complementary land uses mature. This may occur late in the development program. This will depend on the quantity and balance between complementary land uses. However, each phase or

increment must mitigate the cumulative impacts to the regional network resulting from the current phase or increment and previously approved phases or increments.

Location Context: The location context of large, mixed-use developments may impact Community Capture in the following ways:

- **Remote Locations**: For a remote location with a balance of complementary land uses, high trip capture may occur. For the trips not captured on site, longer external trip lengths will result because there would be few opportunities for trips to end near the site.

- **Competing External Opportunities**: If there were ample nearby destinations (shopping, jobs, or entertainment) outside of the community, the Community Capture rate would likely be lower. For example, if a mixed-use development is located near other large developments, the Community Capture rate may be reduced.

- **Trip Generation of Isolated Communities**: Discussion is ongoing regarding the trip generation characteristics of isolated communities. One assumption proposed is if a community is isolated, and a trip cannot be satisfied on site, some discretionary trips are less likely to occur. While not making a trip can be an option for some trips, such as shopping, it is not an option for work-based trips, which have the highest impact during the peak hours.

- **Multimodal Elements** (Encouragement of transit, walking and cycling): The provisions of on-site transit circulators and integrated systems of bicycle, golf cart, and pedestrian paths may have an impact on vehicle trip generation and vehicle trip capture. Such amenities make it easier for trips to remain on site and may reduce the need for vehicle trips to occur.

Some Guidance on Analysis Tools

Travel Demand Models

Currently, large-scale transportation models, such as FSUTMS, which are not specifically modified for Community Capture purposes, may be insensitive to some of the factors expected to affect Community Capture. To address some of the limitations associated with using travel demand models to estimate capture, a methodology is proposed based on the following modifications:

- Consider land use categories in place of or in addition to traditional trip purposes. Within the model, use an increased selection of housing types (single-family, multifamily, rental apartments) and categories (high cost employed, retired, seasonal, medium cost employed, and low cost employed) and a trip purpose table for the expanded housing categories which can be used to create a residential trip generation and trip purpose profile to better match the development plan;

- Consider land use categories at trip attraction ends, such as retail/restaurant price levels to better match with residential income/price category. Also, consider for income/price category. Summarize the potential attractions within the community, based on the marketing plan, to better account for income differences;

- Create transportation analysis zones (TAZs) for each land use along with more detailed coded networks; and

- Carefully use K-factors (travel-time friction factors) within the model to make reasonable adjustments to the trip distribution patterns within the community and to the trip lengths external to the community.

While this methodology appears to be a positive step in addressing some of the traditional limitations of travel demand models in determining capture rates, the methodology needs to be tested to gain a better understanding of the sensitivity of the model to the proposed variables. The use of additional or modified variables must be documented and discussed with reviewing agencies early in the methodology development phase.

Currently, most standard large-scale travel demand models are not sufficiently detailed to predict internal capture. Unmodified models and their "raw" output are not appropriate tools to be used alone to justify Community Capture values. When the model is part of the justification for Community Capture values, clear documentation of the model process, including the submittal of all model files, must be provided, so a professional reviewer with reasonable competence in travel demand models can replicate the analysis and conclusions.

Institute of Transportation Engineers (ITE) Multi-Use Development Methodology

The ITE multi-use development methodology has been the primary tool used to estimate internal capture since 2000. While the ITE multi-use development methodology does not account for variables such as proximity of on-site land uses and location context, the methodology does provide an organized and professionally accepted manner to evaluate internal capture. If the data needed to support a Community Capture assessment is not available, an internal capture value determined using the ITE methodology could be used. A new National Project to update the ITE method is expected to be complete in 2009. This project is expanding the database and refining the method employed in the ITE methodology.

FLITE

Institute of Transportation Engineers
FLORIDA SECTION

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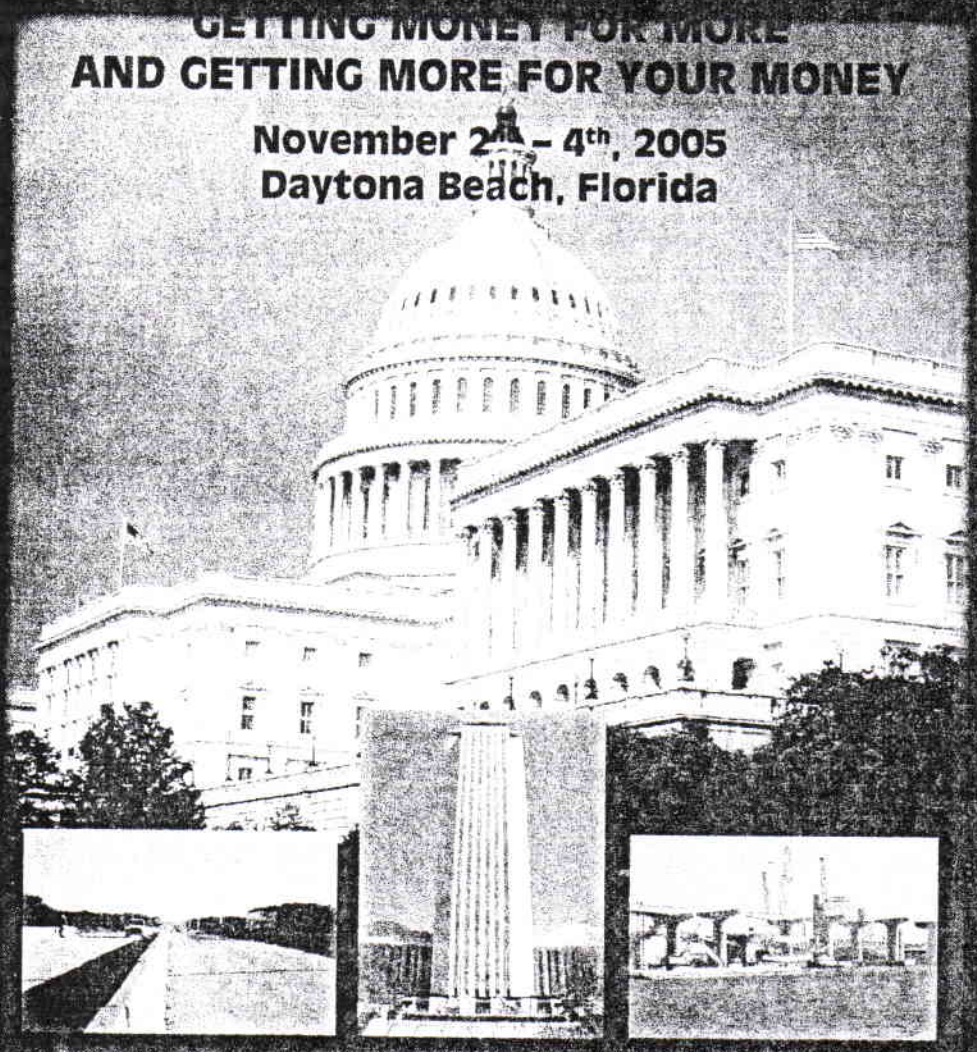

INSIDE

- PREDICTING FUTURE TRAVEL PATTERNS IN FLORIDA MPO AREAS
- TRADITIONAL DEVELOPMENT TRIP GENERATION CHARACTERISTICS
- FSITE STRATEGIC PLAN
- FSITE CHAPTER NEWS
- AND MORE

Traditional Development Trip Generation Characteristics

I. Introduction

Planned communities today are widely employing a New Urbanism approach in design. These concepts are hailed as one of the remedies to the rapid utilization of resources due to suburban sprawl. Traditional neighborhood developments incorporate a varied mixture of land uses usually within walking distance of one another. The proximity of these easily accessible facilities is intended to promote pedestrian, bicycle, and shorter internal auto trips. A large percentage of internal trips should be the result and lessen the impact of the community on the surrounding roadway network. Internal trips are defined as those that have both trip ends within the development project. Although they often utilize one or more segments of a public roadway, there is no net increase in traffic volume on the external roadway system outside the boundary of the project.

These benefits of internal capture and the level of trip reduction associated with traditional land use development, however, are supported by a minimal amount of documented research. Estimations for traffic characteristics such as trip generation and internal capture are sometimes challenged due to this lack of information. This report presents available information from the research conducted for traditional neighborhood developments and provides sources for greater inquiry.

II. Study Review

A. Celebration Monitoring & Modeling Study

Published in September 2003, the Celebration Monitoring & Modeling Study provides a quantified insight into an established traditional community. The report was mandated by the Third Amended and Restated Development Order of the Celebration Development of Regional Impact (DRI). The report contributes information on many aspects of the community. Relevant information includes the development program, traffic counts, trip generation, and internal capture percentages.

Celebration is located in Osceola County, Florida. Interstate 4 (I-4) and US 192 form the community's north and west borders, respectively. Other communities in the area include Lake Buena Vista at approximately 7 miles, and Kissimmee at approximately 10 miles away.

B. Traditional Neighborhood Development Trip Generation Study

Traditional Neighborhood Development Trip Generation Study was prepared by Dr. Asad J. Khattak, Dr. John R. Stone, William E. Letchworth, Ben K. Rasmussen and Bastian J. Schroeder in February 2005. The report was completed for the North Carolina Department of Transportation by the Department of City and Regional Planning of the University of North Carolina in Chapel Hill and the Department of Civil, Construction, and Environmental Engineering at North Carolina State. The report uses local traffic impact analysis methods to estimate trip generation rates. These estimated trip generation rates were compared with actual traffic counts produced by the existing developments.

The Traditional Neighborhood Development surveyed for this study is Southern Village, which is located within the city limits of the City of Chapel Hill. The other suburban development surveyed is located within the Northern Carrboro area. The developments are approximately 7 miles apart. The nearest commercial district is Franklin Street of Chapel Hill and the University of North Carolina and both developments are located equal distances away.

C. Haile Plantation Traffic Study

The Haile Plantation Traffic Study was prepared in November 15, 1996 by Buckholz Traffic. The study was completed to monitor the effect of changes to the Haile Plantation Master Plan and to document the actual project traffic characteristics. Both machine and manual intersection turning movement counts were conducted for the study. The manual counts were conducted at the intersection of SW 46th Boulevard and SW 75th Street, and SW 91st Street and Archer Road. The machine counts were taken at SW 46th Boulevard and SW 91st Street. These locations were determined sufficient to record all traffic movements from the traditional project elements.

Haile Plantation Village is located in Alachua County, FL. The development is approximately 7 miles from the commercial district of the City of Gainesville.

Continued on page 17

D. Internalizing Travel by Mixing Land Uses: A Study of Master-Planned Communities in South Florida

Internalizing Travel by Mixing Land Uses: A Study of Master-Planned Communities in South Florida, a study completed by Reid Ewing, Eric Dumbaugh, and Mike Brown, was presented at the 80th Transportation Research Board Conference in Washington D.C. The travel data originated form the Southeast Florida Travel 2000 Survey conducted by the Florida Department of Transportation. The land use data originated from metropolitan planning organizations and the Florida Department of Transportation. The information for Palm Beach and Broward counties was updated in 1999; the information for Dade County in 1996. Land use measures employed in the study were size, density, entropy, balance and accessibility.

Twenty different neighborhood developments from Palm Beach, Broward and Dade counties are included in this study. These communities were built over the last 40 years, and were both family and retirement oriented. The land uses included in each development included "housing, shopping, services, and recreational facilities."

E. Other Traditional Neighborhood Development Resources

Using the New Urban News' list of traditional neighborhood communities as a starting point, a list of additional nearly or recently completed developments was compiled. Local jurisdictions and development companies were contacted in reference to traffic studies for each of these projects but no usable information was available. These communities could provide opportunities for study in the future.

- Seaside, Walton County, FL. 350 Single Family (SF), 60 ksf commercial, charter school, chapel
- Kentlands, Gaithersburg, MD. 520 SF, 1539 Multi Family (MF), 1,000 ksf commercial & office, elementary school, convenience store/gas station/car wash
- Birkdale Village, Huntersville, NC. 230 SF, 360 MF, 234,921 sf Specialty Retail, 52,202 sf Office
- Daniel Island, Charleston, SC. 10,000 seat Tennis Stadium, 16 tennis courts, 5,100 seat Soccer Stadium, Private High School, K-8 Public, Preschool/Daycare
- I'ON, Mt. Pleasant, SC. 762 SF, 30,000 sf Commercial
- Harbor Town, Memphis, TN. 550 SF, 345 MF, 43 ksf commercial
- Middleton Hills, Middleton, WI. 327 SF, 87 MF, 150 ksf commercial

III. Traffic Generation & Internal Capture

A. Celebration, Osceola County, FL

The land use composition at the time of the Monitoring & Modeling (M&M) study is listed below. In keeping with the traditional community philosophy, the development program is quite diverse. Since Celebration development is still under way, this mixture of uses will change with time.

- Single Family 2,232 DU
- Retail 65,687 square feet
- Multi-Family 1,868 DU
- Hospital 100 beds
- Hotel 90 rooms
- Medical Office 204,940 square feet
- Office 922,857 square feet
- Golf Course 18 holes

Data was collected for the Celebration M&M during 72-hour machine cordon line counts. These counts revealed a significant difference from the internal trip values predicted by the ITE Trip Generation Handbook 6th Edition. This difference was evident in both the peak hour and daily trips and created significant internal capture percentages.

- Total Peak Hour Project Trips (actual counts): 3,458
- Total Peak Hour Project Trips (ITE, 6th Edition): 5,044
- Total Daily Project Trips (actual counts): 40,912
- Total Daily Project Trips (ITE, 6th Edition): 56,544
- Calculated Peak Hour Internal Capture: 31.8%
- Calculated Daily Internal Capture: 27.7%

B. Southern Village, Chapel Hill, NC

The study of Southern Village compares the development to a similar conventional neighborhood. Both development programs are depicted below and the multi-use housing is included for Southern Village.

Southern Village:

- Single Family 611 DU
- Church 27,000 square feet
- Multi-family 309 DU
- Retail 30,000 square feet
- School 90,000 square feet
- Office 95,000 square feet
- Day Care Center 6,000 square feet

Northern Carrboro:

- Single Family 891 DU

Continued on page 18

Traditional Development Trip Generation Characteristics, *continued from page 17*

Traffic counts for Southern Village single-family households recorded a value of 1,336 for the PM peak-hour and a value of 12,609 for the daily period. Using ITE trip generation methods, estimated trip generation values were calculated at 1,363 for the PM peak and 12,250 for the daily. The percent difference between actual and estimated is negligible. Thus, the findings confirm that the ITE trip generation methods were very reasonable for Southern Village.

The authors concluded that the residents of Southern Village did not make significantly fewer trips than residents of the conventional neighborhood. However, the trips by residents of Southern Village were shorter in time and distances, used different modes, and were less frequently external. For instance, each household in Southern Village was responsible for 7.7 auto trips per day. A single-family household in the conventional neighborhood created approximately 10 auto trips per day. The study also found that Southern Village residents traveled 28 fewer miles per day. In Southern Village, 78.4% of all trips were made by automobile. This compares favorably with an average of 89.9% for the Northern Carrboro suburbs, a 92.4% regional average, and a national average of 87%. The internal capture percentage for Southern Village was calculated to be 20.2 %. Southern Village residents also produced 25.8% fewer external trips and 30.3% fewer regional trips.

The intent of this study was to produce a comparison of traffic studies for traditional neighborhood development and conventional communities. The report suggests that no matter the type of residential use, tradition neighborhood developments produce different traffic behaviors than the conventional community and that those behaviors include fewer external and long distance trips.

C. Haile Village Plantation Center, Alachua County, FL

The development program for Haile Plantation is listed below. The community was not complete when the study was conducted, however, a variety of land uses were represented to a large extent.

- Single Family 1,070 DU
- Multi Family 2,460 DU
- Retail 175,000 square feet
- Office 175,000 square feet
- Church 18,000 square feet
- Church/School 12,000 square feet & 600 Students
- School Elementary/Middle 1,650 Students

The traffic study conducted in 1996 concluded that Haile Village Plantation Center is exhibiting an internal capture rate of 24% of the daily trips, and 28% during the PM peak hour. The ITE trip generation manual estimated that a traditional neighborhood project like Haile Plantation would have an internal capture rate of approximately 32% of daily trips and 36% of PM peak hour trips. Based upon the comparison of these two sets of internal capture percentages, it was determined that due to the existing mixture and density of development , the percentages of 24% for the daily and 28% of the PM peak hour were an appropriate expectation for the project at its current state of completion.

D. Southern Florida – Palm Beach, Broward, and Dade Counties

The 20 Traditional Neighborhood Developments for this study were chosen based upon the mix of land uses. Each development was required to have housing, shopping, services, and recreational facilities. All were constructed after 1965. The size of the developments, in population and acreage, ranged significantly. Each of the developments was analyzed according to its gross acreage, population, and employment.

Community	Gross Acreage	Population	Employment
Aventura	692	8,303	5,965
California Club	1,234	13,649	1,869
Century Village	934	12,781	534
Century Village North	716	10,246	331
The Crossings	662	6,036	965
The Hammocks	863	13,801	1,338
Jonathan's Landing	1,205	4,211	3,127
Kendale Lakes	985	12,207	2,588
Kings Point	845	12,523	771
Miami Lakes	2,541	12,918	17,862
Mission Bay	3,851	10,598	7,869
Pembroke Meadows	1,687	5,638	1,032
PGA National	2,421	9,178	2,324
Sabel Chase	325	4,984	1,120
Silver Lakes	3,210	11,329	1,593
The Township	715	4,267	556
Village of Palm Beach Lakes	1,475	8,215	1,818
Wellington	10,727	34,267	5,220
Weston	15,517	44,199	9,206
Winston Park	1,464	8,017	440

The focus of this paper was to evaluate and report internal capture rates from a multitude of traditional neighborhood developments. The land use measures considered in calculations were size, density, entropy, balance, and accessibility. The scale of the development was directly related to capture levels and regional accessibility was inversely related to internal capture rates.

The internal capture percentages for the twenty "traditional" neighborhood developments varied greatly. However, the authors highlighted the trend of the largest traditional neighborhood developments also employing the largest

internal capture percentages.

- Wellington, Palm Beach County 57 %
- Weston, Broward County 52 %
- Century Village Broward, Broward County 43 %
- The Township, Broward County 41 %
- Century Village North, Palm Beach County 40 %
- Village of Palm Beach Lakes, Palm Beach County 34 %
- Winston Park, Broward County 30 %
- The Hammocks, Dade County 28 %
- Silver Lakes, Broward County 27 %
- Miami Lakes, Dade County 25 %
- Mission Bay, Palm Beach County 18 %
- PGA National, Palm Beach County 17 %
- Aventura, Dade County 17 %
- Jonathan's Landing, Palm Beach County 13 %
- Sabel Chase, Dade County 13 %
- Kendale Lakes, Dade County 12 %
- Kings Point, Palm Beach County 10 %
- Pembroke Meadows, Broward County 9 %
- The Crossings, Dade County 6 %
- California Club, Dade County 0 %

The mean internal capture percentage was 25% and the median was 22%. The authors concluded that the traditional neighborhood developments most successful in obtaining increased internal capture were large in size and distant from similar regional trip attractions.

IV. Summary

Most of the studies reviewed in this report indicated support for more research into the effect of traditional neighborhood developments. The studies confirm that while traditional neighborhood developments lower trip distances and encourage other modes, the actual number of total trips produced does not decrease but the net number that reach the external roadway network are reduced by up to over 50% with an average of between 25% and 30%. Each of the studies supports the trend of increasing internal capture with increasing size and diversity of land uses. Many questions still remain regarding the effects on trip length and geographic effect on trip production, but the majority of researchers agree that the ITE trip generation estimates and the results produced using the methodologies are reasonably accurate for these communities.

In conclusion, the data available for use in the development of this paper supports the use of internal capture estimates produced using the ITE Trip Generation Handbook methodologies and that results ranging between 25% and 50% should not be questioned if the land use composition is favorable in size and diversity to supporting the estimated capture rate. Therefore, placing a cap on the level of internal capture that can be assumed for purposes of development planning, a common approach in some jurisdictions due to limited documented data, is not a practice that can be supported by this research.

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Case Study – From ITE Website

ITE Journal - Surface Transportation Security Lessons Learned from 9/11

The terrorist attacks of Sept. 11, 2001 exacted a terrible toll on the United States and fundamentally changed the way of life in America. Surface transportation has changed and continues to change in response to the attack. Agencies that own and operate surface transportation systems must understand the relevant lessons from the 9/11 experience and respond accordingly so that we as a nation are well prepared should we be attacked again. The U.S. Federal Highway Administration (FHWA) commissioned the John A. Volpe National Transportation Systems Center (Cambridge, MA, USA) and Science Applications International Corporation (SAIC) to prepare detailed case studies of surface transportation in the New York City (NYC) and Washington, DC metro areas on the day of and in the days and weeks following the attacks. Published material was reviewed, participants were interviewed and internal agency working documents were analyzed. Extensive chronologies of actions were prepared for each study and impacts of the actions were identified whenever possible. The final two case studies total more than 150 pages. A panel of participants in the actual events have reviewed and approved the studies. The following material summarizes the lessons learned, exploring what did and did not work. This article synthesizes the findings from both studies and presents lessons that can be made available to the transportation profession as a whole. http://www.ite.org/membersonly/itejournal/itejournal/pdf/2002/JB02IA38.pdf

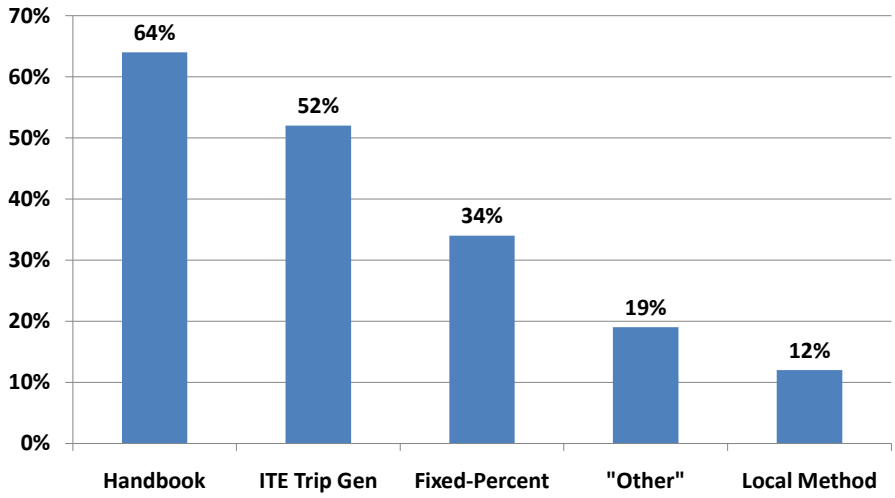
Comparing Methodologies to Estimate Internal Trip Capture at Mixed-Use Developments

Ben Sperry
Texas Transportation Institute
2010 ITE Annual Meeting - Session #32
August 11, 2010

Introduction

- Mixed-Use Developments (MXD)
  - Multiple Land Uses On-Site
  - Popular Development Style
  - Often Pedestrian or Transit-Oriented
- Estimating Trip Generation @ MXD
  - Important Step in Preparing TIA Reports
  - Complex at Mixed-Use Developments
  - Internal Travel Results in Fewer Off-Site Trips
  - Accurate Estimation Benefits All Parties

Survey of Methods in Practice



Source: ITE July 2004 *Multiuse Trip Generation and Internal Capture Rates Questionnaire*

Proposed New Estimation Method

- Issues with *Trip Generation Handbook* Method:
  - Developed from FDOT Studies in Early 90s
  - Limited to PM/Daily, Three Land Uses
- Proposed NCHRP 8-51 Method:
  - Includes Capture Data for AM Peak Period
  - Adds Capture Data for Three New Uses
  - Data From Newer MXD Sites
  - Adjustment for Proximity Between Land Uses

Research Problems

- Several Methods Available in Practice
- New NCHRP 8-51 Method Forthcoming
- Research Questions:
  1. Which method accurately replicates actual trips?
  2. Use of LUC 820 Combined or Separate
  3. More Detailed Method Better Than Fixed Percentage?
  4. NCHRP 8-51 Method Improve Over Current ITE Method?
  5. Effects of Land-Use Proximity at Site?
- Compare to Actual Counts at Five MXD Sites

Analysis Scenarios

Analysis Scenario	Case #	Description
Base Case: No Reduction	0a	Separate Retail/Restaurant
	0b	Combined Retail/Restaurant (LUC 820)
Case 1: Fixed-Percent Reduction	1	10 Percent Based on "Optimal" Base Case
Case 2: *Trip Generation Handbook* Method	2a	Combined Estimate; Assume Retail Capture
	2b	Separate Estimate; Retail Capture Only
	2c	Separate Estimate; Capture on Aggregate Estimate
Case 3: Proposed NCHRP 8-51 Method	3a	No Adjustment for Land Use Proximity
	3b	Adjustment for Land Use Proximity

Study MXD Sites

Site	Location	Site Size[1]	PM Peak Hour Traffic[2]	Count Date
Site 1	Atlanta, Georgia USA	140	2,026	July 2006
Site 2	Plano, Texas USA	75	1,819	May 2007
Site 3	Dallas, Texas USA	9	728	May 2006
Site 4	Chapel Hill, NC USA	310	1,336	March 2003
Site 5	Southlake, Texas USA	125	2,843	May 2008

[1]Acres

[2]Bi-Directional Peak Hour Total Vehicle Trips (Entering plus Exiting)

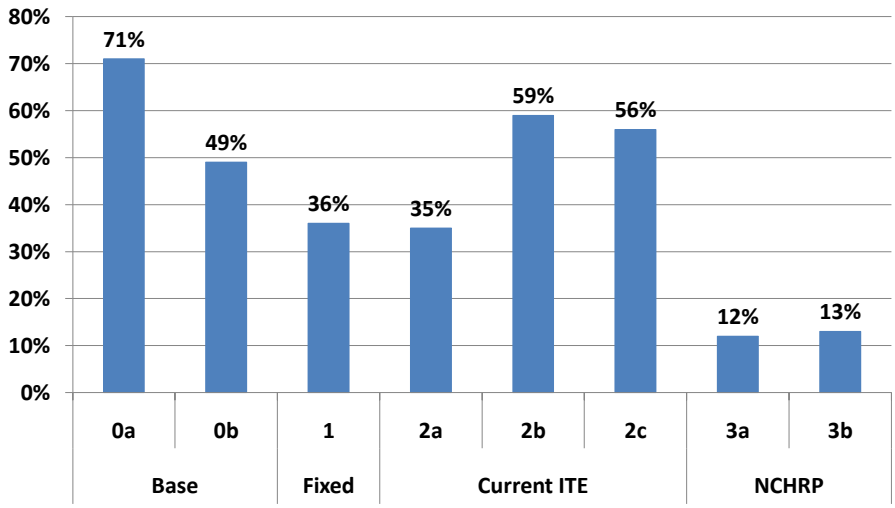
Methodology Details

- ITE *Trip Generation* 8th Edition
- PM Peak Period Only
- Adjustment for Transit, Vehicle Occupancy
- Land Uses Considered in Analysis:
  - Office
  - Retail
  - Restaurant
  - Residential
  - Cinema
  - Hotel

Analysis Results: Percent Error

Method	Case	Site 1	Site 2	Site 3	Site 4	Site 5
Observed Traffic	-	2,026	1,819	728	1,336	2,843
Base	0a	96%	84%	124%	17%	35%
	0b	66%	54%	100%	17%	6%
Fixed-Percent	1	50%	39%	80%	5%	-5%
Current ITE	2a	44%	36%	80%	13%	**2%**
	2b	75%	69%	105%	14%	31%
	2c	72%	59%	104%	13%	30%
NCHRP 8-51	3a	**10%**	-3%	**29%**	-5%	-14%
	3b	16%	**1%**	30%	**-4%**	-14%

Analysis Results: Average Absolute Error



Summary

- Base Case: Overestimated Traffic
- Current ITE Method Overestimated Traffic
- No Method Consistently Underestimated
- Most Accurate Method: NCHRP 8-51 Method
  - Average Absolute Error: 12 Percent
  - Error One-Fifth to One-Third of Other Methods
  - Proximity Adjustment Inconsequential

Conclusions

- Recommend Use of NCHRP 8-51 Method
- More Counts/Data Needed for Comparison

8

RESEARCH AND RECOMMENDATIONS ON INTERNAL TRIP CAPTURE RATES FOR OLOWALU NEW TOWN

PREPARED BY

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November 7, 2014

BACKGROUND
“A LITTLE HISTORY”

THE IMPACT OF THE 1956 HIGHWAY ACT ON URBAN DEVELOPMENT

URBAN DEVELODPMENT PATTERNS – 2000

THE RISE OF “MIXED USE DEVELOPMENT”

THE IMPACT ON TRANSPORTATION PLANNING

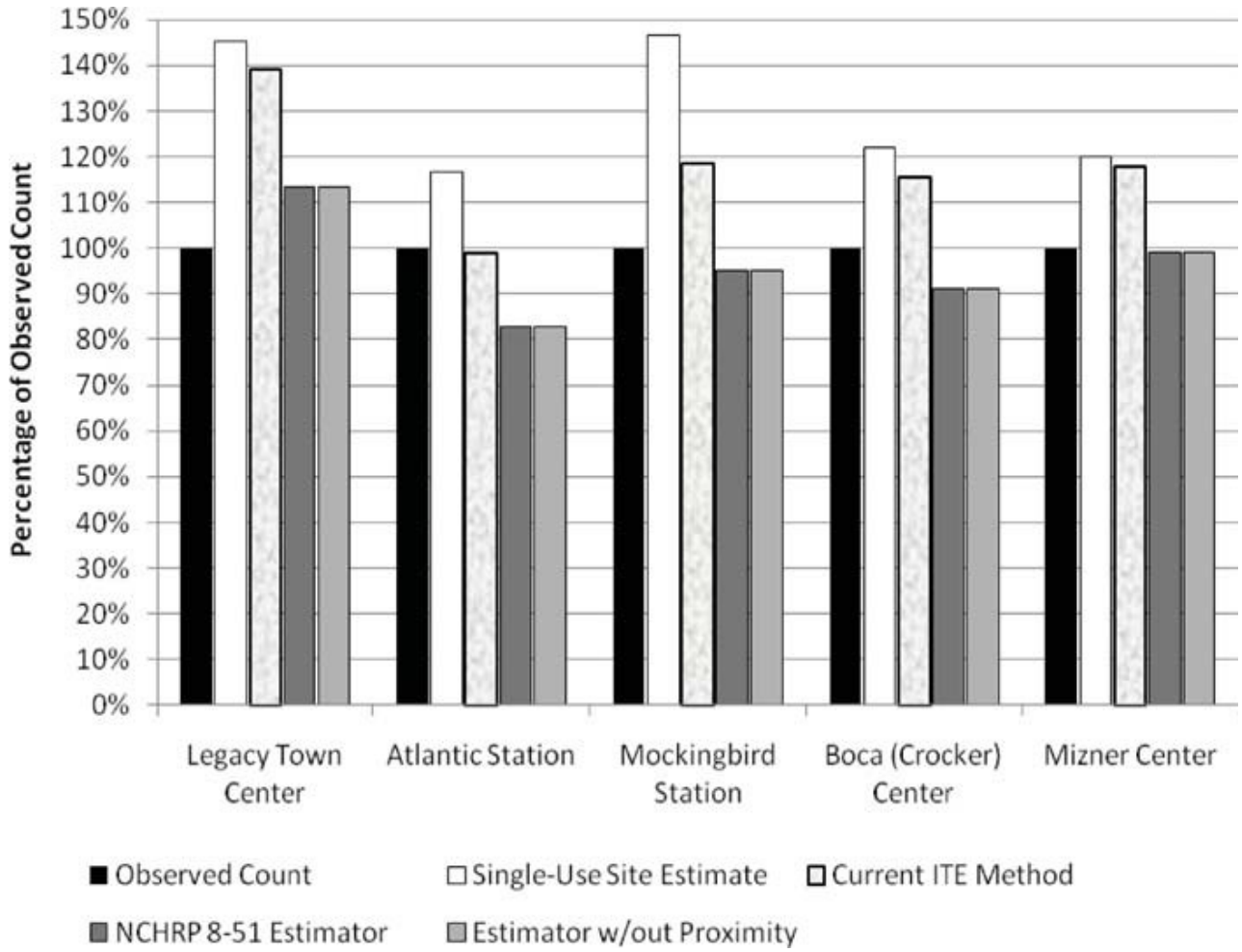
PRESENTATION CONTENT

1. BACKGROUND – A Little History
2. REVIEW OF RELEVANT RESEARCH REFERENCES
3. REVIEW OF RELEVANT RESEARCH METHODS
4. COMPARISON OF ESTIMATE METHODOLOGY
6. COMMENTS ON ESTIMATE METHODOLOGY
7. RESEARCH RESULTS – MAUI L.R. TRANS. PLAN
8. RESEARCH RESULTS – PRODUCTIONS AND ATTRACTIONS
9. COMPARISON OF RESULTS
10. TIAR – Table 1: Internal Capture of Generated Trips
11. TIAR – Table 2: Bypass and External Diverted Trips
12. CONCLUSIONS AND RECOMMENDATIONS

A REVIEW OF RELEVANT RESEARCH

- Relevant Research Sources
  - ITE Trip Generation Handbook – 2014 Edition
  - NCHRP Report 684 Mixed Use Traffic Estimation
  - Productions and Attractions Analysis
  - Preliminary Traffic Impact Analysis Report (TIAR)
  - Florida DOT Internal Capture Rates
  - Florida DOT Policy on Mixed Use,
  - FLITE Newsletter Mixed Use Articles, and
  - the Maui Long Range Transportation Plan.

COMPARISON OF TRAFFIC ESTIMATE METHODS



Source: NCHRP Report 684 Enhancing Internal Trip Capture Estimation for Mixed Use Developments

COMMENTS ON ESTIMATE METHODS

- The Black Bars Represent Actual Ground Counts.
- The White Bars represent a simplified "single site use method".
- The Light Gray Bars represent the Current ITE Method (productions/attractions approach) and range **between 0-10% high.**
- The NCHRP Estimator and the Estimator w/o Proximity is generally **5-10% low.**
- Conclusion: The Consultants believe the Current ITE Method best represents the " most likely" real conditions.

RESEARCH RESULTS

Maui Regional Transportation Plan (trip ends)

- Productions 23,598 trip ends
- Attractions 14,787 trip ends
- Productions minus Attractions = 8,810 trip ends
- External trips 37.3%
- Internal Capture 62.7%

ITE Productions and Attractions Analysis

- Productions 5,762 trips
- Attractions 8,230 trips
- Total Trips 13,992
- External trips = 8230 - 5762 = 2468
- External Trip % = 2468 / 13,992
- External trips = 17.6%
- Internal Capture = 82.4%

COMPARISON OF RESULTS

Traffic Analysis	Trip Product.	Trip Attract	Total Trips	Percent Internal	Percent External
Maui Regional Transportation Plan	23,598 (trip ends)	7,394 (trip ends)	19,193	62.7%	37.3%
ITE Trip Generation	5,762	8,230	13,992	58.8%	41.2%
ITE Product./ Attractions Analysis	5,762	8,230	13,992	82.4%	17.6%
TIAR Traffic Analysis			16,400	61.0%	39.0%

TIAR - Table 1: Assumed Internal Capture Rates by Land Use Type

ITE Land Use Code	Land Use Description	Percentage of Trips Internal to Olowalu Town	Percentage of Trips External to Olowalu Town
730	Government Office Building	85%	15%
110	General Light Industrial	30%	70%
590	Library	90%	10%
520	Elementary School	90%	10%
415/417	Regional Park with Beach	50%	50%
310	Hotel	10%	90%
732	United States Post Office	95%	5%
230	Condominium/Townhouse	45%	55%
944	Gasoline/Service Station	95%	5%
220	Apartments	45%	55%
210	Single-Family Detached Housing	45%	55%
820	Commercial Retail	75%	25%
710	General Office	30%	70%

TIAR - Table 2: Pass by and Diverted External Trips on Honoapi'ilani Highway

ITE Land Use Code	Land Use Description	Percentage of Trips to/from Olowalu Town Already On Honoapi'ilani Hwy	Percentage of Trips to/from Olowalu Town Not Already On Honoapi'ilani Hwy
730	Government Office Building	50%	50%
110	General Light Industrial	20%	80%
590	Library	20%	80%
520	Elementary School	80%	20%
415/417	Regional Park with Beach	20%	80%
310	Boutique Hotel	20%	80%
732	United States Post Office	80%	20%
230	Condominium/Townhouse	20%	80%
944	Gasoline/Service Station	90%	10%
220	Apartments	20%	80%
210	Single-Family Detached Housing	20%	80%
820	Commercial Retail	80%	20%
710	General Office	20%	80%

CONCLUSIONS AND RECOMMENDATIONS

- RESEARCH HAS FOUND THAT MIXED USE DEVELOPMENT IS A WELL ESTABLISHED LAND USE PATTERN IN MANY U. S. URBAN AREAS.
- MANY DEPARTMENTS OF TRANSPORTATION RECOGNIZE THE REDUCTION OF EXTERNAL TRAFFIC WITH MIXED USE DEVELOPMENT
- IN FACT, MIXED USE DEVELOPMENT IS THE PREFERRED DEVELOPMENT TYPE IN MANY URBAN AREAS
- THE OLOWALU NEW TOWN LAND USE RECOMMENDATIONS FIT WELL INTO THE PATTERN OF REDUCED EXTERNAL TRIP GENERATION
- IT IS RECOMMENDED THAT THE HAWAII DOT RECOGNIZE THE INTERNAL CAPTURE RATES AND THE RESULTING REDUCED EXTERNAL TRAFFIC ON THE ROADWAY NETWORK

9

TECHBRIEF

This techbrief is an archived publication and may contain dated technical, contact, and link information

Publication Number: FHWA-HRT-07-033

Synthesis of the Median U-Turn Intersection Treatment

FHWA Contact: Joe Bared, HRDS-05, (202) 493-3314, or
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PDF Version (919 KB)

PDF files can be viewed with the Acrobat® Reader®

Objective

In the United States, congestion at intersections throughout urban and suburban areas continues to worsen. Crashes reported at intersections have continued to increase. One potential treatment to combat congestion and safety problems at intersections is the Median U-Turn Intersection Treatment (MUTIT), which has been used extensively in Michigan for many years and has been implemented successfully in Florida, Maryland, New Jersey, and Louisiana in recent years (Figure 1).

Figure 1. Example of MUTIT on Michigan corridors (Source: AAA, Michigan).

The treatment involves the elimination of direct left turns at signal-controlled intersections from major and/or minor approaches. Drivers desiring to turn left from the major road onto an intersecting cross street must first travel through the at-grade, signal-controlled intersection and then execute a U turn at the median opening downstream of the intersection. These drivers then can turn right at the crossstreet. For drivers on the sidestreet desiring to turn left onto the major road, they must first turn right at the signal-controlled intersection and then execute a U turn at the downstream median opening and proceed back through the signalized intersection. The MUTIT can be implemented with and without signal control at the median openings on the major road.

This synthesis summarizes the advantages and disadvantages of the MUTIT compared to conventional, at-grade signal-controlled

intersections with left turns permitted from all approaches. The synthesis presents design guidelines including the location and design of the median crossovers on the major roads. Many of the guidelines presented in the synthesis are from the Michigan Department of Transportation (MDOT), and address directional and bidirectional crossovers and widened areas called "loons" that facilitate the U-turn maneuver by larger vehicles and at roads with narrow medians. The synthesis also discusses application criteria for the MUTIT, and presents information on the capacity and crash experience at these intersections relative to traditional intersections. Special considerations related to signal phasing at the median openings and signal phasing at the at-grade intersection also are discussed. Empirical evidence supports the practice that the reduction in signal phases at intersections can have higher vehicle-processing capacity and better level-of-service. In terms of safety, past research has shown that the reported numbers of crashes at MUTITs are 20 to 50 percent lower than comparable conventional intersections. The major safety benefit is a reduction in the probability of head-on and angle crashes that typically have high percentages of injury severity. Although the MUTIT typically is considered a corridor-wide treatment, the concept has been used successfully at isolated intersections to improve traffic flow and enhance safety.

Introduction

The MUTIT eliminates left turns at intersections and allows the maneuver to be made via median crossovers beyond the intersection. Drivers desiring to turn left at the subject intersection from the major road first must travel through the intersection, execute a U turn at the median crossover, and then make a right turn at the crossroad. Drivers on the minor road desiring to make a left at the subject intersection first make a right turn at the intersection onto the major road, and then make a U turn at the median crossover, and subsequently go straight through the intersection. Figure 1 shows an illustrative photograph of the MUTIT implementation in Michigan, and figure 2 shows the schematic for a typical MUTIT. The MUTIT is typically a corridor treatment. However, the concept is used at isolated intersections to alleviate specific traffic operational and safety problems. Levinson et al. (1) recommended that the application of MUTIT along the corridor should not be mixed with other indirect left-turn treatments or conventional left-turn treatments, thereby meeting driver expectancy. Figure 3 shows the MUTIT movements corresponding to left turns at conventional at-grade intersections.

The MUTIT has been used widely in the State of Michigan. Several highways in Michigan, particularly in the Detroit Metropolitan area, were constructed with wide medians on wide rights-of-way. Many of these medians are 18.3 to 30.5 meters (m) (60 to 100 feet (ft)) wide and were built decades ago in semirural areas to separate opposing directions of traffic and to provide an adequate median width for landscaping and beautification. The wide rights-of-way were originally established for "super highways," as they were called in the 1920s. By the early 1960s, many of these highways had capacity problems, generally because of interlocking left turns at the conventional intersections. To address this capacity problem, MUTITs replaced conventional intersections on various corridors. Today, there are more than 684 kilometers (km) (425 miles (mi)) of "boulevards" with over 700 directional crossovers on the Michigan State highway system. Partial implementations or designs with similar concepts have appeared in Florida, Maryland, New Mexico, and New Orleans. Hummer and Reid (2) and Levinson et al. (1) compared the MUTITs to conventional intersections. Hummer and Reid recommended that agencies consider the median U-turn alternative for junctions on high design arterials where relatively high through volumes conflict with moderate or low left-turn volumes, regardless of the cross-street through volumes.

Some of the advantages cited include:

- Reduced delay and better progression for through traffic on the major arterial.
- Increased capacity at the main intersection.
- Fewer stops for through traffic, especially where there are STOP-controlled directional crossovers.
- Reduced risk to crossing pedestrians.
- Fewer and more separated conflict points.
- Two-phase signal control allows shorter cycle lengths, thereby permitting more flexibility in traffic signal progression.

Figure 2. Typical schematics of MUTIT.

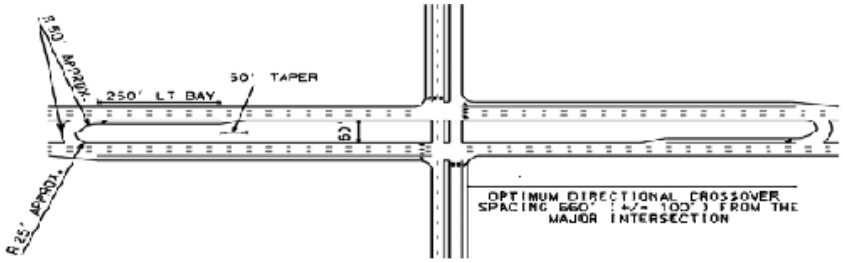
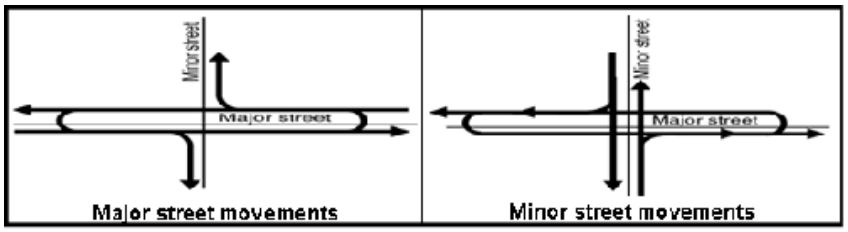


Figure 3. Vehicular movements at a MUTIT
(Source: Signalized Intersections Information Guide, FHWA-HRT-04-091, pg. 243).



Some disadvantages include:

- Possible driver confusion and disregard of left-turn prohibition at the main intersection.
- Possible increased delay, travel distances, and stops for left-turning traffic.
- Larger rights-of-way required for the arterial, although this potentially could be mitigated by the provision of loons (discussed later in this document) on roads with narrow medians.
- Higher operation and maintenance costs attributable to additional traffic signal control equipment if the directional crossovers are signalized.
- Longer minimum green times for cross-street phases or two-cycle pedestrian crossing.

MUTIT Design Guidelines

The 2004 AASHTO Green Book (3) recommends a distance of 122 to 183 m (400 to 600 ft) for the minimum spacing between the median crossover and the MUTIT intersection. The Michigan Department of Transportation (MDOT) recommends a distance of 201 m (660 ft) (+/- 30.5 m (100 ft)) for the median crossover from the MUTIT intersection. The distances recommended by the MDOT were established to accommodate drivers desiring to turn left from the crossroad. The longer distance facilitates the completion of the U-turn maneuver at the median crossover and subsequent right turn maneuver at the intersection of the major road and cross street for a 72 km/hour (h) (45 mi/h) posted speed limit on the major road. The selection of the spacing from the median crossover to the intersection is also a tradeoff between preventing spillback from the main intersection and the adverse impacts of additional travel for the left-turning vehicles. The Access Management Manual recommends an access spacing of 201 m (660 ft) on minor arterials and 402.3 m (1320 ft) on principal arterials between consecutive directional median openings on divided highways. Figures 4a, 4b, and 4c below show typical U-turn maneuvers. Table 1 gives the minimum median widths required for U turns from the major road as suggested by the MDOT.

Figure 4a. Left lane to inner lane maneuver.

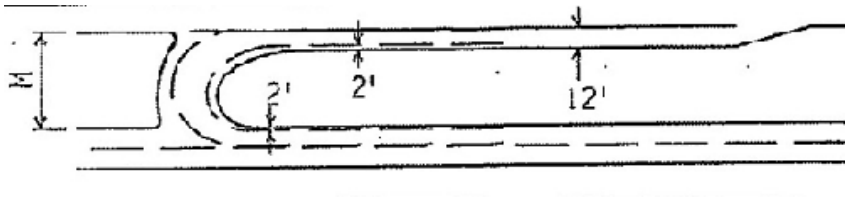


Figure 4b. Left lane to second lane maneuver.

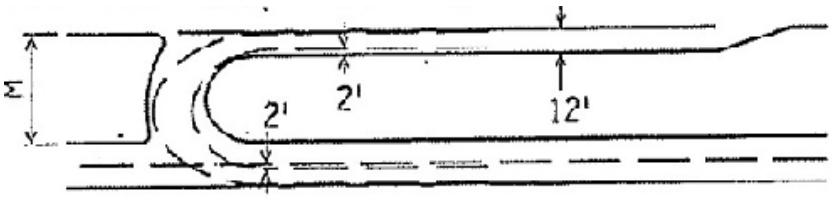


Figure 4c. Left lane to third lane maneuver.

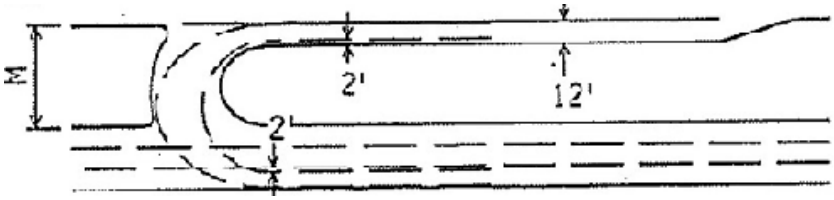


Table 1. Minimum median widths M for U-turn maneuvers suggested by MDOT.

Type of Maneuver	P	SU	BUS	WB-50	WB-60
	Length of Design Vehicle, m (ft)				
	5.8 (19)	9.1 (30)	12.2 (40)	16.8 (55)	21.3 (70)
Left Lane to Inner Lane	13.4 (44)	23.2 (76)	24.4 (80)	25 (82)	25 (82)
Left Lane to 2nd Lane	9.8 (32)	19.5 (64)	20.7 (68)	21.3 (70)	21.3 (70)
Left Lane to 3rd Lane	6.7 (22)	16.5 (54)	17.7 (58)	18.3 (60)	18.3 (60)

Where:
P = passenger car
SU = Single-unit truck
WB-50 = Semitruc medium size
WB-60 = Semitruck large size

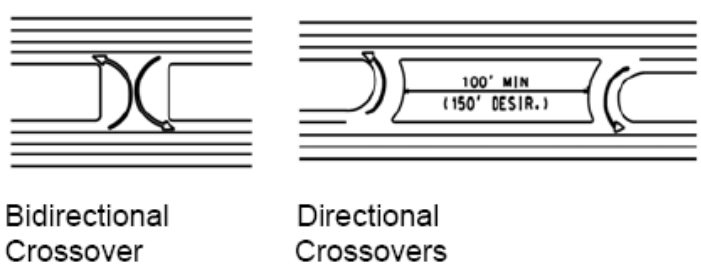
Location and Design of Median Crossovers

Figure 5 shows the two types of median crossovers, the "bidirectional" and the "directional." A bidirectional crossover is simply an opening in the median for vehicles to make U turns from either direction. Cars may enter from either direction. Bidirectional crossovers are sometimes installed without any deceleration or storage lanes. Most bidirectional median crossovers without deceleration/storage lanes can only store one or two vehicles. With high turning volumes, an interlocking effect is sometimes created. The vehicles queued to enter the crossover cannot do so until the vehicles in the crossover move out of the opening and merge into the travel lanes. A directional crossover is a one-way crossover with a deceleration/storage lane. This type of median crossover allows vehicles traveling in one direction of the boulevard to enter. As a result, motorists at a properly designed directional crossover should never experience the interlocking effect found at medians with a bidirectional crossover.

Taylor et al. (4) studied the effects of replacing existing bidirectional crossovers with directional crossovers on eight roadway sections in Michigan between 1991 and 1997. The study investigated crash frequency on roadway segments for two datasets. The study did not adjust for regression to the mean using control sites. One dataset included all the intersection crashes in the study segment, and the other dataset excluded intersection crashes from the study segment. The important findings of this study were:

- In total crash frequencies, 4 percent to 60 percent reductions were observed for the eight sections examined. The average reduction in total crash frequencies was 31 percent.
- In injury crash frequencies, 3 percent to 71 percent reductions were observed for the eight sections examined. The average reduction in injury crash frequencies was 32 percent.
- The crash types that experienced the largest decreases in crash frequency were rear-end and angle crashes. This effect was attributed to the lack of storage space and restricted visibility associated with bidirectional crossovers. There was an average 37 percent reduction in rear-end crashes when the bidirectional median crossovers were converted to directional median crossovers.
- Replacing bidirectional median crossovers at four-legged intersections and three-legged intersections produced reductions in total crash frequencies of 58 percent and 34 percent, respectively.

Figure 5. Directional and bidirectional crossovers.



Scheuer and Kunde (5) studied the effects of replacing existing bidirectional crossovers with directional crossovers on two segments of Grand River Avenue in Wayne County, MI, totaling 6.78 km (4.21 mi). The study segment was an eight-lane boulevard in a commercialized area with many driveways and minor crossroads. Three years of "before" crash data and approximately 2 years of "after" crash data were used in the analysis. The project achieved a total crash reduction of 24 percent. When the intersections where the crossovers were in-line with a crossroad are omitted, the crash reduction was 29 percent. Head-on and angle crashes showed the greatest reduction. The sideswipe crashes did increase, but the decrease in the heads-on and angle crashes far outweighed the increase of sideswipe crashes.

Castronovo et al. (6) studied the safety performance of divided highways with directional median crossovers versus bidirectional median crossovers. The key findings were:

- Divided highways with exclusive directional median crossovers have approximately the same crash rates as divided highways with exclusive bidirectional median crossovers for those sections without traffic signals.
- As the traffic signal density increases, divided highways with exclusive directional crossovers had 50 percent lower crash rates than crashes rates for divided highways with exclusive bidirectional median crossovers.

Figure 6a. Cured section of directional crossover (Source: MDOT Geometric Design Guide 670).

CREST OF MOUND, FOR DRAINAGE AND AETHETICS, SHOULD SHOULD NOT EXCEED 1' ABOVE TOP OF CURB. IF NOT PAVED, VEGETATION MUST NOT OBSTRUCT DRIVER SIGHT DISTANCE (TYP.)

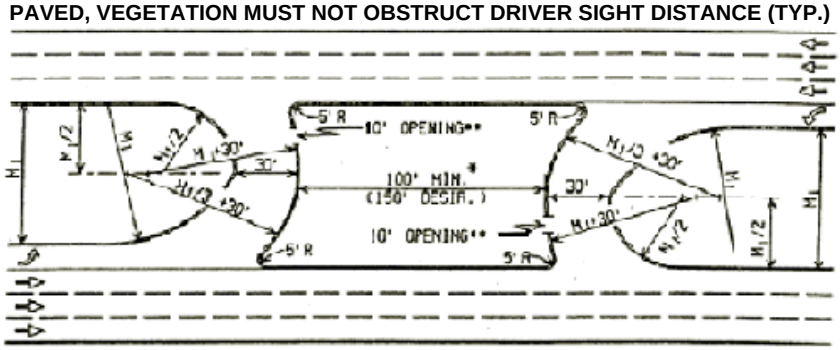
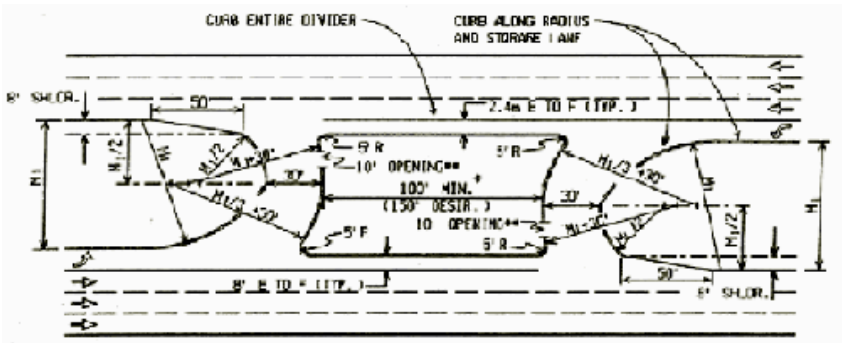


Figure 6b. Uncured section of directional median crossovers (Source: MDOT Geometric Design Guide 670).



Based on the studies cited, directional median crossovers likely provide better traffic operations and safety performance than bidirectional median crossovers. Figures 6a and 6b illustrate MDOT guidelines for designing directional median crossovers.

Location and Design of Loons

The design vehicle and the number of opposing lanes directly govern the required median width at the MUTIT median crossover junction. If the available median width is not sufficient, then agencies add additional pavement outside the travel lane to allow the design vehicle to complete the U-turn maneuver and merge back into the traffic stream. The additional pavements are typically referred to as "loons." Sisiopiku and Aylsworth-Bonzelet (7) defined loons as expanded paved aprons opposite a median crossover. Figure 7 shows a schematic diagram of a loon design, and figure 8 is a photo of an actual loon implementation in Wilmington, NC. The design width for loons will be the difference between the recommended median width in table 1 and the available median width.

Sisiopiku and Aylsworth-Bonzelet (7) evaluated the design and operation of loons and developed guidelines for loon design and placement. The important findings of the study were:

- Consistent placement of advance warning signs preceding the indirect median crossover and associated loon assisted driver expectancy when using MUTITs.
- Proper design of U turns for the appropriate design vehicle was essential to ensure safe traffic operation at the loons.
- At signalized median crossovers, the clearance intervals should account for the extra travel time required for drivers to travel through the loon.
- Suboptimal gap acceptance for U-turn maneuvers and driver confusion were two issues for loons either tapered into downstream right-turn lanes or for situations where right-turn lanes were located within approximately 45.7 m (150 ft) downstream of the loon. However, the placement of a loon and consecutive right-turn lane was recommended for major roads with MUTITs and high U-turning volumes at the median crossover
- Minimal differences were found between the travel times for commercial and passenger vehicles at MUTIT sites with signalized median crossovers. At unsignalized median crossovers, commercial vehicles were forced to wait for larger gaps in the conflicting traffic stream to complete their U-turn maneuvers.
- Several crashes involved commercial vehicles parked or backing within the median crossovers. Inadequate storage in the left lane preceding the median crossover due to the parked commercial vehicles caused spillback into through lanes. Commercial vehicles parked in the loon presented challenges for larger commercial vehicles executing U turns.

- A majority of the crashes at the loons were fixed-object crashes or sideswipe crashes. The objects most commonly hit were delineator posts, signposts (in the median and along the mainline), and spot locations of guardrail. A majority of the sideswipe crashes involved vehicles merging into traffic from the loon, or mainline traffic attempting to use the right turn lane.
- The study recommended a minimum 1.82-m (6-ft) auxiliary shoulder, with a 0.91-m (3-ft) paved area to provide the additional width necessary to ensure that the required pavement width will not be destroyed by U-turning vehicles that require the entire width of the loon. The study also recommended placement of short curves at both ends of the tapered section of the loon to assist the driver through the loon and U-turn maneuver.

Overall, loons are good design practice for facilities with narrow medians. With the use of loons, agencies can realize safety and operational benefits of a divided roadway (boulevard) with MUTITs, without incurring the significant cost of acquiring enough land along the entire corridor to provide sufficient median width.

Alternative Intersection Design

Michigan corridors with MUTIT typically have medians widths ranging from 18.3 to 30.5 m (60 to 100 ft). A wide median on the major road at the intersection of the major road and the cross street increases the pedestrian crossing distance along the sidestreet. Larger clearance intervals are required for the sidestreet signal phase with an increased possibility of vehicles and pedestrians getting "stranded" in the median space. Therefore, narrower medians with sufficient pedestrian refuge areas may be more efficient for the pedestrians and sidestreet traffic at the intersection of the major road and cross street. Figure 9 shows a possible reduction in median width at the intersection for a roadway with a median width of 18.3 m (60 ft) and a posted speed limit of 80.5 mi/h (50 mi/h). The reduction in median width was achieved by using reverse curves of sufficiently large radii on normal crowned sections of the roadway.

Capacity of Nonsignalized U-Turn Lanes

The Highway Capacity Manual 2000 (HCM) treats U turns as left turns for estimating saturation flow rate. However, the operational effects of U turns and left turns are different. U-turning vehicles have slower turning speeds than left-turning vehicles. Al-Masaeid (8) studied the capacity of U turns at unsignalized intersections as a function of the conflicting traffic flow on two opposing through lanes for median-divided roadways in Jordan . Figure 10 shows the field data collection results. He developed regression equations to predict the U-turn capacity based on the conflicting flows on two opposing through lanes.

$C = 799 - 0.31 * q_c$

$C = 1{,}545 - 790 * \text{exponential}\ (q_c/3{,}600)$

$C = 799 - 0.62 * q_{cp}$

Where:

C = capacity of U-turn movement in passenger car equivalent units per hour (PCU/hr).

q_c = conflicting traffic flow on two lanes (PCU/hr).

q_{cp} = conflicting traffic flow per lane (PCU/hr).

Yang et al. (9) studied the gap acceptance of U-turn maneuvers at median opening for 10 sites in Tampa, FL, and concluded that the critical gap ranged from 5.8 seconds to 7.4 seconds. Carter et al. (10) collected data at 14 signalized intersections with U turns in North Carolina. Based on a large database, they recommend a saturation flow adjustment factor of 0.82 for U-turn lanes at signalized intersections without conflicting right-turn overlap phase on the side street. Tsao and Ando (11) and Liu et al. (12) suggested saturation flow rate reduction factors of 0.8 and 0.76 for U-turn lanes at signalized intersections, respectively.

Provision of a Signal Phase to Serve U turns

The HCM suggests implementing a protected left-turn phase when the cross product of the hourly left-turning volumes and the corresponding hourly opposing through volumes exceeds the threshold value based on the number of opposing through lanes. Cross product thresholds of 50,000, 90,000, and 110,000 are applicable for one, two, and three lanes of opposing through traffic, respectively. The Traffic Control Devices (TCD) Handbook suggests the following criteria for where and when a left-turn phase should be provided:

1. Volume

a. Number for left turns multiplied by the opposing conflicting volumes in the peak hour exceeds 100,000 on a four-lane street or exceeds 50,000 on a two-lane street.
b. Left-turn peak-hour volume of more than 90 vehicles per hour, or 50 vehicles per hour on streets with through traffic at speeds over 72 km/h (45 mi/h).
c. At pretimed signal-controlled intersections, more than two vehicles per cycle per approach at the end of green during peak

hour.

2. Delay

Left-turn delay of more than 2.0 vehicle hours in the peak hour on a critical approach, provided there are at least two left turns per cycle during peak hour and the average delay per left-turning vehicle exceeds 35 seconds.

3. Crashes—number of left-turn crashes

a. One approach—4 crashes in 1 year or 6 crashes in 2 years.
b. Both approaches—6 crashes in 1 year or 10 crashes in 2 years.

The criteria above apply when determining whether a separate left-turn phase is needed at a signal-controlled intersection. The criteria can be applied equally, or in a more conservative way, applied to determine when signal control is needed at median crossovers to accommodate U turns. Signalized median crossovers can provide higher U-turn capacities compared to unsignalized median crossovers when the green time for the signalized median U-turn phase is adequate to satisfy the traffic demand. In addition, it is relatively easy to coordinate the signal at a median crossover with the signal at the main intersection without adding much extra delay to the high-volume mainline traffic.

Figure 7. Schematic of a loon implementation for a Michigan MUTIT.

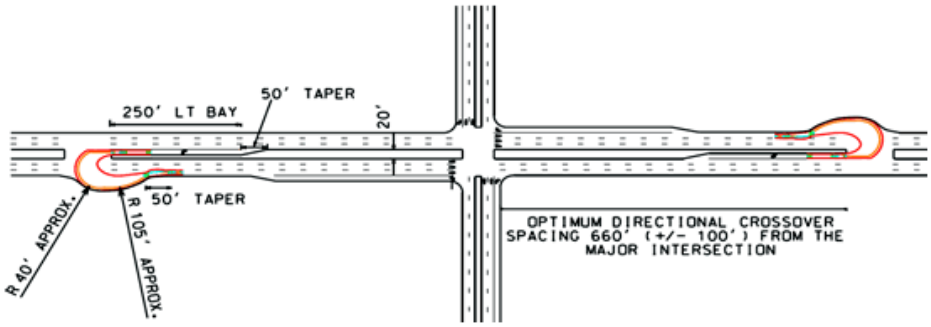
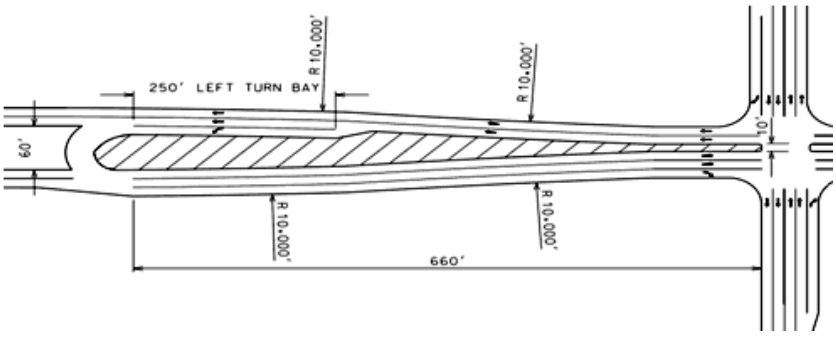


Figure 8. Example of loon implementation for a Michigan MUTIT.

Figure 9. Example of a transition from a wide median section to a narrow median section on MUTIT corridors.



Signal Phasing

The signal control at the intersection of the major road and minor crossroad operates with two signal phases because all left turns are prohibited at this junction. Figures 11a and 11b show the typical signal phasing diagram for the 2-phase signal. In some cases, the green signal indication at the median crossover junction for phase 2 can be delayed slightly relative to the green signal indication for the through/right-turning vehicles on the crossroad. This facilitates uninterrupted movement for the left-turning vehicles from the crossroad. If the median crossover is unsignalized, the signal phasing would only apply at the major road/minor road junction. Typical signal cycle lengths for the MUTIT range from 60 to 120 seconds. If the left-turn volumes are heavy, shorter cycle lengths will reduce spillback into the intersection. The pedestrians move in the direction of traffic with signalized pedestrian phases. Signalized

pedestrian phases across the major road with wide medians might reduce the operational efficiency of the MUTIT when cross-street traffic is minimal but pedestrian presence is significant during the peak hour periods.

Signing Plan

Figure 12 shows the typical signing plan for MUTIT in Michigan. Figures 13a to 13e show several examples of "innovative" signing treatments for MUTITs executed in Michigan. Sisoupiku and Aylsworth-Bonzelet (7) observed several motorists violating the turn prohibition and executing direct left-turns from the crossroad at rural sites. At intersections where violations were observed, there existed standard indirect left-turn signs and overhead signing prohibiting left-turns. Positive guidance communicated through additional signs may be beneficial in reducing driver confusion and ensuring higher rates of driver compliance.

Figure 10. Scatter plot of U-turn capacity versus conflicting traffic flow for unsignalized median openings.
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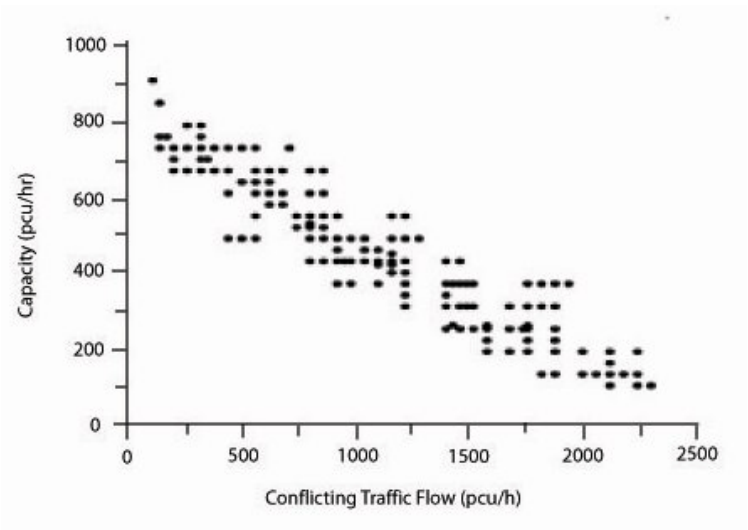


Traffic Operational Performance

Reid and Hummer (13) compared traffic operations along a typical arterial highway with MUTITs versus conventional designs with two-way left-turn lanes (TWLTL). The analysis corridor was a 4.02-km (2.5-mi) section of the Northwestern Highway Corridor in Detroit, MI. The section consisted of five major signalized intersections with varied spacing from 0.5 to 1.1 km (1,600 to 3,500 ft) and annual average daily traffic (AADT) ranging from 52,000 to 60,000 vehicles per day. Researchers used CORSIM to simulate traffic performance and used SYNCHRO to develop optimized signal timings. Four time periods were considered in the analysis, including peak periods in the morning, noon, midday (2:00 p.m. to 3:00 p.m.), and evening. Average measures of effectiveness (MOEs) were developed for a total of 48 CORSIM runs. The MUTIT showed a 17 percent decrease in total travel time within the study area network compared to TWLTL.

Figure 11. Example of typical signal phasing for the MUTIT.

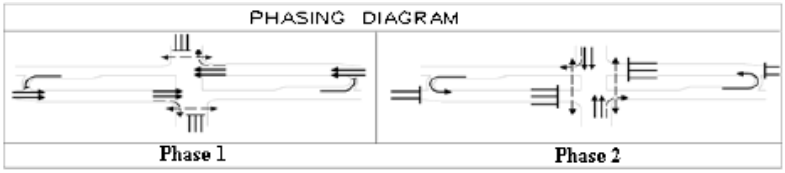


Figure 12. Example of typical signing plan for the MUTIT in Michigan.

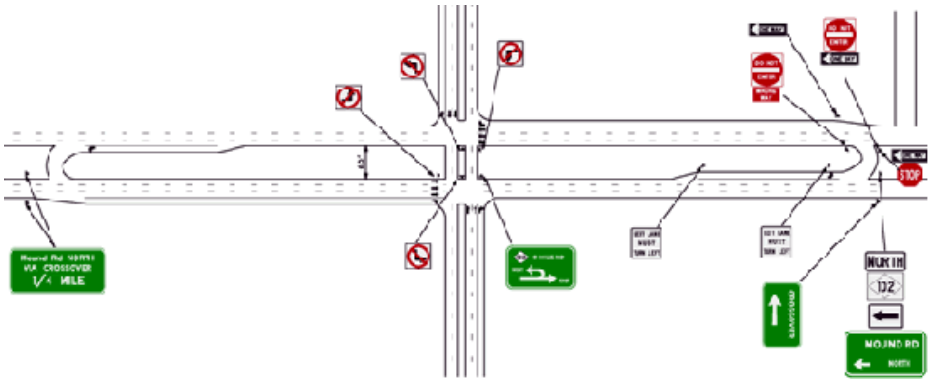


FIGURE 13. EXAMPLES OF "INNOVATIVE" SIGNING PLANS FOR THE MUTIT IN MICHIGAN.

Figure 13a. Example 1 of innovative signing. (Credit: Lee Rodegerdts)

Figure 13b. Example 2 of innovative signing.
(Credit: Chris J. Bessert, www.michiganhighways.org)

Figure 13c. Example 3 of innovative signing.
(Credit: Warren Hughes)

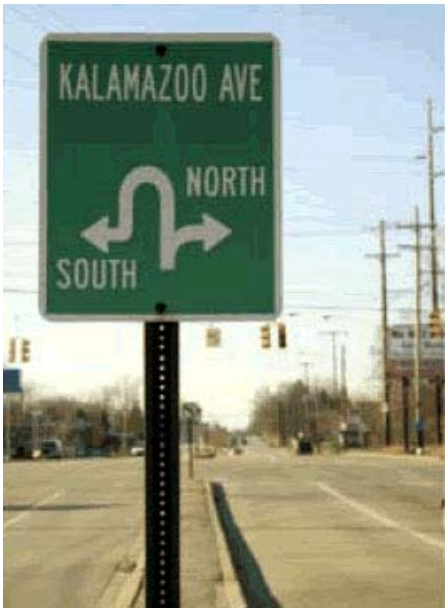


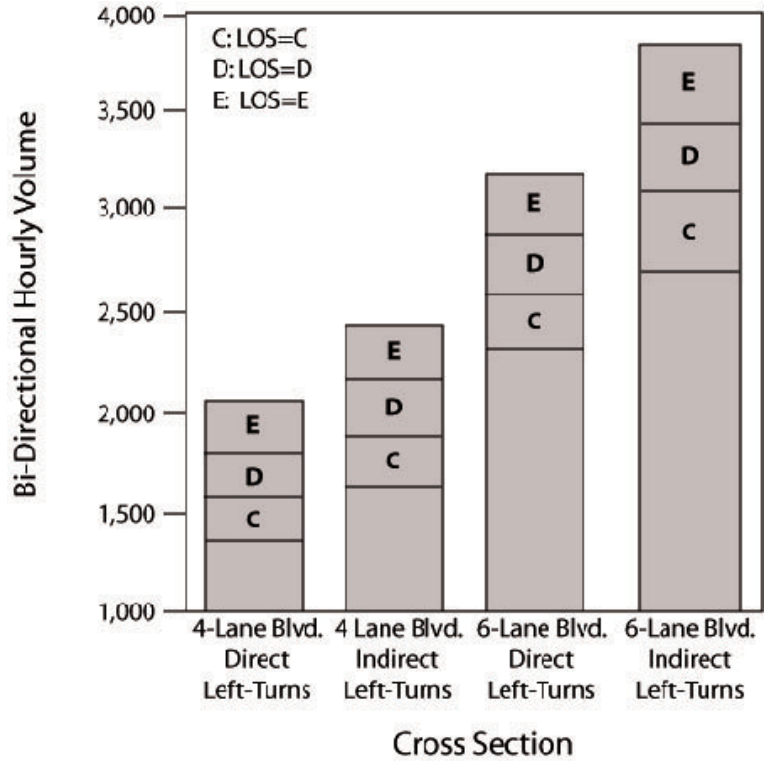
Figure 13d. Example 4 of innovative signing.
(Credit: Shawn Glynn)

Average speeds increased by 25 percent for MUTIT compared to the TWLTL. The average number of stops increased for the MUTIT compared to the TWLTL. The analysis indicated that the MUTIT had the potential to significantly improve system travel times and speeds in the corridor during the busiest hours of the day to not compromise system travel times during off-peak periods. Reid and Hummer (14) later used CORSIM to compare the traffic performance of seven unconventional arterial intersection designs, including the quadrant, median U-turn, superstreet, bowtie, jughandle, split intersection, and continuous flow intersections. The study used turning movement volumes from existing isolated intersections in Virginia and North Carolina. Off-peak, peak, and volumes corresponding to 15 percent higher than the peak volumes were examined. A total of 36 to 42 CORSIM simulation runs of 30-minute durations were analyzed for each intersection. For MUTITs, the CORSIM models used unsignalized U-turn crossovers for two-lane collector roads and signalized U-turn crossovers for four-lane collector roads. Entering volumes for the simulated intersections ranged from 4,500 vehicles per hour (vph) to 7,500 vph.

The MUTIT produced significantly lower average total travel times in comparison to the conventional intersection. The change in overall travel times for all movements through the intersection, when compared to a conventional intersection, was −21 to +6 percent during peak conditions. The overall change in the number of stops when compared to a conventional intersection was −2 to +30 percent during peak conditions.

Maki (15) compared the MUTIT and the conventional TWLTL on 4-lane and 6-lane boulevards and found a 20 to 50 percent increase in capacity (throughput) for the MUTIT. Figure 14 shows the level of service (LOS) comparison between corridors with MUTITs and conventional intersections.

Figure 14. LOS comparison of divided highways.
(Source: Robert Maki, City of Surprise, AZ)



Bared and Kaiser (16) studied the traffic operational benefits of signalized median U turns on a typical 4-lane road intersecting a 4-lane road using CORSIM. The cross-street left turn movement was allowed at the major road/cross street intersection resulting in a three-phase signal. An acceleration lane was provided for the right-turning vehicles from the major road to the cross street. These two features used in the study are different from the typical MUTIT implementations in Michigan. Entering volumes at the intersections used in the simulations ranged from 2,000 vph to 7,000 vph. The key findings of the study were:

- Considerable savings of travel time were observed for the U-turn design at higher entering flows (greater than 6,000 vph) compared to conventional intersections with 10 percent and 20 percent left-turning volumes.
- On average, the proportion of vehicles stopping on the network was lower for the U-turn design. For 10 percent left-turning volumes, differences ranged from 20 percent to 40 percent. For 20 percent left turns, a noticeable reduction in percent stops started at about 4,500 vph.
- Providing an acceleration lane on the crossroad was recommended to improve traffic operational efficiency.
- Longer offsets for the U-turn crossovers resulted in increased travel time but benefited the network at higher traffic volumes by providing adequate storage for the U-turning vehicles and preventing spillback into the intersection.

Dorothy et al. (17) evaluated traffic operational measures to study the differences in the performance of MUTITs compared to the conventional TWLTLs. The TRAF-NETSIM model was used to simulate these situations for 1-hour periods. The simulated network had signals every 0.8 km (0.5 mi) with the directional crossovers every 0.4 km (0.25 mi). A 60/40 split between the entering volumes on major road and cross street was assumed. When turning percentages were low, the crossovers were modeled as STOP-controlled; with higher volumes, signal control was assumed in the model. The signal cycle was 80 seconds with a 60/40 distribution of green time for the major road phase and cross-street phase, respectively. The median width varied from 12.2 to 30.5 m (40 to 100 ft). The key findings were:

- When the left-turning traffic percentage was 10 percent, MUTITs with signalized directional crossovers had lower left-turn total travel times than conventional intersections. The differences were 20 seconds/vehicle, 40 seconds/vehicle and 150 seconds/vehicle at 30 percent, 50 percent and 70 percent mainline saturation, respectively. Similarly, MUTITs with signalized directional crossovers had lower left-turn total travel times than conventional intersections when the left-turning traffic percentage was 25 percent. The differences were 20, 30, and 70 seconds/vehicle at 30 percent, 70 percent, and 90 percent mainline saturation, respectively.
- The MUTITs provided consistently lower network travel times compared to the five-lane TWLTL design.
- For low left-turning percentages, the directional median crossovers with stop control had approximately the same left turn total

time and network total time, as compared to directional medians with signalized crossovers.

Topp and Hummer (18) compared median crossovers on the cross street with median crossovers on the arterial highway for MUTITs using CORSIM. The left-turning volumes on the major road varied from 100 vph to 400 vph, the through volumes on the major road varied from 1,000 vph to 2,000 vph, the left turns on the cross street varied from 50 vph to 200 vph, and the through volumes on the cross street varied from 500 vph to 1,000 vph. The median crossovers were signalized wherever warranted. Results showed that the MUTIT design with the U-turn movement located along the cross street reduced percent stops, total travel time, and delay for most of the volume combinations analyzed in comparison to the crossover on the arterial.

Savage (19) studied the conversion of five-lane roadway with a TWLTL to a MUTIT in Michigan and found a 20 to 50 percent increase in the corridor capacity. Koepke et al. (20) found that the directional crossover design provides about 14 to 18 percent more capacity than the conventional dual left-turn lane designs. The results of critical lane volume analyses, after taking into account overlapping traffic movements, revealed reductions of about 7 to 17 percent in critical lane volumes, depending upon the number of arterial lanes (six or eight) and the traffic mix. Lower critical lane volumes translate into higher traffic flow capacity at the intersection. A study by Stover (21) computed critical lane volumes for the intersection of two six-lane, arterial roads. The effects of redirecting left turns were computed using these volumes. The provision of dual left-turn lanes on all approaches reduces critical lane volumes by 12 percent compared to providing single left-turn lanes but still requires multiphase traffic signal controls. The rerouting of left turns via directional crossovers and their prohibition at the main intersection reduces critical lane volumes by 17 percent.

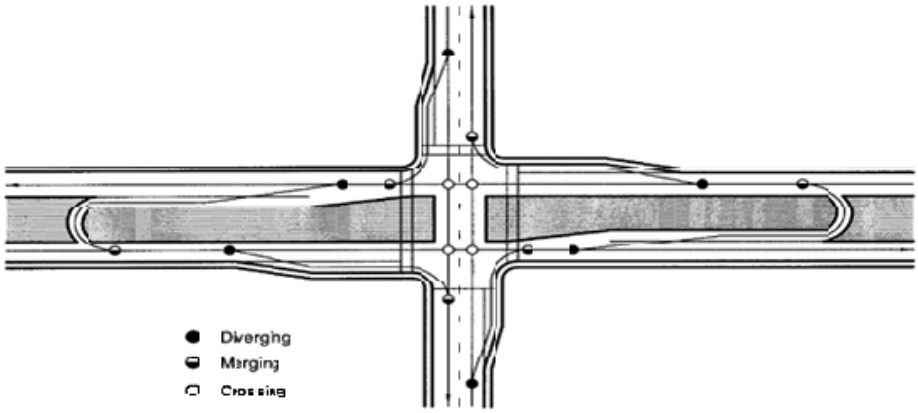
Overall, the literature shows that reducing signal phases and redirecting the left-turning movement at the intersection for the MUTIT provided significant benefits in terms of increased roadway capacity and reductions in travel time and vehicular delay when compared to conventional intersections.

Traffic Safety Performance

Table 2 from the FHWA Signalized Intersections: Informational Guide (22) shows the number of conflict points at a four-leg signalized intersection as compared to the MUTIT. The MUTIT eliminates all crossing (left turn) conflict points and reduces the number of merge/diverge conflict points as compared to a four-leg signalized intersection. Figure 15 shows the conflict point diagram for a MUTIT.

Observations indicated a 60 percent reduction in total crash frequencies and 75 percent reduction in total injuries. Reductions of 17 percent, 96 percent, and 61 percent were observed for rear-end crashes, angle crashes, and side-swipe crashes, respectively.

Figure 15. Conflict point diagram for the MUTIT.



Kach (23) compared the safety performance of conventional signalized intersections to MUTIT locations in the State of Michigan. The final comparison study subset consisted of 15 MUTIT locations and 30 conventional intersections.

Table 2. Number of conflict points at a four-leg signalized intersection compared to the MUTIT.

Conflict Type	Four-Leg Signalized Intersection	MUTIT
Merging/diverging	16	12
Crossing (left turn)	12	0
Crossing (angle)	4	4
Total	**32**	16

Maki (15) evaluated the safety benefits of replacing existing conventional signalized intersections with the MUTITs on Grand River

Avenue in Wayne County, MI. The 0.7-km (0.43-mi) study segment on Grand River Avenue was from the east of Poinciana to west of Delaware Street. The analysis period for the before-after study was 1990 to 1995.

The crossroads in all cases were undivided with crossroads intersecting at either 90 degrees or on a skew. Crash data for the years 1986-1990 were obtained for each site. Table 3 shows the safety performance of the MUTITs in comparison to conventional intersections. "Alpha" in Table 3 denotes the confidence level that the two rates are statistically different. Table 4 shows the estimated reduction in the expected number of crashes by crash type for all crashes, injury crashes, and property damage only (PDO) crashes for a road with 60,000 AADT.

Castronovo et al. (24) analyzed the MUTIT safety benefits versus conventional intersections as a function of traffic signal density using data from 123 segments of boulevards totaling 363.7 km (226 mi). The results indicated that as traffic signal density increased, the MUTIT had increasingly lower crash rates (measured in crashes per 161 million vehicle kilometers (100 million vehicle miles). For typical suburban conditions, with signal densities of one or more signals per 1.61 km (1 mi), the crash rate for MUTITs was about one half of the rate for conventional intersections. For typical rural conditions, with signal densities of one or less signal per 1.61 km (1 mi), the reduction in crashes for MUTITs was 36 percent when compared to conventional intersections.

In NCHRP Report 524 (25), researchers studied the safety performance of unsignalized median openings. The research results indicated that access management strategies that increase U-turn volumes at unsignalized median openings can be used safely and effectively. Analyses of collision data found that collisions related to U-turn and left-turn maneuvers at unsignalized median openings occur infrequently. In urban arterial corridors, unsignalized median openings had an average of 0.41 U-turn-plus-left-turn accidents per median opening per year. In rural arterial corridors, unsignalized median openings experienced an average of 0.20 U-turn-plus-left-turn accidents per median opening per year. On the basis of these limited collision frequencies, the authors concluded that there is no indication that U turns at unsignalized median openings are a general safety concern.

CONCLUSIONS

Based on the literature review conducted, the following summarizes the major conclusions:

- Michigan and other States have successfully used the MUTIT for over four decades without major problems related to traffic operational failures or safety hazards.
- Positive guidance communicated through additional signs and pavement markings at MUTIT sites may be beneficial in reducing driver confusion and enhancing traffic safety.
- With respect to driver expectancy, the MUTIT should not be mixed with other indirect and direct left-turn strategies on corridor level implementations.
- Though the MUTIT is typically a corridor treatment, the concept has been used successfully for isolated intersections to improve traffic operations and safety.
- Loons can be installed to accommodate larger U-turning vehicles, so the MUTIT can be a feasible treatment for corridors with narrow medians.
- Directional median crossovers provide better operational and safety benefits compared to bidirectional median crossovers.
- Reducing signal phases at the intersection provides increased capacity for the MUTIT in comparison to the conventional intersections. The capacity increases are typically in the range of 20 percent to 50 percent.
- The total network travel time savings can and usually does outweigh the additional travel time required for left-turning vehicles from the major road and cross street for corridors with the MUTIT compared to conventional intersections.
- The safety performance of MUTIT is better than conventional intersections because they have fewer vehicle-vehicle conflict points. Typical total crash reductions range from 20 percent to 50 percent.
- Head-on and angle crashes that have high probabilities of injury are significantly reduced for the MUTIT compared to conventional intersections.

Table 3. Safety comparison of MUTITs and conventional intersections.

Dataset	Rate Type	Group	Mean Crash Rates (Crashes/MVE)	Standard Deviation	Alpha
Corridor	**All**	MUTIT (*Reduction*)	1.554 *(14%)*	0.784	73
		Conventional	1.806	0.679	
Intersection Related	**All**	MUTIT (*Reduction*)	1.388 *(16%)*	0.593	80
		Conventional	1.644	0.643	
	PDO	MUTIT (*Reduction*)	0.982 *(9%)*	0.392	49
		Conventional	1.077	0.467	
	Injury	MUTIT (*Reduction*)	0.407 *(30%)*	0.266	97
		Conventional	0.58	0.252	

Table 4. Expected crashes for MUTITs and conventional intersections for a 5-year period [WH12].

Crash Type	Injury Crashes				PDO Crashes				All Crashes			
	Conventional		MUTTIT		Conventional		MUTTIT		Conventional		MUTTIT	
	%	Expected Crashes	%	Expected Crashes	%	Expected Crashes	%	Expected Crashes	%	Expected Crashes	%	Expected Crashes
Overturn	1.53	0.97	0.92	0.41	0.64	0.75	0.27	0.29	0.95	1.71	1.03	1.57
Fixed Object	3.56	2.26	4.25	1.89	4.77	5.62	6.97	7.5	4.36	7.85	6.13	9.38
Head-on	0.80	0.51	0.27	0.12	0.43	0.51	0.33	0.35	0.56	1.01	0.35	0.53
Angle St	36.87	23.4	19.77	8.8	18.35	21.63	9.06	9.75	24.73	44.53	12.12	18.54
Rear End	37.99	24.11	65.93	29.35	51.67	60.9	69.85	75.14	46.94	84.51	68.29	104.44
Angle Turn	3.56	2.26	4.76	2.12	6.71	7.91	7.74	8.33	5.62	10.12	6.84	10.46
Rear End Lt	1.53	0.97	0.81	0.36	4.18	4.93	0.93	1	3.27	5.89	0.88	1.35
Rear End Rt	0.20	0.13	0.65	0.29	1.45	1.71	1.43	1.54	1.02	1.84	1.19	1.82
Sdswipe Opp	0.20	0.13	0.13	0.06	0.27	0.32	0.22	0.24	0.25	0.45	0.20	0.3
Head-on Lt	13.75	8.73	2.52	1.12	10.89	12.84	2.75	2.96	11.87	21.37	2.66	4.07
Sdswpipe same	0.00	0	0.00	0	0.64	0.75	0.44	0.47	0.42	0.76	0.31	0.47
Σ	100.00	63.47	100.00	44.52	100.00	117.87	100.00	107.57	100.00	180.04	100.00	152.93

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Key Words—Traffic operation; safety; median U-turn; traffic modeling

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Median U-Turn Intersection Treatment: Safety and Operational Benefits

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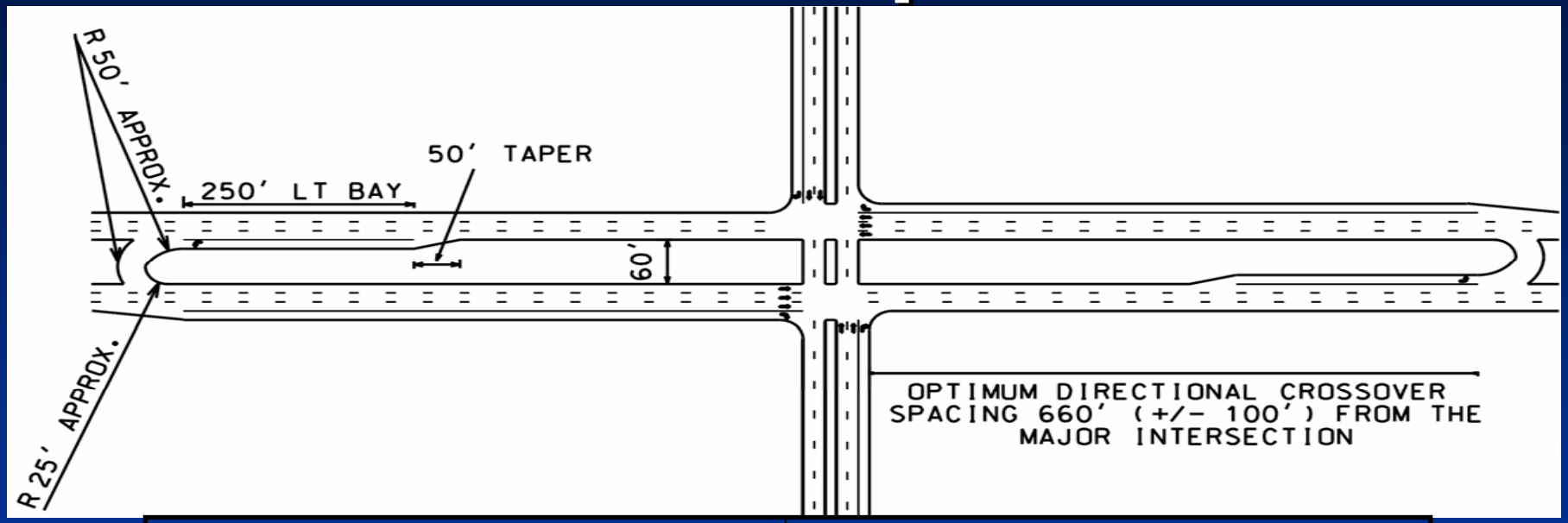
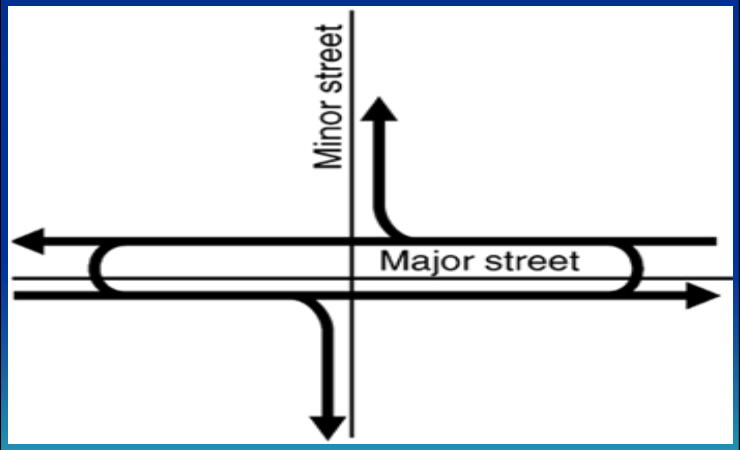
U.S. Department of Transportation
Federal Highway Administration

Michigan left-Turn

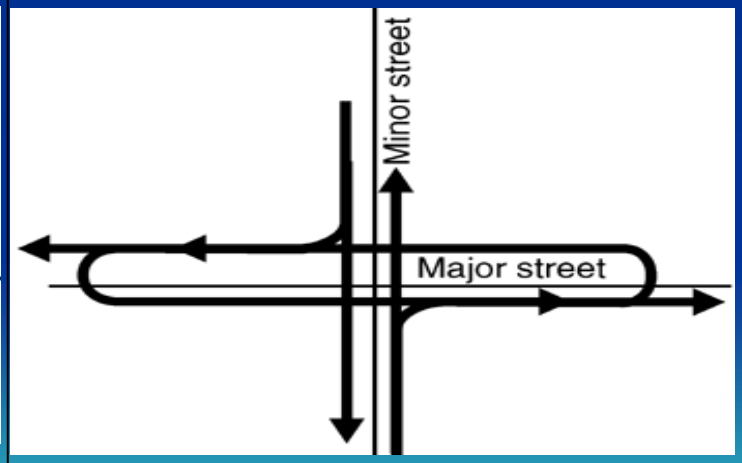
U.S. Department of Transportation
Federal Highway Administration

Concept





Major street movements



Minor street movements

U.S. Department of Transportation
Federal Highway Administration

General Advantages

- The two-phase signal control allows shorter cycles.
- Reduced delay for through traffic on the major arterial.
- Increased capacity at the main intersection.
- Improved progression and fewer stops for through traffic, especially where there are STOP-controlled directional crossovers.
- Reduced risk to crossing pedestrians.
- Fewer conflict points. Greater separation of conflict points.

General Disadvantages

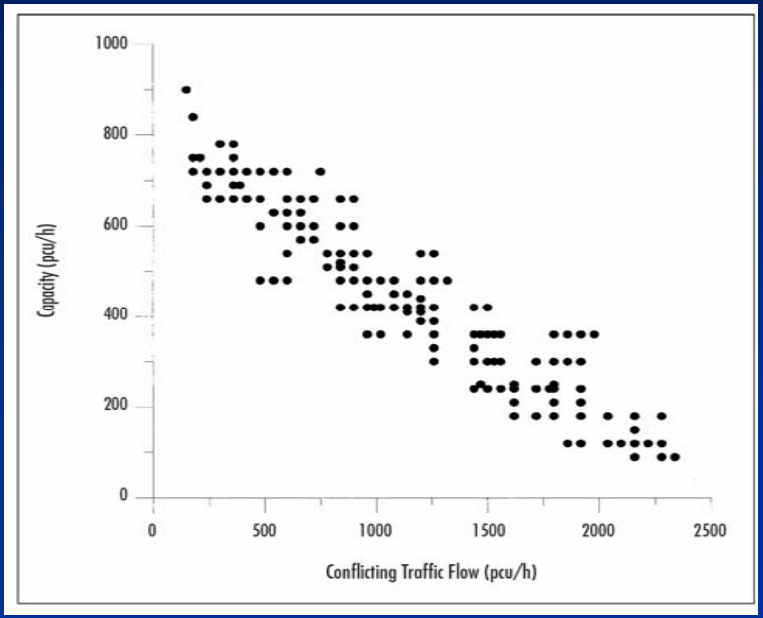
- Possible driver confusion and disregard of left-turn prohibition at the main intersection.
- Possible increased delay, travel distances and stops for ***left-turning*** traffic.
- Larger rights-of-way required for the arterial, although this could potentially be mitigated on roads with narrow medians.
- Higher operation and maintenance costs attributable to additional traffic signal control equipment if the directional crossovers are signalized.
- Longer minimum green times for cross street phases or two-cycle pedestrian crossing.

Traffic Operational Performance

- Difference in travel time (for limited flow scenarios) ranged from -21 to +6% compared to conventional design.
- Lower left-turn travel time at low and high degrees of saturation for mainline traffic.
- Some reported increases in capacity ranging from 20 to 50%, others 14 to 17%.

U-Turn Capacity at unsignalized and signalized crossings

- Capacity for non-signalized intersection (ITE Journal article, figure on right)
- Critical gap range from 5.8 to 7.4 seconds.
- Suggested saturation flow rate reduction factors of 0.82 and 0.76 for U-turn lanes at signalized intersections.



Traffic Conflict Points

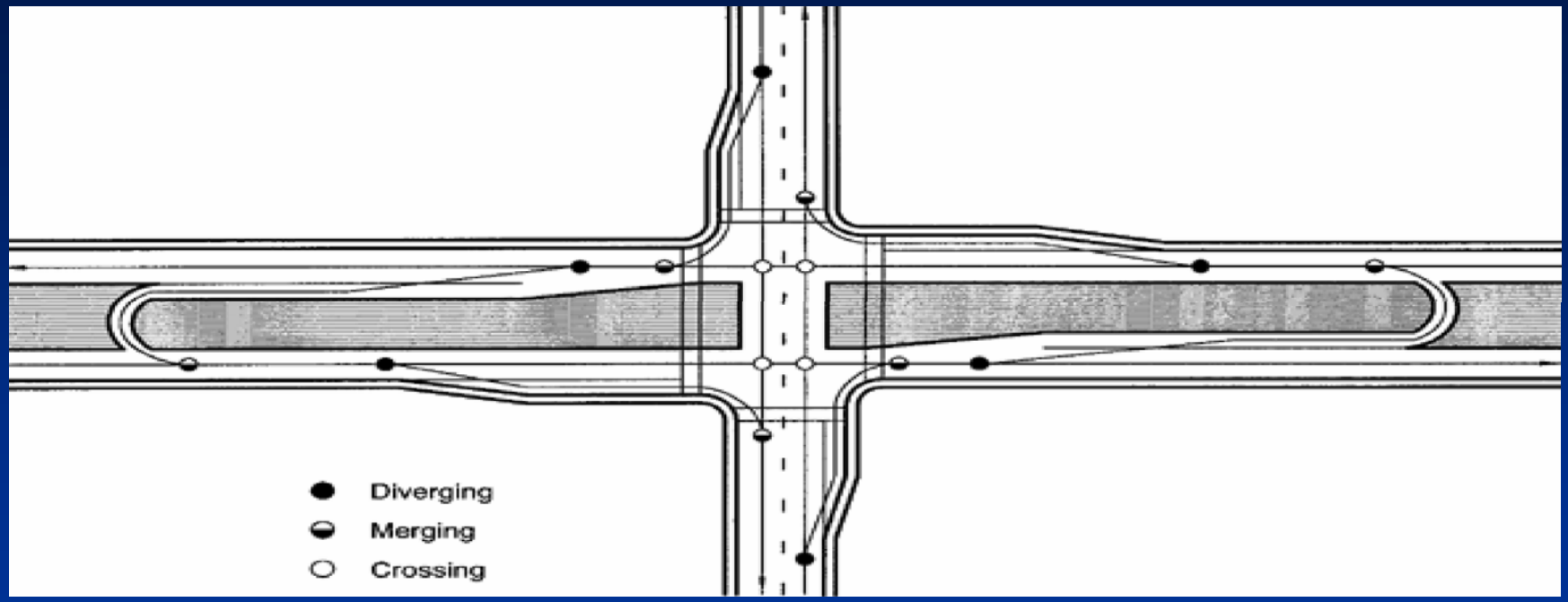


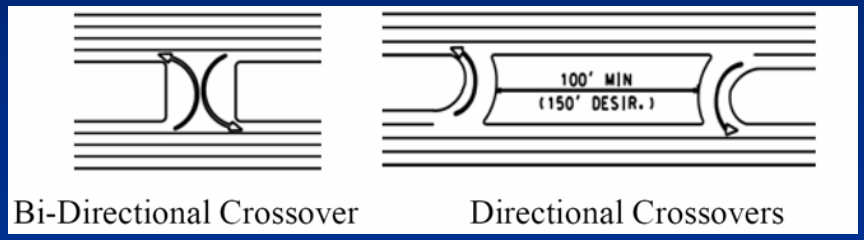
Table 2. Number of conflict points at a four-leg signalized intersection compared to the MUTIT

Conflict type	Four-Leg Signalized Intersection	MUTIT
Merging/diverging	16	12
Crossing (left turn)	12	0
Crossing (angle)	4	4
Total	32	16

Effects on Crashes

- Crash reductions of 17 percent, 96 percent and 61 percent were observed for rear-end crashes, angle crashes, and side-swipe crashes, respectively.
- Overall reduction of 9 to 30%.
- In rural areas, crash rates are about 36%.

Directional crossover is safer than bi-directional



Michigan DOT Guidelines

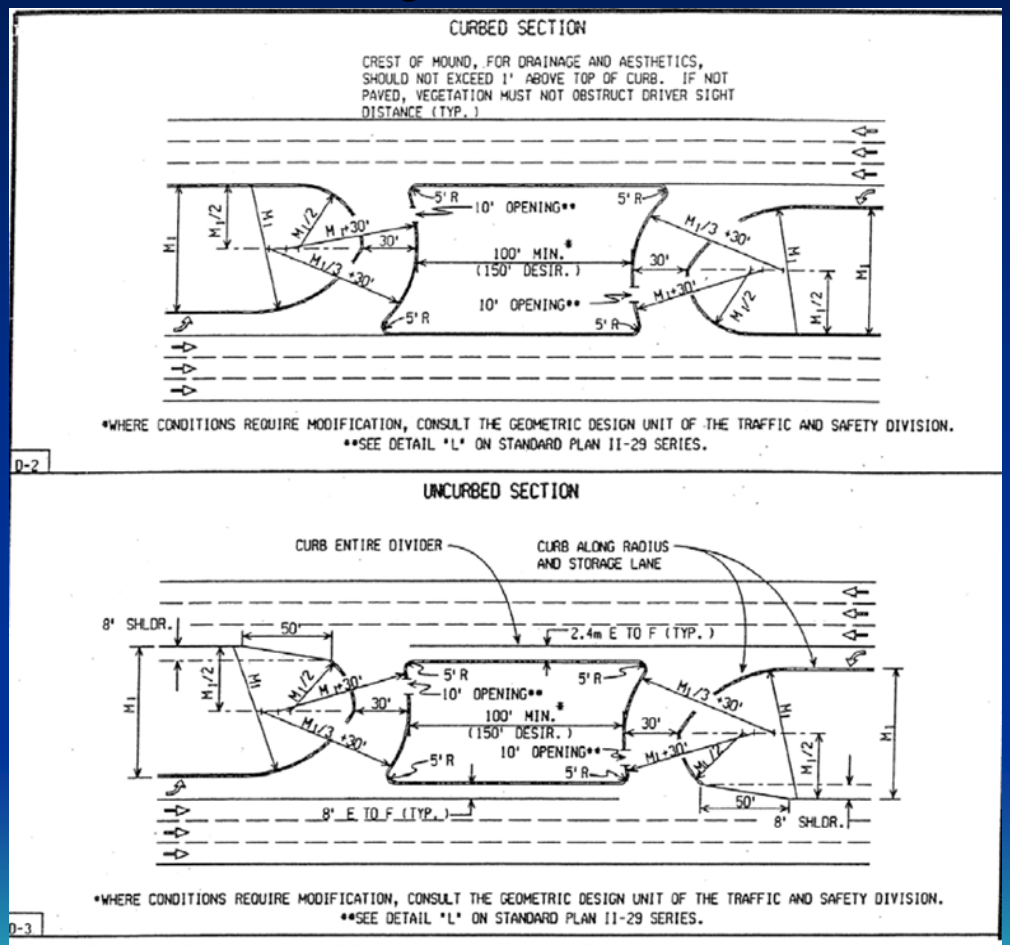
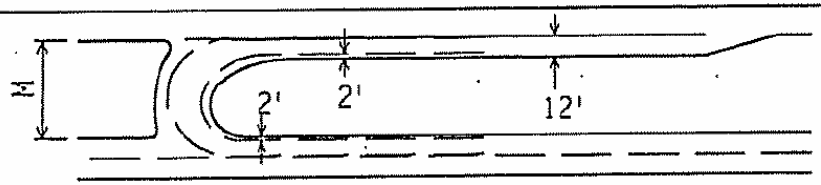
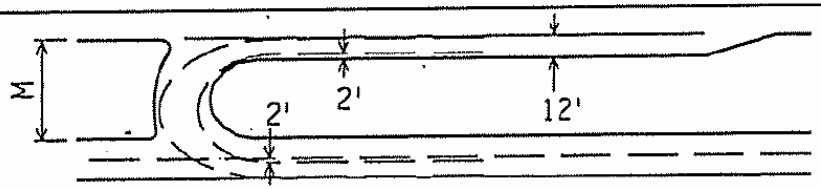
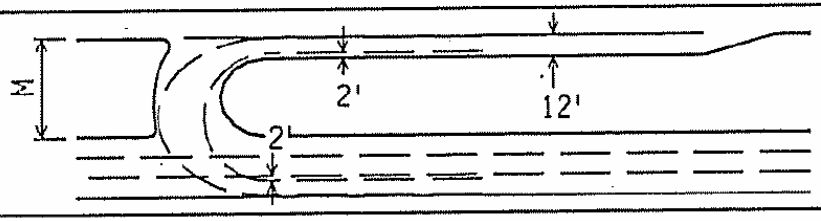


Figure 5. Michigan DOT Design Guidelines for Directional Median Crossovers

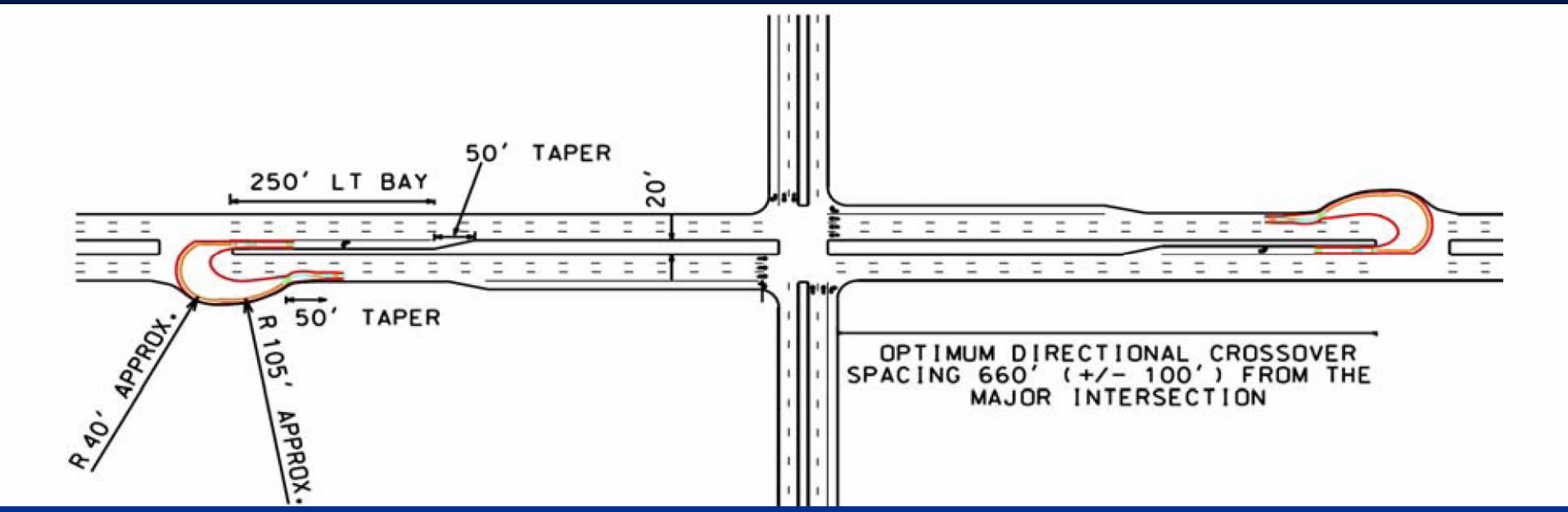
Location and Design of Median Crossovers

Minimum Designs for U-Turns

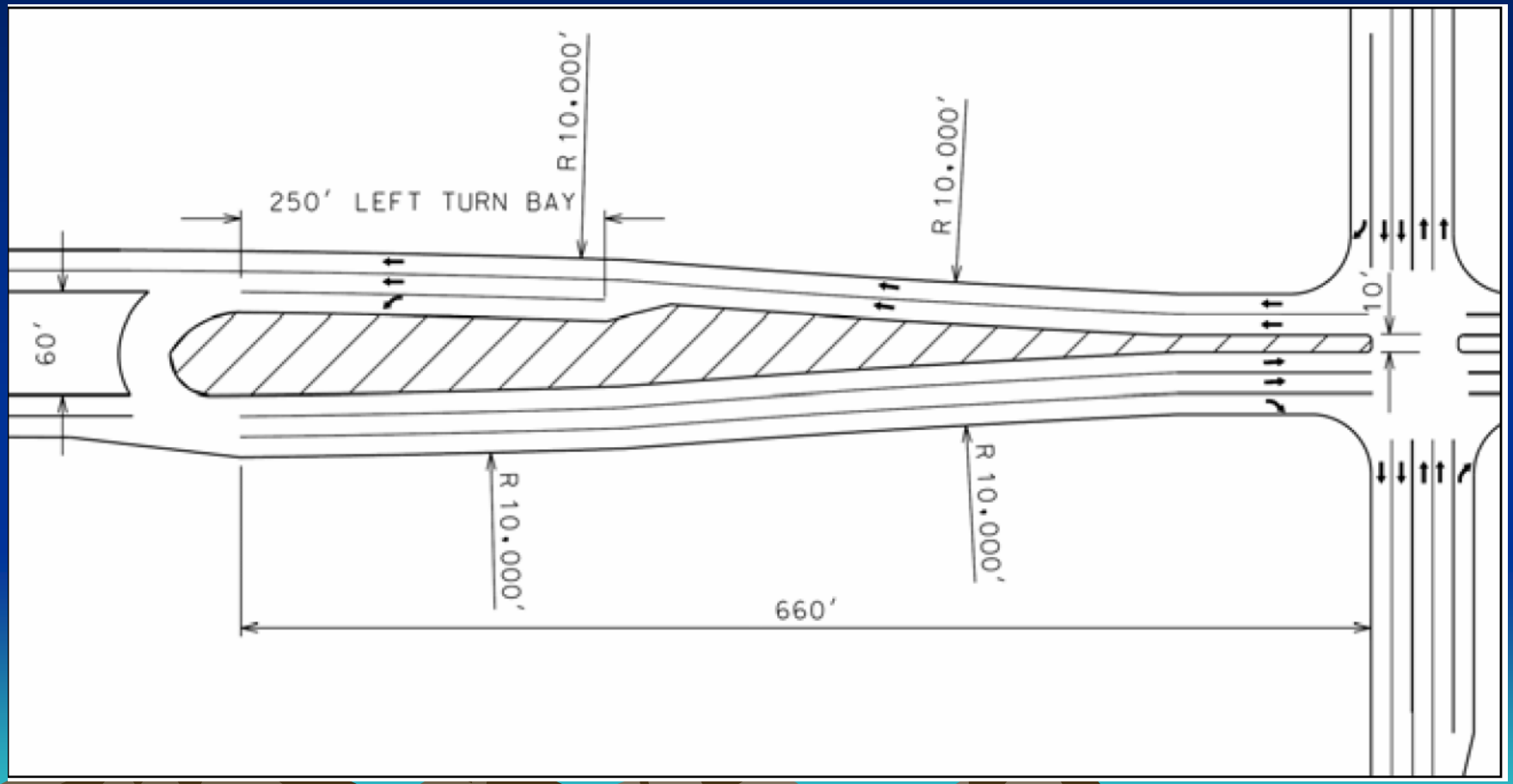
Type of Maneuver		M = Min. width of median - feet for design vehicle				
		P	SU	BUS	WB-50	WB-60
		Length of Design Vehicle				
		19'	30'	40'	55'	70'
Left Lane to Inner Lane		44'	76'	80'	82'	82'
Left Lane to 2nd Lane		32'	64'	68'	70'	70'
Left Lane to 3rd Lane		22'	54'	58'	60'	60'

P = Passenger
SU = Single Unit Truck
WB-50 = Semi-Truck Medium Size
WB-60 = Semi-Truck Large Size

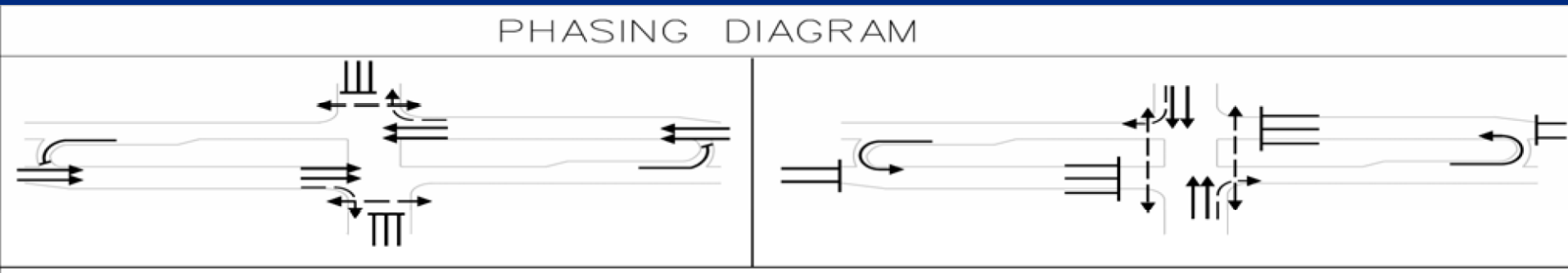
Loons on Roads with Narrow Medians



Narrowing at Main Intersection

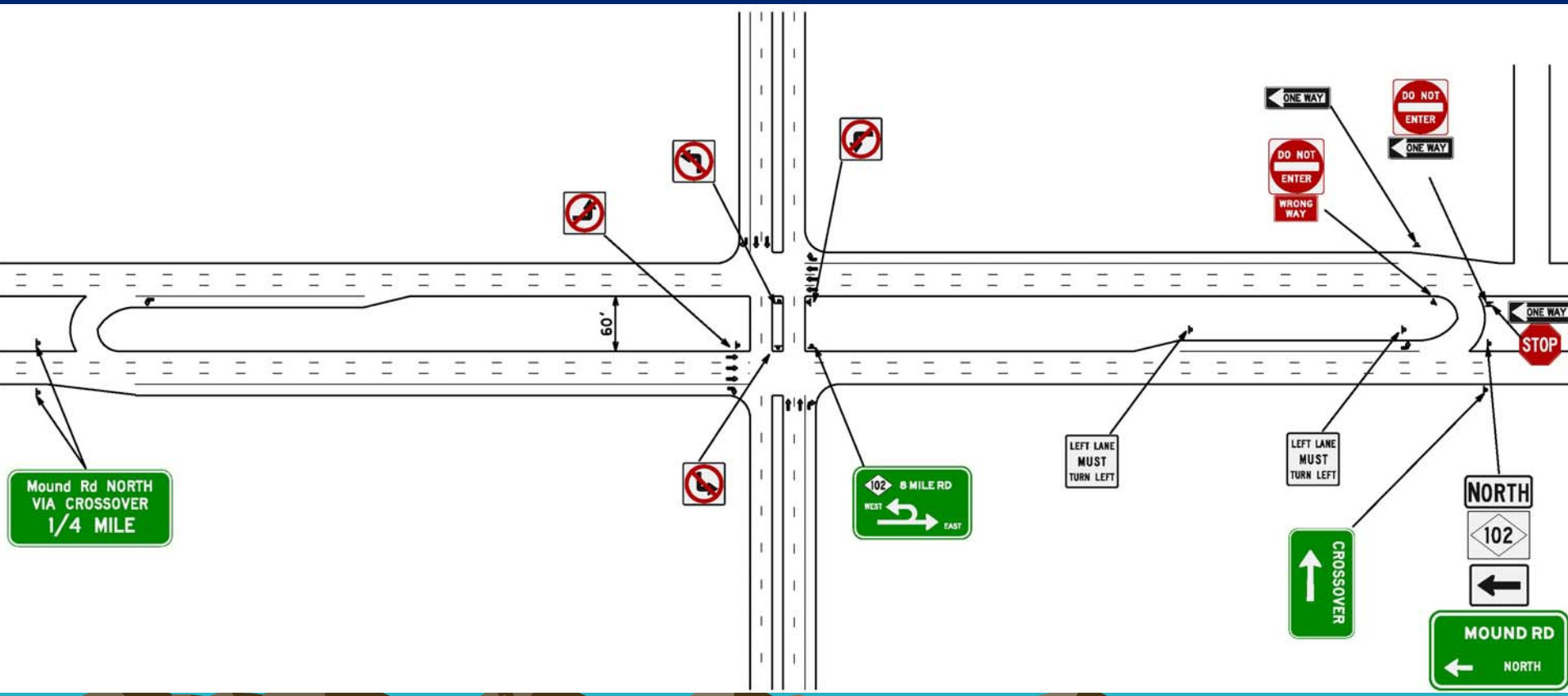


Signal Phasing



Phase 1 **Phase 2**

Example of Signing Plan in Michigan



Examples of Signs on Cross Street

Example of a Sign on the Mainline

Additional Resources

- “Synthesis of the Median U-turn Intersection Treatment, Safety and Operational Benefits.” Publication No. FHWA-HRT-07-033.
- Can be found on the internet at the following address: http://www.tfhrc.gov/safety/pubs/07033/07033.pdf

Synthesis of J-Turn Design Standards And Criteria

December 2010

Final Draft Report

MDOT
MISSISSIPPI DEPARTMENT OF TRANSPORTATION

ABMB ENGINEERS, INC. 25

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I. Abstract

Transportation professionals today are faced with the challenge to meet the mobility needs of an ever increasing population with limited resources. One potential treatment to mitigate congestion and safety problems at rural expressway intersections, while trying to avoid signalization or grade-separation, is the J-Turn intersection treatment, which has been successfully implemented in Michigan, Florida, Maryland, New Jersey, and Louisiana.

The treatment involves the prohibition of left-turn and through movements from the side-street approaches and accommodates them by requiring drivers to turn right onto the main road and then make a u-turn maneuver at a one-way directional median opening downstream. Left-turns from the main road approaches are executed in a manner similar to left-turns at a conventional intersection and are unaffected. Although this type of intersection treatment is typically considered a corridor-wide treatment, the concept has been successfully used at isolated intersections to improve traffic flow and enhance safety

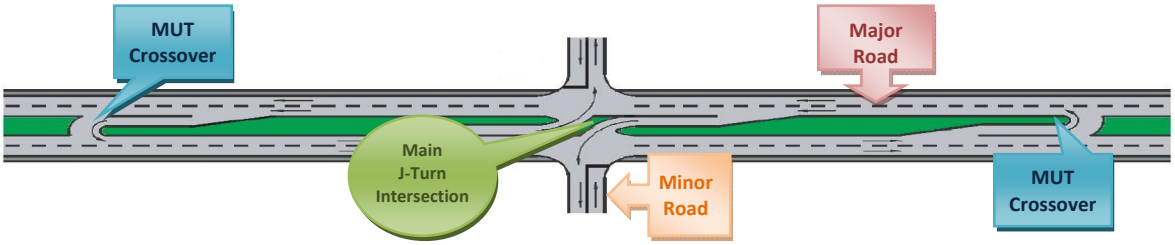
This synthesis presents design guideline recommendations for the implementation of J-Turn intersection treatments in Mississippi. Specific items addressed in this document include general design elements, cross-sectional elements, intersection and crossover design details, pedestrian accommodations, traffic control devices, lighting, signing, historical safety performance, construction costs and phasing, and public involvement efforts. The recommendations herein should be considered as minimums. The recommendations contained in this document cannot apply to all situations as every project is unique and typically require their own variations to site-specific conditions.

Many of the design elements recommended for the J-Turn intersection and MUT crossovers match the current MDOT practices for arterials. All references contained in this document refer to the 2001 edition of the *MDOT Roadway Design Manual,* which is currently undergoing a major revision. Therefore, the designer should verify that the most recent design criteria is being used prior to beginning a design.

II. Summary of J-Turn Intersection Concept

A J-Turn intersection, shown in **Figure 1**, is a variant of the Restricted Crossing U-turn (RCUT) intersection in that both the main intersection and the two crossovers are unsignalized. The J-Turn intersection design is usually recommended for low volume divided expressways. It involves the elimination of direct left turns from an intersection's minor approach using a directional median (which allows direct left-turns from the major road, but prohibits minor road traffic from entering the median) with downstream median u-turn (MUT) crossovers. Although this type of intersection treatment is typically considered a corridor-wide treatment, the concept has been successfully used at isolated intersections to improve traffic flow and enhance safety. This type of intersection design is a conflict point management treatment that eliminates and controls intersection conflict points. The J-Turn intersection treatment should not be mixed with other indirect or direct left turn strategies on corridor level implementations.

Figure 1 - Typical J-Turn Intersection



The J-Turn intersection design concept has been successfully used in Michigan and other states for over four decades. The term "J-Turn" for this style of intersection was coined by the Maryland State Highway Administration (MSHA). This intersection design is also known by other names in other states such as the "Superstreet" intersection in North Carolina or the "Right-Turn U-Turn" (RTUT) intersection in Florida.

If traffic signals are warranted at either the main intersection or the median u-turn (MUT) crossovers the J-Turn intersection design may not wholly apply and is not specifically addressed in this report.

Advantages of the J-Turn intersection design include:

+ Allows the major arterials through traffic to proceed without stopping.
+ Eliminates the need for traffic signals that will not fit into existing time-space (progression) patterns along arterial roadways.
+ Reduces the number of conflict points when compared to conventional intersection designs.
+ Crashes occurring at the conflict points are expected to be less severe than at conflict points of conventional intersections.

Disadvantages of the J-Turn intersection design include:

- Possible driver confusion.
- May be perceived to adversely affect roadside business access.
- Combined median right-of-way and lane width requirements for loon construction can be required for u-turning vehicles.

Situations suitable for a J-Turn intersection:

- Relatively low to medium side-street through volumes and heavy left-turn volumes from the major road.
- The minor road total volume to total intersection volume ratio is typically less than or equal to 0.20.
- Areas where median widths are larger than 64 ft. Narrower medians will require additional design considerations for accommodating large u-turning vehicles (see **Section IV.A**).
- Intersections that experience a high number of far-side right-angle collisions.
- Intersections where minor road crossing traffic gap times are insufficient to complete the maneuver safely and cause multiple vehicles to stack into the median opening.

For intersections with very high left-turn and through volumes from the side road approaches, the J-Turn intersection design is not the optimum choice. The J-Turn intersection design better serves an intersection with more major road left turns than minor road through movements. The AASHTO publication *A policy on Geometric Design of Highways and Streets* (a.k.a. Green Book) currently discourages the use of a J-Turn type intersection on high-speed or high-volume highways due to "the difficulty of weaving and the long lengths involved" in the indirect minor road movements, unless "the volumes intercepted are light and the median is of adequate width."

III. Design Elements

A J-Turn expressway is basically a principal arterial with the indirect left-turn treatment implemented on a corridor basis. Therefore, many of the design elements recommended for the J-Turn intersection and MUT crossovers match the current MDOT practices for arterials. All references contained in this document refer to the 2001 edition of the *MDOT Roadway Design Manual,* which is currently undergoing a major revision. Therefore, the designer should verify that the most recent edition of the manual is being referenced.

A. Design Speed

For J-Turn intersection and MUT crossover treatment designs on multi-lane rural arterials and collectors, **the recommended design speed is 65 mph**. This applies to both new construction and 3R projects. In urban areas the design speed varies widely and the designer should refer to the MDOT Roadway Design Manual for the appropriate design speed.

B. Design Vehicle

The appropriate design vehicle should be determined by restrictions placed on the intersecting roadway. According to the current edition of the *MDOT Roadway Design Manual,* the minimum design vehicle for rural collectors and urban arterials is a WB-40 and for rural arterials is a WB-50. However, upcoming revisions to the design manual increase the size of the minimum design vehicle for rural arterials to a WB-62. Therefore, all J-Turn intersection and MUT crossover designs recommended in this document were developed using a WB-62 as the design vehicle. At locations with narrow median widths, the WB-62 may not be viable and the design vehicle selection should be based upon all relevant considerations for the specific site.

C. Superelevation

For most situations where the J-Turn intersection treatment is implemented, the typical maximum superelevation rate is 10%. However, the designer should refer to the latest edition of the *MDOT Roadway Design Manual* for each specific location.

D. Clear Zone

The roadside clear zone is the distance beyond the edge of traveled way that should be clear of any non-traversable hazards or fixed objects. The clear zone is variable and should be determined based on design speed, traffic volume and roadway classification as according to *MDOT Roadway Design Manual – Section 9-2.0.* **A clear zone distance of 30 ft is recommended** for practicality and to provide a consistent roadway template.

E. Sight Distance

Sufficient sight distance should be provided at the J-Turn intersections as well as the MUT crossovers. The design of the J-Turn intersection must meet the intersection sight-distance requirements for an at-grade intersection as set forth in the *MDOT Roadway Design Manual*. MUT crossover designs must meet the stopping-sight distance requirements set forth for median openings in the MDOT Roadway Design Manual.

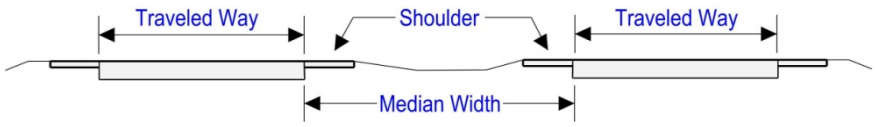
According to the *FDOT Median Handbook*, the sight distance for u-turns at unsignalized median openings for speeds of 60 mph should be no less than 1,540 ft.

IV. Cross-Sectional Elements

A. Median Widths

As illustrated in **Figure 2,** the median width should be measured between the inside edges of the two traveled ways of the opposing roadways. **Median widths greater than or equal to 64 ft are recommended** to accommodate large trucks and minimize shoulder encroachment when making u-turn maneuvers. In rural areas the typical MDOT median width is 101 ft and in urban areas is 64 ft.

Figure 2 - Median Width Measurement



Existing roadways with median widths of 64 ft or less will require additional design considerations to allow large trucks to execute u-turns at the MUT crossovers. Alternative median design treatments to accommodate u-turns by large trucks include:

- Allow vehicles to turn onto the existing or widened shoulder, which could have strengthened full-depth pavement.
- Add pavement outside the travel lane to allow the design vehicle to complete the u-turn maneuver and merge back into traffic stream (**Figure 3**). The added pavement is known as a *loon*.
- Widen the median, median "bulb-out", using reverse curves in the vicinity of the crossover to better accommodate u-turns (**Figure 4**).

Figure 3 - Loon Illustrations

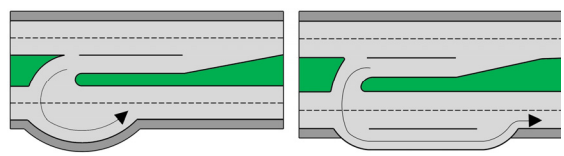
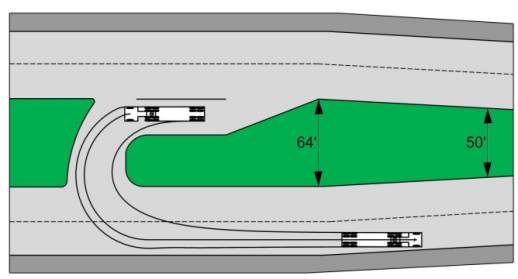


Figure 4 - Median "Bulb-Out" Illustration



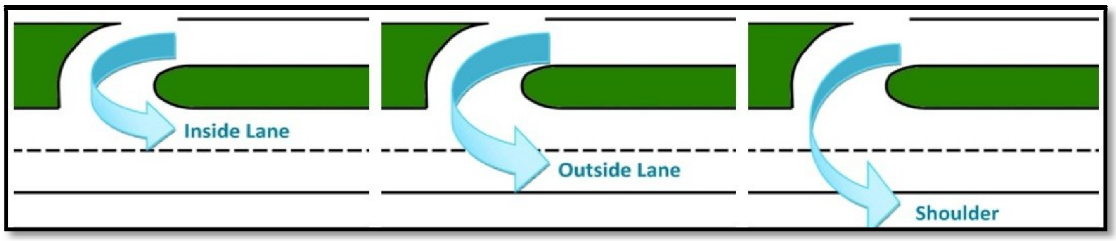
The expected design vehicle u-turn lane destinations for common MDOT median widths are provided in **Table 1**. The possible u-turn lane destinations include the inside lane, outside lane, shoulder, or loon and are illustrated in **Figure 5**.

Table 1 – Design Vehicle U-turn Lane Destinations by Median Widths

DESIGN VEHICLE (length, ft)	MEDIAN WIDTH		
	40'	64'	101' +
BUS (40')	Shoulder	Inside Lane	Inside Lane
WB-40 (40')	*	Outside Lane	Inside Lane
WB-50 (50')	*	Shoulder	Inside Lane
WB-62 (62')	*	Shoulder	Inside Lane
WB-67 (67')	*	Shoulder	Inside Lane

* U-turn cannot be completed within usable roadway width.
- 12 foot-wide lanes have been assumed. All turns begin from median u-turn lane.
- U-turn lane destinations shown on roadway without improvements.

Figure 5 – U-Turn Lane Destination Possibilities



B. Lane Widths

For both rural and urban areas, **it is recommended that the travel lanes and auxiliary lanes be 12 ft wide**. On existing roadways, auxiliary lane widths of 11 ft are acceptable if lane widening is not possible.

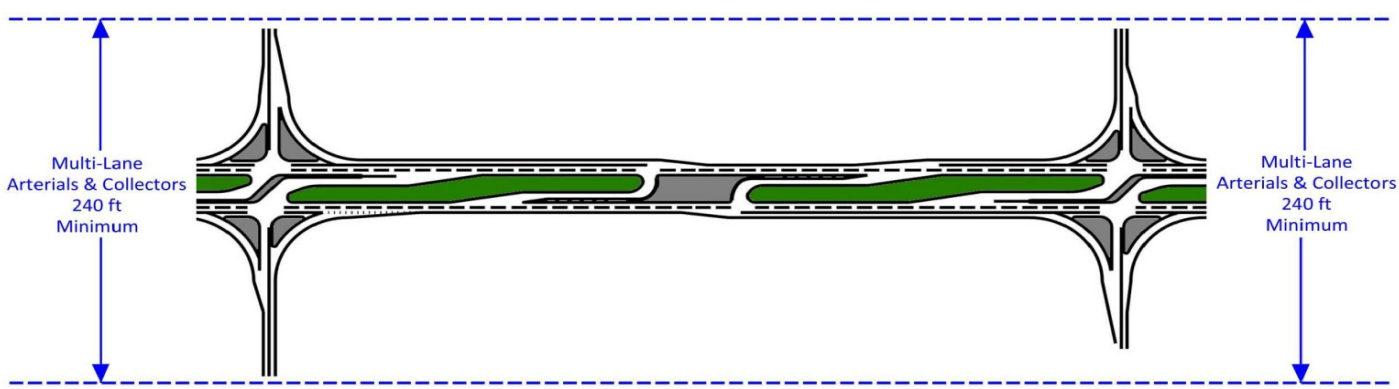
C. Shoulder Widths

Shoulder widths are variable and should be determined based on traffic volume and roadway classification as according to the latest edition of the *MDOT Roadway Design Manual*. If the design includes loons at the MUT crossovers, a total outside shoulder width of 6 ft, with a minimum of 4 ft paved, is recommended in the vicinity of the loons.

D. Right-of-Way

In accordance with the *MDOT Roadway Design Manual* for rural multi-lane arterials and collectors, **the recommended standard minimum right-of-way width is 240 ft** and is illustrated in **Figure 6**. In restrictive areas, it may not be possible to obtain the 240 ft right-of-way needed for the desired median width to accommodate u-turn maneuvers by large trucks. Some design alternatives for areas with restricted right-of-way are discussed in **Section IV.A** of this report.

Figure 6 - J-Turn Intersection Right-of-Way Requirements



V. Intersection Design Elements

The recommended typical designs for the J-Turn intersection treatment with MUT crossovers are shown in **Figures 16 – 19** for commonly used MDOT median widths.

A. J-Turn Intersection Design

The minor road approaches of the J-Turn intersection should be designed for all right turn movements since all through and left-turning vehicles are converted to right-turning vehicles. The J-Turn intersection has only one-way median openings for exclusive use of left-turning traffic from the main road. Turning radii treatments for J-Turn intersection designs should accommodate the design vehicles appropriate for the area type and functional classification of the intersecting roadways. Curbs should be mountable, Type 2, to allow emergency vehicles to cross the curb if required. The recommended geometric design details of the main J-Turn intersection for commonly used MDOT median widths are shown in **Figures 7 -10**.

Figure 7 - Recommended J-Turn Intersection Design Detail for 40 ft Medians

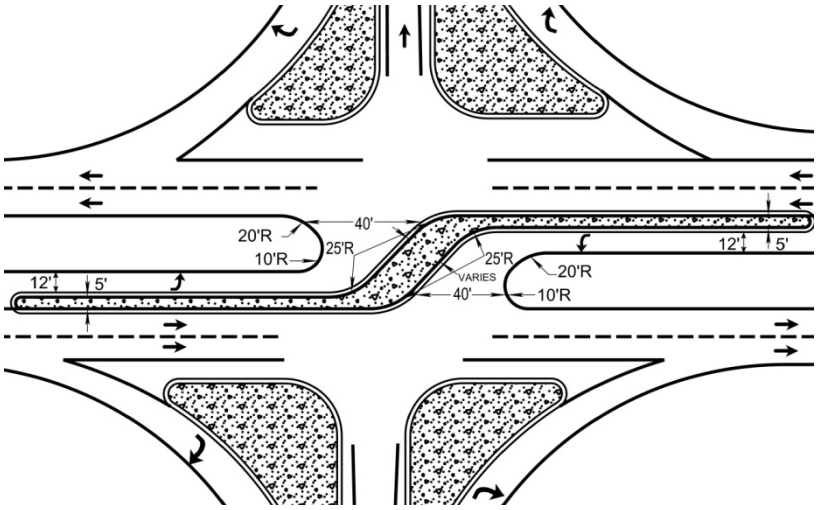


Figure 8 - Recommended J-Turn Intersection Design Detail for 64 ft Medians

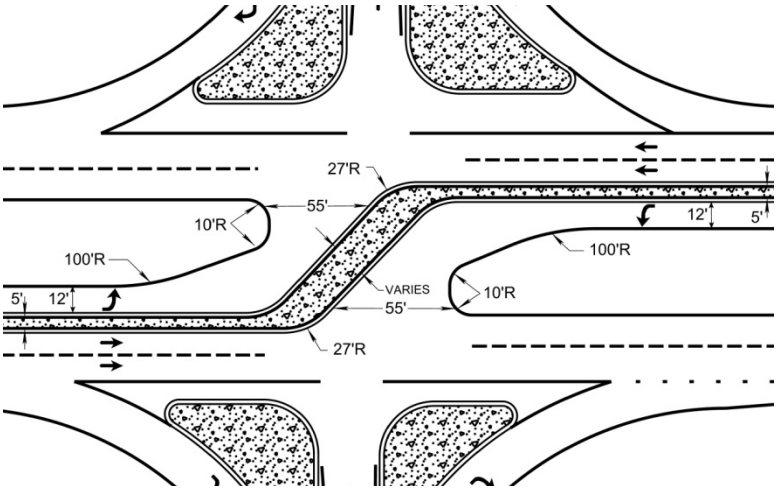


Figure 9 - Recommended J-Turn Intersection Design Detail for 101 ft Medians

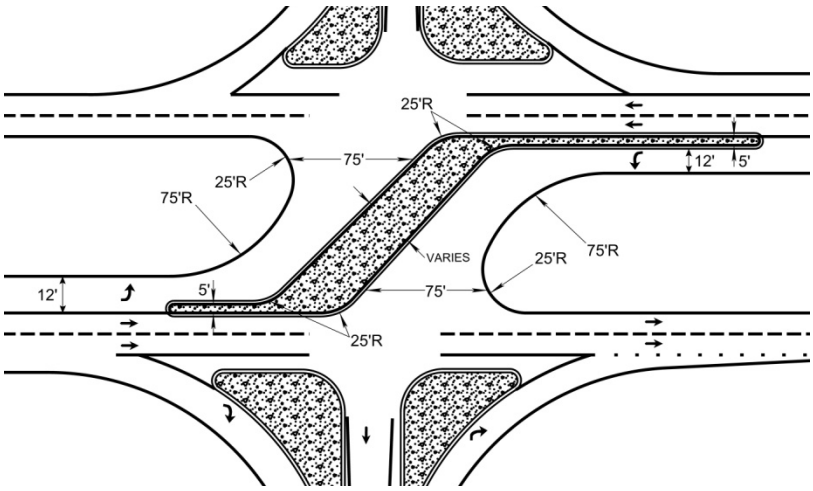
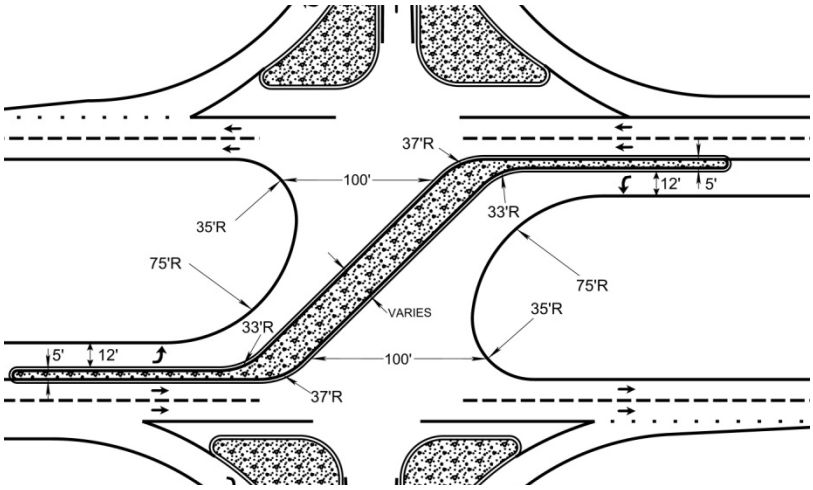


Figure 10 - Recommended J-Turn Intersection Design Detail for 126 ft Medians



1. Access Management

Driveways should not be allowed near the main intersection or on the opposite side of arterial from the MUT to reduce the chance of wrong-way movements in the MUT crossover and main J-Turn intersection.

2. Channelization and Boulevards

If the side roads are not of the boulevard or expressway type, **it is highly recommended that right-turn channels be installed for the minor road right-turn movements** to minimize wrong way maneuvers. If right-turn channels are included in the design, the distance to the MUT crossover may need to be increased.

3. Auxiliary Lanes

Auxiliary lanes should be provided at the main J-Turn intersection. The J-Turn intersection must be designed with exclusive right-turn lanes on the main roadway with sufficient length and width to accommodate the additional volume of right-turning vehicles (those that were the minor road through vehicles.) **It is recommended that the exclusive right-turn lanes on the main roadway are to be a minimum of 200 ft in length with a 150 ft taper if right-of-way allows. The exclusive left-turn lanes on the main roadway are**

recommended to be a minimum of 250 ft with 150 ft taper. For median widths less than 64 ft, a minimum taper length of 75 ft is acceptable if there is insufficient distance to accommodate a 150 ft taper as recommended. To accommodate the additional right-turning traffic from the minor road approach dual right-turn lanes are acceptable.

B. Median U-turn Crossover (MUT) Design

J-Turn intersection design treatments include two unsignalized one-lane directional medians located upstream and downstream from the main J-Turn intersection. Locations where the median width is 64 ft or less, design modifications discussed in **Section IV.A** may be needed near the MUT crossovers to safely accommodate oversized vehicle u-turn maneuvers. Furthermore, if the traffic composition includes a high number of longer vehicles, such as logging trucks, then the design of any required loons should be done such that these trucks do not block each other's line-of-sight when entering the through lanes from a loon area. A loon width of 10 ft is recommended for designs on median widths of less than 64 ft. The recommended geometric design details of the MUT crossovers for commonly used MDOT median widths are shown in **Figures 11 – 14.**

Figure 11 – Recommended MUT Crossover Design Detail for 40 ft Medians

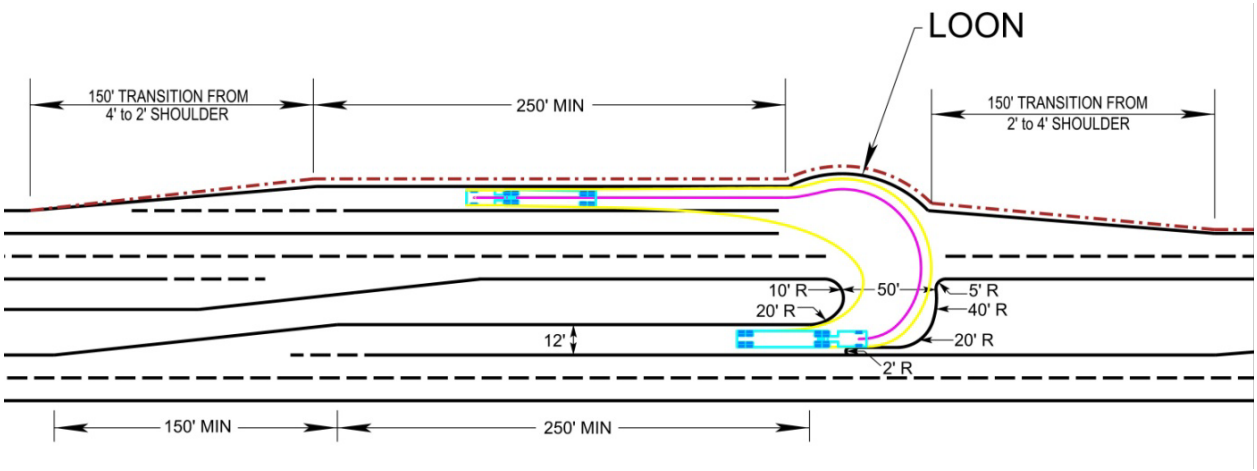


Figure 12 - Recommended MUT Crossover Design Detail for 64 ft Medians

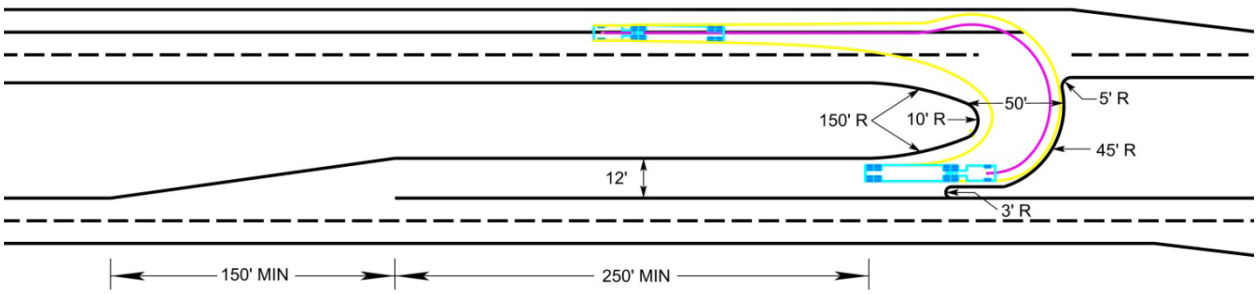


Figure 13 - Recommended MUT Crossover Design Detail for 101 ft Medians

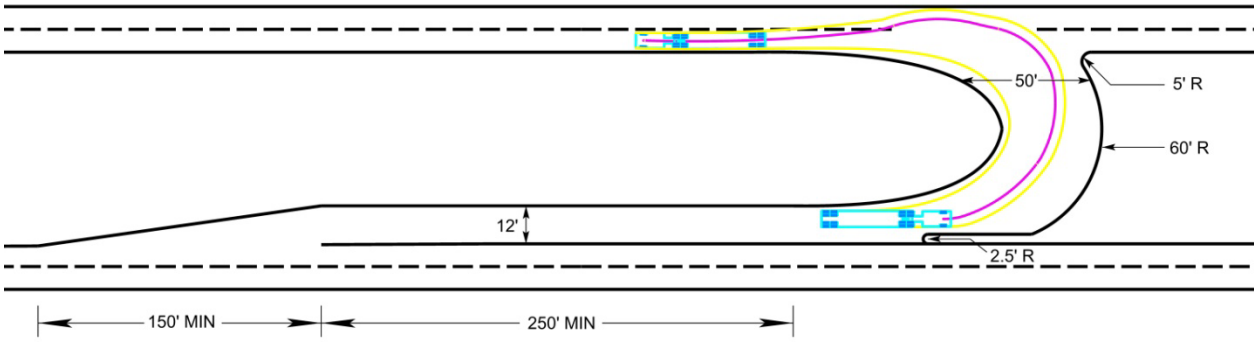
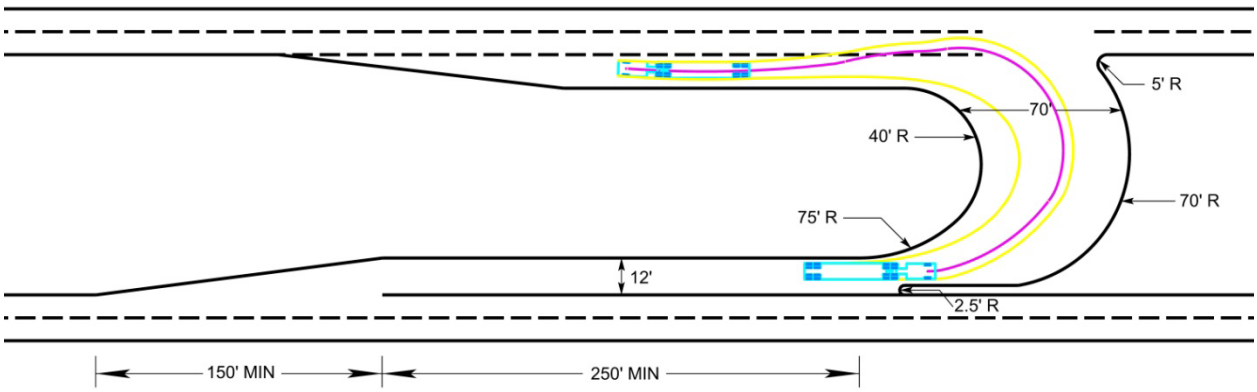


Figure 14 - Recommended MUT Crossover Design Detail for 126 ft Medians



Typically, a common profile grade line is used for both roadways of divided highways where the median width is 64 ft or less. For median widths in excess of 64 ft, independent profile grade lines may be desireable because of the natural terrain. However, an appreciable grade differential between the divided roadways should be avoided at the MUT crossovers as well as at the J-Turn intersection. Traffic entering from the crossroad may make a wrong-way maneuver if the pavement of the far roadway is obscured because of grade differential. In general, the grade of the crossover connections should not exceed 6%. **Table 2** provides the maximum elevation differential between adjacent roadways for various horizontal distances between centerlines. Typical gap acceptance times for a conventional intersection design are provided in **Table 3.**

Table 2 - Maximum Elevation Differential Between Adjacent Roadways

Horizontal Distance ℄ to ℄ (ft)	Maximum Profile Grade Differential With Crossover (ft)
64	1.0
88	2.0
125	4.2
150	5.7
200	8.7
250	11.7

Source: MDOT Roadway Design Manual

Table 3 - Typical Gap Acceptance Times for Conventional Intersections (seconds)

	2-Lane Facility Gap Times			4-Lane Facility Gap Times		
	Passenger Car	Single-Unit Truck	Tractor/Semi-Trailer	Passenger Car	Single-Unit Truck	Tractor/Semi-Trailer
Left-Turn from Minor Road	7.5	9.5	11.5	8.0	10.2	12.2
Right-Turn from Minor Road	7.5	9.5	11.5	7.5	9.5	11.5
Crossing	6.5	8.5	10.5	7.5	9.9	11.9
Left-Turn from Major Road	5.5	6.5	7.5	6.0	7.2	8.2

1. Crossover Spacing

MDOT *Roadway Design Manual* policy regarding median opening spacing states that median openings should be no closer than 880 ft apart in urban areas and 1,760 ft in rural areas. Based on existing information, utilizing existing median spacing required by MDOT design standards should be adequate and provide a safe distance for acceleration, weaving, and deceleration movements. However, access should never be allowed at MUT crossover locations, **therefore utilizing existing 880 ft (urban spacing) and 1760 ft (rural spacing) can be allowed if no access right-of-way can be provided adjacent to the MUT crossovers and other site conditions allow**. Generally, no access limits are preferred within 100 ft of the centerline of MUT crossovers. If the existing median openings are not suitable for conversion to MUT crossovers, **then new MUT crossover sites should be constructed no less than 800 ft and no more than 1,320 ft from the centerline of the J-Turn intersection.**

Recommended MUT Crossover Spacing Requirements:

MIN = 800 ft
MAX = 1,320 ft

Based on existing MDOT design criteria and historical highway construction by MDOT.

Several factors should be considered when selecting the appropriate spacing from the main J-Turn intersection to the two MUT crossovers. Longer spacing between the J-Turn intersection and MUT crossovers decrease spillback probabilities, providing more time and space for drivers to maneuver into the proper lane and react to highway signs. Shorter spacing between the J-Turn intersection and MUT crossovers translates into shorter weaving distances and travel times. Typical MUT crossover spacing requirements set forth by other agencies ranged from 560 ft to 1,320 ft and are provided in **Table 4**. Currently, criteria for a minimum weaving length for this treatment do not exist. The Type C weaving maneuver, as described in the *2000 Highway Capacity Manual*, is most closely compared to the weaving maneuver of a right-turn followed by a u-turn and may be applicable.

Table 4 - Other Agencies MUT Crossover Spacing Requirements

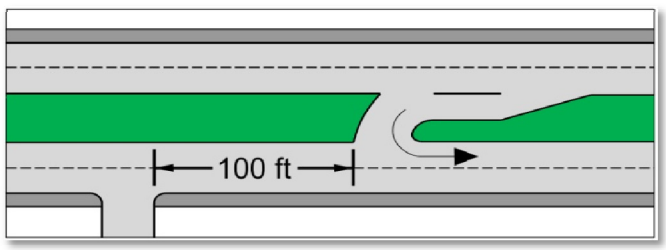
	Minimum	Maximum
AASHTO*	400 ft	600 ft
TRB Access Management Manual	660 ft	1,320 ft
North Carolina	800 ft	1,000 ft
Michigan	560 ft	760 ft
Oregon	990 ft	1,320 ft
Missouri**	600 ft	1,000 ft

** Based on signalized intersection treatment*
*** Specific location to be determined via capacity analysis*

2. Access Management

When selecting a MUT crossover location for the J-Turn intersection design, the highway access type must be considered. The MUT crossover should be designed and built for single-direction u-turns only. At crossovers where u-turns are permitted at the same time as right-turns from a driveway, the potential for conflicts exists and should be considered. **Allowing roadway access near an existing median crossover is undesirable because of the increase in the number of conflict points.** If the desired location of the MUT crossover is located at an existing median opening of Type 2B or Type 3, access rights purchase should be considered to avoid potential access adjacent to the MUT crossover. **Reconfiguration of an existing median crossing should be designed to provide single-direction u-turns only**. Driveway access should be located a minimum of 100 feet away from the MUT crossovers, as illustrated in **Figure 15,** to discourage wrong way maneuvers and minimize conflicts.

Figure 15 – Minimum Driveway Spacing Near MUT Crossovers



3. Auxiliary Lanes

Auxiliary lanes should be provided at both of the MUT crossovers located downstream from the main J-Turn intersection. The MUT crossovers must be designed with exclusive deceleration/storage lanes on the main roadway with sufficient length and width to accommodate the expected volume of u-turning vehicles. **It is recommended that the exclusive u-turn/left-turn lanes at the MUT crossovers be a minimum of 250 ft in length with a 150 ft taper.** One-lane or two-lane crossovers for u-turns may be needed depending on traffic volume demands and the number of receiving lanes. ***However, if two-lane crossovers are used it is recommended that the crossover be signalized and therefore the J-Turn intersection design set forth in this report may not wholly apply.***

To better accommodate trucks and older drivers, acceleration lanes are recommended at the MUT crossover locations to provide traffic with the opportunity to enter the travel lanes at or near the speed of through traffic. The minimum acceleration lane length should be based on *MDOT Roadway Design Manual* requirements. **For situations where auxiliary lanes serving the J-Turn intersection are located downstream from a loon at a distance of 150 ft or less, it is recommended that an auxiliary lane be constructed to connect the loon and existing auxiliary lane.**

For median widths less than 64 ft, a minimum taper length of 75 ft is acceptable if there is insufficient distance to accommodate a 150 ft taper as recommended.

Figure 16 - 40 ft Median Intersection Design

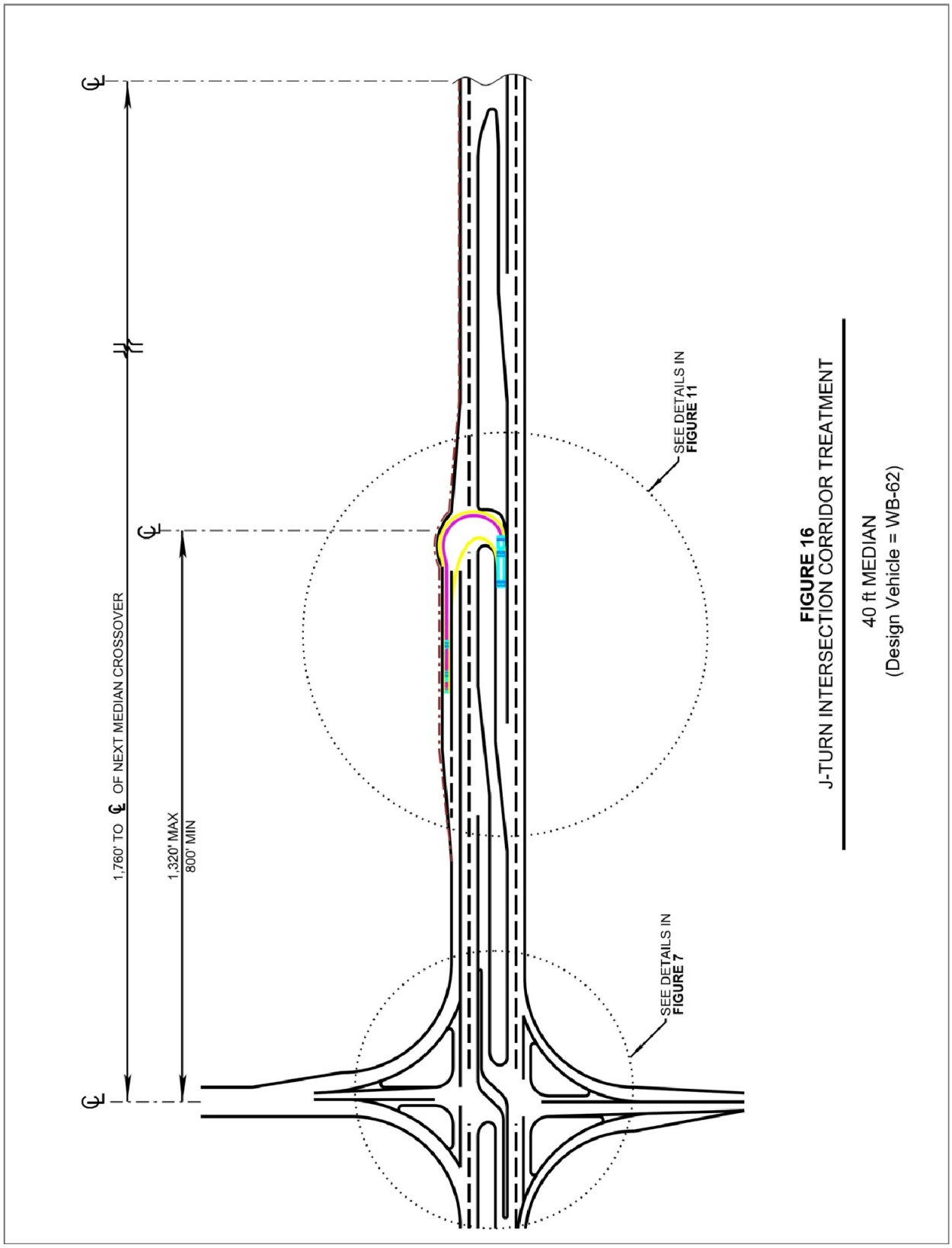


Figure 17 - 64 ft Median Intersection Design

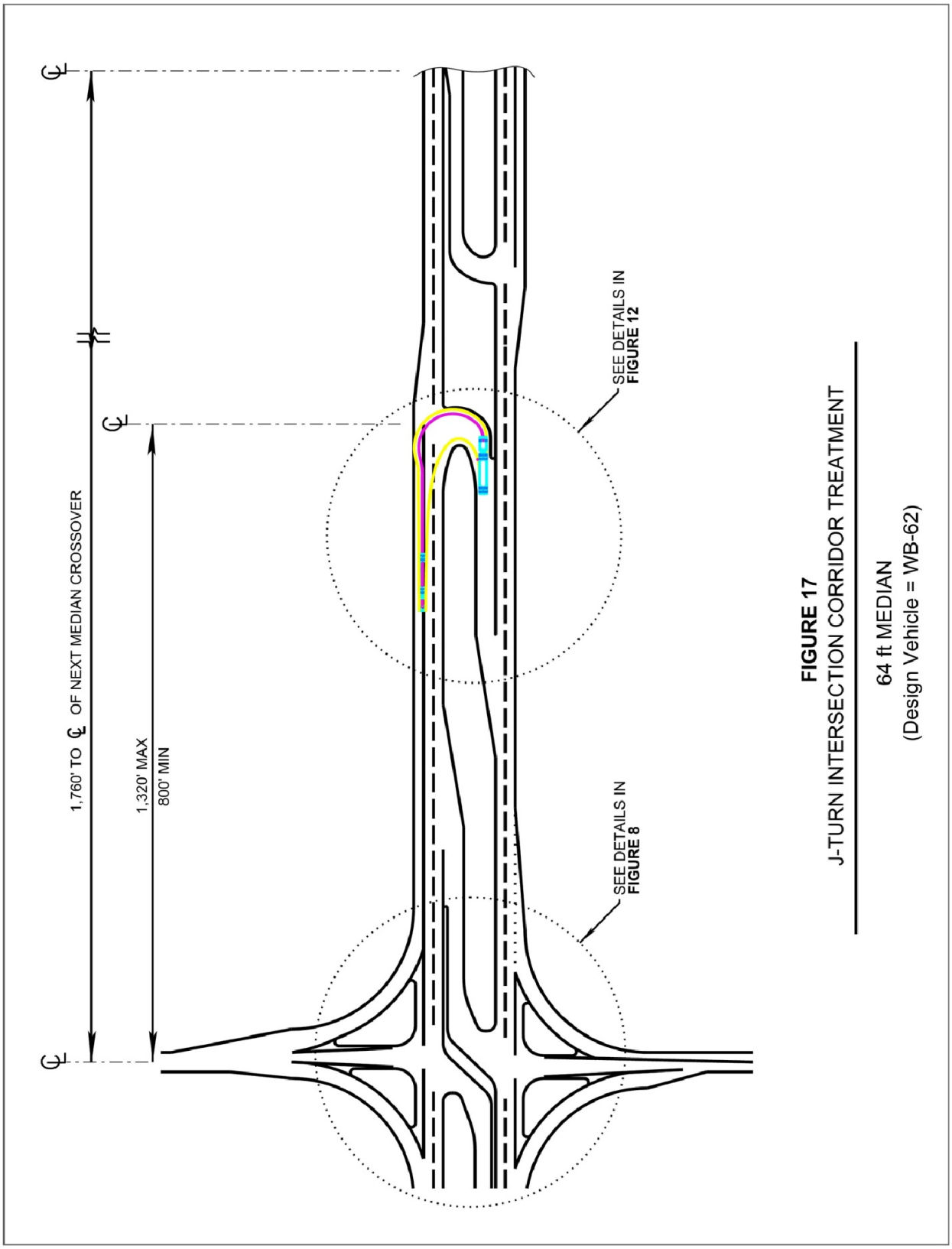


Figure 18 - 101 ft Median Intersection Design

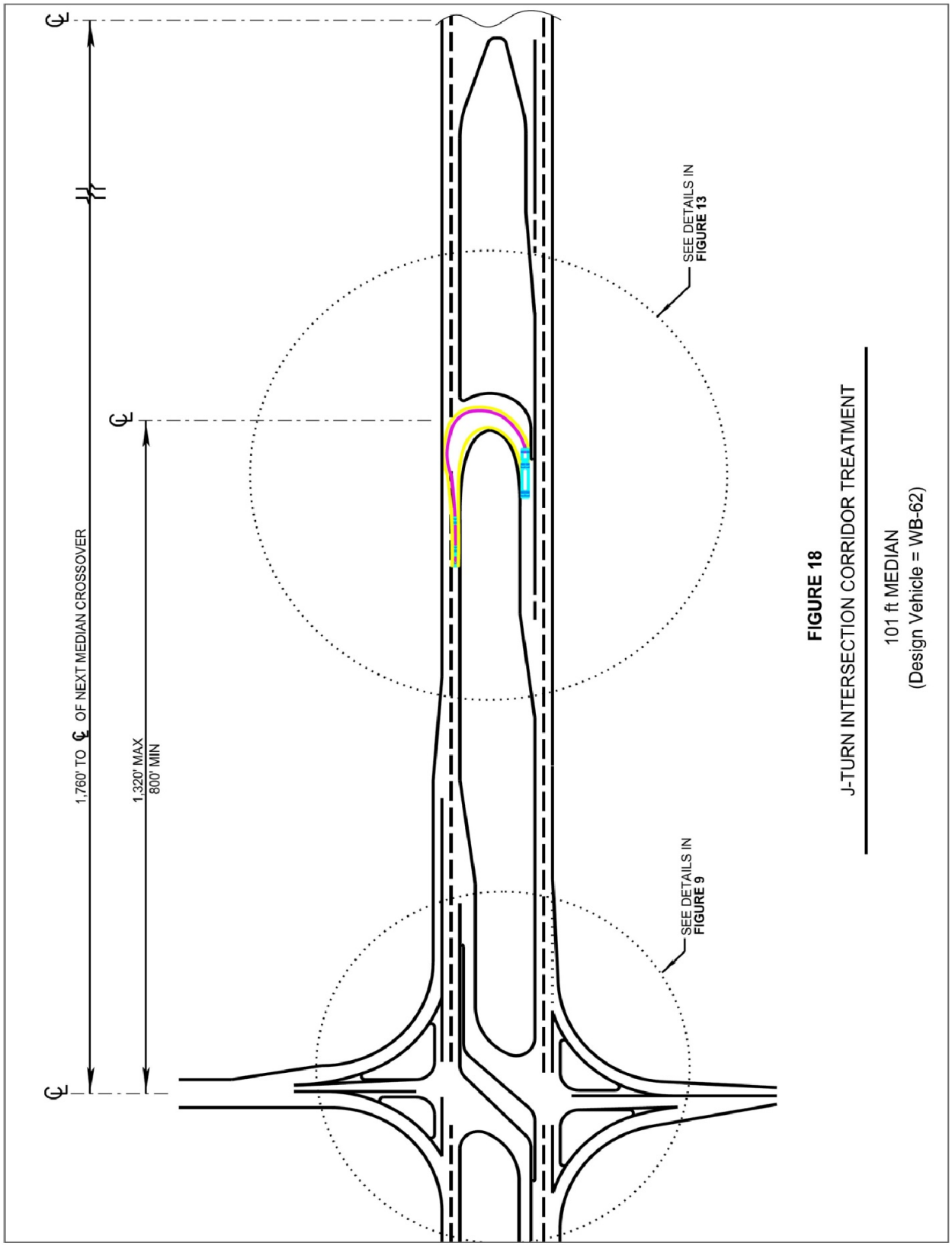
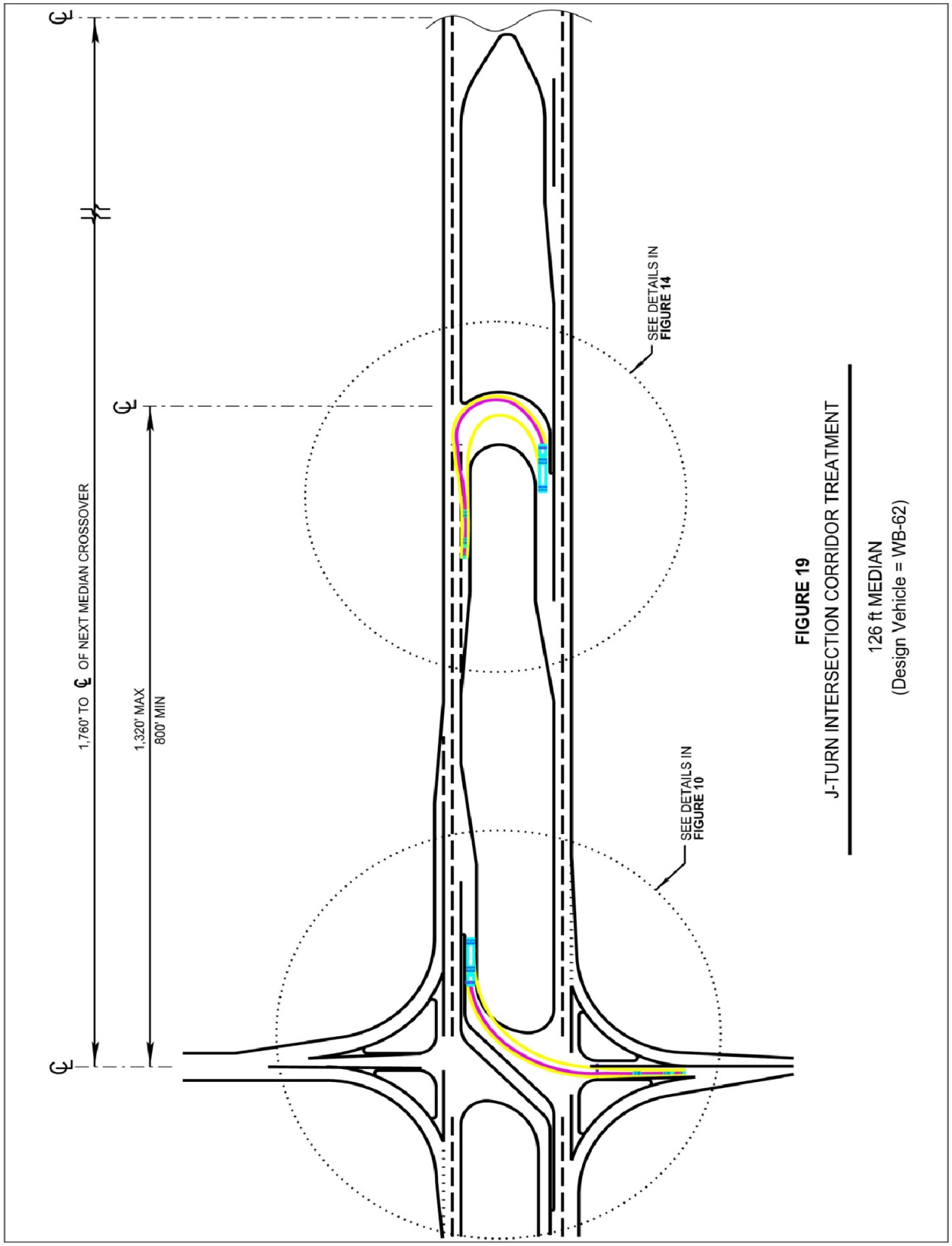


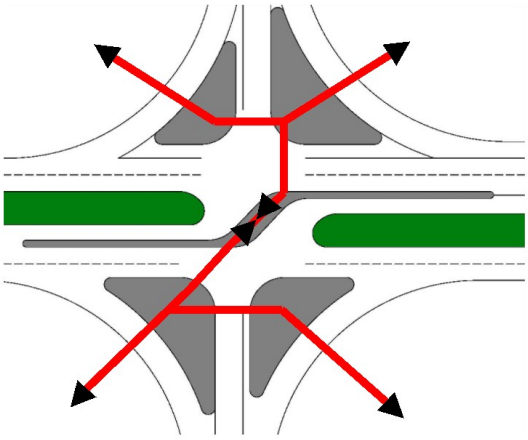
Figure 19 - 126 ft Median Intersection Design



VI. Pedestrian and Bicyclist Accommodations

Pedestrian crossings at a J-Turn intersection are discouraged due to the unsignalized complex crossing maneuvers required to traverse the intersection. The complex maneuvers required for pedestrians to cross a J-Turn intersection are shown in **Figure 20**. Should pedestrians be expected, the J-Turn intersection design may need to be modified to better accommodate them. The J-Turn intersection design may be modified such that the pedestrian crossing distances are shorter. Reducing the pedestrian crossing distance may be achieved by the elimination of right-turn lanes and/or channels, and using the tightest turning radii.

Figure 20 - Typical RCUT Pedestrian Crossings



Bicyclists desiring to make left turns from the side road face a choice of using pedestrian crosswalks to cross the major road and then the far side road or using the MUT crossovers in a manner similar to drivers of motor vehicles. Bicyclists on the major road approaches who want to turn left onto the side road are faced with a similar decision. They can use the pedestrian crosswalks to cross the side road leg and then the far major road leg. It is recommended agencies design the intersection to accommodate most left-turning bicyclists using the crosswalks. In urban areas, curb-cuts with ADA compliant ramps are recommended even if pedestrian crosswalks are not installed so they may be utilized by bicyclists who choose to walk across the intersection pushing their bicycle.

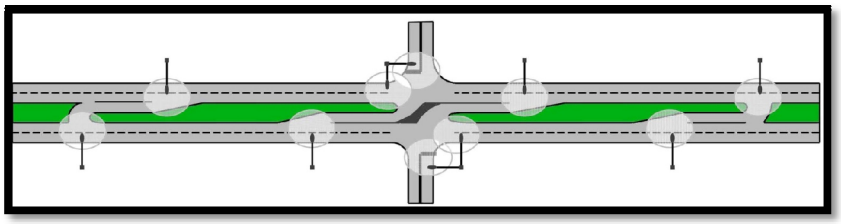
VII. Signals

For existing J-Turn intersections or MUT crossovers, traffic signal warrants contained in the MUTCD should be used in deciding whether or not to install a traffic signal. In this case, the higher major street left-turn volume or median u-turn volume can be treated as the minor street higher volume approach. **If either the J-Turn intersection or MUT crossovers warrant a traffic signal, then RCUT intersection design criteria should be evaluated.** RCUT intersection design criteria can be found in the FHWA publication *FHWA-HRT-09-060, Alternative Intersections/Interchanges: Informational Report (AIIR).*

VIII. Lighting

Since the J-Turn intersection design involves a relatively complex maneuver for left-turning vehicles, there may sometimes be the need to provide lighting at the J-Turn intersection and MUT crossovers. Particular consideration should be given to rural intersections where there may be a substantial need to enhance the visibility of drivers. Individual sites should be evaluated for lighting needs using guidelines such as the *NCHRP Report 152 – "Warrants for Highway Lighting"*. An example J-Turn corridor lighting treatment is illustrated in **Figure 21**.

Figure 21 – Typical Lighting for J-Turn Intersection and MUT Crossovers



IX. Signing

Signing at a J-Turn intersection and MUT crossovers is critical because the design may not meet the expectations of left-turning drivers unfamiliar with the intersection or intersection type. Therefore, a J-Turn intersection may require additional signing compared to a conventional intersection design. Positive guidance communicated through additional signs and pavement markings may be beneficial in reducing driver confusion and ensuring higher rates of driver compliance. The recommended MUT crossover signing is shown in **Figure 22** and the recommended J-Turn intersection signing is shown in **Figure 23**.

It is recommended that parking be proactively prohibited in and near loons. If loons or "bulb-outs" are included in the design, parking in those areas must be proactively prohibited through the use of regulatory signs such as R7-1 "No Parking Any Time".

Customized guide signs are recommended for inclusion in the J-Turn intersection and MUT crossover signing plans.

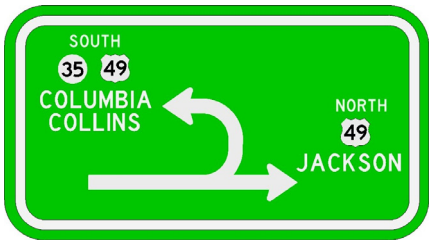


Figure 22 - Recommended MUT Crossover Signing Treatment

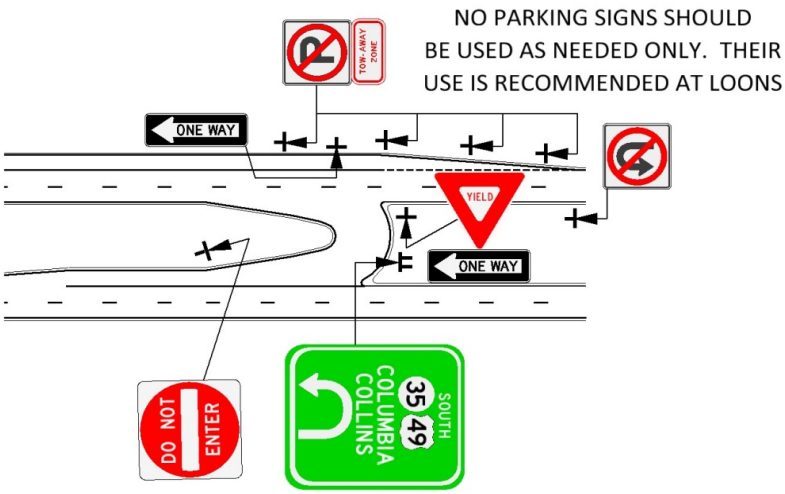
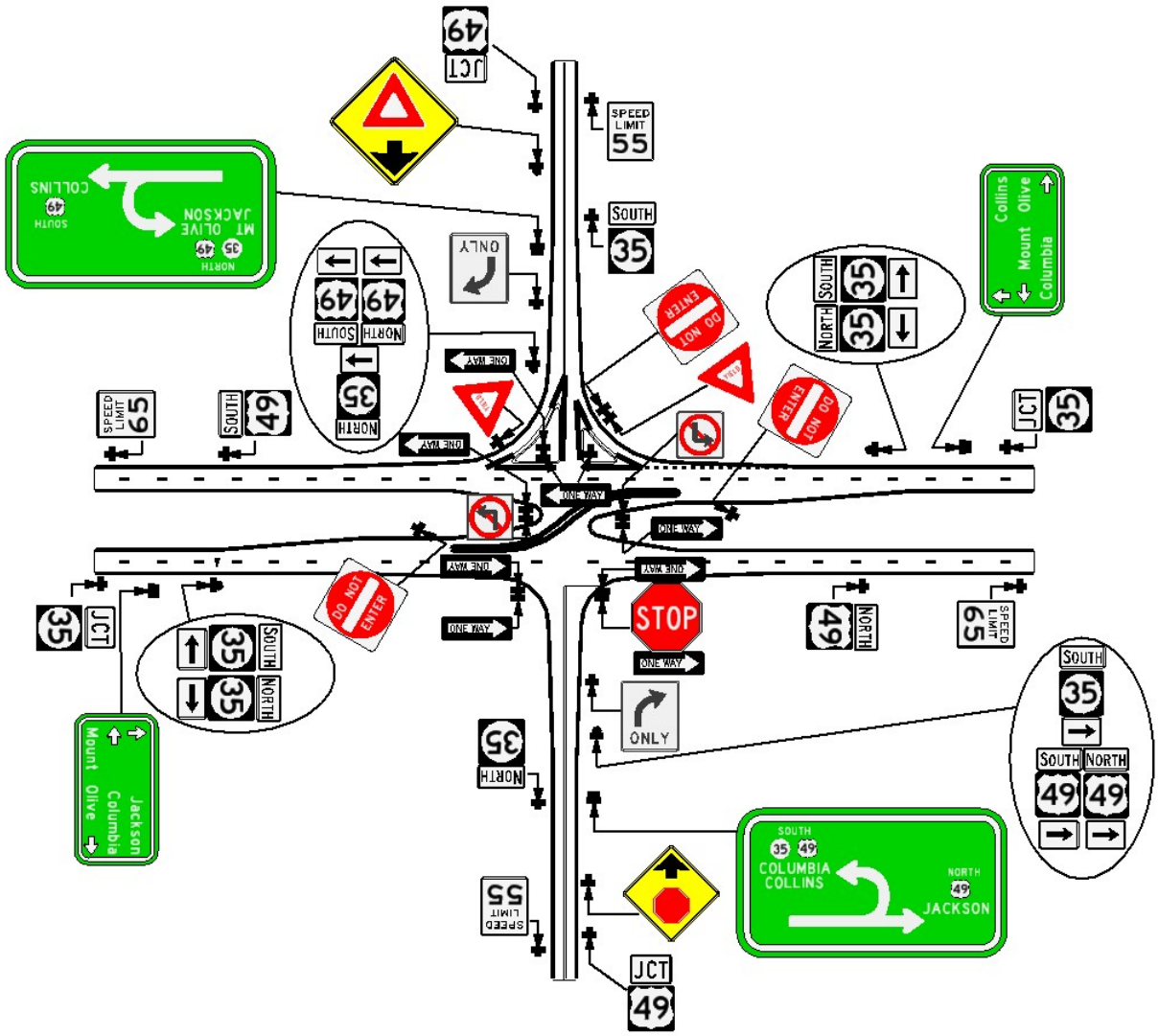


Figure 23 – Recommended J-Turn Intersection Signing Treatment

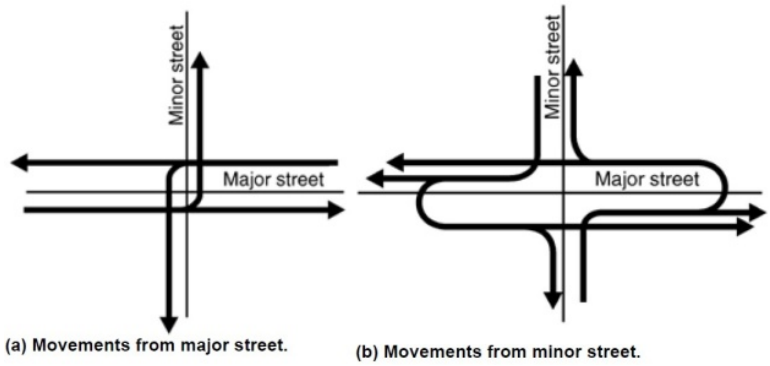


X. Safety Performance

A. Conflict Points Comparison

The assumed safety benefit of J-Turn intersections is that they reduce the potential for right-angle collisions (particularly far-side right-angle collisions) by eliminating direct crossing and left-turn maneuvers from the minor roads at two-way stop controlled (TWSC) expressway intersections. Minor road traffic wishing to turn left or cross straight through the intersection is forced to make these maneuvers indirectly by turning right, weaving to the left, making a downstream u-turn, and then returning to the intersection to complete their desired maneuver (illustrated in **Figure 24**). However, J-Turn intersections may potentially lead to an increase in rear-end and sideswipe collisions related to weaving maneuvers and u-turns when compared to a typical TWSC intersection.

Figure 24 - J-Turn Intersection Vehicle Maneuvers (FHWA)



There is no suggestion that u-turns at unsignalized median openings exhibit increased crash potential; therefore, the J-Turn intersection design replaces the high risk, far-side conflict points associated with direct minor road left-turns and crossing maneuvers with less risky conflict points associated with right-turns, u-turns, and weaving maneuvers. Not only are the total number of conflict points reduced, but more importantly the J-Turn intersection eliminates 14 crossing path conflict points present at a TWSC intersection, greatly reducing the opportunity for right-angle collisions. The J-Turn intersection design exhibits 20 conflict points compared to 32 at a TWSC intersection. **Figure 25** shows a conflict-point diagram for a conventional TWSC intersection and **Figure 26** shows a conflict-point diagram for a J-Turn intersection.

Figure 25 - Conflict-Point Diagram for Conventional Intersection (FHWA)

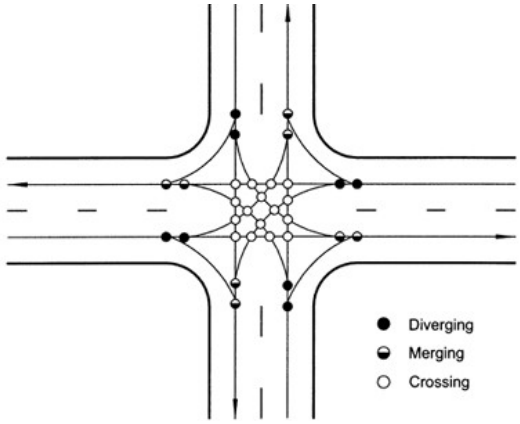
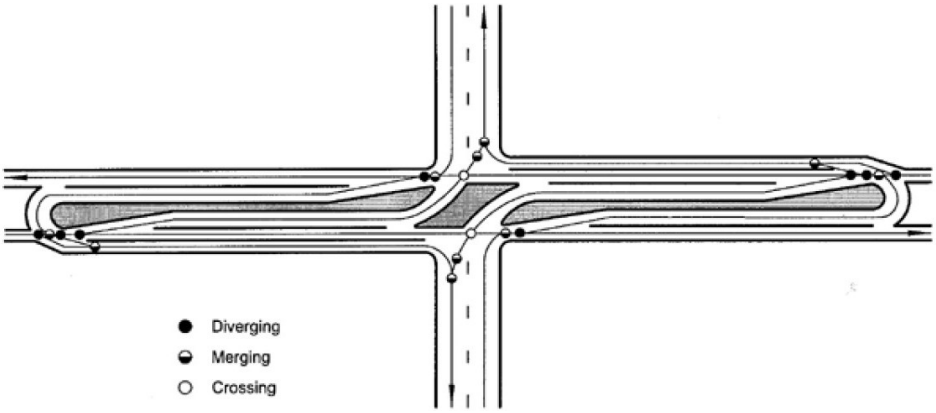


Figure 26 - Conflict-point Diagram for J-Turn Intersection (FHWA)



B. Crash Risk

All movements through a typical TWSC expressway intersection do not have the same crash risk. The highest risk movements (i.e., those accounting for the largest share of severe crashes) tend to be minor road maneuvers across the far-side of the intersection (i.e., left-turn and crossing maneuvers from the minor roadway). Thus, elimination of these maneuvers and their associated conflict points can be an effective means of improving expressway intersection safety. *NCHRP Report 420* reports an estimated 20% reduction in accident rates by replacing direct left-turns from driveways with right-turn/u-turn treatments. **Table 5** provides the accident rate per million turning vehicles for both full and directional median openings.

Table 5 - Median Accident Rate per Million Turning Vehicles

Median Opening Type	Accident Rate (per 10^6 turning vehicles)
Directional Midblock	0.29
Directional 3-Leg	1.40
Directional 4-Leg	2.57
Full 3-Leg	2.69
Full 4-Leg	3.01

Source: NCHRP Report 524

C. Case Studies

The NCDOT Safety Evaluation Group performed *Spot Safety Studies* at various locations where conventional intersections and/or median crossovers were converted to J-Turn intersections and MUTs. The purpose of the study was to determine what effect the modifications had on the collision patterns at the subject intersection over a three year period. The study sites are listed below and a summary of the before and after collision results are provided in **Table 6** and **Table 7.**

- US 23/74 @ NC 1155 – Haywood County, North Carolina
- US 23/74 @ NC 1243/1158 – Haywood County, North Carolina
- US 29-70/I-85 Business @ SR 1774 – Davidson County, North Carolina
- US 74 Bypass @ US 74 Service Rd. (near NC 226) – Cleveland County, North Carolina

- US 70 @ SR 1731 (Piney Grove Rd.) – Wayne County, North Carolina

Table 6 – Case Studies Collision Summary by Type

	BEFORE J-Turn	AFTER J-Turn	% CHANGE
Rear End	13	8	-38%
Angle	47	0	-100%
Turning	32	10	-69%
Sideswipe	8	3	-63%
TOTAL	**100**	**21**	**-79%**

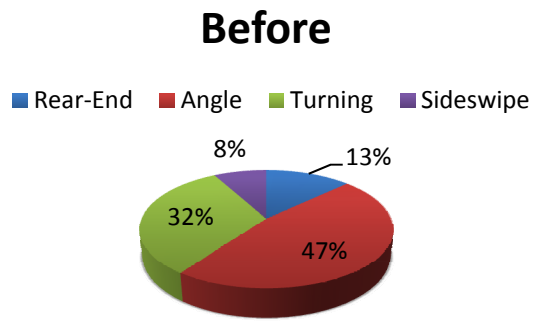
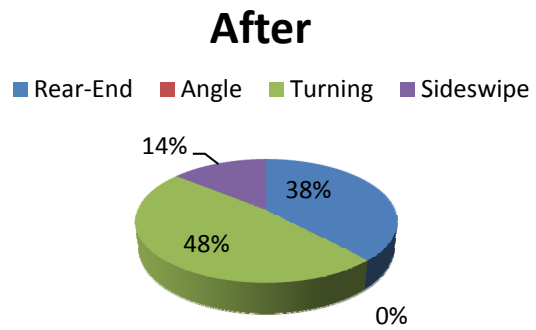


Table 7 – Case Studies Collision Summary by Severity

	BEFORE J-Turn	AFTER J-Turn	% CHANGE
Injury	56	10	-82%
Fatality	2	1	-50 %



In order to track the results of J-Turn intersection treatments, it is recommended that post-implementation safety studies be performed and shared with other transportation agencies. A minimum 3-year post-implementation period for crash analysis is recommended.

XI. Project Budget Considerations

Mobilization, overhead lighting, pavement markings, grading and drainage costs were not significantly different between the J-Turn intersection design and a conventional intersection design. In most cases no special grading or features such as retaining walls are needed.

Additional utility relocations and right-of-way acquisitions may increase the cost of a J-Turn intersection to a slightly higher level than a conventional intersection. Additional pavement width or reinforced shoulders are common in J-Turn intersection designs and extra funds for those elements should be budgeted.

Additional permanent roadway signing is frequently required at a J-Turn intersection than at a conventional intersection. Additional regulatory signing and guide signs for the traffic using the crossovers for left-turn maneuvers can create substantial additional cost. Additional temporary signing and variable message signs may be desirable during the construction phase and initial period of operation to provide additional clarification to unfamiliar drives. Public involvement and media costs associated with driver education can also be a significant component of the project budget and should not be overlooked.

XII. Construction Phasing

Maintenance of traffic during the construction of a J-Turn intersection is similar to that of conventional intersections, and other impacts such as to emergency vehicles, buses, and bicyclists are not likely to be major issues. The recommended stages of construction are as follows:

Phase #1 – Construction of elements necessary for the design vehicle to execute median u-turns.

1 A: Perform work along the outside of the outermost through lanes. This could include:

- Shoulder widening;
- Pavement structure reinforcement or reconstruction;
- Loon construction; and
- Right-turn lane construction (also used as a loon).

1B: Construct median deceleration lanes and u-turn crossovers.

Phase #2 – Construction at the main intersection to prohibit left turns from the minor roadway.

2A: Construction of channelization on the minor roadway that forces all traffic approaching from the minor roadway to turn right.

2B: Construction of median channelization that will ultimately prohibit turns from the minor road approaches but will allow left turns from the main roadway onto the minor roadway.

While the median channelization is under construction the median should be temporarily closed to all traffic. Any traffic desiring to access the minor roadway will be detoured straight through the intersection and then execute a u-turn at the downstream MUT crossover that was constructed under Phase #1.

Phase #3 – Final surface course pavement will be installed. Permanent striping and signing will be installed. Median will be reopened allowing left-turns form the main roadway onto the minor roadway.

XIII. Public Involvement

The potential for confusion with the J-Turn intersection concept exists for any driver who is unfamiliar with the concept or any geographical area that has never been exposed to the concept. A public information campaign that is designed by a team of transportation and media professionals is recommended if it is believed that confusion may occur with the J-Turn intersection implementation. The media campaign should be implemented with sufficient time to educate the public about the design concept and to prepare for a successful opening of the new intersection.

As with any change in traffic operations, driver confusion and acceptance is a concern. The design of a media campaign should be done in coincidence with the roadway design efforts. The execution of the media campaign may need to begin prior to roadway construction activities. That decision may be driven by the estimated construction time and may also depend on construction phasing needed for the specific project. Previous experiences with J-Turn intersection installations in Maryland and at RCUT intersection installations in North Carolina indicate that drivers adapt well to the J-Turn intersection design.

It is sometimes difficult to illustrate unfamiliar traffic operation concepts to the public using traditional drawings and written or verbal descriptions. The implementation of a microsimulation model may be worthwhile for achieving clear public understanding.

Microsimulation modeling software is a tool that is now commonly used to graphically illustrated concepts. The conceptual and operational illustration of a J-Turn intersection design and may be considered useful in any J-Turn media campaign.

A typical J-Turn intersection microsimulation model can be developed and used over and over in media campaigns and public involvement meetings to provide clear illustrations of the J-Turn concept at most any proposed location.

XIV. Summary of Recommendations

Situations most suitable for the J-Turn Intersection treatment:

- Low volume divided expressways.
- Low to medium side-street through volumes and heavy left-turn volumes from the major road.
- Minor road total volume to total intersection volume ratio is typically less than or equal to 0.20.
- Median widths are 64 ft and larger.
- High number of far-side right-angle collisions.
- Minor road crossing traffic gap times are insufficient.
- Intersections with more major road left-turns than minor road through movements.

Design Elements:

- All references contained in this document refer to the 2001 edition of the *MDOT Roadway Design Manual*, which is currently undergoing a major revision. Therefore, the designer should verify that the most recent edition is being used.
- 65 mph design speed for multi-lane arterials and collectors.
- WB-62 design vehicle.
- Typical maximum superelevation rate of 10%.
- 30 ft clear zone.
- J-Turn intersection design must meet the intersection sight-distance requirements for an at-grade intersection as set forth in the *MDOT Roadway Design Manual*.
- MUT crossover design must meet the stopping-sight distance requirements set forth for median openings in the *MDOT Roadway Design Manual*.

Cross-Sectional Elements:

- Median widths should be greater than 64 ft.
- For median widths of 64 ft and less, additional design considerations such as shoulders with strengthened full-depth pavement or loons are needed.
- 12 ft travel lanes and auxiliary lanes.
- Shoulder widths are variable and should be determined according to the *MDOT Roadway Design Manual*.
- If loons are included in the design, the total outside shoulder width should be 6 ft, with a minimum of 4 ft paved in the vicinity of the loons.
- Right-of-way width should be a minimum of 240 ft.

J-Turn Intersection Design Elements:

- Turning radii treatments should accommodate the design vehicles appropriate for the area type and functional classification of the intersecting roadways.
- Curbs should be mountable, Type 2, to allow emergency vehicles to cross the curb if required.
- Driveways should not be allowed near the J-Turn intersection.

- If the side roads are not of the boulevard or expressway type, right-turn channels should be installed to minimize wrong way maneuvers. If right-turn channels are included in the design, the distance to the MUT crossover may need to be increased.
- Design must include exclusive right-turn lanes on the main roadway, at least 200 ft in length with a 150 ft taper.
- Design must include exclusive left-turn lanes on the main roadway, at least 250 ft in length with a 150 ft taper.
- Dual right-turn lanes are acceptable.
- In areas where the median width is less than 64 ft, a minimum taper length of 75 ft is acceptable.
- Appreciable grade differential between the divided roadways should be avoided.

MUT Crossover Design Elements:

- Turning radii treatments should accommodate the design vehicles appropriate for the area type and functional classification of the intersecting roadways.
- Driveways should not be allowed near or on the opposite side of arterial from the crossovers.
- Appreciable grade differential between the divided roadways should be avoided.
- Grade of the crossover connections should not exceed 6%.
- Utilizing existing 880 ft (urban spacing) and 1760 ft (rural spacing) can be allowed if no access right-of-way can be provided adjacent to the MUT crossovers and other site conditions allow.
- New MUT crossover sites should be constructed no less than 800 ft and no more than 1,320 ft from the centerline of the J-Turn intersection.
- If the desired location of the MUT crossover is located at an existing median opening of Type 2B or Type 3, access rights purchase should be considered.
- Reconfiguration of an existing median crossing should be designed to provide single-direction u-turns only.
- Driveway access should be located a minimum of 100 ft away from the MUT crossovers.
- Design must include exclusive u-turn lanes on the main roadway, at least 250 ft in length with a 150 ft taper.
- If the median is wide enough, design should include acceleration lanes in the median for u-turning vehicles.
- Where auxiliary lanes serving the J-Turn intersection are located downstream from a loon, at a distance of 150 ft or less, the auxiliary lane should be constructed to connect the loon and existing auxiliary lane.

Other Considerations:

- Pedestrian crossings at a J-Turn intersection are discouraged.
- In urban areas with a high number of bicyclists, curb-cuts with ADA compliant ramps should be included in the design even if pedestrian crosswalks are not installed.
- Individual sites should be evaluated for lighting needs using guidelines such as the *NCHRP Report 152 – "Warrants for Highway Lighting".*
- Signing is critical to help meet driver expectations.
- Positive guidance communicated through additional signs and pavement markings may be beneficial.

- Parking should be proactively prohibited in the vicinity of “bulb-outs” and loons.
- Customized guide signs specifically designed for this type of intersection treatment should be included in the signing plans.
- 3-year post-implementation safety studies should be performed for crash analyses and shared with other transportation agencies.
- If it is believed that driver confusion may occur, transportation and media professionals should design a public information campaign to educate those impacted. Use of microsimulation models can be helpful.
- Additional funds should be budgeted for items including added pavement widths, reinforced shoulders, custom signing, and driver education through public involvement and media campaigns.
- Stages of construction should be:
  Phase #1 – Construction of elements necessary for the design vehicle to execute median u-turns.
  Phase #2 – Construction at the main intersection to prohibit left-turns from the minor roadway.
  Phase #3 – Final pavement striping and signing installed.

For typical MDOT median widths, the recommended geometric designs of the J-Turn intersection and MUT crossovers are shown on pages 15 – 18.

XV. Glossary

AASHTO

American Association of State Highway Transportation Officials

Access

A public or private roadway used to enter or leave a public highway from adjacent land using a legal motor vehicle. An access may be a driveway or a street.

Arterial

Roadway that provides the highest level of service at the greatest speed for the longest uninterrupted distance with some degree of access control.

Auxiliary Lanes

The portion of the roadway adjoining the traveled way for speed change, turning, storage for turning, weaving, truck climbing, and other purposes supplementary to through-traffic movement.

Clear Zone

Term used to designate the unobstructed, relatively flat area provided beyond the edge of the traveled way for recovery of errant vehicles. The clear zone includes any shoulders or auxiliary lanes.

Collector

Roadway that provides a less highly developed level of service at a lower speed for shorter distances by collecting traffic from local roads and connecting them with arterials.

Conflict-Point

Represent locations where vehicle paths cross as they move from one intersection leg to another.

Conventional Intersection

A four-leg intersection with full median opening.

Corridor

A set of essentially parallel transportation facilities designed for travel between two points. A corridor contains several subsystems, such as freeways, rural (or two-lane) highways, arterials, transit, and pedestrian and bicycle facilities.

Design Speed

A selected speed used to determine the various geometric design features of the roadway.

Design Vehicle

Selected vehicles, with representative weight, dimensions, and operating characteristics used to establish highway design controls for accommodating vehicles of the designated classes.

Directional Median Opening

An opening in a restrictive median which provides for u-turns and/or left-turn ingress or egress movements.

Downstream
The direction of traffic flow.

Expressway
A high-speed (≥ 50 mph), multi-lane, divided highway with partial access control.

FHWA
Federal Highway Administration

Full Median Opening
An opening in a restrictive median that allows all turning and through movements to be made.

Gap Time
The time, in seconds, for the front bumper of the second of two successive vehicles to reach the starting point of the front bumper of the first vehicle.

HCM
TRB's Highway Capacity Manual

J-Turn Intersection
A directional median opening combined with two median u-turns that allow left-turning traffic off the expressway, but forces left-turning and crossing minor road traffic to turn right, merge left, make a u-turn, and return to the intersection.

Loon
Expanded paved aprons opposite a median crossover used to facilitate the larger turning path of commercial vehicles along roadways with narrow medians.

Luminaire
A lighting unit consisting of one or more electric lamps with all of the necessary parts and wiring.

MDOT
Mississippi Department of Transportation

MUTCD
Manual on uniform Traffic Control Devices

Major Street
The intersecting street with greater traffic volume, larger cross-section, and higher functional class.

Median
The portion of a divided highway separating the traveled ways for traffic in opposing directions.

Median "Bulb-Out"
Widened median near vicinity of MUT crossovers to facilitate the larger turning path of commercial vehicles along roadways with narrow medians.

Median U-turn (MUT) Crossover
Crossover median openings that allow u-turn maneuvers only that are located downstream in both directions from the main J-Turn intersection.

Minor Street
The intersecting street with less traffic volume, smaller cross-section, and lower functional class than the major street.

NCHRP
National Cooperative Highway Research Program

Right-of-Way
A general term denoting land, property, or interest therein, usually a strip, acquired for or devoted to transportation purposes.

Roadway
The portion of a highway, including shoulders, for vehicular use. A divided highway has two or more roadways.

Shoulder
The portion of the roadway contiguous with the traveled way that accommodates stopped vehicles, emergency use, and lateral support for subbase, base, and surface courses.

Sight Distance
The length of the roadway ahead that is visible to the driver.

Signal Warrant
A threshold condition to determine whether a traffic signal is justified based on satisfaction of an engineering study. There are eight warrants currently provided in the latest edition of the MUTCD.

Superelevation
An increase in the normal roadway cross slope or transitional removal of adverse crown or cross slope to flat before gradually increasing the roadway slope or tilting the roadway surface to partially counterbalance the centripetal force (i.e., lateral acceleration) on a vehicle that is negotiating a horizontal curve.

TRB
Transportation Research Board

Traveled Way
The portion of the roadway for the movement of vehicles, exclusive of shoulders.

Upstream
The direction from which traffic is flowing.

Weaving
The crossing of traffic streams moving in the same general direction accomplished by merging and diverging.

XVI. Sources

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TABLE 2

Generalized **Annual Average Daily** Volumes for Florida's **Areas Transitioning into Urbanized Areas** OR **Areas Over 5,000 Not In Urbanized Areas**[1]

10/4/10

STATE SIGNALIZED ARTERIALS

Class I (>0.00 to 1.99 signalized intersections per mile)

Lanes	Median	B	C	D	E
2	Undivided	8,900	14,100	15,200	***
4	Divided	26,900	32,100	33,800	***
6	Divided	41,500	48,600	51,000	***

Class II (2.00 to 4.50 signalized intersections per mile)

Lanes	Median	B	C	D	E
2	Undivided	**	9,400	13,700	14,700
4	Divided	**	22,700	30,000	31,700
6	Divided	**	35,700	45,400	47,800

Class III (more than 4.5 signalized intersections per mile)

Lanes	Median	B	C	D	E
2	Undivided	**	4,700	10,700	13,400
4	Divided	**	11,500	25,500	28,900
6	Divided	**	18,000	39,800	43,900

FREEWAYS

Lanes	B	C	D	E
4	42,600	57,600	68,700	73,600
6	63,900	86,600	103,300	113,700
8	85,200	115,600	137,600	153,700
10	106,400	145,600	172,400	192,800

Freeway Adjustments

Auxiliary Lanes	Ramp Metering
+ 20,000	+5%

UNINTERRUPTED FLOW HIGHWAYS

Lanes	Median	B	C	D	E
2	Undivided	8,000	15,100	21,100	26,800
4	Divided	31,400	45,400	58,800	66,600
6	Divided	47,200	68,100	88,200	100,000

Uninterrupted Flow Highway Adjustments

Lanes	Median	Exclusive left lanes	Adjustment factors
2	Divided	Yes	+5%
Multi	Undivided	Yes	-5%
Multi	Undivided	No	-25%

Non-State Signalized Roadway Adjustments

(Alter corresponding state volumes by the indicated percent.)

Major City/County Roadways	- 10%
Other Signalized Roadways	- 35%

State & Non-State Signalized Roadway Adjustments

(Alter corresponding volume by the indicated percent.)

Divided/Undivided & Turn Lane Adjustments

Lanes	Median	Exclusive Left Lanes	Exclusive Right Lanes	Adjustment Factors
2	Divided	Yes	No	+5%
2	Undivided	No	No	-20%
Multi	Undivided	Yes	No	-5%
Multi	Undivided	No	No	-25%
–	–	–	Yes	+ 5%

One-Way Facility Adjustment

Multiply the corresponding two-directional volumes in this table by 0.6.

26,800 X 1.05 = 28,140

BICYCLE MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.

Paved Shoulder/ Bicycle Lane Coverage	B	C	D	E
0-49%	**	2,800	7,300	>7,300
50-84%	2,200	3,400	13,100	>13,100
85-100%	4,100	>4,100	***	***

PEDESTRIAN MODE[2]

(Multiply motorized vehicle volumes shown below by number of directional roadway lanes to determine two-way maximum service volumes.)

Sidewalk Coverage	B	C	D	E
0-49%	**	**	5,000	14,400
50-84%	**	**	11,300	18,800
85-100%	**	11,400	18,800	>18,800

[1] Values shown are presented as two-way annual average daily volumes for levels of service and are for the automobile/truck modes unless specifically stated. Although presented as daily volumes, they actually represent peak hour direction conditions with applicable K and D factors applied. This table does not constitute a standard and should be used only for general planning applications. The computer models from which this table is derived should be used for more specific planning applications. The table and deriving computer models should not be used for corridor or intersection design, where more refined techniques exist. Calculations are based on planning applications of the Highway Capacity Manual, Bicycle LOS Model, Pedestrian LOS Model and Transit Capacity and Quality of Service Manual, respectively for the automobile/truck, bicycle, pedestrian and bus modes.

[2] Level of service for the bicycle and pedestrian modes in this table is based on number of motorized vehicles, not number of bicyclists or pedestrians using the facility.

** Cannot be achieved using table input value defaults.

*** Not applicable for that level of service letter grade. For the automobile mode, volumes greater than level of service D become F because intersection capacities have been reached. For the bicycle mode, the level of service letter grade (including F) is not achievable because there is no maximum vehicle volume threshold using table input value defaults.

Source:
Florida Department of Transportation
Systems Planning Office
605 Suwannee Street, MS 19
Tallahassee, FL 32399-0450

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HIGHPLAN 2012 Conceptual Planning Analysis

Project Information

Analyst	RDD	**Highway Name**	HP Hwy	**Study Period**	**Kother**
Date Prepared	4/22/2011 1:23:21 PM	**From**	Transfer Center	**Analysis Type**	Multilane Segment
Agency	F&W	**To**	Mile Marker 14	**Program**	HIGHPLAN 2012
Area Type	Rural Developed	**Peak Direction**	Northbound	**Version Date**	12/12/2012

File Name	C:\2000 - Olowalu New Town\HighPlan Analysis\Highplan analysis for 4 lanes 20150411.xhp
User Notes	Daily future with project in 4 lane section

Highway Data

Roadway Variables				Traffic Variables			
Segment Length	5.000	**Median**	No	**AADT**	8000	**PHF**	1.000
# Thru Lanes	4	**Left Turn Impact**	No	**K**	0.095	**% Heavy Vehicles**	4.0
Terrain	Level	**Pass Lane Length**	N/A	**D**	0.575	**Base Capacity**	2100
Posted Speed	50	**% NPZ**	N/A	**Peak Dir. Hrly. Vol.**	437	**Local Adj. Factor**	0.88
Free Flow Speed	55	**Class**	3	**Off Peak Dir. Hrly. Vol.**	323	**Adjusted Capacity**	1721

LOS Results

v/c Ratio	0.13	**Density**	4.8	**PTSF**	N/A	**ATS**	55.0	**% FFS**	100.0
FFS Delay	0.0	**LOS Thresh. Delay**	27.3	**Service Measure**	Density	**LOS**	A		

Service Volumes

Note: The maximum normally acceptable directional service volume for LOS E in Florida for this facility type and area type is 1850 veh/h/ln.

	A	B	C	D	E
Lanes	**Hourly Volume In Peak Direction**				
1					
2	540	1260	1980	2580	3030
3	810	1890	2970	3870	4550
4	1080	2520	3960	5160	6060
Lanes	**Hourly Volume In Both Directions**				
2					
4	940	2200	3450	4490	5270
6	1410	3290	5170	6740	7920
8	1880	4390	6890	8980	10540
Lanes	**Annual Average Daily Traffic**				
* 2					
4	9900	23200	36400	47300	55500
6	14900	34700	54500	71000	83400
8	19800	46300	72600	94600	111000

Cannot be achieved based on

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Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	2947	2841	2923	2873	2860	2888
Vehs Exited	2879	2781	2861	2790	2782	2818
Starting Vehs	116	119	132	111	109	121
Ending Vehs	184	179	194	194	187	189
Denied Entry Before	1	0	0	2	0	1
Denied Entry After	1	0	0	1	0	0
Travel Distance (mi)	4979	4760	4935	4747	4799	4844
Travel Time (hr)	185.9	178.2	184.9	177.3	179.1	181.1
Total Delay (hr)	14.9	14.0	14.6	14.3	14.2	14.4
Total Stops	388	426	431	376	404	403
Fuel Used (gal)	150.6	144.3	149.2	142.8	144.9	146.4

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	752	756	693	706	674	717
Vehs Exited	690	687	656	643	619	658
Starting Vehs	116	119	132	111	109	121
Ending Vehs	178	188	169	174	164	172
Denied Entry Before	1	0	0	2	0	1
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	1299	1272	1162	1163	1120	1203
Travel Time (hr)	48.7	48.1	43.7	43.2	41.7	45.1
Total Delay (hr)	4.0	4.0	3.5	3.3	3.3	3.6
Total Stops	104	147	104	90	84	107
Fuel Used (gal)	39.1	39.1	35.2	34.9	34.0	36.4

Interval #2 Information

Start Time	7:15
End Time	7:30
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	733	710	722	716	728	721
Vehs Exited	713	743	689	704	720	714
Starting Vehs	178	188	169	174	164	172
Ending Vehs	198	155	202	186	172	180
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	2	2	0	0	1
Travel Distance (mi)	1237	1206	1198	1159	1225	1205
Travel Time (hr)	46.2	45.0	44.6	43.6	45.7	45.0
Total Delay (hr)	3.7	3.5	3.4	3.6	3.6	3.6
Total Stops	116	97	91	99	121	106
Fuel Used (gal)	37.5	36.5	36.2	34.6	36.6	36.3

Interval #3 Information

Start Time	7:30
End Time	7:45
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	744	681	753	719	739	728
Vehs Exited	746	662	765	725	719	720
Starting Vehs	198	155	202	186	172	180
Ending Vehs	196	174	190	180	192	187
Denied Entry Before	0	2	2	0	0	1
Denied Entry After	3	2	1	0	0	1
Travel Distance (mi)	1235	1134	1286	1238	1218	1222
Travel Time (hr)	45.9	42.4	48.0	46.1	45.3	45.5
Total Delay (hr)	3.6	3.3	3.8	3.8	3.5	3.6
Total Stops	96	84	123	89	98	97
Fuel Used (gal)	37.3	34.1	39.1	37.6	36.8	37.0

Interval #4 Information

Start Time	7:45
End Time	8:00
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	718	694	755	732	719	720
Vehs Exited	730	689	751	718	724	720
Starting Vehs	196	174	190	180	192	187
Ending Vehs	184	179	194	194	187	189
Denied Entry Before	3	2	1	0	0	1
Denied Entry After	1	0	0	1	0	0
Travel Distance (mi)	1208	1149	1289	1187	1237	1214
Travel Time (hr)	45.1	42.8	48.6	44.4	46.3	45.4
Total Delay (hr)	3.6	3.2	3.9	3.6	3.8	3.6
Total Stops	72	98	113	98	101	93
Fuel Used (gal)	36.8	34.5	38.8	35.8	37.5	36.7

2: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	1.8	0.1	1.9
Total Del/Veh (s)	5.7	0.2	3.3
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0
Total Stops	0	0	0
Stop/Veh	0.00	0.00	0.00
Travel Dist (mi)	467.3	15.5	482.8
Travel Time (hr)	17.6	1.3	18.9
Avg Speed (mph)	27	11	26
Fuel Used (gal)	13.1	1.4	14.6
Fuel Eff. (mpg)	35.6	10.7	33.1
HC Emissions (g)	209	27	236
CO Emissions (g)	3037	701	3738
NOx Emissions (g)	500	99	599
Vehicles Entered	1142	868	2010
Vehicles Exited	1138	868	2006
Hourly Exit Rate	1138	868	2006
Input Volume	1143	861	2004
% of Volume	100	101	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

3: Olowalu Access 2 & HP Hwy Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.0	0.0	0.1
Total Delay (hr)	0.2	0.1	0.1	0.4
Total Del/Veh (s)	2.2	0.7	1.8	1.1
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0	0.0
Total Stops	5	0	0	5
Stop/Veh	0.02	0.00	0.00	0.00
Travel Dist (mi)	14.6	121.9	25.0	161.6
Travel Time (hr)	0.8	4.3	1.0	6.1
Avg Speed (mph)	19	28	25	26
Fuel Used (gal)	0.3	3.7	0.6	4.6
Fuel Eff. (mpg)	43.3	33.1	40.4	34.8
HC Emissions (g)	3	46	5	54
CO Emissions (g)	107	955	119	1182
NOx Emissions (g)	10	133	14	157
Vehicles Entered	289	825	173	1287
Vehicles Exited	290	823	173	1286
Hourly Exit Rate	290	823	173	1286
Input Volume	295	806	175	1276
% of Volume	98	102	99	101
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

4: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	3.2	3.2
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	11.2	11.2
Travel Time (hr)	0.7	0.7
Avg Speed (mph)	16	16
Fuel Used (gal)	0.8	0.8
Fuel Eff. (mpg)	13.9	13.9
HC Emissions (g)	13	13
CO Emissions (g)	520	520
NOx Emissions (g)	42	42
Vehicles Entered	173	173
Vehicles Exited	173	173
Hourly Exit Rate	173	173
Input Volume	175	175
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0

5: External Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	0.6	0.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	96.6	96.6
Travel Time (hr)	3.4	3.4
Avg Speed (mph)	28	28
Fuel Used (gal)	3.1	3.1
Fuel Eff. (mpg)	31.1	31.1
HC Emissions (g)	31	31
CO Emissions (g)	901	901
NOx Emissions (g)	87	87
Vehicles Entered	1231	1231
Vehicles Exited	1230	1230
Hourly Exit Rate	1230	1230
Input Volume	1260	1260
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

6: HP Hwy & Mauka Access 2 Performance by movement

Movement	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.2	0.0	0.3
Total Del/Veh (s)	0.8	0.7	0.5	0.6
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.1	0.0
Total Stops	0	2	0	2
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	3.2	133.2	5.7	142.0
Travel Time (hr)	0.2	4.8	0.2	5.2
Avg Speed (mph)	20	28	23	27
Fuel Used (gal)	0.1	4.4	0.2	4.6
Fuel Eff. (mpg)	56.6	30.5	37.2	31.0
HC Emissions (g)	0	55	1	56
CO Emissions (g)	9	1316	40	1364
NOx Emissions (g)	1	161	3	165
Vehicles Entered	61	1306	55	1422
Vehicles Exited	60	1311	55	1426
Hourly Exit Rate	60	1311	55	1426
Input Volume	60	1295	60	1415
% of Volume	100	101	92	101
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

7: HP Hwy & O-turn 2E Performance by movement

Movement	EBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.5	0.6
Total Del/Veh (s)	1.9	1.6	1.6
Stop Delay (hr)	0.1	0.0	0.1
Stop Del/Veh (s)	1.6	0.0	0.3
Total Stops	62	2	64
Stop/Veh	0.28	0.00	0.05
Travel Dist (mi)	3.6	299.2	302.8
Travel Time (hr)	0.3	10.6	10.9
Avg Speed (mph)	10	28	28
Fuel Used (gal)	0.2	8.6	8.8
Fuel Eff. (mpg)	19.3	34.8	34.5
HC Emissions (g)	1	141	142
CO Emissions (g)	40	2388	2428
NOx Emissions (g)	5	379	384
Vehicles Entered	225	1134	1359
Vehicles Exited	225	1137	1362
Hourly Exit Rate	225	1137	1362
Input Volume	213	1142	1355
% of Volume	106	100	101
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: HP Hwy & O-turn 2E Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.4	0.6
Total Del/Veh (s)	2.8	1.5	1.8
Stop Delay (hr)	0.0	0.1	0.1
Stop Del/Veh (s)	0.6	0.3	0.4
Total Stops	42	62	104
Stop/Veh	0.19	0.07	0.09
Travel Dist (mi)	23.0	90.3	113.2
Travel Time (hr)	1.1	3.6	4.7
Avg Speed (mph)	21	25	24
Fuel Used (gal)	0.8	3.5	4.2
Fuel Eff. (mpg)	29.9	26.0	26.7
HC Emissions (g)	5	52	57
CO Emissions (g)	238	1422	1659
NOx Emissions (g)	20	159	180
Vehicles Entered	225	895	1120
Vehicles Exited	225	895	1120
Hourly Exit Rate	225	895	1120
Input Volume	213	888	1101
% of Volume	106	101	102
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

9: O-turn 2W Performance by movement

Movement	NBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.4	0.5
Total Del/Veh (s)	3.2	1.2	1.3
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.3	0.1	0.1
Total Stops	4	25	29
Stop/Veh	0.04	0.02	0.02
Travel Dist (mi)	16.4	182.7	199.1
Travel Time (hr)	0.7	6.6	7.3
Avg Speed (mph)	24	28	27
Fuel Used (gal)	0.5	5.5	5.9
Fuel Eff. (mpg)	35.1	33.5	33.6
HC Emissions (g)	4	74	78
CO Emissions (g)	86	1438	1525
NOx Emissions (g)	12	207	219
Vehicles Entered	109	1253	1362
Vehicles Exited	109	1247	1356
Hourly Exit Rate	109	1247	1356
Input Volume	106	1236	1342
% of Volume	103	101	101
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

10: HP Hwy & O-turn 2W Performance by movement

Movement	WBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.2	0.2
Total Del/Veh (s)	1.8	0.8	0.9
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	1.5	0.0	0.2
Total Stops	34	0	34
Stop/Veh	0.31	0.00	0.03
Travel Dist (mi)	1.9	184.4	186.3
Travel Time (hr)	0.2	6.4	6.6
Avg Speed (mph)	11	29	28
Fuel Used (gal)	0.1	5.3	5.3
Fuel Eff. (mpg)	20.2	35.1	34.9
HC Emissions (g)	1	45	46
CO Emissions (g)	26	821	847
NOx Emissions (g)	3	129	132
Vehicles Entered	109	868	977
Vehicles Exited	109	866	975
Hourly Exit Rate	109	866	975
Input Volume	106	851	957
% of Volume	103	102	102
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

11: HP Hwy & O-turn 1E Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.3	0.5
Total Del/Veh (s)	3.2	1.4	1.6
Stop Delay (hr)	0.0	0.0	0.1
Stop Del/Veh (s)	0.3	0.2	0.2
Total Stops	7	38	45
Stop/Veh	0.05	0.04	0.04
Travel Dist (mi)	17.6	120.1	137.8
Travel Time (hr)	0.8	4.5	5.3
Avg Speed (mph)	23	27	26
Fuel Used (gal)	0.5	4.0	4.5
Fuel Eff. (mpg)	32.8	30.2	30.5
HC Emissions (g)	4	48	52
CO Emissions (g)	130	1184	1314
NOx Emissions (g)	15	146	161
Vehicles Entered	130	894	1024
Vehicles Exited	130	891	1021
Hourly Exit Rate	130	891	1021
Input Volume	133	875	1008
% of Volume	98	102	101
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

12: O-turn 1E & HP Hwy Performance by movement

Movement	EBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.4	0.5
Total Del/Veh (s)	1.8	1.2	1.3
Stop Delay (hr)	0.1	0.0	0.1
Stop Del/Veh (s)	1.4	0.0	0.1
Total Stops	38	0	38
Stop/Veh	0.29	0.00	0.03
Travel Dist (mi)	2.3	257.4	259.7
Travel Time (hr)	0.2	9.1	9.3
Avg Speed (mph)	11	28	28
Fuel Used (gal)	0.1	7.4	7.5
Fuel Eff. (mpg)	20.4	35.0	34.7
HC Emissions (g)	1	123	124
CO Emissions (g)	29	2041	2069
NOx Emissions (g)	4	332	336
Vehicles Entered	130	1209	1339
Vehicles Exited	129	1202	1331
Hourly Exit Rate	129	1202	1331
Input Volume	133	1200	1333
% of Volume	97	100	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

13: O-turn 1 W Performance by movement

Movement	NBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.3	0.4
Total Del/Veh (s)	2.6	1.0	1.1
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.1	0.1	0.1
Total Stops	2	26	28
Stop/Veh	0.02	0.02	0.02
Travel Dist (mi)	8.5	129.1	137.6
Travel Time (hr)	0.4	4.7	5.1
Avg Speed (mph)	23	27	27
Fuel Used (gal)	0.2	4.1	4.3
Fuel Eff. (mpg)	35.1	31.7	31.9
HC Emissions (g)	1	60	61
CO Emissions (g)	38	1285	1324
NOx Emissions (g)	5	174	179
Vehicles Entered	81	1251	1332
Vehicles Exited	81	1250	1331
Hourly Exit Rate	81	1250	1331
Input Volume	76	1260	1336
% of Volume	107	99	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

14: HP Hwy & O-turn 1 W Performance by movement

Movement	WBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.0	0.3	0.3
Total Del/Veh (s)	2.1	1.0	1.1
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	1.7	0.0	0.1
Total Stops	30	0	30
Stop/Veh	0.37	0.00	0.03
Travel Dist (mi)	1.4	273.0	274.4
Travel Time (hr)	0.1	9.4	9.6
Avg Speed (mph)	10	29	29
Fuel Used (gal)	0.1	7.7	7.8
Fuel Eff. (mpg)	20.3	35.5	35.4
HC Emissions (g)	0	73	74
CO Emissions (g)	16	1245	1261
NOx Emissions (g)	2	206	208
Vehicles Entered	81	861	942
Vehicles Exited	81	860	941
Hourly Exit Rate	81	860	941
Input Volume	76	843	919
% of Volume	107	102	102
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

15: HP Hwy & Olowalu Access 1 Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	0.1	0.1	0.1	0.2
Total Del/Veh (s)	1.8	0.4	1.6	0.8
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0	0.0
Total Stops	2	0	0	2
Stop/Veh	0.01	0.00	0.00	0.00
Travel Dist (mi)	11.4	86.8	11.2	109.4
Travel Time (hr)	0.6	3.1	0.5	4.1
Avg Speed (mph)	21	28	23	27
Fuel Used (gal)	0.3	2.7	0.3	3.2
Fuel Eff. (mpg)	42.7	32.5	41.3	34.1
HC Emissions (g)	2	36	2	40
CO Emissions (g)	78	767	72	917
NOx Emissions (g)	7	102	6	115
Vehicles Entered	176	849	114	1139
Vehicles Exited	175	846	114	1135
Hourly Exit Rate	175	846	114	1135
Input Volume	175	832	110	1117
% of Volume	100	102	104	102
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

16: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	3.1	3.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	9.0	9.0
Travel Time (hr)	0.5	0.5
Avg Speed (mph)	18	18
Fuel Used (gal)	0.6	0.6
Fuel Eff. (mpg)	15.1	15.1
HC Emissions (g)	10	10
CO Emissions (g)	360	360
NOx Emissions (g)	31	31
Vehicles Entered	114	114
Vehicles Exited	113	113
Hourly Exit Rate	113	113
Input Volume	110	110
% of Volume	103	103
Denied Entry Before	0	0
Denied Entry After	0	0

17: RIRO Access & HP Hwy Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.1	0.0	0.1
Total Del/Veh (s)	0.5	0.6	0.2	0.6
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0	0.0
Total Stops	0	0	0	0
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	0.7	116.9	1.4	119.0
Travel Time (hr)	0.0	4.1	0.1	4.2
Avg Speed (mph)	20	29	25	29
Fuel Used (gal)	0.0	3.5	0.0	3.5
Fuel Eff. (mpg)	62.5	33.6	44.2	33.8
HC Emissions (g)	0	47	0	48
CO Emissions (g)	1	911	3	916
NOx Emissions (g)	0	138	0	138
Vehicles Entered	16	884	10	910
Vehicles Exited	16	883	10	909
Hourly Exit Rate	16	883	10	909
Input Volume	13	879	10	902
% of Volume	123	100	100	101
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

18: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.6	0.6
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	20	20
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	14.2	14.2
HC Emissions (g)	0	0
CO Emissions (g)	23	23
NOx Emissions (g)	1	1
Vehicles Entered	10	10
Vehicles Exited	10	10
Hourly Exit Rate	10	10
Input Volume	10	10
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

19: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.3	0.3
Total Del/Veh (s)	1.3	1.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	115.1	115.1
Travel Time (hr)	4.2	4.2
Avg Speed (mph)	27	27
Fuel Used (gal)	3.6	3.6
Fuel Eff. (mpg)	32.0	32.0
HC Emissions (g)	59	59
CO Emissions (g)	1163	1163
NOx Emissions (g)	174	174
Vehicles Entered	870	870
Vehicles Exited	871	871
Hourly Exit Rate	871	871
Input Volume	861	861
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0

20: HP Hwy Performance by movement

Movement	NBT	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.3	0.3
Total Del/Veh (s)	0.9	0.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	152.5	152.5
Travel Time (hr)	5.4	5.4
Avg Speed (mph)	28	28
Fuel Used (gal)	4.8	4.8
Fuel Eff. (mpg)	32.1	32.1
HC Emissions (g)	83	83
CO Emissions (g)	1694	1694
NOx Emissions (g)	229	229
Vehicles Entered	1136	1136
Vehicles Exited	1134	1134
Hourly Exit Rate	1134	1134
Input Volume	1142	1142
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0

21: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.4	1.4
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	112.3	112.3
Travel Time (hr)	4.1	4.1
Avg Speed (mph)	27	27
Fuel Used (gal)	3.3	3.3
Fuel Eff. (mpg)	33.5	33.5
HC Emissions (g)	54	54
CO Emissions (g)	878	878
NOx Emissions (g)	151	151
Vehicles Entered	871	871
Vehicles Exited	870	870
Hourly Exit Rate	870	870
Input Volume	861	861
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0

23: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.8	0.8
Total Del/Veh (s)	3.2	3.2
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	102.5	102.5
Travel Time (hr)	4.2	4.2
Avg Speed (mph)	24	24
Fuel Used (gal)	2.2	2.2
Fuel Eff. (mpg)	45.9	45.9
HC Emissions (g)	35	35
CO Emissions (g)	541	541
NOx Emissions (g)	80	80
Vehicles Entered	870	870
Vehicles Exited	867	867
Hourly Exit Rate	867	867
Input Volume	861	861
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0

24: Performance by movement

Movement	NBT	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.6	0.6
Total Del/Veh (s)	1.8	1.8
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	126.0	126.0
Travel Time (hr)	4.8	4.8
Avg Speed (mph)	26	26
Fuel Used (gal)	3.7	3.7
Fuel Eff. (mpg)	34.5	34.5
HC Emissions (g)	59	59
CO Emissions (g)	928	928
NOx Emissions (g)	140	140
Vehicles Entered	1137	1137
Vehicles Exited	1136	1136
Hourly Exit Rate	1136	1136
Input Volume	1143	1143
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0

26: Bend Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	0.6	0.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	41.9	41.9
Travel Time (hr)	1.6	1.6
Avg Speed (mph)	26	26
Fuel Used (gal)	1.2	1.2
Fuel Eff. (mpg)	35.6	35.6
HC Emissions (g)	19	19
CO Emissions (g)	271	271
NOx Emissions (g)	44	44
Vehicles Entered	1138	1138
Vehicles Exited	1137	1137
Hourly Exit Rate	1137	1137
Input Volume	1143	1143
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0

27: HP Hwy & Ehehene Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.4	0.0	0.0	0.0	0.4
Denied Del/Veh (s)	0.1	0.1	1.3	3.3	0.0	0.0	0.7
Total Delay (hr)	0.1	0.0	0.7	0.0	0.0	1.0	1.8
Total Del/Veh (s)	58.5	10.9	2.1	1.6	11.8	4.3	3.2
Stop Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	57.0	11.1	0.0	0.0	6.6	0.0	0.2
Total Stops	4	7	0	0	2	0	13
Stop/Veh	1.00	1.00	0.00	0.00	0.67	0.00	0.01
Travel Dist (mi)	0.2	0.3	223.8	0.4	1.1	352.5	578.3
Travel Time (hr)	0.1	0.0	8.6	0.0	0.0	13.0	21.8
Avg Speed (mph)	2	8	27	25	23	27	27
Fuel Used (gal)	0.0	0.0	6.5	0.0	0.0	11.2	17.8
Fuel Eff. (mpg)	9.3	28.0	34.2	36.7	30.0	31.5	32.5
HC Emissions (g)	0	0	106	0	0	202	309
CO Emissions (g)	1	2	1780	2	6	3917	5708
NOx Emissions (g)	0	0	272	0	1	546	819
Vehicles Entered	4	7	1136	2	3	866	2018
Vehicles Exited	4	7	1135	2	3	855	2006
Hourly Exit Rate	4	7	1135	2	3	855	2006
Input Volume	5	6	1137	2	3	859	2012
% of Volume	80	117	100	100	100	100	100
Denied Entry Before	0	0	1	0	0	0	1
Denied Entry After	0	0	0	0	0	0	0

28: Performance by movement

Movement	NBT	SET	SER	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0		0.0	0.0
Total Delay (hr)	0.1	0.0	0.7	0.8
Total Del/Veh (s)	0.3		2.8	1.4
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0		0.0	0.0
Total Stops	0	0	0	0
Stop/Veh	0.00		0.00	0.00
Travel Dist (mi)	23.9	0.0	29.3	53.2
Travel Time (hr)	0.9	0.0	2.3	3.2
Avg Speed (mph)	26	12	13	17
Fuel Used (gal)	0.7	0.0	0.7	1.4
Fuel Eff. (mpg)	35.6	37.2	40.7	38.2
HC Emissions (g)	11	0	11	22
CO Emissions (g)	154	0	194	349
NOx Emissions (g)	25	0	22	47
Vehicles Entered	1138	0	868	2006
Vehicles Exited	1138	0	868	2006
Hourly Exit Rate	1138	0	868	2006
Input Volume	1143	1	861	2005
% of Volume	100	0	101	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

29: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.4	0.4
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.2	0.2
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.2	0.2
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	20	20
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	12.1	12.1
HC Emissions (g)	0	0
CO Emissions (g)	11	11
NOx Emissions (g)	1	1
Vehicles Entered	5	5
Vehicles Exited	5	5
Hourly Exit Rate	5	5
Input Volume	5	5
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

30: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.4	3.4
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.2	0.2
Fuel Eff. (mpg)	14.2	14.2
HC Emissions (g)	2	2
CO Emissions (g)	141	141
NOx Emissions (g)	9	9
Vehicles Entered	55	55
Vehicles Exited	55	55
Hourly Exit Rate	55	55
Input Volume	60	60
% of Volume	92	92
Denied Entry Before	0	0
Denied Entry After	0	0

31: HP Hwy & Mauka Access1 Performance by movement

Movement	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.3	0.0	0.3
Total Del/Veh (s)	0.7	0.8	0.3	0.8
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0	0.0
Total Stops	0	0	0	0
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	2.9	168.7	8.2	179.8
Travel Time (hr)	0.1	6.0	0.3	6.5
Avg Speed (mph)	20	28	25	28
Fuel Used (gal)	0.1	5.1	0.2	5.4
Fuel Eff. (mpg)	57.3	32.8	40.9	33.3
HC Emissions (g)	0	69	2	71
CO Emissions (g)	13	1384	46	1444
NOx Emissions (g)	1	194	5	200
Vehicles Entered	60	1271	60	1391
Vehicles Exited	60	1265	60	1385
Hourly Exit Rate	60	1265	60	1385
Input Volume	60	1273	60	1393
% of Volume	100	99	100	99
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

32: Conn to Transfer Sta/Transfer Station Performance by movement

Movement	EBT	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.9	0.0	0.9
Total Del/Veh (s)	11.3	8.2	2.5	0.6	2.5
Stop Delay (hr)	0.0	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	10.1	8.7	0.0	0.0	0.1
Total Stops	5	2	2	0	9
Stop/Veh	1.00	1.00	0.00	0.00	0.01
Travel Dist (mi)	0.1	0.3	390.8	1.0	392.2
Travel Time (hr)	0.0	0.0	14.0	0.0	14.1
Avg Speed (mph)	5	17	28	28	28
Fuel Used (gal)	0.0	0.0	11.5	0.0	11.6
Fuel Eff. (mpg)	18.2	37.4	33.9	36.7	33.9
HC Emissions (g)	0	0	149	0	149
CO Emissions (g)	0	0	2677	4	2682
NOx Emissions (g)	0	0	434	0	435
Vehicles Entered	5	2	1282	3	1292
Vehicles Exited	5	2	1268	3	1278
Hourly Exit Rate	5	2	1268	3	1278
Input Volume	5	2	1296	2	1305
% of Volume	100	100	98	150	98
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

33: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.7	1.7
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	1.1	1.1
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	26	26
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	21.0	21.0
HC Emissions (g)	0	0
CO Emissions (g)	22	22
NOx Emissions (g)	2	2
Vehicles Entered	8	8
Vehicles Exited	8	8
Hourly Exit Rate	8	8
Input Volume	7	7
% of Volume	114	114
Denied Entry Before	0	0
Denied Entry After	0	0

34: HP Hwy & Conn to Transfer Sta Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	2.8	0.2	0.2
Total Delay (hr)	0.0	0.0	0.0
Total Del/Veh (s)	0.2	0.2	0.2
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0
Total Stops	0	0	0
Stop/Veh	0.00	0.00	0.00
Travel Dist (mi)	0.4	60.8	61.2
Travel Time (hr)	0.0	2.1	2.1
Avg Speed (mph)	26	29	29
Fuel Used (gal)	0.0	1.9	1.9
Fuel Eff. (mpg)	31.1	32.6	32.6
HC Emissions (g)	0	20	20
CO Emissions (g)	6	493	499
NOx Emissions (g)	0	56	56
Vehicles Entered	5	860	865
Vehicles Exited	5	861	866
Hourly Exit Rate	5	861	866
Input Volume	5	843	848
% of Volume	100	102	102
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

35: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.6	0.6
Total Del/Veh (s)	2.6	2.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	177.4	177.4
Travel Time (hr)	6.6	6.6
Avg Speed (mph)	27	27
Fuel Used (gal)	5.5	5.5
Fuel Eff. (mpg)	32.0	32.0
HC Emissions (g)	93	93
CO Emissions (g)	1869	1869
NOx Emissions (g)	238	238
Vehicles Entered	859	859
Vehicles Exited	852	852
Hourly Exit Rate	852	852
Input Volume	864	864
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0

36: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.5	3.5
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.3	0.3
Fuel Eff. (mpg)	13.9	13.9
HC Emissions (g)	4	4
CO Emissions (g)	164	164
NOx Emissions (g)	12	12
Vehicles Entered	60	60
Vehicles Exited	60	60
Hourly Exit Rate	60	60
Input Volume	60	60
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

Total Network Performance

Denied Delay (hr)	0.5
Denied Del/Veh (s)	0.6
Total Delay (hr)	13.9
Total Del/Veh (s)	16.6
Stop Delay (hr)	0.6
Stop Del/Veh (s)	0.8
Total Stops	403
Stop/Veh	0.13
Travel Dist (mi)	4843.8
Travel Time (hr)	181.1
Avg Speed (mph)	27
Fuel Used (gal)	146.4
Fuel Eff. (mpg)	33.1
HC Emissions (g)	2100
CO Emissions (g)	40713
NOx Emissions (g)	5772
Vehicles Entered	2888
Vehicles Exited	2818
Hourly Exit Rate	2818
Input Volume	32190
% of Volume	9
Denied Entry Before	1
Denied Entry After	0

Arterial Level of Service: SB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Conn to Transfer Sta	34	0.2	8.9	0.1	31
O-turn 1 W	14	1.0	39.1	0.3	29
Olowalu Access 1	15	0.4	12.8	0.1	30
O-turn 1E	11	0.8	16.9	0.1	29
O-turn 2W	10	0.8	26.3	0.2	29
Olowalu Access 2	3	0.7	18.4	0.2	30
Total		3.9	122.4	1.0	29

Intersection: 3: Olowalu Access 2 & HP Hwy

Movement	EB
Directions Served	R
Maximum Queue (ft)	55
Average Queue (ft)	8
95th Queue (ft)	41
Link Distance (ft)	300
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 6: HP Hwy & Mauka Access 2

Movement	WB
Directions Served	R
Maximum Queue (ft)	11
Average Queue (ft)	0
95th Queue (ft)	8
Link Distance (ft)	290
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 7: HP Hwy & O-turn 2E

Movement	EB	NB	NB	NB
Directions Served	L	T	T	T
Maximum Queue (ft)	70	21	4	5
Average Queue (ft)	32	1	0	0
95th Queue (ft)	66	10	3	4
Link Distance (ft)	46	1359	1359	1359
Upstream Blk Time (%)	3			
Queuing Penalty (veh)	6			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 8: HP Hwy & O-turn 2E

Movement	SB	SB
Directions Served	L	T
Maximum Queue (ft)	53	92
Average Queue (ft)	6	3
95th Queue (ft)	31	67
Link Distance (ft)		502
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	800	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 9: O-turn 2W

Movement	NB
Directions Served	LT
Maximum Queue (ft)	49
Average Queue (ft)	2
95th Queue (ft)	25
Link Distance (ft)	752
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 10: HP Hwy & O-turn 2W

Movement	WB	SB
Directions Served	L	T
Maximum Queue (ft)	60	4
Average Queue (ft)	23	0
95th Queue (ft)	54	3
Link Distance (ft)	58	1078
Upstream Blk Time (%)	1	
Queuing Penalty (veh)	1	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 11: HP Hwy & O-turn 1E

Movement	SB	SB
Directions Served	L	LT
Maximum Queue (ft)	17	49
Average Queue (ft)	1	3
95th Queue (ft)	10	21
Link Distance (ft)		687
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	800	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 12: O-turn 1E & HP Hwy

Movement	EB
Directions Served	L
Maximum Queue (ft)	54
Average Queue (ft)	26
95th Queue (ft)	54
Link Distance (ft)	48
Upstream Blk Time (%)	1
Queuing Penalty (veh)	1
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 13: O-turn 1 W

Movement	NB
Directions Served	LT
Maximum Queue (ft)	17
Average Queue (ft)	1
95th Queue (ft)	11
Link Distance (ft)	519
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 14: HP Hwy & O-turn 1 W

Movement	WB
Directions Served	L
Maximum Queue (ft)	58
Average Queue (ft)	22
95th Queue (ft)	50
Link Distance (ft)	56
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 15: HP Hwy & Olowalu Access 1

Movement	EB
Directions Served	R
Maximum Queue (ft)	54
Average Queue (ft)	3
95th Queue (ft)	22
Link Distance (ft)	377
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 17: RIRO Access & HP Hwy

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 20: HP Hwy

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 24:

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 27: HP Hwy & Ehehene

Movement	WB	SB
Directions Served	LR	L
Maximum Queue (ft)	40	31
Average Queue (ft)	8	2
95th Queue (ft)	29	16
Link Distance (ft)	228	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		250
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 28:

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 31: HP Hwy & Mauka Access1

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 32: Conn to Transfer Sta/Transfer Station

Movement	EB	WB
Directions Served	T	TR
Maximum Queue (ft)	35	21
Average Queue (ft)	5	1
95th Queue (ft)	25	10
Link Distance (ft)	60	641
Upstream Blk Time (%)	0	
Queuing Penalty (veh)	0	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 34: HP Hwy & Conn to Transfer Sta

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Network Summary

Network wide Queuing Penalty: 8

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Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	4:57	4:57	4:57	4:57	4:57	4:57
End Time	6:00	6:00	6:00	6:00	6:00	6:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	3963	3921	3941	3928	3986	3947
Vehs Exited	3832	3790	3807	3742	3897	3814
Starting Vehs	174	171	157	162	155	162
Ending Vehs	305	302	291	348	244	299
Denied Entry Before	1	0	0	0	0	0
Denied Entry After	1	1	1	2	1	1
Travel Distance (mi)	6553	6590	6500	6525	6698	6573
Travel Time (hr)	281.3	291.7	258.8	281.2	279.1	278.4
Total Delay (hr)	55.8	65.1	34.9	56.3	48.9	52.2
Total Stops	1952	2542	954	2064	1563	1814
Fuel Used (gal)	210.1	213.9	202.9	208.8	213.8	209.9

Interval #0 Information Seeding

Start Time	4:57
End Time	5:00
Total Time (min)	3

Volumes adjusted by Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	5:00
End Time	5:15
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	996	1045	1009	982	1000	1003
Vehs Exited	903	895	891	876	873	887
Starting Vehs	174	171	157	162	155	162
Ending Vehs	267	321	275	268	282	280
Denied Entry Before	1	0	0	0	0	0
Denied Entry After	3	2	0	1	1	1
Travel Distance (mi)	1610	1701	1614	1629	1607	1632
Travel Time (hr)	62.8	70.2	62.5	63.6	62.4	64.3
Total Delay (hr)	7.3	11.6	6.8	7.5	7.3	8.1
Total Stops	185	411	208	184	218	239
Fuel Used (gal)	49.9	54.1	50.7	50.2	49.6	50.9

Interval #2 Information

Start Time	5:15
End Time	5:30
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	1005	940	930	948	1012	967
Vehs Exited	988	978	961	941	1015	974
Starting Vehs	267	321	275	268	282	280
Ending Vehs	284	283	244	275	279	272
Denied Entry Before	3	2	0	1	1	1
Denied Entry After	1	4	0	1	1	1
Travel Distance (mi)	1667	1633	1565	1576	1693	1627
Travel Time (hr)	70.4	73.7	61.9	62.7	71.3	68.0
Total Delay (hr)	13.1	17.7	7.9	8.4	13.1	12.1
Total Stops	437	675	201	199	479	402
Fuel Used (gal)	53.1	53.5	47.6	48.6	54.6	51.5

Interval #3 Information

Start Time	5:30
End Time	5:45
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	956	964	966	1005	1004	979
Vehs Exited	961	964	949	975	987	968
Starting Vehs	284	283	244	275	279	272
Ending Vehs	279	283	261	305	296	282
Denied Entry Before	1	4	0	1	1	1
Denied Entry After	1	1	2	0	5	1
Travel Distance (mi)	1623	1636	1624	1694	1707	1657
Travel Time (hr)	73.8	73.3	65.3	76.4	74.1	72.6
Total Delay (hr)	18.0	17.0	9.4	18.0	15.5	15.6
Total Stops	704	668	228	744	536	577
Fuel Used (gal)	53.3	53.2	50.9	55.6	55.4	53.7

Interval #4 Information

Start Time	5:45
End Time	6:00
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	1006	972	1036	993	970	995
Vehs Exited	980	953	1006	950	1022	984
Starting Vehs	279	283	261	305	296	282
Ending Vehs	305	302	291	348	244	299
Denied Entry Before	1	1	2	0	5	1
Denied Entry After	1	1	1	2	1	1
Travel Distance (mi)	1653	1620	1696	1626	1691	1657
Travel Time (hr)	74.3	74.5	69.1	78.5	71.2	73.5
Total Delay (hr)	17.3	18.8	10.7	22.3	13.0	16.4
Total Stops	626	788	317	937	330	598
Fuel Used (gal)	53.8	53.1	53.8	54.4	54.2	53.8

2: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	2.6	0.1	2.7
Total Del/Veh (s)	6.6	0.3	3.6
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0
Total Stops	0	0	0
Stop/Veh	0.00	0.00	0.00
Travel Dist (mi)	565.9	23.1	589.0
Travel Time (hr)	21.6	2.0	23.6
Avg Speed (mph)	26	11	25
Fuel Used (gal)	16.0	2.2	18.2
Fuel Eff. (mpg)	35.4	10.6	32.4
HC Emissions (g)	267	41	308
CO Emissions (g)	3860	1024	4884
NOx Emissions (g)	624	150	775
Vehicles Entered	1383	1296	2679
Vehicles Exited	1381	1295	2676
Hourly Exit Rate	1381	1295	2676
Input Volume	1367	1338	2705
% of Volume	101	97	99
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

3: Olowalu Access 2 & HP Hwy Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.0	0.0	0.1
Total Delay (hr)	0.3	0.3	0.3	0.9
Total Del/Veh (s)	3.0	0.9	2.6	1.6
Stop Delay (hr)	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	0.5	0.0	0.1	0.1
Total Stops	39	0	0	39
Stop/Veh	0.11	0.00	0.00	0.02
Travel Dist (mi)	18.3	192.6	52.0	263.0
Travel Time (hr)	1.1	6.9	2.2	10.2
Avg Speed (mph)	17	28	24	26
Fuel Used (gal)	0.5	6.0	1.3	7.8
Fuel Eff. (mpg)	40.0	32.0	39.7	33.8
HC Emissions (g)	4	84	11	99
CO Emissions (g)	136	1824	289	2249
NOx Emissions (g)	13	243	31	287
Vehicles Entered	362	1306	359	2027
Vehicles Exited	362	1306	358	2026
Hourly Exit Rate	362	1306	358	2026
Input Volume	365	1289	357	2011
% of Volume	99	101	100	101
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

4: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.3	0.3
Total Del/Veh (s)	3.3	3.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	23.2	23.2
Travel Time (hr)	1.4	1.4
Avg Speed (mph)	16	16
Fuel Used (gal)	1.7	1.7
Fuel Eff. (mpg)	13.5	13.5
HC Emissions (g)	24	24
CO Emissions (g)	1023	1023
NOx Emissions (g)	83	83
Vehicles Entered	358	358
Vehicles Exited	357	357
Hourly Exit Rate	357	357
Input Volume	357	357
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

5: External Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	0.6	0.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	108.4	108.4
Travel Time (hr)	3.9	3.9
Avg Speed (mph)	28	28
Fuel Used (gal)	3.5	3.5
Fuel Eff. (mpg)	30.6	30.6
HC Emissions (g)	39	39
CO Emissions (g)	1098	1098
NOx Emissions (g)	109	109
Vehicles Entered	1383	1383
Vehicles Exited	1381	1381
Hourly Exit Rate	1381	1381
Input Volume	1404	1404
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

6: HP Hwy & Mauka Access 2 Performance by movement

Movement	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.1	0.0
Total Delay (hr)	0.0	0.3	0.0	0.4
Total Del/Veh (s)	0.8	0.7	0.6	0.7
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.1	0.0
Total Stops	1	4	0	5
Stop/Veh	0.02	0.00	0.00	0.00
Travel Dist (mi)	3.3	163.0	6.1	172.4
Travel Time (hr)	0.2	5.9	0.3	6.4
Avg Speed (mph)	21	28	23	27
Fuel Used (gal)	0.1	5.4	0.2	5.7
Fuel Eff. (mpg)	58.0	30.0	35.2	30.5
HC Emissions (g)	1	75	1	77
CO Emissions (g)	14	1771	44	1829
NOx Emissions (g)	1	221	4	226
Vehicles Entered	63	1616	60	1739
Vehicles Exited	62	1618	60	1740
Hourly Exit Rate	62	1618	60	1740
Input Volume	60	1600	60	1720
% of Volume	103	101	100	101
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

7: HP Hwy & O-turn 2E Performance by movement

Movement	EBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.6	0.8
Total Del/Veh (s)	2.7	1.7	1.8
Stop Delay (hr)	0.2	0.0	0.2
Stop Del/Veh (s)	2.4	0.0	0.4
Total Stops	98	1	99
Stop/Veh	0.39	0.00	0.06
Travel Dist (mi)	4.0	363.8	367.8
Travel Time (hr)	0.4	12.9	13.3
Avg Speed (mph)	9	28	28
Fuel Used (gal)	0.2	10.5	10.8
Fuel Eff. (mpg)	18.6	34.5	34.2
HC Emissions (g)	1	184	185
CO Emissions (g)	46	3150	3196
NOx Emissions (g)	6	493	499
Vehicles Entered	252	1378	1630
Vehicles Exited	252	1380	1632
Hourly Exit Rate	252	1380	1632
Input Volume	248	1370	1618
% of Volume	102	101	101
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: HP Hwy & O-turn 2E Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.8	1.0
Total Del/Veh (s)	3.3	1.9	2.1
Stop Delay (hr)	0.1	0.2	0.3
Stop Del/Veh (s)	1.4	0.6	0.7
Total Stops	64	132	196
Stop/Veh	0.25	0.09	0.12
Travel Dist (mi)	25.6	143.2	168.8
Travel Time (hr)	1.2	5.8	7.1
Avg Speed (mph)	21	25	24
Fuel Used (gal)	0.8	5.5	6.4
Fuel Eff. (mpg)	30.8	25.8	26.5
HC Emissions (g)	7	80	87
CO Emissions (g)	270	2218	2488
NOx Emissions (g)	25	253	278
Vehicles Entered	252	1422	1674
Vehicles Exited	252	1421	1673
Hourly Exit Rate	252	1421	1673
Input Volume	248	1406	1654
% of Volume	102	101	101
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

9: O-turn 2W Performance by movement

Movement	NBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.6	0.8
Total Del/Veh (s)	3.6	1.4	1.7
Stop Delay (hr)	0.0	0.1	0.1
Stop Del/Veh (s)	0.5	0.1	0.2
Total Stops	17	33	50
Stop/Veh	0.08	0.02	0.03
Travel Dist (mi)	30.5	216.2	246.8
Travel Time (hr)	1.3	7.9	9.2
Avg Speed (mph)	23	27	27
Fuel Used (gal)	0.9	6.6	7.4
Fuel Eff. (mpg)	35.4	32.9	33.2
HC Emissions (g)	7	99	106
CO Emissions (g)	170	1954	2124
NOx Emissions (g)	24	277	301
Vehicles Entered	205	1480	1685
Vehicles Exited	204	1476	1680
Hourly Exit Rate	204	1476	1680
Input Volume	196	1465	1661
% of Volume	104	101	101
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

10: HP Hwy & O-turn 2W Performance by movement

Movement	WBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.5	0.7
Total Del/Veh (s)	3.3	1.2	1.5
Stop Delay (hr)	0.2	0.0	0.2
Stop Del/Veh (s)	2.8	0.0	0.3
Total Stops	95	1	96
Stop/Veh	0.47	0.00	0.06
Travel Dist (mi)	3.5	303.1	306.7
Travel Time (hr)	0.4	10.7	11.1
Avg Speed (mph)	9	28	28
Fuel Used (gal)	0.2	8.8	9.0
Fuel Eff. (mpg)	18.8	34.4	34.1
HC Emissions (g)	1	84	86
CO Emissions (g)	43	1589	1632
NOx Emissions (g)	6	244	249
Vehicles Entered	204	1425	1629
Vehicles Exited	203	1426	1629
Hourly Exit Rate	203	1426	1629
Input Volume	196	1412	1608
% of Volume	104	101	101
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

11: HP Hwy & O-turn 1E Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.7	0.8
Total Del/Veh (s)	3.7	1.7	1.9
Stop Delay (hr)	0.0	0.2	0.2
Stop Del/Veh (s)	0.7	0.5	0.5
Total Stops	15	101	116
Stop/Veh	0.10	0.07	0.07
Travel Dist (mi)	20.1	196.9	217.0
Travel Time (hr)	0.9	7.5	8.4
Avg Speed (mph)	22	26	26
Fuel Used (gal)	0.6	6.5	7.2
Fuel Eff. (mpg)	32.1	30.1	30.3
HC Emissions (g)	5	85	90
CO Emissions (g)	155	1986	2141
NOx Emissions (g)	19	259	277
Vehicles Entered	148	1463	1611
Vehicles Exited	148	1462	1610
Hourly Exit Rate	148	1462	1610
Input Volume	149	1452	1601
% of Volume	99	101	101
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

12: O-turn 1E & HP Hwy Performance by movement

Movement	EBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.5	0.6
Total Del/Veh (s)	2.2	1.3	1.4
Stop Delay (hr)	0.1	0.0	0.1
Stop Del/Veh (s)	1.8	0.0	0.2
Total Stops	53	0	53
Stop/Veh	0.36	0.00	0.03
Travel Dist (mi)	2.6	305.7	308.3
Travel Time (hr)	0.3	10.8	11.1
Avg Speed (mph)	10	28	28
Fuel Used (gal)	0.1	8.9	9.0
Fuel Eff. (mpg)	20.2	34.4	34.2
HC Emissions (g)	1	159	160
CO Emissions (g)	33	2742	2774
NOx Emissions (g)	4	433	437
Vehicles Entered	148	1434	1582
Vehicles Exited	147	1424	1571
Hourly Exit Rate	147	1424	1571
Input Volume	149	1422	1571
% of Volume	99	100	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

13: O-turn 1 W Performance by movement

Movement	NBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.5	0.5
Total Del/Veh (s)	2.7	1.1	1.3
Stop Delay (hr)	0.0	0.0	0.1
Stop Del/Veh (s)	0.2	0.1	0.1
Total Stops	5	35	40
Stop/Veh	0.04	0.02	0.03
Travel Dist (mi)	13.2	148.9	162.0
Travel Time (hr)	0.6	5.5	6.1
Avg Speed (mph)	22	27	27
Fuel Used (gal)	0.4	4.8	5.1
Fuel Eff. (mpg)	36.0	31.3	31.7
HC Emissions (g)	4	71	74
CO Emissions (g)	84	1541	1625
NOx Emissions (g)	12	208	219
Vehicles Entered	125	1438	1563
Vehicles Exited	125	1434	1559
Hourly Exit Rate	125	1434	1559
Input Volume	125	1443	1568
% of Volume	100	99	99
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

14: HP Hwy & O-turn 1 W Performance by movement

Movement	WBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.7	0.8
Total Del/Veh (s)	4.2	1.7	1.9
Stop Delay (hr)	0.1	0.0	0.1
Stop Del/Veh (s)	3.8	0.0	0.3
Total Stops	70	0	70
Stop/Veh	0.56	0.00	0.04
Travel Dist (mi)	2.1	458.7	460.9
Travel Time (hr)	0.3	16.1	16.4
Avg Speed (mph)	8	28	28
Fuel Used (gal)	0.1	13.2	13.3
Fuel Eff. (mpg)	19.0	34.7	34.6
HC Emissions (g)	1	126	127
CO Emissions (g)	26	2358	2384
NOx Emissions (g)	3	360	363
Vehicles Entered	125	1447	1572
Vehicles Exited	124	1445	1569
Hourly Exit Rate	124	1445	1569
Input Volume	125	1440	1565
% of Volume	99	100	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

15: HP Hwy & Olowalu Access 1 Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	0.1	0.2	0.1	0.5
Total Del/Veh (s)	2.1	0.6	2.0	1.0
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.1	0.0	0.0	0.0
Total Stops	10	0	0	10
Stop/Veh	0.05	0.00	0.00	0.01
Travel Dist (mi)	14.3	142.1	21.4	177.8
Travel Time (hr)	0.7	5.1	0.9	6.7
Avg Speed (mph)	20	28	23	26
Fuel Used (gal)	0.3	4.5	0.5	5.3
Fuel Eff. (mpg)	42.0	31.8	40.3	33.3
HC Emissions (g)	2	67	4	73
CO Emissions (g)	98	1443	158	1699
NOx Emissions (g)	8	190	12	210
Vehicles Entered	219	1387	217	1823
Vehicles Exited	220	1388	217	1825
Hourly Exit Rate	220	1388	217	1825
Input Volume	212	1388	216	1816
% of Volume	104	100	100	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

16: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	3.2	3.2
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	17.3	17.3
Travel Time (hr)	1.0	1.0
Avg Speed (mph)	18	18
Fuel Used (gal)	1.1	1.1
Fuel Eff. (mpg)	15.4	15.4
HC Emissions (g)	13	13
CO Emissions (g)	604	604
NOx Emissions (g)	46	46
Vehicles Entered	217	217
Vehicles Exited	217	217
Hourly Exit Rate	217	217
Input Volume	216	216
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

17: RIRO Access & HP Hwy Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.2	0.0	0.0	0.0
Total Delay (hr)	0.0	0.5	0.0	0.5
Total Del/Veh (s)	0.6	1.3	0.2	1.2
Stop Delay (hr)	0.0	0.1	0.0	0.1
Stop Del/Veh (s)	0.0	0.1	0.0	0.1
Total Stops	0	13	0	13
Stop/Veh	0.00	0.01	0.00	0.01
Travel Dist (mi)	0.8	184.0	2.6	187.3
Travel Time (hr)	0.0	6.7	0.1	6.8
Avg Speed (mph)	20	28	26	27
Fuel Used (gal)	0.0	5.7	0.1	5.8
Fuel Eff. (mpg)	64.0	32.2	43.2	32.3
HC Emissions (g)	0	79	0	79
CO Emissions (g)	2	1769	7	1777
NOx Emissions (g)	0	238	1	239
Vehicles Entered	17	1401	19	1437
Vehicles Exited	17	1399	19	1435
Hourly Exit Rate	17	1399	19	1435
Input Volume	15	1385	22	1422
% of Volume	113	101	86	101
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

18: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	1.1	1.1
Travel Time (hr)	0.1	0.1
Avg Speed (mph)	20	20
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	13.0	13.0
HC Emissions (g)	1	1
CO Emissions (g)	48	48
NOx Emissions (g)	3	3
Vehicles Entered	19	19
Vehicles Exited	19	19
Hourly Exit Rate	19	19
Input Volume	22	22
% of Volume	86	86
Denied Entry Before	0	0
Denied Entry After	0	0

19: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	5.5	5.5
Total Del/Veh (s)	14.6	14.6
Stop Delay (hr)	3.7	3.7
Stop Del/Veh (s)	9.9	9.9
Total Stops	422	422
Stop/Veh	0.31	0.31
Travel Dist (mi)	177.8	177.8
Travel Time (hr)	11.5	11.5
Avg Speed (mph)	15	15
Fuel Used (gal)	6.5	6.5
Fuel Eff. (mpg)	27.4	27.4
HC Emissions (g)	101	101
CO Emissions (g)	2392	2392
NOx Emissions (g)	291	291
Vehicles Entered	1352	1352
Vehicles Exited	1335	1335
Hourly Exit Rate	1335	1335
Input Volume	1338	1338
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

20: HP Hwy Performance by movement

Movement	NBT	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	185.2	185.2
Travel Time (hr)	6.6	6.6
Avg Speed (mph)	28	28
Fuel Used (gal)	5.8	5.8
Fuel Eff. (mpg)	31.7	31.7
HC Emissions (g)	109	109
CO Emissions (g)	2216	2216
NOx Emissions (g)	297	297
Vehicles Entered	1380	1380
Vehicles Exited	1378	1378
Hourly Exit Rate	1378	1378
Input Volume	1370	1370
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0

21: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	11.2	11.2
Total Del/Veh (s)	30.2	30.2
Stop Delay (hr)	5.8	5.8
Stop Del/Veh (s)	15.5	15.5
Total Stops	565	565
Stop/Veh	0.42	0.42
Travel Dist (mi)	170.8	170.8
Travel Time (hr)	17.0	17.0
Avg Speed (mph)	10	10
Fuel Used (gal)	7.4	7.4
Fuel Eff. (mpg)	23.0	23.0
HC Emissions (g)	100	100
CO Emissions (g)	2098	2098
NOx Emissions (g)	246	246
Vehicles Entered	1335	1335
Vehicles Exited	1317	1317
Hourly Exit Rate	1317	1317
Input Volume	1338	1338
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

23: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	11.2	11.2
Total Del/Veh (s)	30.7	30.7
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	1	1
Stop/Veh	0.00	0.00
Travel Dist (mi)	154.5	154.5
Travel Time (hr)	16.4	16.4
Avg Speed (mph)	9	9
Fuel Used (gal)	6.5	6.5
Fuel Eff. (mpg)	23.9	23.9
HC Emissions (g)	82	82
CO Emissions (g)	1554	1554
NOx Emissions (g)	159	159
Vehicles Entered	1317	1317
Vehicles Exited	1301	1301
Hourly Exit Rate	1301	1301
Input Volume	1338	1338
% of Volume	97	97
Denied Entry Before	0	0
Denied Entry After	0	0

24: Performance by movement

Movement	NBT	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.8	0.8
Total Del/Veh (s)	2.0	2.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	153.3	153.3
Travel Time (hr)	5.9	5.9
Avg Speed (mph)	26	26
Fuel Used (gal)	4.5	4.5
Fuel Eff. (mpg)	34.1	34.1
HC Emissions (g)	77	77
CO Emissions (g)	1218	1218
NOx Emissions (g)	181	181
Vehicles Entered	1383	1383
Vehicles Exited	1380	1380
Hourly Exit Rate	1380	1380
Input Volume	1370	1370
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0

26: Bend Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.3	0.3
Total Del/Veh (s)	0.7	0.7
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	1	1
Stop/Veh	0.00	0.00
Travel Dist (mi)	50.9	50.9
Travel Time (hr)	2.0	2.0
Avg Speed (mph)	26	26
Fuel Used (gal)	1.5	1.5
Fuel Eff. (mpg)	34.9	34.9
HC Emissions (g)	25	25
CO Emissions (g)	363	363
NOx Emissions (g)	58	58
Vehicles Entered	1383	1383
Vehicles Exited	1383	1383
Hourly Exit Rate	1383	1383
Input Volume	1370	1370
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0

27: HP Hwy & Ehehene Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	1.0	0.0	0.0	0.0	1.0
Denied Del/Veh (s)	0.1	0.1	2.6	2.6	0.0	0.0	1.4
Total Delay (hr)	0.6	0.1	1.2	0.0	0.0	2.0	3.9
Total Del/Veh (s)	321.2	144.4	3.1	2.4	17.1	5.5	5.2
Stop Delay (hr)	0.6	0.1	0.0	0.0	0.0	0.0	0.8
Stop Del/Veh (s)	319.5	144.0	0.0	0.0	11.5	0.0	1.0
Total Stops	7	3	0	0	2	0	12
Stop/Veh	1.00	1.00	0.00	0.00	0.67	0.00	0.00
Travel Dist (mi)	0.3	0.1	271.8	0.3	1.2	526.9	800.6
Travel Time (hr)	0.6	0.1	11.3	0.0	0.1	19.8	32.0
Avg Speed (mph)	0	1	26	24	21	27	26
Fuel Used (gal)	0.2	0.0	8.4	0.0	0.0	16.6	25.2
Fuel Eff. (mpg)	1.9	3.6	32.5	31.1	32.0	31.7	31.7
HC Emissions (g)	0	0	136	0	0	296	433
CO Emissions (g)	8	2	2217	1	6	5308	7543
NOx Emissions (g)	0	0	357	0	1	800	1158
Vehicles Entered	7	3	1380	2	3	1295	2690
Vehicles Exited	5	2	1381	2	3	1280	2673
Hourly Exit Rate	5	2	1381	2	3	1280	2673
Input Volume	7	3	1364	2	3	1337	2716
% of Volume	71	67	101	100	100	96	98
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0

28: Performance by movement

Movement	NBT	SET	SER	All
Denied Delay (hr)	0.0	0.0	0.4	0.4
Denied Del/Veh (s)	0.0	0.0	1.0	0.5
Total Delay (hr)	0.1	0.0	2.6	2.8
Total Del/Veh (s)	0.4	7.2	7.2	3.7
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0	0.0
Total Stops	0	0	0	0
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	29.0	0.0	43.9	72.9
Travel Time (hr)	1.1	0.0	5.4	6.5
Avg Speed (mph)	26	8	9	12
Fuel Used (gal)	0.8	0.0	2.1	3.0
Fuel Eff. (mpg)	35.2	20.1	20.5	24.6
HC Emissions (g)	14	0	33	46
CO Emissions (g)	201	0	585	786
NOx Emissions (g)	32	0	67	99
Vehicles Entered	1383	1	1300	2684
Vehicles Exited	1383	1	1296	2680
Hourly Exit Rate	1383	1	1296	2680
Input Volume	1370	1	1338	2709
% of Volume	101	100	97	99
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	1	1

29: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.6	0.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.2	0.2
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	20	20
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	12.2	12.2
HC Emissions (g)	0	0
CO Emissions (g)	11	11
NOx Emissions (g)	1	1
Vehicles Entered	4	4
Vehicles Exited	4	4
Hourly Exit Rate	4	4
Input Volume	5	5
% of Volume	80	80
Denied Entry Before	0	0
Denied Entry After	0	0

30: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.8	3.8
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.3	0.3
Fuel Eff. (mpg)	13.8	13.8
HC Emissions (g)	3	3
CO Emissions (g)	162	162
NOx Emissions (g)	13	13
Vehicles Entered	60	60
Vehicles Exited	60	60
Hourly Exit Rate	60	60
Input Volume	60	60
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

31: HP Hwy & Mauka Access1 Performance by movement

Movement	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.4	0.0	0.4
Total Del/Veh (s)	0.7	0.9	0.3	0.9
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.1	0.0
Total Stops	0	1	0	1
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	2.8	203.6	7.6	214.1
Travel Time (hr)	0.1	7.3	0.3	7.7
Avg Speed (mph)	20	28	25	28
Fuel Used (gal)	0.0	6.3	0.2	6.5
Fuel Eff. (mpg)	57.3	32.5	37.9	32.8
HC Emissions (g)	0	86	2	89
CO Emissions (g)	11	1769	52	1831
NOx Emissions (g)	1	246	6	252
Vehicles Entered	59	1516	56	1631
Vehicles Exited	59	1509	56	1624
Hourly Exit Rate	59	1509	56	1624
Input Volume	60	1511	60	1631
% of Volume	98	100	93	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

32: Conn to Transfer Sta/Transfer Station Performance by movement

Movement	EBT	WBT	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	1.1	0.0	1.2
Total Del/Veh (s)	13.7	14.4	10.7	2.9	0.9	3.0
Stop Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	12.6	11.6	11.1	0.0	0.0	0.2
Total Stops	9	3	8	2	0	22
Stop/Veh	1.00	1.00	1.00	0.00	0.00	0.02
Travel Dist (mi)	0.2	0.3	1.0	436.2	0.9	438.6
Travel Time (hr)	0.0	0.0	0.1	15.8	0.0	16.0
Avg Speed (mph)	4	14	15	28	27	27
Fuel Used (gal)	0.0	0.0	0.0	13.2	0.0	13.3
Fuel Eff. (mpg)	15.4	33.3	34.5	32.9	35.3	32.9
HC Emissions (g)	0	0	0	192	0	192
CO Emissions (g)	1	1	2	3589	4	3597
NOx Emissions (g)	0	0	0	555	0	556
Vehicles Entered	9	3	8	1430	3	1453
Vehicles Exited	9	3	8	1416	3	1439
Hourly Exit Rate	9	3	8	1416	3	1439
Input Volume	9	2	6	1440	2	1459
% of Volume	100	150	133	98	150	99
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0

33: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.9	1.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.5	0.5
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	1.6	1.6
Travel Time (hr)	0.1	0.1
Avg Speed (mph)	25	25
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	20.3	20.3
HC Emissions (g)	1	1
CO Emissions (g)	30	30
NOx Emissions (g)	2	2
Vehicles Entered	12	12
Vehicles Exited	12	12
Hourly Exit Rate	12	12
Input Volume	11	11
% of Volume	109	109
Denied Entry Before	0	0
Denied Entry After	0	0

34: HP Hwy & Conn to Transfer Sta Performance by movement

Movement	WBL	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.1	0.1
Denied Del/Veh (s)	0.0	2.4	0.3	0.3
Total Delay (hr)	0.0	0.0	0.1	0.2
Total Del/Veh (s)	13.3	0.2	0.4	0.4
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	11.7	0.0	0.0	0.0
Total Stops	3	0	0	3
Stop/Veh	1.00	0.00	0.00	0.00
Travel Dist (mi)	0.1	0.6	102.1	102.8
Travel Time (hr)	0.0	0.0	3.7	3.7
Avg Speed (mph)	4	25	29	28
Fuel Used (gal)	0.0	0.0	3.2	3.3
Fuel Eff. (mpg)	10.8	28.5	31.5	31.4
HC Emissions (g)	0	0	34	34
CO Emissions (g)	1	10	901	912
NOx Emissions (g)	0	1	99	100
Vehicles Entered	3	9	1444	1456
Vehicles Exited	3	9	1445	1457
Hourly Exit Rate	3	9	1445	1457
Input Volume	2	9	1438	1449
% of Volume	150	100	100	101
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

35: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	1.0	1.0
Total Del/Veh (s)	2.9	2.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	265.2	265.2
Travel Time (hr)	9.9	9.9
Avg Speed (mph)	27	27
Fuel Used (gal)	8.4	8.4
Fuel Eff. (mpg)	31.6	31.6
HC Emissions (g)	142	142
CO Emissions (g)	2909	2909
NOx Emissions (g)	360	360
Vehicles Entered	1285	1285
Vehicles Exited	1278	1278
Hourly Exit Rate	1278	1278
Input Volume	1344	1344
% of Volume	95	95
Denied Entry Before	0	0
Denied Entry After	0	0

36: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.2	3.2
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.2	0.2
Fuel Eff. (mpg)	13.2	13.2
HC Emissions (g)	4	4
CO Emissions (g)	166	166
NOx Emissions (g)	13	13
Vehicles Entered	56	56
Vehicles Exited	56	56
Hourly Exit Rate	56	56
Input Volume	60	60
% of Volume	93	93
Denied Entry Before	0	0
Denied Entry After	0	0

Total Network Performance

Denied Delay (hr)	1.6
Denied Del/Veh (s)	1.4
Total Delay (hr)	50.6
Total Del/Veh (s)	44.3
Stop Delay (hr)	11.7
Stop Del/Veh (s)	10.3
Total Stops	1814
Stop/Veh	0.44
Travel Dist (mi)	6573.5
Travel Time (hr)	278.4
Avg Speed (mph)	24
Fuel Used (gal)	209.9
Fuel Eff. (mpg)	31.3
HC Emissions (g)	3065
CO Emissions (g)	61364
NOx Emissions (g)	8387
Vehicles Entered	3947
Vehicles Exited	3814
Hourly Exit Rate	3814
Input Volume	44087
% of Volume	9
Denied Entry Before	0
Denied Entry After	1

Arterial Level of Service: SB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Conn to Transfer Sta	34	0.4	9.2	0.1	30
O-turn 1 W	14	1.7	39.6	0.3	29
Olowalu Access 1	15	0.6	12.9	0.1	30
O-turn 1E	11	0.9	17.1	0.1	29
O-turn 2W	10	1.2	26.8	0.2	29
Olowalu Access 2	3	0.9	18.7	0.2	29
Total		5.7	124.2	1.0	29

Intersection: 3: Olowalu Access 2 & HP Hwy

Movement	EB
Directions Served	R
Maximum Queue (ft)	158
Average Queue (ft)	31
95th Queue (ft)	104
Link Distance (ft)	300
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 6: HP Hwy & Mauka Access 2

Movement	WB
Directions Served	R
Maximum Queue (ft)	32
Average Queue (ft)	1
95th Queue (ft)	13
Link Distance (ft)	290
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 7: HP Hwy & O-turn 2E

Movement	EB	NB	NB
Directions Served	L	T	T
Maximum Queue (ft)	72	8	4
Average Queue (ft)	41	0	0
95th Queue (ft)	70	4	3
Link Distance (ft)	46	1359	1359
Upstream Blk Time (%)	6		
Queuing Penalty (veh)	14		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: HP Hwy & O-turn 2E

Movement	SB	SB
Directions Served	L	T
Maximum Queue (ft)	61	10
Average Queue (ft)	13	0
95th Queue (ft)	50	7
Link Distance (ft)		502
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	800	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 9: O-turn 2W

Movement	NB	NB
Directions Served	LT	T
Maximum Queue (ft)	71	10
Average Queue (ft)	11	0
95th Queue (ft)	45	0
Link Distance (ft)	752	752
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 10: HP Hwy & O-turn 2W

Movement	WB	SB
Directions Served	L	T
Maximum Queue (ft)	74	9
Average Queue (ft)	44	0
95th Queue (ft)	73	5
Link Distance (ft)	58	1078
Upstream Blk Time (%)	3	
Queuing Penalty (veh)	5	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 11: HP Hwy & O-turn 1E

Movement	SB	SB	SB
Directions Served	L	LT	T
Maximum Queue (ft)	26	37	18
Average Queue (ft)	2	4	1
95th Queue (ft)	17	27	13
Link Distance (ft)		687	687
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	800		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: O-turn 1E & HP Hwy

Movement	EB	NB
Directions Served	L	T
Maximum Queue (ft)	60	4
Average Queue (ft)	30	0
95th Queue (ft)	58	3
Link Distance (ft)	48	1084
Upstream Blk Time (%)	2	
Queuing Penalty (veh)	3	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 13: O-turn 1 W

Movement	NB	NB
Directions Served	LT	T
Maximum Queue (ft)	51	9
Average Queue (ft)	3	0
95th Queue (ft)	22	6
Link Distance (ft)	519	519
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 14: HP Hwy & O-turn 1 W

Movement	WB	SB
Directions Served	L	T
Maximum Queue (ft)	68	3
Average Queue (ft)	36	0
95th Queue (ft)	64	2
Link Distance (ft)	56	1614
Upstream Blk Time (%)	2	
Queuing Penalty (veh)	2	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 15: HP Hwy & Olowalu Access 1

Movement	EB
Directions Served	R
Maximum Queue (ft)	76
Average Queue (ft)	13
95th Queue (ft)	55
Link Distance (ft)	377
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 17: RIRO Access & HP Hwy

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	47	40
Average Queue (ft)	3	3
95th Queue (ft)	44	35
Link Distance (ft)	674	674
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 20: HP Hwy

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 24:

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 27: HP Hwy & Ehehene

Movement	WB	SB
Directions Served	LR	L
Maximum Queue (ft)	70	31
Average Queue (ft)	19	3
95th Queue (ft)	70	16
Link Distance (ft)	228	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		250
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 28:

Movement	NB	B21	B21	B19	B19	B19
Directions Served	T	T		T	T	
Maximum Queue (ft)	6	710	545	360	330	89
Average Queue (ft)	0	362	238	129	109	3
95th Queue (ft)	5	920	739	437	391	52
Link Distance (ft)	54	625	625	655	655	655
Upstream Blk Time (%)		36	7	0	0	
Queuing Penalty (veh)		242	48	2	1	
Storage Bay Dist (ft)						
Storage Blk Time (%)						
Queuing Penalty (veh)						

Intersection: 31: HP Hwy & Mauka Access1

Movement	WB
Directions Served	R
Maximum Queue (ft)	6
Average Queue (ft)	0
95th Queue (ft)	5
Link Distance (ft)	267
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 32: Conn to Transfer Sta/Transfer Station

Movement	EB	WB
Directions Served	T	TR
Maximum Queue (ft)	30	34
Average Queue (ft)	8	6
95th Queue (ft)	30	24
Link Distance (ft)	60	641
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 34: HP Hwy & Conn to Transfer Sta

Movement	WB
Directions Served	L
Maximum Queue (ft)	28
Average Queue (ft)	2
95th Queue (ft)	14
Link Distance (ft)	60
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 317

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Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	2700	2711	2695	2666	2639	2679
Vehs Exited	2719	2703	2669	2609	2641	2669
Starting Vehs	130	127	108	108	127	119
Ending Vehs	111	135	134	165	125	132
Denied Entry Before	5	0	1	1	1	1
Denied Entry After	1	1	1	0	1	0
Travel Distance (mi)	4623	4631	4558	4488	4491	4558
Travel Time (hr)	138.2	139.3	135.0	132.8	133.7	135.8
Total Delay (hr)	29.9	31.0	28.5	27.7	28.6	29.2
Total Stops	1872	2011	1867	1811	1878	1887
Fuel Used (gal)	138.6	140.0	136.8	133.7	135.2	136.9

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by PHF, Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	640	655	631	666	660	648
Vehs Exited	660	634	609	629	635	633
Starting Vehs	130	127	108	108	127	119
Ending Vehs	110	148	130	145	152	132
Denied Entry Before	5	0	1	1	1	1
Denied Entry After	0	0	1	0	1	0
Travel Distance (mi)	1134	1100	1063	1094	1112	1101
Travel Time (hr)	33.7	33.1	30.8	32.7	34.2	32.9
Total Delay (hr)	7.2	7.3	6.0	7.2	8.1	7.2
Total Stops	430	511	390	458	529	465
Fuel Used (gal)	34.0	33.5	31.5	32.8	34.3	33.2

Interval #2 Information

Start Time	7:15
End Time	7:30
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	712	657	632	611	670	655
Vehs Exited	678	664	633	622	671	653
Starting Vehs	110	148	130	145	152	132
Ending Vehs	144	141	129	134	151	138
Denied Entry Before	0	0	1	0	1	0
Denied Entry After	1	0	0	1	0	0
Travel Distance (mi)	1177	1147	1067	1067	1155	1123
Travel Time (hr)	35.2	34.4	31.2	31.1	34.1	33.2
Total Delay (hr)	7.6	7.6	6.4	6.2	7.2	7.0
Total Stops	476	495	426	426	470	457
Fuel Used (gal)	35.1	34.5	31.8	31.7	34.4	33.5

Interval #3 Information

Start Time	7:30
End Time	7:45
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	723	714	743	712	670	715
Vehs Exited	728	728	738	701	675	716
Starting Vehs	144	141	129	134	151	138
Ending Vehs	139	127	134	145	146	139
Denied Entry Before	1	0	0	1	0	0
Denied Entry After	0	2	2	1	1	1
Travel Distance (mi)	1237	1225	1258	1192	1121	1207
Travel Time (hr)	37.8	37.0	38.2	35.2	32.9	36.2
Total Delay (hr)	8.7	8.4	8.8	7.4	6.7	8.0
Total Stops	541	514	570	496	427	509
Fuel Used (gal)	37.4	37.2	38.4	35.4	33.6	36.4

Interval #4 Information

Start Time	7:45
End Time	8:00
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	625	685	689	677	639	666
Vehs Exited	653	677	689	657	660	666
Starting Vehs	139	127	134	145	146	139
Ending Vehs	111	135	134	165	125	132
Denied Entry Before	0	2	2	1	1	1
Denied Entry After	1	1	1	0	1	0
Travel Distance (mi)	1075	1159	1169	1136	1103	1128
Travel Time (hr)	31.6	34.9	34.8	33.7	32.5	33.5
Total Delay (hr)	6.4	7.7	7.3	7.0	6.6	7.0
Total Stops	425	491	481	431	452	455
Fuel Used (gal)	32.1	34.8	35.1	33.7	32.9	33.7

1: HP Hwy & RIRO Access 3 Performance by movement

Movement	EBR	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0
Total Delay (hr)	0.0	0.3	0.9	0.0	1.2
Total Del/Veh (s)	4.7	0.9	3.8	5.2	2.2
Stop Delay (hr)	0.0	0.0	0.1	0.0	0.1
Stop Del/Veh (s)	4.6	0.0	0.5	1.6	0.3
Total Stops	14	0	39	1	54
Stop/Veh	1.00	0.00	0.04	0.09	0.03
Travel Dist (mi)	2.8	226.1	213.2	2.5	444.7
Travel Time (hr)	0.1	5.4	5.8	0.1	11.4
Avg Speed (mph)	23	42	36	30	39
Fuel Used (gal)	0.1	6.3	8.2	0.1	14.6
Fuel Eff. (mpg)	38.2	36.2	26.0	26.9	30.4
HC Emissions (g)	0	141	196	1	338
CO Emissions (g)	5	3421	6235	55	9716
NOx Emissions (g)	1	519	659	3	1183
Vehicles Entered	14	1161	868	10	2053
Vehicles Exited	14	1162	873	10	2059
Hourly Exit Rate	14	1162	873	10	2059
Input Volume	14	1168	870	10	2062
% of Volume	98	100	100	98	100
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0
Density (ft/veh)					505
Occupancy (veh)	0	5	6	0	11

2: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	2.2	2.2
Travel Time (hr)	0.1	0.1
Avg Speed (mph)	28	28
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	25.3	25.3
HC Emissions (g)	1	1
CO Emissions (g)	30	30
NOx Emissions (g)	2	2
Vehicles Entered	10	10
Vehicles Exited	10	10
Hourly Exit Rate	10	10
Input Volume	10	10
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

3: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.8	0.8
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	36.9	36.9
Travel Time (hr)	1.4	1.4
Avg Speed (mph)	26	26
Fuel Used (gal)	1.5	1.5
Fuel Eff. (mpg)	24.6	24.6
HC Emissions (g)	11	11
CO Emissions (g)	481	481
NOx Emissions (g)	41	41
Vehicles Entered	175	175
Vehicles Exited	174	174
Hourly Exit Rate	174	174
Input Volume	179	179
% of Volume	97	97
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	1	1

4: HP Hwy Performance by movement

Movement	NBT	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.4	1.0	1.4
Total Del/Veh (s)	1.1	4.1	2.4
Stop Delay (hr)	0.0	0.1	0.1
Stop Del/Veh (s)	0.0	0.4	0.2
Total Stops	0	80	80
Stop/Veh	0.00	0.09	0.04
Travel Dist (mi)	144.2	176.1	320.3
Travel Time (hr)	3.6	5.0	8.6
Avg Speed (mph)	40	35	37
Fuel Used (gal)	3.7	4.3	8.0
Fuel Eff. (mpg)	39.0	41.3	40.2
HC Emissions (g)	79	96	176
CO Emissions (g)	1599	2211	3810
NOx Emissions (g)	293	325	618
Vehicles Entered	1162	889	2051
Vehicles Exited	1161	890	2051
Hourly Exit Rate	1161	890	2051
Input Volume	1168	888	2056
% of Volume	99	100	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (ft/veh)			318
Occupancy (veh)	4	5	9

5: HP Hwy & Olowalu Town Access 2/Mauka Access 2 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.3	0.4	0.2	3.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	2.1	0.2	0.0	0.2	0.3	0.0	0.9	3.3	0.0	0.2	2.8	0.2
Total Del/Veh (s)	41.9	32.3	1.4	46.9	53.3	0.7	51.0	10.9	3.3	27.5	13.0	6.1
Stop Delay (hr)	2.0	0.2	0.0	0.2	0.3	0.0	0.9	1.6	0.0	0.1	1.3	0.0
Stop Del/Veh (s)	39.1	29.7	0.1	45.8	52.0	0.0	47.6	5.3	0.8	22.1	6.0	1.9
Total Stops	158	16	2	18	16	0	61	327	4	20	236	31
Stop/Veh	0.86	0.67	0.02	0.95	0.89	0.00	0.92	0.30	0.19	0.91	0.31	0.33
Travel Dist (mi)	35.7	4.8	20.3	3.7	3.5	4.5	15.4	258.8	5.1	8.1	283.6	34.6
Travel Time (hr)	3.6	0.4	0.8	0.5	0.4	0.2	1.3	9.1	0.2	0.4	9.2	1.0
Avg Speed (mph)	10	13	26	8	8	19	11	28	31	22	31	33
Fuel Used (gal)	1.5	0.2	0.5	0.2	0.2	0.1	0.5	6.5	0.1	0.3	9.8	1.1
Fuel Eff. (mpg)	23.5	26.2	38.9	20.8	20.2	30.9	28.5	39.7	50.0	28.4	29.0	30.9
HC Emissions (g)	12	1	4	0	0	0	3	132	0	2	243	8
CO Emissions (g)	325	25	105	15	12	12	114	2853	17	98	6933	542
NOx Emissions (g)	34	2	12	1	1	1	12	454	3	9	796	41
Vehicles Entered	179	24	104	18	17	24	65	1079	21	21	758	91
Vehicles Exited	179	24	104	19	18	23	65	1080	21	22	760	92
Hourly Exit Rate	179	24	104	19	18	23	65	1080	21	22	760	92
Input Volume	177	20	104	20	20	20	68	1082	20	20	758	91
% of Volume	101	117	100	93	88	112	96	100	102	107	100	101
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	3	0	1	0	0	0	1	9	0	0	9	1

5: HP Hwy & Olowalu Town Access 2/Mauka Access 2 Performance by movement

Movement	All
Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.3
Total Delay (hr)	10.3
Total Del/Veh (s)	15.2
Stop Delay (hr)	6.7
Stop Del/Veh (s)	9.8
Total Stops	889
Stop/Veh	0.37
Travel Dist (mi)	677.9
Travel Time (hr)	27.1
Avg Speed (mph)	25
Fuel Used (gal)	21.1
Fuel Eff. (mpg)	32.2
HC Emissions (g)	405
CO Emissions (g)	11051
NOx Emissions (g)	1368
Vehicles Entered	2401
Vehicles Exited	2407
Hourly Exit Rate	2407
Input Volume	2403
% of Volume	100
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	789
Occupancy (veh)	27

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	14.1	14.1
Travel Time (hr)	0.7	0.7
Avg Speed (mph)	19	19
Fuel Used (gal)	0.5	0.5
Fuel Eff. (mpg)	26.5	26.5
HC Emissions (g)	1	1
CO Emissions (g)	65	65
NOx Emissions (g)	7	7
Vehicles Entered	67	67
Vehicles Exited	66	66
Hourly Exit Rate	66	66
Input Volume	62	62
% of Volume	107	107
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	1	1

7: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.9	0.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	23.4	23.4
Travel Time (hr)	0.9	0.9
Avg Speed (mph)	26	26
Fuel Used (gal)	1.0	1.0
Fuel Eff. (mpg)	24.1	24.1
HC Emissions (g)	10	10
CO Emissions (g)	362	362
NOx Emissions (g)	34	34
Vehicles Entered	115	115
Vehicles Exited	115	115
Hourly Exit Rate	115	115
Input Volume	112	112
% of Volume	102	102
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	1	1

9: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.9	0.8	1.7
Total Del/Veh (s)	2.8	3.2	3.0
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.2	0.1
Total Stops	0	29	29
Stop/Veh	0.00	0.03	0.01
Travel Dist (mi)	388.8	106.9	495.7
Travel Time (hr)	9.6	3.2	12.8
Avg Speed (mph)	40	34	39
Fuel Used (gal)	9.4	5.3	14.7
Fuel Eff. (mpg)	41.2	20.4	33.7
HC Emissions (g)	200	131	331
CO Emissions (g)	3536	4126	7662
NOx Emissions (g)	756	443	1199
Vehicles Entered	1164	890	2054
Vehicles Exited	1162	890	2052
Hourly Exit Rate	1162	890	2052
Input Volume	1168	888	2056
% of Volume	99	100	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (ft/veh)	182	199	186
Occupancy (veh)	10	3	13

18: HP Hwy & Olowalu Town Access 1/Mauka Access 1 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.4	0.3	0.2	4.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	1.1	0.2	0.0	0.3	0.3	0.0	0.6	4.6	0.1	0.1	2.3	0.0
Total Del/Veh (s)	44.7	32.4	1.1	49.9	48.4	1.2	54.6	13.4	10.0	13.2	10.3	2.1
Stop Delay (hr)	1.1	0.2	0.0	0.3	0.2	0.0	0.5	1.5	0.0	0.1	1.2	0.0
Stop Del/Veh (s)	42.4	29.4	0.0	47.6	45.0	0.0	48.7	4.3	0.8	10.0	5.6	1.1
Total Stops	82	15	1	20	18	0	39	342	2	14	244	18
Stop/Veh	0.89	0.79	0.02	0.91	0.90	0.00	1.00	0.28	0.11	0.78	0.31	0.31
Travel Dist (mi)	17.2	3.5	11.8	3.0	2.7	2.9	14.6	450.4	7.0	7.2	330.2	23.8
Travel Time (hr)	1.8	0.3	0.5	0.4	0.4	0.1	1.0	15.0	0.2	0.2	9.7	0.6
Avg Speed (mph)	10	12	26	7	7	26	15	30	30	29	34	38
Fuel Used (gal)	0.7	0.1	0.3	0.2	0.1	0.1	0.6	15.7	0.2	0.2	8.4	0.6
Fuel Eff. (mpg)	23.1	26.7	39.9	18.5	20.4	44.3	24.4	28.7	32.2	42.4	39.4	41.5
HC Emissions (g)	5	0	4	1	0	0	6	328	1	1	196	7
CO Emissions (g)	133	15	71	26	18	7	264	10090	79	25	4044	214
NOx Emissions (g)	15	2	10	2	1	1	22	1103	7	5	702	29
Vehicles Entered	90	18	63	21	19	22	39	1222	19	17	789	57
Vehicles Exited	89	18	63	21	20	22	39	1218	19	18	789	57
Hourly Exit Rate	89	18	63	21	20	22	39	1218	19	18	789	57
Input Volume	95	20	63	20	20	20	37	1221	20	20	789	55
% of Volume	94	88	100	102	98	107	106	100	93	88	100	103
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	2	0	0	0	0	0	1	15	0	0	10	1

18: HP Hwy & Olowalu Town Access 1/Mauka Access 1 Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.2
Total Delay (hr)	9.5
Total Del/Veh (s)	14.3
Stop Delay (hr)	5.1
Stop Del/Veh (s)	7.7
Total Stops	795
Stop/Veh	0.33
Travel Dist (mi)	874.4
Travel Time (hr)	30.2
Avg Speed (mph)	29
Fuel Used (gal)	27.1
Fuel Eff. (mpg)	32.2
HC Emissions (g)	550
CO Emissions (g)	14987
NOx Emissions (g)	1900
Vehicles Entered	2376
Vehicles Exited	2373
Hourly Exit Rate	2373
Input Volume	2383
% of Volume	100
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	818
Occupancy (veh)	30

20: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	2.3	2.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.5	0.5
Total Stops	2	2
Stop/Veh	0.04	0.04
Travel Dist (mi)	8.4	8.4
Travel Time (hr)	0.3	0.3
Avg Speed (mph)	24	24
Fuel Used (gal)	0.4	0.4
Fuel Eff. (mpg)	22.2	22.2
HC Emissions (g)	3	3
CO Emissions (g)	136	136
NOx Emissions (g)	10	10
Vehicles Entered	55	55
Vehicles Exited	55	55
Hourly Exit Rate	55	55
Input Volume	62	62
% of Volume	89	89
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

25: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.5	0.5
Total Del/Veh (s)	1.9	1.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	202.6	202.6
Travel Time (hr)	5.0	5.0
Avg Speed (mph)	41	41
Fuel Used (gal)	5.5	5.5
Fuel Eff. (mpg)	36.9	36.9
HC Emissions (g)	128	128
CO Emissions (g)	3002	3002
NOx Emissions (g)	456	456
Vehicles Entered	879	879
Vehicles Exited	875	875
Hourly Exit Rate	875	875
Input Volume	883	883
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	5	5

28: HP Hwy & Ehehene St Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.4	0.0	0.0	0.0	0.4
Denied Del/Veh (s)	0.2	4.1	1.3	1.8	0.0	0.0	0.8
Total Delay (hr)	0.1	0.0	0.6	0.0	0.0	0.6	1.3
Total Del/Veh (s)	63.2	13.3	1.8	1.1	8.7	2.4	2.2
Stop Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	61.5	13.4	0.0	0.0	4.3	0.0	0.2
Total Stops	4	8	0	0	1	0	13
Stop/Veh	1.00	1.00	0.00	0.00	1.00	0.00	0.01
Travel Dist (mi)	0.3	0.6	253.1	0.6	0.5	292.8	547.9
Travel Time (hr)	0.1	0.1	6.7	0.0	0.0	7.2	14.0
Avg Speed (mph)	4	11	40	35	33	41	40
Fuel Used (gal)	0.0	0.0	6.7	0.0	0.0	7.1	13.9
Fuel Eff. (mpg)	14.5	27.2	38.0	43.3	46.7	41.0	39.5
HC Emissions (g)	0	0	142	0	0	174	315
CO Emissions (g)	2	3	2986	3	1	3134	6128
NOx Emissions (g)	0	0	520	0	0	634	1155
Vehicles Entered	4	8	1156	3	1	889	2061
Vehicles Exited	4	8	1156	3	1	886	2058
Hourly Exit Rate	4	8	1156	3	1	886	2058
Input Volume	5	6	1162	2	2	886	2063
% of Volume	80	128	100	150	50	100	100
Denied Entry Before	0	0	1	0	0	0	1
Denied Entry After	0	0	0	0	0	0	0
Density (ft/veh)							484
Occupancy (veh)	0	0	6	0	0	7	14

29: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.4	0.4
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.9	0.9
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	20	20
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	12.7	12.7
HC Emissions (g)	1	1
CO Emissions (g)	40	40
NOx Emissions (g)	2	2
Vehicles Entered	17	17
Vehicles Exited	17	17
Hourly Exit Rate	17	17
Input Volume	17	17
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

32: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.3	0.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.1	0.1
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.3	0.3
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	23	23
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	17.7	17.7
HC Emissions (g)	0	0
CO Emissions (g)	10	10
NOx Emissions (g)	1	1
Vehicles Entered	4	4
Vehicles Exited	4	4
Hourly Exit Rate	4	4
Input Volume	4	4
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

33: HP Hwy & Transfer Station Performance by movement

Movement	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1
Denied Del/Veh (s)	0.1	0.0	0.0	2.7	0.2	0.1
Total Delay (hr)	0.0	1.9	0.0	0.0	0.1	2.0
Total Del/Veh (s)	18.4	5.3	6.5	8.8	0.4	3.4
Stop Delay (hr)	0.0	0.1	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	18.7	0.2	0.0	7.9	0.0	0.2
Total Stops	2	16	0	7	0	25
Stop/Veh	1.00	0.01	0.00	0.54	0.00	0.01
Travel Dist (mi)	0.1	540.3	1.5	2.2	140.7	684.8
Travel Time (hr)	0.0	14.2	0.0	0.1	3.3	17.6
Avg Speed (mph)	5	38	33	24	43	39
Fuel Used (gal)	0.0	18.2	0.0	0.1	3.9	22.2
Fuel Eff. (mpg)	22.4	29.7	31.6	35.8	35.9	30.9
HC Emissions (g)	0	410	0	0	93	503
CO Emissions (g)	0	11451	13	22	2308	13794
NOx Emissions (g)	0	1446	2	2	340	1789
Vehicles Entered	2	1281	4	13	860	2160
Vehicles Exited	2	1272	4	13	859	2150
Hourly Exit Rate	2	1272	4	13	859	2150
Input Volume	2	1288	5	12	861	2168
% of Volume	100	99	80	106	100	99
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Density (ft/veh)						548
Occupancy (veh)	0	14	0	0	3	18

34: External Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	223.7	223.7
Travel Time (hr)	5.4	5.4
Avg Speed (mph)	42	42
Fuel Used (gal)	6.3	6.3
Fuel Eff. (mpg)	35.7	35.7
HC Emissions (g)	142	142
CO Emissions (g)	3546	3546
NOx Emissions (g)	517	517
Vehicles Entered	1272	1272
Vehicles Exited	1272	1272
Hourly Exit Rate	1272	1272
Input Volume	1287	1287
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	5	5

Total Network Performance

Denied Delay (hr)	0.8
Denied Del/Veh (s)	1.1
Total Delay (hr)	28.4
Total Del/Veh (s)	36.4
Stop Delay (hr)	12.3
Stop Del/Veh (s)	15.8
Total Stops	1887
Stop/Veh	0.67
Travel Dist (mi)	4558.4
Travel Time (hr)	135.8
Avg Speed (mph)	34
Fuel Used (gal)	136.9
Fuel Eff. (mpg)	33.3
HC Emissions (g)	2915
CO Emissions (g)	74821
NOx Emissions (g)	10281
Vehicles Entered	2679
Vehicles Exited	2669
Hourly Exit Rate	2669
Input Volume	17807
% of Volume	15
Denied Entry Before	1
Denied Entry After	0
Density (ft/veh)	540
Occupancy (veh)	135

Arterial Level of Service: NB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Ehehene St	28	1.8	20.7	0.2	42
	9	2.8	29.6	0.3	41
	4	1.1	11.2	0.1	39
RIRO Access 3	1	0.9	16.5	0.2	43
Mauka Access 2	5	10.9	30.1	0.2	29
Mauka Access 1	18	14.8	44.2	0.4	31
Transfer Station	33	5.5	39.2	0.4	39
Total		37.7	191.5	1.9	36

Arterial Level of Service: SB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Transfer Station	33	0.4	13.7	0.2	45
Olowalu Town Access	18	10.3	43.7	0.4	35
Olowalu Town Access	5	12.4	42.2	0.4	32
RIRO Access 3	1	3.2	22.9	0.2	38
	4	4.1	20.1	0.2	35
	9	3.2	12.8	0.1	34
Ehehene St	28	2.4	28.8	0.3	42
Total		36.0	184.1	1.9	36

Intersection: 1: HP Hwy & RIRO Access 3

Movement	EB
Directions Served	R
Maximum Queue (ft)	31
Average Queue (ft)	10
95th Queue (ft)	33
Link Distance (ft)	1088
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 4: HP Hwy

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	118	129
Average Queue (ft)	22	22
95th Queue (ft)	78	78
Link Distance (ft)	994	994
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 5: HP Hwy & Olowalu Town Access 2/Mauka Access 2

Movement	EB	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	L	L	T	T	R	L
Maximum Queue (ft)	134	170	52	40	58	39	57	82	240	253	33	46
Average Queue (ft)	37	93	12	3	15	12	16	38	118	122	4	13
95th Queue (ft)	104	152	36	21	43	33	42	72	214	225	20	39
Link Distance (ft)			1046	1046		1036			1214	1214		
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400	400			250		400	400			250	250
Storage Blk Time (%)										0		
Queuing Penalty (veh)										0		

Intersection: 5: HP Hwy & Olowalu Town Access 2/Mauka Access 2

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	224	229	65
Average Queue (ft)	76	86	17
95th Queue (ft)	174	185	44
Link Distance (ft)	1896	1896	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			600
Storage Blk Time (%)	0		
Queuing Penalty (veh)	0		

Intersection: 18: HP Hwy & Olowalu Town Access 1/Mauka Access 1

Movement	EB	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	L	L	T	T	R	L
Maximum Queue (ft)	80	118	55	30	65	59	36	65	317	353	134	41
Average Queue (ft)	13	52	10	2	22	19	6	33	119	125	5	10
95th Queue (ft)	45	101	35	16	54	50	25	65	254	266	58	31
Link Distance (ft)			1001	1001		736			1896	1896		
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	500	500			250		400	400			200	250
Storage Blk Time (%)									0	2		
Queuing Penalty (veh)									0	0		

Intersection: 18: HP Hwy & Olowalu Town Access 1/Mauka Access 1

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	194	192	40
Average Queue (ft)	83	94	12
95th Queue (ft)	159	172	34
Link Distance (ft)	2146	2146	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			600
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 28: HP Hwy & Ehehene St

Movement	WB	WB	SB
Directions Served	L	R	L
Maximum Queue (ft)	26	26	16
Average Queue (ft)	4	5	1
95th Queue (ft)	19	20	9
Link Distance (ft)	407		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		100	200
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: HP Hwy & Transfer Station

Movement	WB	SB
Directions Served	R	L
Maximum Queue (ft)	17	38
Average Queue (ft)	1	7
95th Queue (ft)	10	27
Link Distance (ft)	205	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		250
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 1

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Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	4:57	4:57	4:57	4:57	4:57	4:57
End Time	6:00	6:00	6:00	6:00	6:00	6:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	3651	3628	3678	3572	3629	3633
Vehs Exited	3631	3578	3628	3490	3569	3580
Starting Vehs	177	182	174	160	150	168
Ending Vehs	197	232	224	242	210	218
Denied Entry Before	2	3	1	1	1	1
Denied Entry After	5	2	0	0	0	1
Travel Distance (mi)	6265	6170	6167	6023	6087	6142
Travel Time (hr)	227.0	211.9	213.9	204.7	199.6	211.4
Total Delay (hr)	80.5	67.6	69.1	63.5	56.6	67.4
Total Stops	4080	3993	3924	3686	3575	3851
Fuel Used (gal)	201.8	195.8	197.8	191.5	192.9	196.0

Interval #0 Information Seeding

Start Time	4:57
End Time	5:00
Total Time (min)	3

Volumes adjusted by PHF, Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	5:00
End Time	5:15
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	892	883	934	820	904	885
Vehs Exited	849	875	906	796	850	855
Starting Vehs	177	182	174	160	150	168
Ending Vehs	220	190	202	184	204	197
Denied Entry Before	2	3	1	1	1	1
Denied Entry After	0	2	0	0	1	1
Travel Distance (mi)	1540	1530	1586	1389	1507	1510
Travel Time (hr)	50.7	51.0	55.8	42.7	48.8	49.8
Total Delay (hr)	14.9	15.2	18.3	10.1	13.5	14.4
Total Stops	929	983	1124	679	816	905
Fuel Used (gal)	48.5	47.9	50.9	43.0	46.8	47.4

Interval #2 Information

Start Time	5:15
End Time	5:30
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	934	884	826	877	899	884
Vehs Exited	922	865	851	857	909	880
Starting Vehs	220	190	202	184	204	197
Ending Vehs	232	209	177	204	194	198
Denied Entry Before	0	2	0	0	1	1
Denied Entry After	1	3	1	0	0	1
Travel Distance (mi)	1587	1495	1371	1495	1522	1494
Travel Time (hr)	56.9	50.2	43.8	46.7	48.7	49.2
Total Delay (hr)	19.8	15.2	11.4	11.7	12.9	14.2
Total Stops	1069	957	708	770	828	868
Fuel Used (gal)	50.8	47.8	42.8	46.6	47.7	47.1

Interval #3 Information

Start Time	5:30
End Time	5:45
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	960	943	966	974	982	963
Vehs Exited	935	939	937	918	947	933
Starting Vehs	232	209	177	204	194	198
Ending Vehs	257	213	206	260	229	230
Denied Entry Before	1	3	1	0	0	1
Denied Entry After	0	3	3	3	3	2
Travel Distance (mi)	1610	1602	1630	1576	1614	1606
Travel Time (hr)	62.3	58.4	55.9	54.1	53.7	56.9
Total Delay (hr)	24.5	20.8	17.8	17.3	15.9	19.3
Total Stops	1104	1105	1059	1080	997	1067
Fuel Used (gal)	52.8	51.6	52.8	50.3	52.0	51.9

Interval #4 Information

Start Time	5:45
End Time	6:00
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	865	918	952	901	844	895
Vehs Exited	925	899	934	919	863	909
Starting Vehs	257	213	206	260	229	230
Ending Vehs	197	232	224	242	210	218
Denied Entry Before	0	3	3	3	3	2
Denied Entry After	5	2	0	0	0	1
Travel Distance (mi)	1529	1542	1580	1564	1444	1532
Travel Time (hr)	57.0	52.4	58.5	61.2	48.4	55.5
Total Delay (hr)	21.3	16.3	21.6	24.4	14.3	19.6
Total Stops	978	948	1033	1157	934	1010
Fuel Used (gal)	49.7	48.5	51.2	51.6	46.3	49.5

1: HP Hwy & RIRO Access 3 Performance by movement

Movement	EBR	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0
Total Delay (hr)	0.1	0.4	2.7	0.0	3.1
Total Del/Veh (s)	12.5	0.9	7.0	6.9	4.0
Stop Delay (hr)	0.1	0.0	0.4	0.0	0.5
Stop Del/Veh (s)	12.2	0.0	1.1	1.3	0.6
Total Stops	15	0	60	1	76
Stop/Veh	1.00	0.00	0.04	0.04	0.03
Travel Dist (mi)	3.2	269.7	333.4	5.6	611.9
Travel Time (hr)	0.2	6.4	10.3	0.2	17.1
Avg Speed (mph)	19	42	32	28	36
Fuel Used (gal)	0.1	7.7	13.8	0.2	21.8
Fuel Eff. (mpg)	33.4	35.1	24.2	26.4	28.1
HC Emissions (g)	0	197	321	1	520
CO Emissions (g)	10	4782	10407	97	15297
NOx Emissions (g)	1	694	1061	7	1763
Vehicles Entered	15	1385	1361	23	2784
Vehicles Exited	15	1387	1372	23	2797
Hourly Exit Rate	15	1387	1372	23	2797
Input Volume	15	1400	1372	22	2809
% of Volume	98	99	100	102	100
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0
Density (ft/veh)					337
Occupancy (veh)	0	6	10	0	17

2: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	4.8	4.8
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	27	27
Fuel Used (gal)	0.2	0.2
Fuel Eff. (mpg)	24.6	24.6
HC Emissions (g)	1	1
CO Emissions (g)	66	66
NOx Emissions (g)	5	5
Vehicles Entered	23	23
Vehicles Exited	23	23
Hourly Exit Rate	23	23
Input Volume	22	22
% of Volume	102	102
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

3: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	77.1	77.1
Travel Time (hr)	3.0	3.0
Avg Speed (mph)	26	26
Fuel Used (gal)	3.2	3.2
Fuel Eff. (mpg)	24.2	24.2
HC Emissions (g)	28	28
CO Emissions (g)	1083	1083
NOx Emissions (g)	99	99
Vehicles Entered	368	368
Vehicles Exited	364	364
Hourly Exit Rate	364	364
Input Volume	365	365
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	3	3

4: HP Hwy Performance by movement

Movement	NBT	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.5	17.6	18.1
Total Del/Veh (s)	1.3	46.1	23.6
Stop Delay (hr)	0.0	14.4	14.4
Stop Del/Veh (s)	0.0	37.8	18.8
Total Stops	0	1092	1092
Stop/Veh	0.00	0.80	0.40
Travel Dist (mi)	171.7	270.0	441.7
Travel Time (hr)	4.4	23.7	28.0
Avg Speed (mph)	39	11	16
Fuel Used (gal)	4.5	8.8	13.3
Fuel Eff. (mpg)	38.0	30.8	33.3
HC Emissions (g)	107	127	235
CO Emissions (g)	2197	2816	5013
NOx Emissions (g)	379	306	685
Vehicles Entered	1384	1369	2753
Vehicles Exited	1385	1338	2723
Hourly Exit Rate	1385	1338	2723
Input Volume	1400	1368	2768
% of Volume	99	98	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (ft/veh)			98
Occupancy (veh)	4	24	28

5: HP Hwy & Olowalu Town Access 2/Mauka Access 2 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.2	0.6	0.2	2.7	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	3.3	0.2	0.1	0.2	0.3	0.0	2.0	3.9	0.0	0.2	8.0	0.6
Total Del/Veh (s)	54.3	36.0	2.1	44.1	48.9	0.8	45.8	11.4	3.6	39.3	22.8	12.2
Stop Delay (hr)	3.1	0.2	0.0	0.2	0.3	0.0	1.8	1.8	0.0	0.2	3.3	0.1
Stop Del/Veh (s)	51.0	32.7	0.6	43.0	47.6	0.0	41.5	5.3	0.8	30.6	9.3	2.8
Total Stops	215	15	12	18	19	0	141	371	5	18	488	67
Stop/Veh	0.99	0.75	0.09	0.95	0.90	0.00	0.89	0.30	0.26	1.00	0.39	0.35
Travel Dist (mi)	42.6	3.9	26.4	3.7	4.2	4.3	37.8	291.8	4.5	6.5	464.2	70.8
Travel Time (hr)	5.0	0.3	1.0	0.4	0.5	0.2	3.0	10.5	0.1	0.4	18.5	2.5
Avg Speed (mph)	9	12	25	9	8	19	12	28	31	18	25	28
Fuel Used (gal)	2.0	0.2	0.7	0.2	0.2	0.1	1.3	7.3	0.1	0.3	17.8	2.6
Fuel Eff. (mpg)	21.6	25.6	37.2	20.6	20.6	31.2	29.7	39.8	48.2	24.3	26.0	27.5
HC Emissions (g)	9	1	8	0	0	0	10	174	0	2	416	18
CO Emissions (g)	324	21	190	14	15	11	337	3665	15	103	12307	1209
NOx Emissions (g)	30	2	23	1	1	1	37	560	3	8	1327	87
Vehicles Entered	213	19	136	19	21	22	157	1218	19	17	1238	188
Vehicles Exited	214	20	136	19	21	23	158	1216	19	18	1232	189
Hourly Exit Rate	214	20	136	19	21	23	158	1216	19	18	1232	189
Input Volume	212	20	140	20	20	20	160	1226	20	20	1238	185
% of Volume	101	98	97	93	102	112	99	99	93	88	100	102
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	5	0	1	0	0	0	3	10	0	0	18	2

5: HP Hwy & Olowalu Town Access 2/Mauka Access 2 Performance by movement

Movement	All
Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.2
Total Delay (hr)	18.8
Total Del/Veh (s)	20.4
Stop Delay (hr)	11.0
Stop Del/Veh (s)	11.9
Total Stops	1369
Stop/Veh	0.41
Travel Dist (mi)	960.6
Travel Time (hr)	42.5
Avg Speed (mph)	23
Fuel Used (gal)	32.7
Fuel Eff. (mpg)	29.3
HC Emissions (g)	638
CO Emissions (g)	18213
NOx Emissions (g)	2081
Vehicles Entered	3267
Vehicles Exited	3265
Hourly Exit Rate	3265
Input Volume	3284
% of Volume	99
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	502
Occupancy (veh)	42

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.1	1.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	12.0	12.0
Travel Time (hr)	0.6	0.6
Avg Speed (mph)	19	19
Fuel Used (gal)	0.5	0.5
Fuel Eff. (mpg)	26.6	26.6
HC Emissions (g)	1	1
CO Emissions (g)	57	57
NOx Emissions (g)	6	6
Vehicles Entered	56	56
Vehicles Exited	57	57
Hourly Exit Rate	57	57
Input Volume	62	62
% of Volume	93	93
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	1	1

7: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	0.9	0.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	43.3	43.3
Travel Time (hr)	1.7	1.7
Avg Speed (mph)	26	26
Fuel Used (gal)	1.8	1.8
Fuel Eff. (mpg)	23.8	23.8
HC Emissions (g)	24	24
CO Emissions (g)	775	775
NOx Emissions (g)	78	78
Vehicles Entered	215	215
Vehicles Exited	215	215
Hourly Exit Rate	215	215
Input Volume	221	221
% of Volume	97	97
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	2	2

9: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	1.2	2.4	3.6
Total Del/Veh (s)	3.2	6.4	4.8
Stop Delay (hr)	0.0	0.5	0.5
Stop Del/Veh (s)	0.0	1.4	0.7
Total Stops	0	42	42
Stop/Veh	0.00	0.03	0.02
Travel Dist (mi)	461.0	160.4	621.4
Travel Time (hr)	11.6	6.0	17.6
Avg Speed (mph)	40	27	35
Fuel Used (gal)	11.3	11.2	22.5
Fuel Eff. (mpg)	40.9	14.3	27.6
HC Emissions (g)	265	284	549
CO Emissions (g)	4560	10248	14808
NOx Emissions (g)	964	905	1869
Vehicles Entered	1379	1337	2716
Vehicles Exited	1380	1331	2711
Hourly Exit Rate	1380	1331	2711
Input Volume	1397	1367	2764
% of Volume	99	97	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (ft/veh)	151	106	136
Occupancy (veh)	12	6	18

18: HP Hwy & Olowalu Town Access 1/Mauka Access 1 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.4	0.3	0.1	4.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	1.5	0.2	0.0	0.4	0.2	0.0	1.2	5.5	0.1	0.1	6.4	0.1
Total Del/Veh (s)	47.7	34.1	1.5	50.5	49.5	1.1	52.4	14.5	10.2	20.5	17.1	4.3
Stop Delay (hr)	1.4	0.2	0.0	0.3	0.2	0.0	1.0	1.7	0.0	0.1	3.0	0.0
Stop Del/Veh (s)	45.3	31.0	0.3	48.2	46.2	0.0	45.4	4.5	0.9	15.2	8.1	1.5
Total Stops	101	16	7	24	16	0	73	386	2	19	538	41
Stop/Veh	0.91	0.73	0.08	0.92	0.94	0.00	0.89	0.28	0.08	0.86	0.40	0.34
Travel Dist (mi)	20.5	4.2	16.5	3.5	2.3	2.8	30.4	501.6	8.8	9.2	558.2	50.0
Travel Time (hr)	2.3	0.4	0.6	0.5	0.3	0.1	2.0	17.1	0.3	0.4	18.9	1.4
Avg Speed (mph)	9	12	26	7	7	26	15	29	30	26	30	36
Fuel Used (gal)	0.9	0.2	0.4	0.2	0.1	0.1	1.2	17.7	0.3	0.2	14.3	1.3
Fuel Eff. (mpg)	22.6	25.8	38.9	18.6	20.6	43.0	24.7	28.3	31.8	40.7	39.1	39.4
HC Emissions (g)	4	1	5	1	0	0	17	417	2	1	315	16
CO Emissions (g)	132	24	109	29	15	5	625	12101	105	35	6647	595
NOx Emissions (g)	13	2	14	2	1	1	58	1357	9	7	1077	62
Vehicles Entered	108	22	89	25	17	21	81	1345	24	22	1335	119
Vehicles Exited	107	22	89	25	16	21	80	1351	24	22	1335	119
Hourly Exit Rate	107	22	89	25	16	21	80	1351	24	22	1335	119
Input Volume	111	20	85	20	20	20	87	1348	20	20	1342	114
% of Volume	96	107	105	122	78	102	92	100	117	107	99	105
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	2	0	1	0	0	0	2	17	0	0	19	1

18: HP Hwy & Olowalu Town Access 1/Mauka Access 1 Performance by movement

Movement	All
Denied Delay (hr)	0.1
Denied Del/Veh (s)	0.2
Total Delay (hr)	15.7
Total Del/Veh (s)	17.5
Stop Delay (hr)	8.1
Stop Del/Veh (s)	9.0
Total Stops	1223
Stop/Veh	0.38
Travel Dist (mi)	1208.1
Travel Time (hr)	44.3
Avg Speed (mph)	27
Fuel Used (gal)	36.8
Fuel Eff. (mpg)	32.8
HC Emissions (g)	779
CO Emissions (g)	20422
NOx Emissions (g)	2602
Vehicles Entered	3208
Vehicles Exited	3211
Hourly Exit Rate	3211
Input Volume	3210
% of Volume	100
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	558
Occupancy (veh)	44

20: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	2.2	2.2
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	2	2
Stop/Veh	0.03	0.03
Travel Dist (mi)	10.5	10.5
Travel Time (hr)	0.4	0.4
Avg Speed (mph)	24	24
Fuel Used (gal)	0.5	0.5
Fuel Eff. (mpg)	22.4	22.4
HC Emissions (g)	3	3
CO Emissions (g)	160	160
NOx Emissions (g)	12	12
Vehicles Entered	67	67
Vehicles Exited	68	68
Hourly Exit Rate	68	68
Input Volume	62	62
% of Volume	111	111
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

25: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.8	0.8
Total Del/Veh (s)	2.1	2.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	306.8	306.8
Travel Time (hr)	7.7	7.7
Avg Speed (mph)	40	40
Fuel Used (gal)	8.4	8.4
Fuel Eff. (mpg)	36.3	36.3
HC Emissions (g)	205	205
CO Emissions (g)	4867	4867
NOx Emissions (g)	706	706
Vehicles Entered	1330	1330
Vehicles Exited	1326	1326
Hourly Exit Rate	1326	1326
Input Volume	1373	1373
% of Volume	97	97
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	8	8

28: HP Hwy & Ehehene St Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.9	0.0	0.0	0.0	0.9
Denied Del/Veh (s)	0.1	4.0	2.3	3.5	0.0	0.0	1.2
Total Delay (hr)	0.5	0.0	1.0	0.0	0.0	1.1	2.6
Total Del/Veh (s)	254.6	25.2	2.6	1.3	24.9	2.9	3.4
Stop Delay (hr)	0.5	0.0	0.0	0.0	0.0	0.0	0.5
Stop Del/Veh (s)	252.5	24.7	0.0	0.0	21.9	0.0	0.7
Total Stops	7	5	0	0	2	0	14
Stop/Veh	1.00	1.00	0.00	0.00	0.67	0.00	0.01
Travel Dist (mi)	0.6	0.4	300.7	0.4	0.9	440.3	743.3
Travel Time (hr)	0.5	0.1	8.6	0.0	0.0	10.9	20.2
Avg Speed (mph)	1	7	39	34	20	40	39
Fuel Used (gal)	0.1	0.0	8.3	0.0	0.0	10.9	19.4
Fuel Eff. (mpg)	4.3	18.6	36.2	43.1	35.6	40.4	38.4
HC Emissions (g)	0	0	191	0	0	287	478
CO Emissions (g)	11	4	3771	2	3	5211	9001
NOx Emissions (g)	0	0	678	0	1	1005	1684
Vehicles Entered	7	5	1374	2	3	1332	2723
Vehicles Exited	7	5	1374	2	3	1324	2715
Hourly Exit Rate	7	5	1374	2	3	1324	2715
Input Volume	7	3	1394	2	3	1366	2775
% of Volume	97	167	99	100	100	97	98
Denied Entry Before	0	0	1	0	0	0	1
Denied Entry After	0	0	1	0	0	0	1
Density (ft/veh)							341
Occupancy (veh)	1	0	8	0	0	11	19

29: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.5	0.5
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.5	0.5
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	19	19
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	12.4	12.4
HC Emissions (g)	0	0
CO Emissions (g)	23	23
NOx Emissions (g)	2	2
Vehicles Entered	10	10
Vehicles Exited	10	10
Hourly Exit Rate	10	10
Input Volume	11	11
% of Volume	89	89
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

32: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.5	0.5
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.4	0.4
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	23	23
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	17.1	17.1
HC Emissions (g)	0	0
CO Emissions (g)	11	11
NOx Emissions (g)	1	1
Vehicles Entered	5	5
Vehicles Exited	5	5
Hourly Exit Rate	5	5
Input Volume	5	5
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

33: HP Hwy & Transfer Station Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	2.4	0.3	0.2
Total Delay (hr)	0.0	0.0	2.3	0.0	0.0	0.3	2.7
Total Del/Veh (s)	47.8	14.2	5.7	9.8	11.8	0.7	3.3
Stop Delay (hr)	0.0	0.0	0.1	0.0	0.0	0.0	0.2
Stop Del/Veh (s)	46.3	14.4	0.2	0.0	11.0	0.0	0.2
Total Stops	2	7	18	0	6	0	33
Stop/Veh	1.00	1.00	0.01	0.00	0.75	0.00	0.01
Travel Dist (mi)	0.1	0.3	606.4	1.0	1.3	240.9	849.9
Travel Time (hr)	0.0	0.0	16.1	0.0	0.1	5.8	22.1
Avg Speed (mph)	3	7	38	32	21	42	39
Fuel Used (gal)	0.0	0.0	20.8	0.0	0.0	6.8	27.7
Fuel Eff. (mpg)	11.3	27.1	29.1	28.4	36.4	35.4	30.6
HC Emissions (g)	0	0	511	0	0	165	676
CO Emissions (g)	0	1	13835	10	9	4108	17963
NOx Emissions (g)	0	0	1767	1	1	590	2360
Vehicles Entered	2	7	1446	2	8	1472	2937
Vehicles Exited	2	7	1434	2	8	1470	2923
Hourly Exit Rate	2	7	1434	2	8	1470	2923
Input Volume	2	6	1446	2	9	1469	2934
% of Volume	100	112	99	100	86	100	100
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Density (ft/veh)							439
Occupancy (veh)	0	0	16	0	0	6	22

34: External Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	249.8	249.8
Travel Time (hr)	6.0	6.0
Avg Speed (mph)	42	42
Fuel Used (gal)	7.1	7.1
Fuel Eff. (mpg)	35.4	35.4
HC Emissions (g)	177	177
CO Emissions (g)	4274	4274
NOx Emissions (g)	626	626
Vehicles Entered	1422	1422
Vehicles Exited	1419	1419
Hourly Exit Rate	1419	1419
Input Volume	1435	1435
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	6	6

Total Network Performance

Denied Delay (hr)	1.4
Denied Del/Veh (s)	1.3
Total Delay (hr)	66.1
Total Del/Veh (s)	62.6
Stop Delay (hr)	35.3
Stop Del/Veh (s)	33.4
Total Stops	3851
Stop/Veh	1.01
Travel Dist (mi)	6142.2
Travel Time (hr)	211.4
Avg Speed (mph)	29
Fuel Used (gal)	196.0
Fuel Eff. (mpg)	31.3
HC Emissions (g)	4315
CO Emissions (g)	112032
NOx Emissions (g)	14580
Vehicles Entered	3633
Vehicles Exited	3580
Hourly Exit Rate	3580
Input Volume	24098
% of Volume	15
Denied Entry Before	1
Denied Entry After	1
Density (ft/veh)	347
Occupancy (veh)	210

Arterial Level of Service: NB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Ehehene St	28	2.6	22.4	0.2	40
	9	3.2	30.0	0.3	40
	4	1.3	11.3	0.1	39
RIRO Access 3	1	0.9	16.5	0.2	43
Mauka Access 2	5	11.4	30.6	0.2	29
Mauka Access 1	18	15.8	45.4	0.4	30
Transfer Station	33	5.8	39.4	0.4	39
Total		41.0	195.7	1.9	36

Arterial Level of Service: SB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Transfer Station	33	0.7	14.1	0.2	44
Olowalu Town Access	18	17.1	50.4	0.4	30
Olowalu Town Access	5	21.7	51.5	0.4	26
RIRO Access 3	1	6.0	25.6	0.2	34
	4	46.0	61.9	0.2	11
	9	6.4	16.1	0.1	27
Ehehene St	28	2.9	29.5	0.3	41
Total		100.9	249.1	1.9	27

Intersection: 1: HP Hwy & RIRO Access 3

Movement	EB
Directions Served	R
Maximum Queue (ft)	40
Average Queue (ft)	11
95th Queue (ft)	36
Link Distance (ft)	1088
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 4: HP Hwy

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	657	662
Average Queue (ft)	308	316
95th Queue (ft)	646	660
Link Distance (ft)	994	994
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 5: HP Hwy & Olowalu Town Access 2/Mauka Access 2

Movement	EB	EB	EB	EB	WB	WB	WB	NB	NB	NB	NB	NB
Directions Served	L	L	T	R	L	T	R	L	L	T	T	R
Maximum Queue (ft)	147	188	46	74	58	56	9	104	128	273	276	29
Average Queue (ft)	60	107	11	16	15	15	0	46	67	134	143	4
95th Queue (ft)	135	170	33	57	42	42	7	89	111	240	253	19
Link Distance (ft)			1046	1046		1036	1036			1214	1214	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400	400			250			400	400			250
Storage Blk Time (%)											1	
Queuing Penalty (veh)											0	

Intersection: 5: HP Hwy & Olowalu Town Access 2/Mauka Access 2

Movement	SB	SB	SB	SB
Directions Served	L	T	T	R
Maximum Queue (ft)	100	435	450	106
Average Queue (ft)	14	163	179	31
95th Queue (ft)	59	350	363	75
Link Distance (ft)		1896	1896	
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)	250			600
Storage Blk Time (%)		4		
Queuing Penalty (veh)		1		

Intersection: 18: HP Hwy & Olowalu Town Access 1/Mauka Access 1

Movement	EB	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	L	L	T	T	R	L
Maximum Queue (ft)	118	132	58	64	77	52	78	91	353	364	88	46
Average Queue (ft)	20	61	11	8	25	17	23	45	134	143	3	13
95th Queue (ft)	67	113	38	39	64	48	60	79	273	289	47	36
Link Distance (ft)			1001	1001		736			1896	1896		
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	500	500			250		400	400			200	250
Storage Blk Time (%)									0	3	0	
Queuing Penalty (veh)									0	1	0	

Intersection: 18: HP Hwy & Olowalu Town Access 1/Mauka Access 1

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	338	344	57
Average Queue (ft)	176	198	21
95th Queue (ft)	298	321	47
Link Distance (ft)	2146	2146	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			600
Storage Blk Time (%)	2		
Queuing Penalty (veh)	0		

Intersection: 28: HP Hwy & Ehehene St

Movement	WB	WB	SB	B9
Directions Served	L	R	L	T
Maximum Queue (ft)	55	25	28	130
Average Queue (ft)	13	4	3	5
95th Queue (ft)	41	17	15	95
Link Distance (ft)	407			600
Upstream Blk Time (%)				0
Queuing Penalty (veh)				0
Storage Bay Dist (ft)		100	200	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 33: HP Hwy & Transfer Station

Movement	WB	WB	SB
Directions Served	L	R	L
Maximum Queue (ft)	25	22	27
Average Queue (ft)	2	5	6
95th Queue (ft)	12	19	23
Link Distance (ft)	205	205	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			250
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 2

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Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	3901	3869	3963	3853	3885	3895
Vehs Exited	3825	3801	3904	3799	3823	3831
Starting Vehs	158	151	145	166	164	156
Ending Vehs	234	219	204	220	226	217
Denied Entry Before	3	1	0	0	1	1
Denied Entry After	0	2	1	0	1	1
Travel Distance (mi)	5766	5727	5780	5668	5681	5724
Travel Time (hr)	221.3	220.3	222.2	217.9	217.7	219.9
Total Delay (hr)	21.3	22.0	22.1	21.6	21.3	21.7
Total Stops	892	925	849	894	931	895
Fuel Used (gal)	178.7	177.8	180.1	177.1	177.7	178.3

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	1027	1000	965	941	961	974
Vehs Exited	974	925	895	924	913	925
Starting Vehs	158	151	145	166	164	156
Ending Vehs	211	226	215	183	212	207
Denied Entry Before	3	1	0	0	1	1
Denied Entry After	2	1	1	0	1	1
Travel Distance (mi)	1493	1438	1395	1398	1415	1428
Travel Time (hr)	57.4	54.7	53.6	53.8	54.2	54.7
Total Delay (hr)	5.8	4.9	5.2	5.2	5.3	5.3
Total Stops	214	210	209	238	256	225
Fuel Used (gal)	46.6	44.5	43.2	43.5	44.1	44.4

Interval #2 Information

Start Time	7:15
End Time	7:30
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	960	906	985	999	1022	974
Vehs Exited	954	918	993	953	1008	964
Starting Vehs	211	226	215	183	212	207
Ending Vehs	217	214	207	229	226	219
Denied Entry Before	2	1	1	0	1	1
Denied Entry After	0	1	0	0	1	0
Travel Distance (mi)	1447	1378	1448	1453	1506	1446
Travel Time (hr)	55.6	52.3	55.7	56.2	58.0	55.6
Total Delay (hr)	5.4	4.9	5.5	5.8	5.9	5.5
Total Stops	250	189	218	242	253	230
Fuel Used (gal)	44.8	42.2	44.4	45.2	47.2	44.8

Interval #3 Information

Start Time	7:30
End Time	7:45
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	951	994	1051	946	921	969
Vehs Exited	951	992	1032	970	936	977
Starting Vehs	217	214	207	229	226	219
Ending Vehs	217	216	226	205	211	209
Denied Entry Before	0	1	0	0	1	0
Denied Entry After	0	0	0	0	1	0
Travel Distance (mi)	1390	1473	1506	1391	1324	1417
Travel Time (hr)	53.3	56.7	58.1	53.2	50.3	54.3
Total Delay (hr)	5.0	5.8	6.0	5.2	4.6	5.3
Total Stops	211	274	234	192	190	218
Fuel Used (gal)	42.9	46.0	47.2	44.0	41.3	44.3

Interval #4 Information

Start Time	7:45
End Time	8:00
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	963	969	962	967	981	967
Vehs Exited	946	966	984	952	966	962
Starting Vehs	217	216	226	205	211	209
Ending Vehs	234	219	204	220	226	217
Denied Entry Before	0	0	0	0	1	0
Denied Entry After	0	2	1	0	1	1
Travel Distance (mi)	1436	1438	1431	1427	1437	1434
Travel Time (hr)	55.0	56.6	54.8	54.7	55.2	55.3
Total Delay (hr)	5.1	6.5	5.6	5.3	5.4	5.6
Total Stops	217	252	188	222	232	222
Fuel Used (gal)	44.4	45.1	45.3	44.4	45.1	44.8

2: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	2.1	0.1	2.2
Total Del/Veh (s)	6.2	0.2	3.5
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0
Total Stops	0	0	0
Stop/Veh	0.00	0.00	0.00
Travel Dist (mi)	507.1	18.3	525.3
Travel Time (hr)	19.2	1.6	20.8
Avg Speed (mph)	26	11	25
Fuel Used (gal)	14.3	1.7	16.0
Fuel Eff. (mpg)	35.5	10.7	32.8
HC Emissions (g)	264	38	302
CO Emissions (g)	3834	912	4746
NOx Emissions (g)	628	130	758
Vehicles Entered	1234	1026	2260
Vehicles Exited	1237	1025	2262
Hourly Exit Rate	1237	1025	2262
Input Volume	1250	1048	2298
% of Volume	99	98	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

3: Olowalu Access 2 & HP Hwy Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.1	0.0	0.0	0.1
Denied Del/Veh (s)	0.5	0.0	0.0	0.2
Total Delay (hr)	0.6	0.1	0.3	1.1
Total Del/Veh (s)	3.9	0.6	2.8	2.1
Stop Delay (hr)	0.1	0.0	0.0	0.1
Stop Del/Veh (s)	0.5	0.0	0.1	0.2
Total Stops	66	0	0	66
Stop/Veh	0.11	0.00	0.00	0.04
Travel Dist (mi)	29.3	123.7	58.6	211.5
Travel Time (hr)	1.9	4.4	2.5	8.8
Avg Speed (mph)	16	28	23	24
Fuel Used (gal)	0.8	3.9	1.5	6.2
Fuel Eff. (mpg)	36.6	32.0	38.0	34.1
HC Emissions (g)	7	59	14	81
CO Emissions (g)	238	1289	397	1924
NOx Emissions (g)	24	170	41	234
Vehicles Entered	580	832	405	1817
Vehicles Exited	578	830	404	1812
Hourly Exit Rate	578	830	404	1812
Input Volume	585	856	400	1841
% of Volume	99	97	101	98
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

4: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	3.3	3.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	26.2	26.2
Travel Time (hr)	1.6	1.6
Avg Speed (mph)	16	16
Fuel Used (gal)	2.0	2.0
Fuel Eff. (mpg)	13.4	13.4
HC Emissions (g)	27	27
CO Emissions (g)	1177	1177
NOx Emissions (g)	95	95
Vehicles Entered	404	404
Vehicles Exited	404	404
Hourly Exit Rate	404	404
Input Volume	400	400
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0

5: External Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.3	0.3
Total Del/Veh (s)	0.6	0.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	118.5	118.5
Travel Time (hr)	4.2	4.2
Avg Speed (mph)	28	28
Fuel Used (gal)	3.9	3.9
Fuel Eff. (mpg)	30.6	30.6
HC Emissions (g)	42	42
CO Emissions (g)	1201	1201
NOx Emissions (g)	116	116
Vehicles Entered	1511	1511
Vehicles Exited	1509	1509
Hourly Exit Rate	1509	1509
Input Volume	1540	1540
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

6: HP Hwy & Mauka Access 2 Performance by movement

Movement	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.3	0.0	0.4
Total Del/Veh (s)	0.7	0.7	0.6	0.7
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.1	0.1	0.1
Total Stops	0	2	0	2
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	3.3	163.1	6.2	172.6
Travel Time (hr)	0.2	6.0	0.3	6.4
Avg Speed (mph)	21	27	23	27
Fuel Used (gal)	0.1	5.8	0.2	6.0
Fuel Eff. (mpg)	56.0	28.3	34.3	28.8
HC Emissions (g)	0	91	2	93
CO Emissions (g)	12	2220	56	2288
NOx Emissions (g)	1	269	5	275
Vehicles Entered	63	1615	60	1738
Vehicles Exited	64	1612	60	1736
Hourly Exit Rate	64	1612	60	1736
Input Volume	60	1623	60	1743
% of Volume	107	99	100	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

7: HP Hwy & O-turn 2E Performance by movement

Movement	EBL	NBT	All
Denied Delay (hr)	0.1	0.0	0.1
Denied Del/Veh (s)	1.3	0.0	0.3
Total Delay (hr)	0.3	0.6	0.9
Total Del/Veh (s)	2.6	1.8	2.0
Stop Delay (hr)	0.3	0.0	0.3
Stop Del/Veh (s)	2.3	0.0	0.6
Total Stops	107	2	109
Stop/Veh	0.27	0.00	0.07
Travel Dist (mi)	4.0	327.6	331.7
Travel Time (hr)	0.7	11.6	12.3
Avg Speed (mph)	7	28	27
Fuel Used (gal)	0.3	9.5	9.8
Fuel Eff. (mpg)	13.6	34.5	33.9
HC Emissions (g)	2	183	186
CO Emissions (g)	64	3121	3185
NOx Emissions (g)	9	492	501
Vehicles Entered	396	1242	1638
Vehicles Exited	396	1243	1639
Hourly Exit Rate	396	1243	1639
Input Volume	395	1250	1645
% of Volume	100	99	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: HP Hwy & O-turn 2E Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.8	1.0
Total Del/Veh (s)	3.9	2.4	2.6
Stop Delay (hr)	0.1	0.2	0.3
Stop Del/Veh (s)	1.2	0.7	0.8
Total Stops	58	127	185
Stop/Veh	0.29	0.10	0.13
Travel Dist (mi)	20.2	116.2	136.4
Travel Time (hr)	1.0	5.2	6.2
Avg Speed (mph)	19	23	22
Fuel Used (gal)	0.8	5.2	5.9
Fuel Eff. (mpg)	26.6	22.5	23.1
HC Emissions (g)	9	80	88
CO Emissions (g)	298	2392	2690
NOx Emissions (g)	29	255	284
Vehicles Entered	197	1212	1409
Vehicles Exited	195	1210	1405
Hourly Exit Rate	195	1210	1405
Input Volume	202	1239	1441
% of Volume	97	98	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

9: O-turn 2W Performance by movement

Movement	NBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.6	0.8
Total Del/Veh (s)	3.4	1.4	1.7
Stop Delay (hr)	0.0	0.0	0.1
Stop Del/Veh (s)	0.3	0.1	0.1
Total Stops	13	32	45
Stop/Veh	0.06	0.02	0.03
Travel Dist (mi)	30.8	215.4	246.2
Travel Time (hr)	1.3	7.9	9.2
Avg Speed (mph)	23	27	27
Fuel Used (gal)	0.9	6.5	7.4
Fuel Eff. (mpg)	35.3	33.0	33.3
HC Emissions (g)	8	105	113
CO Emissions (g)	179	2048	2227
NOx Emissions (g)	25	293	319
Vehicles Entered	206	1476	1682
Vehicles Exited	206	1471	1677
Hourly Exit Rate	206	1471	1677
Input Volume	202	1486	1688
% of Volume	102	99	99
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

10: HP Hwy & O-turn 2W Performance by movement

Movement	WBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.3	0.4
Total Del/Veh (s)	2.2	1.0	1.2
Stop Delay (hr)	0.1	0.0	0.1
Stop Del/Veh (s)	1.8	0.0	0.3
Total Stops	74	1	75
Stop/Veh	0.36	0.00	0.06
Travel Dist (mi)	3.6	212.1	215.7
Travel Time (hr)	0.3	7.4	7.7
Avg Speed (mph)	10	29	28
Fuel Used (gal)	0.2	6.2	6.3
Fuel Eff. (mpg)	19.9	34.5	34.1
HC Emissions (g)	2	63	64
CO Emissions (g)	48	1172	1220
NOx Emissions (g)	6	179	185
Vehicles Entered	206	998	1204
Vehicles Exited	205	998	1203
Hourly Exit Rate	205	998	1203
Input Volume	202	1024	1226
% of Volume	101	97	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

11: HP Hwy & O-turn 1E Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.4	0.6	1.0
Total Del/Veh (s)	5.0	2.2	2.8
Stop Delay (hr)	0.1	0.2	0.3
Stop Del/Veh (s)	1.4	0.6	0.8
Total Stops	58	95	153
Stop/Veh	0.21	0.09	0.12
Travel Dist (mi)	37.3	138.6	175.8
Travel Time (hr)	1.8	5.6	7.4
Avg Speed (mph)	21	25	24
Fuel Used (gal)	1.3	5.2	6.5
Fuel Eff. (mpg)	28.3	26.9	27.2
HC Emissions (g)	11	75	85
CO Emissions (g)	387	2000	2386
NOx Emissions (g)	41	229	269
Vehicles Entered	272	1025	1297
Vehicles Exited	272	1025	1297
Hourly Exit Rate	272	1025	1297
Input Volume	267	1052	1319
% of Volume	102	97	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

12: O-turn 1E & HP Hwy Performance by movement

Movement	EBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.5	0.7
Total Del/Veh (s)	2.6	1.4	1.6
Stop Delay (hr)	0.2	0.0	0.2
Stop Del/Veh (s)	2.2	0.0	0.3
Total Stops	101	1	102
Stop/Veh	0.37	0.00	0.06
Travel Dist (mi)	4.8	304.2	309.0
Travel Time (hr)	0.5	10.8	11.3
Avg Speed (mph)	10	28	27
Fuel Used (gal)	0.3	8.9	9.2
Fuel Eff. (mpg)	18.6	34.1	33.7
HC Emissions (g)	2	173	174
CO Emissions (g)	56	2995	3051
NOx Emissions (g)	8	467	475
Vehicles Entered	272	1428	1700
Vehicles Exited	272	1418	1690
Hourly Exit Rate	272	1418	1690
Input Volume	267	1443	1710
% of Volume	102	98	99
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

13: O-turn 1 W Performance by movement

Movement	NBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.5	0.6
Total Del/Veh (s)	2.9	1.2	1.3
Stop Delay (hr)	0.0	0.1	0.1
Stop Del/Veh (s)	0.4	0.1	0.2
Total Stops	8	39	47
Stop/Veh	0.07	0.02	0.03
Travel Dist (mi)	12.7	164.9	177.6
Travel Time (hr)	0.6	6.1	6.7
Avg Speed (mph)	22	27	27
Fuel Used (gal)	0.4	5.3	5.6
Fuel Eff. (mpg)	35.2	31.2	31.5
HC Emissions (g)	3	76	79
CO Emissions (g)	69	1711	1779
NOx Emissions (g)	10	227	236
Vehicles Entered	119	1607	1726
Vehicles Exited	119	1604	1723
Hourly Exit Rate	119	1604	1723
Input Volume	127	1629	1756
% of Volume	94	98	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

14: HP Hwy & O-turn 1 W Performance by movement

Movement	WBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.1	0.3	0.4
Total Del/Veh (s)	2.8	1.2	1.4
Stop Delay (hr)	0.1	0.0	0.1
Stop Del/Veh (s)	2.4	0.0	0.3
Total Stops	56	0	56
Stop/Veh	0.47	0.00	0.05
Travel Dist (mi)	2.1	312.7	314.7
Travel Time (hr)	0.2	10.9	11.1
Avg Speed (mph)	9	29	28
Fuel Used (gal)	0.1	8.9	9.0
Fuel Eff. (mpg)	19.8	35.1	34.9
HC Emissions (g)	1	89	90
CO Emissions (g)	28	1555	1583
NOx Emissions (g)	4	252	255
Vehicles Entered	119	985	1104
Vehicles Exited	118	987	1105
Hourly Exit Rate	118	987	1105
Input Volume	127	1004	1131
% of Volume	93	98	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

15: HP Hwy & Olowalu Access 1 Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.3	0.0	0.0	0.1
Total Delay (hr)	0.3	0.1	0.1	0.6
Total Del/Veh (s)	3.0	0.5	2.0	1.4
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.3	0.0	0.1	0.1
Total Stops	33	0	0	33
Stop/Veh	0.08	0.00	0.00	0.02
Travel Dist (mi)	26.1	92.1	22.6	140.8
Travel Time (hr)	1.4	3.3	1.0	5.7
Avg Speed (mph)	19	28	23	25
Fuel Used (gal)	0.7	2.9	0.6	4.2
Fuel Eff. (mpg)	37.1	31.6	39.7	33.6
HC Emissions (g)	7	42	5	55
CO Emissions (g)	269	930	178	1376
NOx Emissions (g)	23	121	15	159
Vehicles Entered	401	901	230	1532
Vehicles Exited	400	902	228	1530
Hourly Exit Rate	400	902	228	1530
Input Volume	398	920	238	1556
% of Volume	101	98	96	98
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

16: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	3.2	3.2
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	18.2	18.2
Travel Time (hr)	1.0	1.0
Avg Speed (mph)	18	18
Fuel Used (gal)	1.2	1.2
Fuel Eff. (mpg)	15.4	15.4
HC Emissions (g)	16	16
CO Emissions (g)	679	679
NOx Emissions (g)	56	56
Vehicles Entered	228	228
Vehicles Exited	228	228
Hourly Exit Rate	228	228
Input Volume	238	238
% of Volume	96	96
Denied Entry Before	0	0
Denied Entry After	0	0

17: RIRO Access & HP Hwy Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.2	0.0	0.2
Total Del/Veh (s)	0.6	0.6	0.1	0.6
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0	0.0
Total Stops	0	0	0	0
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	1.4	136.3	3.1	140.8
Travel Time (hr)	0.1	4.8	0.1	4.9
Avg Speed (mph)	20	29	26	28
Fuel Used (gal)	0.0	4.1	0.1	4.2
Fuel Eff. (mpg)	62.0	33.3	45.2	33.6
HC Emissions (g)	0	66	1	67
CO Emissions (g)	4	1277	11	1292
NOx Emissions (g)	0	189	2	191
Vehicles Entered	30	1034	23	1087
Vehicles Exited	30	1035	23	1088
Hourly Exit Rate	30	1035	23	1088
Input Volume	32	1052	25	1109
% of Volume	94	98	92	98
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

18: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	1.3	1.3
Travel Time (hr)	0.1	0.1
Avg Speed (mph)	20	20
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	13.5	13.5
HC Emissions (g)	3	3
CO Emissions (g)	90	90
NOx Emissions (g)	8	8
Vehicles Entered	23	23
Vehicles Exited	23	23
Hourly Exit Rate	23	23
Input Volume	25	25
% of Volume	92	92
Denied Entry Before	0	0
Denied Entry After	0	0

19: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.5	1.5
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	1	1
Stop/Veh	0.00	0.00
Travel Dist (mi)	136.5	136.5
Travel Time (hr)	5.1	5.1
Avg Speed (mph)	27	27
Fuel Used (gal)	4.3	4.3
Fuel Eff. (mpg)	31.4	31.4
HC Emissions (g)	85	85
CO Emissions (g)	1676	1676
NOx Emissions (g)	250	250
Vehicles Entered	1031	1031
Vehicles Exited	1032	1032
Hourly Exit Rate	1032	1032
Input Volume	1049	1049
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

20: HP Hwy Performance by movement

Movement	NBT	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.3	0.3
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	166.7	166.7
Travel Time (hr)	5.9	5.9
Avg Speed (mph)	28	28
Fuel Used (gal)	5.2	5.2
Fuel Eff. (mpg)	32.0	32.0
HC Emissions (g)	106	106
CO Emissions (g)	2093	2093
NOx Emissions (g)	289	289
Vehicles Entered	1241	1241
Vehicles Exited	1242	1242
Hourly Exit Rate	1242	1242
Input Volume	1250	1250
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0

21: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.5	0.5
Total Del/Veh (s)	1.7	1.7
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	132.8	132.8
Travel Time (hr)	5.0	5.0
Avg Speed (mph)	27	27
Fuel Used (gal)	4.0	4.0
Fuel Eff. (mpg)	33.4	33.4
HC Emissions (g)	77	77
CO Emissions (g)	1276	1276
NOx Emissions (g)	213	213
Vehicles Entered	1032	1032
Vehicles Exited	1029	1029
Hourly Exit Rate	1029	1029
Input Volume	1049	1049
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

23: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	1.4	1.4
Total Del/Veh (s)	4.7	4.7
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	121.2	121.2
Travel Time (hr)	5.4	5.4
Avg Speed (mph)	22	22
Fuel Used (gal)	2.5	2.5
Fuel Eff. (mpg)	47.8	47.8
HC Emissions (g)	50	50
CO Emissions (g)	779	779
NOx Emissions (g)	108	108
Vehicles Entered	1029	1029
Vehicles Exited	1027	1027
Hourly Exit Rate	1027	1027
Input Volume	1049	1049
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

24: Performance by movement

Movement	NBT	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.7	0.7
Total Del/Veh (s)	1.9	1.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	137.5	137.5
Travel Time (hr)	5.3	5.3
Avg Speed (mph)	26	26
Fuel Used (gal)	4.0	4.0
Fuel Eff. (mpg)	34.3	34.3
HC Emissions (g)	76	76
CO Emissions (g)	1187	1187
NOx Emissions (g)	180	180
Vehicles Entered	1240	1240
Vehicles Exited	1241	1241
Hourly Exit Rate	1241	1241
Input Volume	1250	1250
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0

26: Bend Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	0.6	0.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	45.7	45.7
Travel Time (hr)	1.8	1.8
Avg Speed (mph)	26	26
Fuel Used (gal)	1.3	1.3
Fuel Eff. (mpg)	35.2	35.2
HC Emissions (g)	25	25
CO Emissions (g)	371	371
NOx Emissions (g)	59	59
Vehicles Entered	1239	1239
Vehicles Exited	1240	1240
Hourly Exit Rate	1240	1240
Input Volume	1250	1250
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0

27: HP Hwy & Ehehene Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.6	0.0	0.0	0.0	0.6
Denied Del/Veh (s)	0.1	0.1	1.7	3.3	0.0	0.0	0.9
Total Delay (hr)	0.1	0.0	0.8	0.0	0.0	1.3	2.3
Total Del/Veh (s)	90.1	21.7	2.5	1.8	17.8	4.6	3.6
Stop Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	88.5	21.8	0.0	0.0	13.6	0.0	0.2
Total Stops	4	7	0	0	1	0	12
Stop/Veh	1.00	1.00	0.00	0.00	1.00	0.00	0.01
Travel Dist (mi)	0.2	0.3	241.2	0.6	0.4	417.5	660.2
Travel Time (hr)	0.1	0.1	9.5	0.0	0.0	15.5	25.3
Avg Speed (mph)	1	5	27	25	21	27	27
Fuel Used (gal)	0.0	0.0	7.1	0.0	0.0	13.2	20.4
Fuel Eff. (mpg)	5.9	19.1	33.8	34.9	28.9	31.6	32.3
HC Emissions (g)	0	0	133	0	0	275	409
CO Emissions (g)	2	2	2177	2	2	5081	7267
NOx Emissions (g)	0	0	339	0	0	731	1071
Vehicles Entered	4	7	1222	3	1	1024	2261
Vehicles Exited	3	7	1227	3	1	1015	2256
Hourly Exit Rate	3	7	1227	3	1	1015	2256
Input Volume	5	6	1244	2	2	1046	2305
% of Volume	60	117	99	150	50	97	98
Denied Entry Before	0	0	1	0	0	0	1
Denied Entry After	0	0	1	0	0	0	1

28: Performance by movement

Movement	NBT	SET	SER	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0	0.0
Total Delay (hr)	0.1	0.0	1.0	1.2
Total Del/Veh (s)	0.4	5.5	3.7	1.9
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0	0.0
Total Stops	0	0	0	0
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	26.0	0.0	34.6	60.6
Travel Time (hr)	1.0	0.0	3.0	4.0
Avg Speed (mph)	26	11	12	15
Fuel Used (gal)	0.7	0.0	1.0	1.7
Fuel Eff. (mpg)	35.3	31.4	34.2	34.7
HC Emissions (g)	14	0	19	33
CO Emissions (g)	202	0	326	527
NOx Emissions (g)	32	0	40	72
Vehicles Entered	1239	1	1026	2266
Vehicles Exited	1239	1	1026	2266
Hourly Exit Rate	1239	1	1026	2266
Input Volume	1251	1	1048	2300
% of Volume	99	100	98	99
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

29: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.3	0.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.2	0.2
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.2	0.2
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	19	19
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	11.8	11.8
HC Emissions (g)	0	0
CO Emissions (g)	9	9
NOx Emissions (g)	1	1
Vehicles Entered	4	4
Vehicles Exited	4	4
Hourly Exit Rate	4	4
Input Volume	4	4
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

30: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.8	3.8
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.3	0.3
Fuel Eff. (mpg)	14.3	14.3
HC Emissions (g)	4	4
CO Emissions (g)	163	163
NOx Emissions (g)	13	13
Vehicles Entered	60	60
Vehicles Exited	60	60
Hourly Exit Rate	60	60
Input Volume	60	60
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

31: HP Hwy & Mauka Access1 Performance by movement

Movement	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.4	0.0	0.4
Total Del/Veh (s)	0.6	0.9	0.3	0.9
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.1	0.0
Total Stops	0	1	0	1
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	2.8	222.5	7.4	232.7
Travel Time (hr)	0.1	8.0	0.3	8.5
Avg Speed (mph)	20	28	25	27
Fuel Used (gal)	0.0	7.1	0.2	7.4
Fuel Eff. (mpg)	57.7	31.1	38.6	31.5
HC Emissions (g)	0	101	2	103
CO Emissions (g)	9	2231	61	2301
NOx Emissions (g)	1	294	6	301
Vehicles Entered	58	1679	55	1792
Vehicles Exited	58	1673	54	1785
Hourly Exit Rate	58	1673	54	1785
Input Volume	60	1693	60	1813
% of Volume	97	99	90	98
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

32: Conn to Transfer Sta/Transfer Station Performance by movement

Movement	EBT	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	1.3	0.0	1.3
Total Del/Veh (s)	9.9	14.6	3.0	0.9	3.0
Stop Delay (hr)	0.0	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	8.8	15.0	0.0	0.0	0.0
Total Stops	3	2	3	0	8
Stop/Veh	1.00	1.00	0.00	0.00	0.01
Travel Dist (mi)	0.1	0.2	478.3	1.5	480.1
Travel Time (hr)	0.0	0.0	17.4	0.1	17.5
Avg Speed (mph)	5	14	28	27	27
Fuel Used (gal)	0.0	0.0	14.5	0.0	14.6
Fuel Eff. (mpg)	19.0	33.7	33.0	36.5	33.0
HC Emissions (g)	0	0	196	0	196
CO Emissions (g)	0	0	3690	7	3697
NOx Emissions (g)	0	0	573	1	574
Vehicles Entered	3	2	1567	5	1577
Vehicles Exited	3	2	1553	5	1563
Hourly Exit Rate	3	2	1553	5	1563
Input Volume	5	2	1584	5	1596
% of Volume	60	100	98	100	98
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

33: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.1	1.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.2	0.2
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	1.0	1.0
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	25	25
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	19.9	19.9
HC Emissions (g)	0	0
CO Emissions (g)	21	21
NOx Emissions (g)	1	1
Vehicles Entered	8	8
Vehicles Exited	8	8
Hourly Exit Rate	8	8
Input Volume	10	10
% of Volume	80	80
Denied Entry Before	0	0
Denied Entry After	0	0

34: HP Hwy & Conn to Transfer Sta Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.1	0.1
Denied Del/Veh (s)	2.7	0.2	0.2
Total Delay (hr)	0.0	0.1	0.1
Total Del/Veh (s)	0.1	0.2	0.2
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0
Total Stops	0	0	0
Stop/Veh	0.00	0.00	0.00
Travel Dist (mi)	0.2	69.7	69.9
Travel Time (hr)	0.0	2.5	2.5
Avg Speed (mph)	26	29	29
Fuel Used (gal)	0.0	2.2	2.2
Fuel Eff. (mpg)	29.9	32.0	32.0
HC Emissions (g)	0	24	24
CO Emissions (g)	3	601	604
NOx Emissions (g)	0	68	69
Vehicles Entered	3	985	988
Vehicles Exited	3	985	988
Hourly Exit Rate	3	985	988
Input Volume	5	1004	1009
% of Volume	60	98	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

35: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.7	0.7
Total Del/Veh (s)	2.6	2.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	210.0	210.0
Travel Time (hr)	7.8	7.8
Avg Speed (mph)	27	27
Fuel Used (gal)	6.6	6.6
Fuel Eff. (mpg)	32.0	32.0
HC Emissions (g)	128	128
CO Emissions (g)	2488	2488
NOx Emissions (g)	323	323
Vehicles Entered	1018	1018
Vehicles Exited	1011	1011
Hourly Exit Rate	1011	1011
Input Volume	1051	1051
% of Volume	96	96
Denied Entry Before	0	0
Denied Entry After	0	0

36: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.2	3.2
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.2	0.2
Fuel Eff. (mpg)	13.6	13.6
HC Emissions (g)	4	4
CO Emissions (g)	163	163
NOx Emissions (g)	13	13
Vehicles Entered	54	54
Vehicles Exited	54	54
Hourly Exit Rate	54	54
Input Volume	60	60
% of Volume	90	90
Denied Entry Before	0	0
Denied Entry After	0	0

Total Network Performance

Denied Delay (hr)	1.0
Denied Del/Veh (s)	0.9
Total Delay (hr)	20.7
Total Del/Veh (s)	18.4
Stop Delay (hr)	1.7
Stop Del/Veh (s)	1.5
Total Stops	895
Stop/Veh	0.22
Travel Dist (mi)	5724.5
Travel Time (hr)	219.9
Avg Speed (mph)	26
Fuel Used (gal)	178.3
Fuel Eff. (mpg)	32.1
HC Emissions (g)	2885
CO Emissions (g)	57517
NOx Emissions (g)	7954
Vehicles Entered	3895
Vehicles Exited	3831
Hourly Exit Rate	3831
Input Volume	39771
% of Volume	10
Denied Entry Before	1
Denied Entry After	1

Arterial Level of Service: SB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Conn to Transfer Sta	34	0.2	9.0	0.1	31
O-turn 1 W	14	1.2	39.2	0.3	29
Olowalu Access 1	15	0.5	12.8	0.1	30
O-turn 1E	11	0.9	17.0	0.1	29
O-turn 2W	10	1.0	26.5	0.2	29
Olowalu Access 2	3	0.6	18.5	0.2	30
Total		4.4	123.0	1.0	29

Intersection: 3: Olowalu Access 2 & HP Hwy

Movement	EB
Directions Served	R
Maximum Queue (ft)	217
Average Queue (ft)	53
95th Queue (ft)	148
Link Distance (ft)	300
Upstream Blk Time (%)	0
Queuing Penalty (veh)	0
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 6: HP Hwy & Mauka Access 2

Movement	WB
Directions Served	R
Maximum Queue (ft)	13
Average Queue (ft)	0
95th Queue (ft)	7
Link Distance (ft)	290
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 7: HP Hwy & O-turn 2E

Movement	EB	NB	NB	NB
Directions Served	L	T	T	T
Maximum Queue (ft)	87	18	9	9
Average Queue (ft)	49	1	0	0
95th Queue (ft)	74	9	6	7
Link Distance (ft)	46	1359	1359	1359
Upstream Blk Time (%)	7			
Queuing Penalty (veh)	14			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 8: HP Hwy & O-turn 2E

Movement	SB
Directions Served	L
Maximum Queue (ft)	68
Average Queue (ft)	8
95th Queue (ft)	39
Link Distance (ft)	
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	800
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 9: O-turn 2W

Movement	NB	NB
Directions Served	LT	T
Maximum Queue (ft)	73	21
Average Queue (ft)	8	1
95th Queue (ft)	40	15
Link Distance (ft)	752	752
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 10: HP Hwy & O-turn 2W

Movement	WB	SB	SB	SB
Directions Served	L	T	T	T
Maximum Queue (ft)	72	4	4	7
Average Queue (ft)	38	0	0	0
95th Queue (ft)	70	3	3	6
Link Distance (ft)	58	1078	1078	1078
Upstream Blk Time (%)	2			
Queuing Penalty (veh)	4			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 11: HP Hwy & O-turn 1E

Movement	SB	SB
Directions Served	L	LT
Maximum Queue (ft)	44	78
Average Queue (ft)	8	17
95th Queue (ft)	32	57
Link Distance (ft)		687
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)	800	
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 12: O-turn 1E & HP Hwy

Movement	EB	NB	NB	NB
Directions Served	L	T	T	T
Maximum Queue (ft)	58	4	6	4
Average Queue (ft)	42	0	0	0
95th Queue (ft)	68	3	4	3
Link Distance (ft)	48	1084	1084	1084
Upstream Blk Time (%)	5			
Queuing Penalty (veh)	14			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 13: O-turn 1 W

Movement	NB	NB
Directions Served	LT	T
Maximum Queue (ft)	53	17
Average Queue (ft)	4	1
95th Queue (ft)	25	15
Link Distance (ft)	519	519
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 14: HP Hwy & O-turn 1 W

Movement	WB	SB
Directions Served	L	T
Maximum Queue (ft)	61	4
Average Queue (ft)	31	0
95th Queue (ft)	59	3
Link Distance (ft)	56	1614
Upstream Blk Time (%)	1	
Queuing Penalty (veh)	1	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 15: HP Hwy & Olowalu Access 1

Movement	EB
Directions Served	R
Maximum Queue (ft)	117
Average Queue (ft)	30
95th Queue (ft)	92
Link Distance (ft)	377
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 17: RIRO Access & HP Hwy

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 20: HP Hwy

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 24:

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 27: HP Hwy & Ehehene

Movement	WB	SB
Directions Served	LR	L
Maximum Queue (ft)	36	19
Average Queue (ft)	8	1
95th Queue (ft)	32	11
Link Distance (ft)	228	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		250
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 28:

Movement	NB	B21
Directions Served	T	T
Maximum Queue (ft)	8	9
Average Queue (ft)	0	0
95th Queue (ft)	0	6
Link Distance (ft)	54	625
Upstream Blk Time (%)	0	
Queuing Penalty (veh)	0	
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 31: HP Hwy & Mauka Access1

Movement	WB
Directions Served	R
Maximum Queue (ft)	7
Average Queue (ft)	0
95th Queue (ft)	5
Link Distance (ft)	267
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 32: Conn to Transfer Sta/Transfer Station

Movement	EB	WB
Directions Served	T	TR
Maximum Queue (ft)	24	16
Average Queue (ft)	3	1
95th Queue (ft)	17	10
Link Distance (ft)	60	641
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 34: HP Hwy & Conn to Transfer Sta

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Network Summary

Network wide Queuing Penalty: 33

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Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	4:57	4:57	4:57	4:57	4:57	4:57
End Time	6:00	6:00	6:00	6:00	6:00	6:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	5222	5163	5170	5268	5094	5185
Vehs Exited	4908	4891	4937	4932	4809	4894
Starting Vehs	179	200	228	214	206	203
Ending Vehs	493	472	461	550	491	492
Denied Entry Before	5	1	4	6	0	3
Denied Entry After	4	10	4	53	11	17
Travel Distance (mi)	7688	7609	7692	7737	7555	7656
Travel Time (hr)	402.0	396.1	374.1	437.8	414.2	404.8
Total Delay (hr)	135.5	131.7	107.6	169.1	151.9	139.2
Total Stops	5803	5605	4870	6673	6027	5795
Fuel Used (gal)	271.5	267.9	263.8	281.9	270.3	271.1

Interval #0 Information Seeding

Start Time	4:57
End Time	5:00
Total Time (min)	3

Volumes adjusted by Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	5:00
End Time	5:15
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	1302	1333	1255	1296	1228	1282
Vehs Exited	1128	1175	1150	1148	1097	1138
Starting Vehs	179	200	228	214	206	203
Ending Vehs	353	358	333	362	337	347
Denied Entry Before	5	1	4	6	0	3
Denied Entry After	0	4	18	9	2	7
Travel Distance (mi)	1872	1835	1878	1845	1781	1842
Travel Time (hr)	82.3	77.0	77.6	81.0	73.8	78.3
Total Delay (hr)	17.3	13.2	12.3	17.0	12.0	14.4
Total Stops	870	682	559	821	670	717
Fuel Used (gal)	62.3	60.0	60.3	61.6	57.5	60.3

Interval #2 Information

Start Time	5:15
End Time	5:30
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	1281	1268	1301	1312	1290	1288
Vehs Exited	1233	1223	1267	1249	1223	1241
Starting Vehs	353	358	333	362	337	347
Ending Vehs	401	403	367	425	404	399
Denied Entry Before	0	4	18	9	2	7
Denied Entry After	10	4	6	2	29	10
Travel Distance (mi)	1877	1927	1979	1943	1925	1930
Travel Time (hr)	91.1	94.3	91.6	102.2	98.3	95.5
Total Delay (hr)	25.8	27.4	22.9	34.6	31.7	28.5
Total Stops	1278	1313	1037	1755	1441	1366
Fuel Used (gal)	64.5	66.3	66.6	69.0	67.7	66.8

Interval #3 Information

Start Time	5:30
End Time	5:45
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	1320	1298	1294	1313	1347	1315
Vehs Exited	1278	1250	1272	1256	1268	1262
Starting Vehs	401	403	367	425	404	399
Ending Vehs	443	451	389	482	483	447
Denied Entry Before	10	4	6	2	29	10
Denied Entry After	5	7	6	12	29	12
Travel Distance (mi)	1990	1948	1896	1935	1967	1947
Travel Time (hr)	110.2	107.2	94.8	116.1	116.7	109.0
Total Delay (hr)	41.3	39.3	29.2	48.9	48.4	41.4
Total Stops	1764	1666	1461	1925	1843	1733
Fuel Used (gal)	71.9	70.7	66.3	72.0	72.6	70.7

Interval #4 Information

Start Time	5:45
End Time	6:00
Total Time (min)	15

Run Number	1	2	3	4	5	Avg
Vehs Entered	1319	1264	1320	1347	1229	1294
Vehs Exited	1269	1243	1248	1279	1221	1252
Starting Vehs	443	451	389	482	483	447
Ending Vehs	493	472	461	550	491	492
Denied Entry Before	5	7	6	12	29	12
Denied Entry After	4	10	4	53	11	17
Travel Distance (mi)	1948	1899	1938	2014	1883	1936
Travel Time (hr)	118.4	117.6	110.3	138.4	125.4	122.0
Total Delay (hr)	51.1	51.8	43.2	68.6	59.8	54.9
Total Stops	1891	1944	1813	2172	2073	1976
Fuel Used (gal)	72.7	70.9	70.6	79.2	72.5	73.2

2: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	3.2	0.1	3.3
Total Del/Veh (s)	7.2	0.3	4.1
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0
Total Stops	0	0	0
Stop/Veh	0.00	0.00	0.00
Travel Dist (mi)	650.9	23.3	674.1
Travel Time (hr)	25.1	2.1	27.2
Avg Speed (mph)	26	11	25
Fuel Used (gal)	18.4	2.2	20.6
Fuel Eff. (mpg)	35.3	10.6	32.7
HC Emissions (g)	288	44	332
CO Emissions (g)	4154	1068	5221
NOx Emissions (g)	663	158	820
Vehicles Entered	1589	1306	2895
Vehicles Exited	1588	1306	2894
Hourly Exit Rate	1588	1306	2894
Input Volume	1581	1512	3093
% of Volume	100	86	94
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

3: Olowalu Access 2 & HP Hwy Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.7	0.0	0.0	0.8
Denied Del/Veh (s)	3.5	0.0	0.0	0.9
Total Delay (hr)	2.4	0.4	1.2	4.0
Total Del/Veh (s)	11.2	1.1	5.2	5.0
Stop Delay (hr)	1.5	0.0	0.0	1.5
Stop Del/Veh (s)	7.0	0.1	0.1	1.9
Total Stops	284	4	0	288
Stop/Veh	0.37	0.00	0.00	0.10
Travel Dist (mi)	38.5	190.3	122.2	351.0
Travel Time (hr)	4.8	6.9	5.8	17.5
Avg Speed (mph)	10	28	21	21
Fuel Used (gal)	1.6	6.2	3.2	11.1
Fuel Eff. (mpg)	23.6	30.8	37.6	31.7
HC Emissions (g)	11	89	30	130
CO Emissions (g)	325	2179	895	3399
NOx Emissions (g)	32	262	93	388
Vehicles Entered	763	1290	840	2893
Vehicles Exited	762	1286	839	2887
Hourly Exit Rate	762	1286	839	2887
Input Volume	765	1300	855	2920
% of Volume	100	99	98	99
Denied Entry Before	0	0	0	0
Denied Entry After	7	0	0	7

4: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.8	0.8
Total Del/Veh (s)	3.5	3.5
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	54.6	54.6
Travel Time (hr)	3.4	3.4
Avg Speed (mph)	16	16
Fuel Used (gal)	4.1	4.1
Fuel Eff. (mpg)	13.4	13.4
HC Emissions (g)	56	56
CO Emissions (g)	2397	2397
NOx Emissions (g)	200	200
Vehicles Entered	839	839
Vehicles Exited	839	839
Hourly Exit Rate	839	839
Input Volume	855	855
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

5: External Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.2	0.2
Total Del/Veh (s)	0.6	0.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	126.1	126.1
Travel Time (hr)	4.5	4.5
Avg Speed (mph)	28	28
Fuel Used (gal)	4.1	4.1
Fuel Eff. (mpg)	30.7	30.7
HC Emissions (g)	45	45
CO Emissions (g)	1242	1242
NOx Emissions (g)	125	125
Vehicles Entered	1608	1608
Vehicles Exited	1606	1606
Hourly Exit Rate	1606	1606
Input Volume	1663	1663
% of Volume	97	97
Denied Entry Before	0	0
Denied Entry After	0	0

6: HP Hwy & Mauka Access 2 Performance by movement

Movement	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.1	0.0
Total Delay (hr)	0.0	0.5	0.0	0.5
Total Del/Veh (s)	0.8	0.8	0.7	0.8
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.1	0.1	0.1
Total Stops	0	4	0	4
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	3.2	208.0	5.8	217.0
Travel Time (hr)	0.2	7.7	0.3	8.1
Avg Speed (mph)	20	27	23	27
Fuel Used (gal)	0.1	7.5	0.2	7.7
Fuel Eff. (mpg)	55.7	27.8	33.8	28.1
HC Emissions (g)	0	99	2	101
CO Emissions (g)	11	2654	53	2717
NOx Emissions (g)	1	310	5	316
Vehicles Entered	61	2059	57	2177
Vehicles Exited	61	2057	57	2175
Hourly Exit Rate	61	2057	57	2175
Input Volume	60	2056	60	2176
% of Volume	102	100	95	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

7: HP Hwy & O-turn 2E Performance by movement

Movement	EBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.6	0.8	1.4
Total Del/Veh (s)	4.4	1.8	2.4
Stop Delay (hr)	0.5	0.0	0.5
Stop Del/Veh (s)	4.0	0.0	0.9
Total Stops	230	4	234
Stop/Veh	0.47	0.00	0.11
Travel Dist (mi)	7.7	417.9	425.6
Travel Time (hr)	1.1	14.9	15.9
Avg Speed (mph)	7	28	27
Fuel Used (gal)	0.5	12.3	12.8
Fuel Eff. (mpg)	15.3	34.0	33.2
HC Emissions (g)	4	200	204
CO Emissions (g)	101	3671	3772
NOx Emissions (g)	15	552	567
Vehicles Entered	485	1586	2071
Vehicles Exited	484	1581	2065
Hourly Exit Rate	484	1581	2065
Input Volume	487	1581	2068
% of Volume	99	100	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

8: HP Hwy & O-turn 2E Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	1.5	4.1	5.6
Total Del/Veh (s)	10.8	9.4	9.7
Stop Delay (hr)	0.9	3.0	3.9
Stop Del/Veh (s)	6.5	6.9	6.8
Total Stops	309	321	630
Stop/Veh	0.63	0.20	0.31
Travel Dist (mi)	49.7	157.9	207.6
Travel Time (hr)	3.5	9.9	13.4
Avg Speed (mph)	14	16	16
Fuel Used (gal)	2.0	7.5	9.5
Fuel Eff. (mpg)	24.4	21.1	21.8
HC Emissions (g)	18	106	124
CO Emissions (g)	649	3296	3944
NOx Emissions (g)	68	348	416
Vehicles Entered	487	1563	2050
Vehicles Exited	485	1548	2033
Hourly Exit Rate	485	1548	2033
Input Volume	487	1578	2065
% of Volume	100	98	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

9: O-turn 2W Performance by movement

Movement	NBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	4.4	1.1	5.5
Total Del/Veh (s)	36.5	2.4	9.3
Stop Delay (hr)	4.0	0.2	4.2
Stop Del/Veh (s)	33.0	0.5	7.1
Total Stops	325	83	408
Stop/Veh	0.75	0.05	0.19
Travel Dist (mi)	63.9	247.4	311.3
Travel Time (hr)	6.7	9.5	16.2
Avg Speed (mph)	10	26	19
Fuel Used (gal)	2.6	8.0	10.6
Fuel Eff. (mpg)	24.9	30.8	29.4
HC Emissions (g)	15	113	127
CO Emissions (g)	398	2544	2942
NOx Emissions (g)	45	337	382
Vehicles Entered	431	1691	2122
Vehicles Exited	423	1687	2110
Hourly Exit Rate	423	1687	2110
Input Volume	427	1691	2118
% of Volume	99	100	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

10: HP Hwy & O-turn 2W Performance by movement

Movement	WBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	1.2	0.8	2.1
Total Del/Veh (s)	10.4	1.8	3.5
Stop Delay (hr)	1.2	0.0	1.2
Stop Del/Veh (s)	9.9	0.0	2.0
Total Stops	278	6	284
Stop/Veh	0.66	0.00	0.13
Travel Dist (mi)	7.3	355.2	362.5
Travel Time (hr)	1.7	12.8	14.5
Avg Speed (mph)	4	28	25
Fuel Used (gal)	0.6	10.6	11.2
Fuel Eff. (mpg)	11.4	33.5	32.2
HC Emissions (g)	5	96	101
CO Emissions (g)	116	2083	2199
NOx Emissions (g)	17	289	306
Vehicles Entered	423	1673	2096
Vehicles Exited	421	1671	2092
Hourly Exit Rate	421	1671	2092
Input Volume	427	1691	2118
% of Volume	99	99	99
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

11: HP Hwy & O-turn 1E Performance by movement

Movement	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.5	1.6	2.1
Total Del/Veh (s)	5.9	3.3	3.7
Stop Delay (hr)	0.2	0.7	0.9
Stop Del/Veh (s)	2.3	1.5	1.6
Total Stops	64	177	241
Stop/Veh	0.21	0.10	0.12
Travel Dist (mi)	42.1	232.0	274.0
Travel Time (hr)	2.1	9.7	11.8
Avg Speed (mph)	20	24	23
Fuel Used (gal)	1.5	8.7	10.2
Fuel Eff. (mpg)	28.4	26.6	26.8
HC Emissions (g)	15	114	128
CO Emissions (g)	460	3121	3581
NOx Emissions (g)	52	367	419
Vehicles Entered	309	1718	2027
Vehicles Exited	309	1714	2023
Hourly Exit Rate	309	1714	2023
Input Volume	311	1736	2047
% of Volume	99	99	99
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

12: O-turn 1E & HP Hwy Performance by movement

Movement	EBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.2	0.7	0.9
Total Del/Veh (s)	2.2	1.5	1.6
Stop Delay (hr)	0.2	0.0	0.2
Stop Del/Veh (s)	1.8	0.0	0.3
Total Stops	96	2	98
Stop/Veh	0.31	0.00	0.05
Travel Dist (mi)	5.4	347.7	353.1
Travel Time (hr)	0.5	12.4	12.9
Avg Speed (mph)	10	28	27
Fuel Used (gal)	0.3	10.3	10.6
Fuel Eff. (mpg)	18.6	33.8	33.3
HC Emissions (g)	2	174	176
CO Emissions (g)	71	3194	3265
NOx Emissions (g)	10	478	488
Vehicles Entered	309	1632	1941
Vehicles Exited	308	1623	1931
Hourly Exit Rate	308	1623	1931
Input Volume	311	1641	1952
% of Volume	99	99	99
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

13: O-turn 1 W Performance by movement

Movement	NBL	NBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.7	0.8	1.5
Total Del/Veh (s)	9.2	1.8	2.8
Stop Delay (hr)	0.4	0.1	0.6
Stop Del/Veh (s)	6.2	0.3	1.1
Total Stops	92	67	159
Stop/Veh	0.35	0.04	0.08
Travel Dist (mi)	27.6	172.5	200.1
Travel Time (hr)	1.7	6.7	8.4
Avg Speed (mph)	16	26	24
Fuel Used (gal)	0.8	5.8	6.6
Fuel Eff. (mpg)	33.5	29.6	30.1
HC Emissions (g)	5	89	95
CO Emissions (g)	143	2107	2251
NOx Emissions (g)	19	270	290
Vehicles Entered	262	1666	1928
Vehicles Exited	259	1662	1921
Hourly Exit Rate	259	1662	1921
Input Volume	252	1709	1961
% of Volume	103	97	98
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

14: HP Hwy & O-turn 1 W Performance by movement

Movement	WBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.7	1.0	1.7
Total Del/Veh (s)	9.2	2.1	3.0
Stop Delay (hr)	0.6	0.0	0.6
Stop Del/Veh (s)	8.7	0.0	1.1
Total Stops	180	3	183
Stop/Veh	0.69	0.00	0.09
Travel Dist (mi)	4.5	555.1	559.6
Travel Time (hr)	0.9	19.7	20.7
Avg Speed (mph)	5	28	27
Fuel Used (gal)	0.3	16.3	16.7
Fuel Eff. (mpg)	13.2	34.0	33.5
HC Emissions (g)	2	143	145
CO Emissions (g)	54	2955	3009
NOx Emissions (g)	8	425	432
Vehicles Entered	259	1750	2009
Vehicles Exited	258	1754	2012
Hourly Exit Rate	258	1754	2012
Input Volume	252	1761	2013
% of Volume	102	100	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

15: HP Hwy & Olowalu Access 1 Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.1	0.0	0.0	0.1
Denied Del/Veh (s)	0.5	0.0	0.0	0.1
Total Delay (hr)	0.9	0.3	0.5	1.7
Total Del/Veh (s)	6.7	0.8	3.3	2.5
Stop Delay (hr)	0.5	0.0	0.0	0.5
Stop Del/Veh (s)	3.3	0.0	0.1	0.7
Total Stops	180	1	0	181
Stop/Veh	0.36	0.00	0.00	0.07
Travel Dist (mi)	32.6	156.7	51.6	240.9
Travel Time (hr)	2.3	5.7	2.5	10.5
Avg Speed (mph)	15	27	21	23
Fuel Used (gal)	1.0	5.3	1.3	7.6
Fuel Eff. (mpg)	32.2	29.7	38.2	31.6
HC Emissions (g)	10	71	13	93
CO Emissions (g)	342	1836	473	2650
NOx Emissions (g)	31	215	38	283
Vehicles Entered	500	1528	526	2554
Vehicles Exited	500	1527	526	2553
Hourly Exit Rate	500	1527	526	2553
Input Volume	496	1551	507	2554
% of Volume	101	98	104	100
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

16: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.5	0.5
Total Del/Veh (s)	3.3	3.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	41.8	41.8
Travel Time (hr)	2.4	2.4
Avg Speed (mph)	18	18
Fuel Used (gal)	2.8	2.8
Fuel Eff. (mpg)	15.2	15.2
HC Emissions (g)	41	41
CO Emissions (g)	1602	1602
NOx Emissions (g)	139	139
Vehicles Entered	526	526
Vehicles Exited	524	524
Hourly Exit Rate	524	524
Input Volume	507	507
% of Volume	103	103
Denied Entry Before	0	0
Denied Entry After	0	0

17: RIRO Access & HP Hwy Performance by movement

Movement	EBR	SBT	SBR	All
Denied Delay (hr)	0.0	0.5	0.0	0.5
Denied Del/Veh (s)	0.1	1.1	0.0	1.1
Total Delay (hr)	0.0	23.6	0.1	23.7
Total Del/Veh (s)	0.6	56.6	3.7	53.7
Stop Delay (hr)	0.0	22.3	0.0	22.3
Stop Del/Veh (s)	0.0	53.4	2.3	50.6
Total Stops	1	783	7	791
Stop/Veh	0.03	0.52	0.13	0.50
Travel Dist (mi)	1.5	192.6	7.3	201.4
Travel Time (hr)	0.1	30.6	0.3	31.0
Avg Speed (mph)	20	6	21	7
Fuel Used (gal)	0.0	11.1	0.2	11.3
Fuel Eff. (mpg)	62.7	17.4	34.0	17.8
HC Emissions (g)	0	116	3	119
CO Emissions (g)	5	2732	83	2820
NOx Emissions (g)	0	302	8	311
Vehicles Entered	32	1497	55	1584
Vehicles Exited	32	1426	54	1512
Hourly Exit Rate	32	1426	54	1512
Input Volume	37	1530	55	1622
% of Volume	86	93	98	93
Denied Entry Before	0	0	0	0
Denied Entry After	0	4	0	4

18: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.0	3.0
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.2	0.2
Fuel Eff. (mpg)	13.1	13.1
HC Emissions (g)	5	5
CO Emissions (g)	178	178
NOx Emissions (g)	15	15
Vehicles Entered	54	54
Vehicles Exited	54	54
Hourly Exit Rate	54	54
Input Volume	55	55
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0

19: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	29.8	29.8
Total Del/Veh (s)	76.4	76.4
Stop Delay (hr)	28.2	28.2
Stop Del/Veh (s)	72.3	72.3
Total Stops	1328	1328
Stop/Veh	0.95	0.95
Travel Dist (mi)	181.5	181.5
Travel Time (hr)	35.9	35.9
Avg Speed (mph)	5	5
Fuel Used (gal)	12.5	12.5
Fuel Eff. (mpg)	14.5	14.5
HC Emissions (g)	142	142
CO Emissions (g)	3317	3317
NOx Emissions (g)	373	373
Vehicles Entered	1398	1398
Vehicles Exited	1350	1350
Hourly Exit Rate	1350	1350
Input Volume	1509	1509
% of Volume	89	89
Denied Entry Before	0	0
Denied Entry After	0	0

20: HP Hwy Performance by movement

Movement	NBT	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	213.2	213.2
Travel Time (hr)	7.6	7.6
Avg Speed (mph)	28	28
Fuel Used (gal)	6.8	6.8
Fuel Eff. (mpg)	31.4	31.4
HC Emissions (g)	115	115
CO Emissions (g)	2430	2430
NOx Emissions (g)	321	321
Vehicles Entered	1587	1587
Vehicles Exited	1586	1586
Hourly Exit Rate	1586	1586
Input Volume	1581	1581
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

21: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	19.0	19.0
Total Del/Veh (s)	50.4	50.4
Stop Delay (hr)	12.1	12.1
Stop Del/Veh (s)	32.2	32.2
Total Stops	931	931
Stop/Veh	0.69	0.69
Travel Dist (mi)	172.1	172.1
Travel Time (hr)	24.7	24.7
Avg Speed (mph)	7	7
Fuel Used (gal)	9.9	9.9
Fuel Eff. (mpg)	17.4	17.4
HC Emissions (g)	122	122
CO Emissions (g)	2695	2695
NOx Emissions (g)	297	297
Vehicles Entered	1350	1350
Vehicles Exited	1325	1325
Hourly Exit Rate	1325	1325
Input Volume	1509	1509
% of Volume	88	88
Denied Entry Before	0	0
Denied Entry After	0	0

23: Bend Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	13.2	13.2
Total Del/Veh (s)	35.6	35.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	155.5	155.5
Travel Time (hr)	18.4	18.4
Avg Speed (mph)	8	8
Fuel Used (gal)	7.3	7.3
Fuel Eff. (mpg)	21.4	21.4
HC Emissions (g)	96	96
CO Emissions (g)	1799	1799
NOx Emissions (g)	179	179
Vehicles Entered	1325	1325
Vehicles Exited	1310	1310
Hourly Exit Rate	1310	1310
Input Volume	1509	1509
% of Volume	87	87
Denied Entry Before	0	0
Denied Entry After	0	0

24: Performance by movement

Movement	NBT	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.9	0.9
Total Del/Veh (s)	2.1	2.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	176.1	176.1
Travel Time (hr)	6.8	6.8
Avg Speed (mph)	26	26
Fuel Used (gal)	5.2	5.2
Fuel Eff. (mpg)	34.1	34.1
HC Emissions (g)	81	81
CO Emissions (g)	1315	1315
NOx Emissions (g)	190	190
Vehicles Entered	1587	1587
Vehicles Exited	1587	1587
Hourly Exit Rate	1587	1587
Input Volume	1581	1581
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

26: Bend Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.3	0.3
Total Del/Veh (s)	0.7	0.7
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	58.5	58.5
Travel Time (hr)	2.3	2.3
Avg Speed (mph)	26	26
Fuel Used (gal)	1.7	1.7
Fuel Eff. (mpg)	35.4	35.4
HC Emissions (g)	26	26
CO Emissions (g)	369	369
NOx Emissions (g)	58	58
Vehicles Entered	1588	1588
Vehicles Exited	1587	1587
Hourly Exit Rate	1587	1587
Input Volume	1581	1581
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0

27: HP Hwy & Ehehene Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	4.5	0.0	0.0	0.0	4.5
Denied Del/Veh (s)	0.1	0.1	10.1	16.1	0.0	0.0	5.6
Total Delay (hr)	1.4	0.3	2.4	0.0	0.1	2.0	6.1
Total Del/Veh (s)	729.1	324.0	5.3	6.1	118.3	5.5	7.6
Stop Delay (hr)	1.4	0.3	0.0	0.0	0.1	0.0	1.8
Stop Del/Veh (s)	727.0	323.7	0.0	0.0	110.9	0.0	2.2
Total Stops	7	3	0	0	3	0	13
Stop/Veh	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Travel Dist (mi)	0.3	0.1	312.4	0.3	1.3	531.2	845.6
Travel Time (hr)	1.4	0.3	17.3	0.0	0.1	20.0	39.2
Avg Speed (mph)	0	0	24	23	9	27	24
Fuel Used (gal)	0.3	0.1	11.5	0.0	0.1	16.7	28.7
Fuel Eff. (mpg)	0.8	1.9	27.1	27.0	21.8	31.8	29.4
HC Emissions (g)	0	0	165	0	0	323	489
CO Emissions (g)	18	4	2713	1	7	5704	8447
NOx Emissions (g)	0	0	476	0	1	873	1350
Vehicles Entered	7	3	1586	1	3	1303	2903
Vehicles Exited	3	3	1587	1	3	1293	2890
Hourly Exit Rate	3	3	1587	1	3	1293	2890
Input Volume	7	3	1578	2	3	1510	3103
% of Volume	43	100	101	50	100	86	93
Denied Entry Before	0	0	3	0	0	0	3
Denied Entry After	0	0	3	0	0	0	3

28: Performance by movement

Movement	NBT	SER	All
Denied Delay (hr)	0.0	1.4	1.4
Denied Del/Veh (s)	0.0	3.9	1.8
Total Delay (hr)	0.2	2.7	2.9
Total Del/Veh (s)	0.4	7.5	3.6
Stop Delay (hr)	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.0
Total Stops	0	0	0
Stop/Veh	0.00	0.00	0.00
Travel Dist (mi)	33.3	44.3	77.6
Travel Time (hr)	1.3	6.6	7.9
Avg Speed (mph)	26	9	12
Fuel Used (gal)	0.9	2.5	3.4
Fuel Eff. (mpg)	35.4	17.9	22.8
HC Emissions (g)	15	39	53
CO Emissions (g)	210	681	891
NOx Emissions (g)	33	75	108
Vehicles Entered	1588	1310	2898
Vehicles Exited	1588	1306	2894
Hourly Exit Rate	1588	1306	2894
Input Volume	1581	1512	3093
% of Volume	100	86	94
Denied Entry Before	0	0	0
Denied Entry After	0	3	3

29: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.7	0.7
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.5	0.5
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.2	0.2
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	19	19
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	12.3	12.3
HC Emissions (g)	0	0
CO Emissions (g)	10	10
NOx Emissions (g)	1	1
Vehicles Entered	4	4
Vehicles Exited	4	4
Hourly Exit Rate	4	4
Input Volume	5	5
% of Volume	80	80
Denied Entry Before	0	0
Denied Entry After	0	0

30: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.6	3.6
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.3	0.3
Fuel Eff. (mpg)	13.9	13.9
HC Emissions (g)	4	4
CO Emissions (g)	176	176
NOx Emissions (g)	14	14
Vehicles Entered	57	57
Vehicles Exited	57	57
Hourly Exit Rate	57	57
Input Volume	60	60
% of Volume	95	95
Denied Entry Before	0	0
Denied Entry After	0	0

31: HP Hwy & Mauka Access1 Performance by movement

Movement	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.5	0.0	0.6
Total Del/Veh (s)	0.6	1.0	0.3	1.0
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.0	0.0	0.1	0.0
Total Stops	0	3	0	3
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	2.8	251.7	8.8	263.2
Travel Time (hr)	0.1	9.1	0.4	9.6
Avg Speed (mph)	20	28	25	27
Fuel Used (gal)	0.0	8.2	0.2	8.5
Fuel Eff. (mpg)	58.7	30.7	35.8	31.0
HC Emissions (g)	0	103	2	106
CO Emissions (g)	10	2441	70	2520
NOx Emissions (g)	1	310	6	316
Vehicles Entered	57	1874	64	1995
Vehicles Exited	57	1865	64	1986
Hourly Exit Rate	57	1865	64	1986
Input Volume	60	1901	60	2021
% of Volume	95	98	107	98
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

32: Conn to Transfer Sta/Transfer Station Performance by movement

Movement	EBT	WBT	WBR	NBT	NBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.1	0.1	0.0	0.0	0.0
Total Delay (hr)	0.0	0.0	0.0	1.5	0.0	1.6
Total Del/Veh (s)	10.1	17.9	11.1	3.3	2.3	3.3
Stop Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	9.1	14.1	11.4	0.0	0.0	0.1
Total Stops	7	1	8	2	0	18
Stop/Veh	1.00	1.00	1.00	0.00	0.00	0.01
Travel Dist (mi)	0.1	0.1	0.9	507.2	0.7	509.1
Travel Time (hr)	0.0	0.0	0.1	18.6	0.0	18.7
Avg Speed (mph)	5	14	15	27	27	27
Fuel Used (gal)	0.0	0.0	0.0	16.0	0.0	16.0
Fuel Eff. (mpg)	17.7	27.9	34.0	31.8	34.8	31.8
HC Emissions (g)	0	0	0	229	0	230
CO Emissions (g)	1	1	2	4679	4	4687
NOx Emissions (g)	0	0	0	683	0	684
Vehicles Entered	7	1	8	1664	2	1682
Vehicles Exited	6	1	8	1648	2	1665
Hourly Exit Rate	6	1	8	1648	2	1665
Input Volume	9	2	6	1707	2	1726
% of Volume	67	50	133	97	100	96
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0

33: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	2.0	2.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.5	0.5
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	1.1	1.1
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	25	25
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	21.1	21.1
HC Emissions (g)	0	0
CO Emissions (g)	22	22
NOx Emissions (g)	2	2
Vehicles Entered	9	9
Vehicles Exited	8	8
Hourly Exit Rate	8	8
Input Volume	11	11
% of Volume	73	73
Denied Entry Before	0	0
Denied Entry After	0	0

34: HP Hwy & Conn to Transfer Sta Performance by movement

Movement	WBT	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.2	0.2
Denied Del/Veh (s)	0.0	2.0	0.5	0.5
Total Delay (hr)	0.0	0.0	0.3	0.3
Total Del/Veh (s)	2.5	0.2	0.7	0.7
Stop Delay (hr)	0.0	0.0	0.0	0.0
Stop Del/Veh (s)	0.7	0.0	0.0	0.0
Total Stops	0	0	1	1
Stop/Veh	0.00	0.00	0.00	0.00
Travel Dist (mi)	0.0	0.5	123.6	124.1
Travel Time (hr)	0.0	0.0	4.7	4.8
Avg Speed (mph)	14	25	27	27
Fuel Used (gal)	0.0	0.0	4.2	4.2
Fuel Eff. (mpg)	7.4	30.6	29.2	29.2
HC Emissions (g)	0	0	40	40
CO Emissions (g)	1	6	1156	1163
NOx Emissions (g)	0	0	129	130
Vehicles Entered	1	7	1750	1758
Vehicles Exited	1	7	1749	1757
Hourly Exit Rate	1	7	1749	1757
Input Volume	2	9	1759	1770
% of Volume	50	78	99	99
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

35: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	1.0	1.0
Total Del/Veh (s)	2.9	2.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	267.2	267.2
Travel Time (hr)	10.0	10.0
Avg Speed (mph)	27	27
Fuel Used (gal)	8.4	8.4
Fuel Eff. (mpg)	31.8	31.8
HC Emissions (g)	156	156
CO Emissions (g)	3122	3122
NOx Emissions (g)	395	395
Vehicles Entered	1295	1295
Vehicles Exited	1286	1286
Hourly Exit Rate	1286	1286
Input Volume	1516	1516
% of Volume	85	85
Denied Entry Before	0	0
Denied Entry After	0	0

36: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	3.7	3.7
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	20	20
Fuel Used (gal)	0.3	0.3
Fuel Eff. (mpg)	13.3	13.3
HC Emissions (g)	4	4
CO Emissions (g)	176	176
NOx Emissions (g)	13	13
Vehicles Entered	64	64
Vehicles Exited	64	64
Hourly Exit Rate	64	64
Input Volume	60	60
% of Volume	107	107
Denied Entry Before	0	0
Denied Entry After	0	0

Total Network Performance

Denied Delay (hr)	7.5
Denied Del/Veh (s)	5.2
Total Delay (hr)	131.7
Total Del/Veh (s)	88.0
Stop Delay (hr)	78.7
Stop Del/Veh (s)	52.6
Total Stops	5795
Stop/Veh	1.08
Travel Dist (mi)	7656.1
Travel Time (hr)	404.8
Avg Speed (mph)	19
Fuel Used (gal)	271.1
Fuel Eff. (mpg)	28.2
HC Emissions (g)	3688
CO Emissions (g)	80329
NOx Emissions (g)	10327
Vehicles Entered	5185
Vehicles Exited	4894
Hourly Exit Rate	4894
Input Volume	54422
% of Volume	9
Denied Entry Before	3
Denied Entry After	17

Arterial Level of Service: SB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Conn to Transfer Sta	34	0.7	9.7	0.1	29
O-turn 1 W	14	2.1	40.1	0.3	28
Olowalu Access 1	15	0.8	13.1	0.1	29
O-turn 1E	11	1.3	17.5	0.1	28
O-turn 2W	10	1.8	27.4	0.2	28
Olowalu Access 2	3	1.1	18.9	0.2	29
Total		7.7	126.7	1.0	29

Intersection: 3: Olowalu Access 2 & HP Hwy

Movement	EB	SB	SB	SB
Directions Served	R	T	T	T
Maximum Queue (ft)	333	6	20	27
Average Queue (ft)	169	0	2	2
95th Queue (ft)	332	5	23	28
Link Distance (ft)	300	757	757	757
Upstream Blk Time (%)	8			
Queuing Penalty (veh)	0			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 6: HP Hwy & Mauka Access 2

Movement	WB
Directions Served	R
Maximum Queue (ft)	15
Average Queue (ft)	1
95th Queue (ft)	8
Link Distance (ft)	290
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 7: HP Hwy & O-turn 2E

Movement	EB	NB	NB
Directions Served	L	T	T
Maximum Queue (ft)	84	40	15
Average Queue (ft)	58	3	1
95th Queue (ft)	79	17	7
Link Distance (ft)	46	1359	1359
Upstream Blk Time (%)	23		
Queuing Penalty (veh)	111		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 8: HP Hwy & O-turn 2E

Movement	SB	SB	SB	SB
Directions Served	L	T	T	T
Maximum Queue (ft)	256	229	346	208
Average Queue (ft)	86	39	44	34
95th Queue (ft)	217	211	235	208
Link Distance (ft)		502	502	502
Upstream Blk Time (%)		0	0	2
Queuing Penalty (veh)		0	3	10
Storage Bay Dist (ft)	800			
Storage Blk Time (%)		0		
Queuing Penalty (veh)		0		

Intersection: 9: O-turn 2W

Movement	NB	NB	NB
Directions Served	LT	T	T
Maximum Queue (ft)	502	440	195
Average Queue (ft)	194	91	10
95th Queue (ft)	426	326	124
Link Distance (ft)	752	752	752
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 10: HP Hwy & O-turn 2W

Movement	WB	SB	SB	SB
Directions Served	L	T	T	T
Maximum Queue (ft)	78	27	24	35
Average Queue (ft)	70	1	1	1
95th Queue (ft)	82	14	10	12
Link Distance (ft)	58	1078	1078	1078
Upstream Blk Time (%)	42			
Queuing Penalty (veh)	179			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 11: HP Hwy & O-turn 1E

Movement	SB	SB	SB
Directions Served	L	LT	T
Maximum Queue (ft)	59	101	9
Average Queue (ft)	14	17	0
95th Queue (ft)	45	63	7
Link Distance (ft)		687	687
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)	800		
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 12: O-turn 1E & HP Hwy

Movement	EB	NB	NB
Directions Served	L	T	T
Maximum Queue (ft)	64	6	33
Average Queue (ft)	42	0	1
95th Queue (ft)	69	4	14
Link Distance (ft)	48	1084	1084
Upstream Blk Time (%)	5		
Queuing Penalty (veh)	15		
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 13: O-turn 1 W

Movement	NB	NB	NB
Directions Served	LT	T	T
Maximum Queue (ft)	235	154	28
Average Queue (ft)	60	14	1
95th Queue (ft)	165	81	21
Link Distance (ft)	519	519	519
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 14: HP Hwy & O-turn 1 W

Movement	WB	SB	SB	SB
Directions Served	L	T	T	T
Maximum Queue (ft)	75	32	4	9
Average Queue (ft)	55	1	0	0
95th Queue (ft)	78	13	3	7
Link Distance (ft)	56	1614	1614	1614
Upstream Blk Time (%)	20			
Queuing Penalty (veh)	51			
Storage Bay Dist (ft)				
Storage Blk Time (%)				
Queuing Penalty (veh)				

Intersection: 15: HP Hwy & Olowalu Access 1

Movement	EB
Directions Served	R
Maximum Queue (ft)	240
Average Queue (ft)	93
95th Queue (ft)	199
Link Distance (ft)	377
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 17: RIRO Access & HP Hwy

Movement	EB	SB	SB	SB	SB
Directions Served	R	T	T	T	R
Maximum Queue (ft)	16	711	716	702	525
Average Queue (ft)	1	279	272	232	69
95th Queue (ft)	8	761	751	690	358
Link Distance (ft)	256	674	674	674	
Upstream Blk Time (%)		11	8	3	
Queuing Penalty (veh)		55	41	17	
Storage Bay Dist (ft)					500
Storage Blk Time (%)				14	0
Queuing Penalty (veh)				8	0

Intersection: 20: HP Hwy

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 24:

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 27: HP Hwy & Ehehene

Movement	WB	SB
Directions Served	LR	L
Maximum Queue (ft)	121	40
Average Queue (ft)	35	4
95th Queue (ft)	115	21
Link Distance (ft)	228	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		250
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 28:

Movement	B21	B21	B19	B19	B19
Directions Served	T		T	T	
Maximum Queue (ft)	740	733	709	715	718
Average Queue (ft)	578	532	469	455	333
95th Queue (ft)	1034	1013	934	930	873
Link Distance (ft)	625	625	655	655	655
Upstream Blk Time (%)	76	28	33	27	16
Queuing Penalty (veh)	577	211	167	138	81
Storage Bay Dist (ft)					
Storage Blk Time (%)					
Queuing Penalty (veh)					

Intersection: 31: HP Hwy & Mauka Access1

Movement	WB	NB	NB
Directions Served	R	T	T
Maximum Queue (ft)	6	10	9
Average Queue (ft)	0	0	0
95th Queue (ft)	5	7	6
Link Distance (ft)	267	677	677
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 32: Conn to Transfer Sta/Transfer Station

Movement	EB	WB
Directions Served	T	TR
Maximum Queue (ft)	30	25
Average Queue (ft)	6	5
95th Queue (ft)	27	21
Link Distance (ft)	60	641
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 34: HP Hwy & Conn to Transfer Sta

Movement	SB
Directions Served	T
Maximum Queue (ft)	11
Average Queue (ft)	0
95th Queue (ft)	8
Link Distance (ft)	371
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Network Summary

Network wide Queuing Penalty: 1665

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Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	3543	3514	3591	3485	3579	3542
Vehs Exited	3500	3518	3601	3428	3539	3519
Starting Vehs	147	144	179	165	139	153
Ending Vehs	190	140	169	222	179	180
Denied Entry Before	1	1	1	0	0	0
Denied Entry After	1	2	0	0	2	0
Travel Distance (mi)	5494	5421	5571	5402	5589	5496
Travel Time (hr)	179.5	175.1	183.0	177.0	181.4	179.2
Total Delay (hr)	48.0	45.5	49.4	47.3	48.0	47.6
Total Stops	3204	3117	3321	3150	3195	3197
Fuel Used (gal)	174.3	171.6	176.2	171.4	176.6	174.0

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3

Volumes adjusted by PHF, Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	7:00
End Time	7:15
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	859	879	889	812	823	847
Vehs Exited	835	844	895	804	800	835
Starting Vehs	147	144	179	165	139	153
Ending Vehs	171	179	173	173	162	172
Denied Entry Before	1	1	1	0	0	0
Denied Entry After	0	1	2	0	2	1
Travel Distance (mi)	1336	1364	1373	1285	1263	1324
Travel Time (hr)	42.6	44.4	45.2	41.5	39.1	42.6
Total Delay (hr)	10.7	11.9	12.2	10.6	9.1	10.9
Total Stops	716	798	830	708	637	732
Fuel Used (gal)	41.8	44.0	43.5	40.4	38.8	41.7

Interval #2 Information

Start Time	7:15
End Time	7:30
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	868	833	854	830	903	855
Vehs Exited	849	823	841	835	879	844
Starting Vehs	171	179	173	173	162	172
Ending Vehs	190	189	186	168	186	183
Denied Entry Before	0	1	2	0	2	1
Denied Entry After	2	3	1	1	1	1
Travel Distance (mi)	1345	1297	1338	1292	1401	1335
Travel Time (hr)	43.2	40.4	43.7	41.2	45.5	42.8
Total Delay (hr)	11.1	9.5	11.5	10.3	12.1	10.9
Total Stops	727	667	824	702	802	743
Fuel Used (gal)	42.3	40.3	42.2	40.5	44.2	41.9

Interval #3 Information

Start Time	7:30
End Time	7:45
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	954	936	958	945	972	953
Vehs Exited	939	970	966	917	935	945
Starting Vehs	190	189	186	168	186	183
Ending Vehs	205	155	178	196	223	188
Denied Entry Before	2	3	1	1	1	1
Denied Entry After	3	1	1	2	2	1
Travel Distance (mi)	1456	1475	1490	1438	1486	1469
Travel Time (hr)	49.1	48.7	49.8	47.8	49.0	48.9
Total Delay (hr)	14.2	13.3	14.2	13.3	13.4	13.7
Total Stops	913	897	924	854	858	892
Fuel Used (gal)	47.1	47.1	47.8	46.1	47.7	47.1

Interval #4 Information

Start Time	7:45
End Time	8:00
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	862	866	890	898	881	881
Vehs Exited	877	881	899	872	925	891
Starting Vehs	205	155	178	196	223	188
Ending Vehs	190	140	169	222	179	180
Denied Entry Before	3	1	1	2	2	1
Denied Entry After	1	2	0	0	2	0
Travel Distance (mi)	1357	1285	1371	1388	1438	1368
Travel Time (hr)	44.7	41.6	44.4	46.4	47.7	45.0
Total Delay (hr)	12.1	10.7	11.6	13.1	13.4	12.2
Total Stops	848	755	743	886	898	826
Fuel Used (gal)	43.1	40.2	42.8	44.4	45.9	43.3

1: HP Hwy & RIRO Access 3 Performance by movement

Movement	EBR	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	0.1	0.0	0.0	0.0	0.0
Total Delay (hr)	0.1	0.3	1.6	0.0	2.1
Total Del/Veh (s)	8.4	0.9	5.5	5.1	3.1
Stop Delay (hr)	0.1	0.0	0.3	0.0	0.4
Stop Del/Veh (s)	8.1	0.0	1.2	1.0	0.6
Total Stops	34	0	70	2	106
Stop/Veh	1.00	0.00	0.07	0.07	0.04
Travel Dist (mi)	6.9	245.8	254.7	6.6	514.1
Travel Time (hr)	0.3	5.8	7.6	0.2	14.0
Avg Speed (mph)	21	42	33	30	37
Fuel Used (gal)	0.2	6.8	10.9	0.2	18.2
Fuel Eff. (mpg)	34.9	36.1	23.4	26.8	28.3
HC Emissions (g)	2	173	236	2	413
CO Emissions (g)	38	4092	8322	133	12585
NOx Emissions (g)	5	612	799	9	1425
Vehicles Entered	34	1263	1052	27	2376
Vehicles Exited	34	1263	1054	28	2379
Hourly Exit Rate	34	1263	1054	28	2379
Input Volume	33	1277	1039	26	2374
% of Volume	104	99	101	110	100
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0
Density (ft/veh)					412
Occupancy (veh)	0	6	8	0	14

2: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.1	0.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	5.9	5.9
Travel Time (hr)	0.2	0.2
Avg Speed (mph)	27	27
Fuel Used (gal)	0.2	0.2
Fuel Eff. (mpg)	25.3	25.3
HC Emissions (g)	2	2
CO Emissions (g)	74	74
NOx Emissions (g)	6	6
Vehicles Entered	28	28
Vehicles Exited	28	28
Hourly Exit Rate	28	28
Input Volume	26	26
% of Volume	110	110
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

3: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	87.0	87.0
Travel Time (hr)	3.4	3.4
Avg Speed (mph)	26	26
Fuel Used (gal)	3.6	3.6
Fuel Eff. (mpg)	24.1	24.1
HC Emissions (g)	27	27
CO Emissions (g)	1153	1153
NOx Emissions (g)	102	102
Vehicles Entered	415	415
Vehicles Exited	413	413
Hourly Exit Rate	413	413
Input Volume	409	409
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	3	3

4: HP Hwy Performance by movement

Movement	NBT	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.4	2.5	2.9
Total Del/Veh (s)	1.2	8.3	4.5
Stop Delay (hr)	0.0	0.7	0.7
Stop Del/Veh (s)	0.0	2.4	1.1
Total Stops	0	280	280
Stop/Veh	0.00	0.26	0.12
Travel Dist (mi)	156.7	216.4	373.1
Travel Time (hr)	3.9	7.4	11.4
Avg Speed (mph)	40	29	33
Fuel Used (gal)	4.1	5.4	9.5
Fuel Eff. (mpg)	38.4	39.8	39.2
HC Emissions (g)	96	109	206
CO Emissions (g)	1963	2748	4711
NOx Emissions (g)	344	354	698
Vehicles Entered	1264	1089	2353
Vehicles Exited	1263	1088	2351
Hourly Exit Rate	1263	1088	2351
Input Volume	1278	1072	2350
% of Volume	99	101	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (ft/veh)			241
Occupancy (veh)	4	7	11

5: HP Hwy & Olowalu Town Access 2/Mauka Access 2 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	2.9	0.6	0.3	2.7	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	4.9	0.2	0.2	0.3	0.3	0.0	2.1	4.3	0.0	0.2	4.4	0.7
Total Del/Veh (s)	47.4	27.2	2.5	48.2	51.2	0.7	45.4	14.2	4.1	36.9	18.9	10.3
Stop Delay (hr)	4.5	0.2	0.0	0.3	0.3	0.0	1.9	2.3	0.0	0.2	2.2	0.2
Stop Del/Veh (s)	43.2	24.2	0.7	47.1	49.7	0.0	41.1	7.7	1.3	29.4	9.4	3.3
Total Stops	347	16	24	21	20	0	148	407	7	18	323	95
Stop/Veh	0.93	0.67	0.11	0.91	0.95	0.00	0.89	0.37	0.33	0.95	0.39	0.41
Travel Dist (mi)	73.0	4.6	42.1	4.4	4.1	3.9	39.3	259.8	4.9	6.8	305.1	85.6
Travel Time (hr)	7.8	0.3	1.7	0.5	0.5	0.2	3.2	10.2	0.2	0.4	11.4	2.9
Avg Speed (mph)	10	14	25	8	8	19	12	26	30	19	27	29
Fuel Used (gal)	3.3	0.2	1.1	0.2	0.2	0.1	1.3	6.7	0.1	0.3	11.7	3.0
Fuel Eff. (mpg)	22.2	27.6	37.4	20.9	20.5	32.5	29.6	39.0	47.5	26.0	26.1	28.1
HC Emissions (g)	23	1	9	0	0	0	9	154	0	2	279	22
CO Emissions (g)	687	31	256	17	16	10	315	3247	18	107	8600	1476
NOx Emissions (g)	69	2	27	2	1	1	34	494	3	8	893	107
Vehicles Entered	365	23	217	23	21	20	165	1086	21	18	815	229
Vehicles Exited	365	23	217	22	21	20	165	1081	21	18	818	229
Hourly Exit Rate	365	23	217	22	21	20	165	1081	21	18	818	229
Input Volume	363	20	214	20	20	20	166	1098	20	20	805	223
% of Volume	101	112	101	107	102	98	100	98	102	88	102	103
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	8	0	2	1	1	0	3	10	0	0	11	3

5: HP Hwy & Olowalu Town Access 2/Mauka Access 2 Performance by movement

Movement	All
Denied Delay (hr)	0.3
Denied Del/Veh (s)	0.4
Total Delay (hr)	17.5
Total Del/Veh (s)	20.7
Stop Delay (hr)	12.0
Stop Del/Veh (s)	14.2
Total Stops	1426
Stop/Veh	0.47
Travel Dist (mi)	833.5
Travel Time (hr)	39.2
Avg Speed (mph)	21
Fuel Used (gal)	28.2
Fuel Eff. (mpg)	29.6
HC Emissions (g)	499
CO Emissions (g)	14779
NOx Emissions (g)	1641
Vehicles Entered	3003
Vehicles Exited	3000
Hourly Exit Rate	3000
Input Volume	2992
% of Volume	100
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	546
Occupancy (veh)	39

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.9	0.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	13.3	13.3
Travel Time (hr)	0.7	0.7
Avg Speed (mph)	19	19
Fuel Used (gal)	0.5	0.5
Fuel Eff. (mpg)	27.1	27.1
HC Emissions (g)	1	1
CO Emissions (g)	63	63
NOx Emissions (g)	7	7
Vehicles Entered	62	62
Vehicles Exited	62	62
Hourly Exit Rate	62	62
Input Volume	62	62
% of Volume	101	101
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	1	1

7: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	0.9	0.9
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	46.8	46.8
Travel Time (hr)	1.8	1.8
Avg Speed (mph)	26	26
Fuel Used (gal)	1.9	1.9
Fuel Eff. (mpg)	24.1	24.1
HC Emissions (g)	26	26
CO Emissions (g)	830	830
NOx Emissions (g)	82	82
Vehicles Entered	232	232
Vehicles Exited	232	232
Hourly Exit Rate	232	232
Input Volume	243	243
% of Volume	95	95
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	2	2

9: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	1.0	1.3	2.3
Total Del/Veh (s)	2.9	4.3	3.5
Stop Delay (hr)	0.0	0.1	0.1
Stop Del/Veh (s)	0.0	0.4	0.2
Total Stops	0	55	55
Stop/Veh	0.00	0.05	0.02
Travel Dist (mi)	422.2	130.4	552.6
Travel Time (hr)	10.5	4.2	14.7
Avg Speed (mph)	40	31	38
Fuel Used (gal)	10.3	7.4	17.8
Fuel Eff. (mpg)	40.9	17.6	31.1
HC Emissions (g)	240	180	419
CO Emissions (g)	4197	6082	10279
NOx Emissions (g)	882	600	1481
Vehicles Entered	1262	1088	2350
Vehicles Exited	1263	1083	2346
Hourly Exit Rate	1263	1083	2346
Input Volume	1277	1072	2349
% of Volume	99	101	100
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (ft/veh)	167	151	162
Occupancy (veh)	11	4	15

18: HP Hwy & Olowalu Town Access 1/Mauka Access 1 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.2	0.5	0.3	4.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay (hr)	2.7	0.2	0.1	0.3	0.2	0.0	1.3	6.8	0.1	0.1	4.1	0.1
Total Del/Veh (s)	41.2	26.6	1.8	50.6	44.2	1.1	55.3	17.7	11.8	23.9	16.2	3.7
Stop Delay (hr)	2.5	0.1	0.0	0.3	0.2	0.0	1.1	2.5	0.0	0.1	2.4	0.1
Stop Del/Veh (s)	38.0	23.7	0.3	48.5	40.7	0.0	47.9	6.5	1.2	19.8	9.6	1.6
Total Stops	205	15	12	22	17	0	77	495	2	19	377	54
Stop/Veh	0.87	0.68	0.08	1.00	0.94	0.00	0.94	0.36	0.09	0.95	0.42	0.40
Travel Dist (mi)	43.9	4.1	28.5	3.1	2.4	2.4	30.4	505.7	8.4	8.5	373.2	56.1
Travel Time (hr)	4.5	0.3	1.1	0.4	0.3	0.1	2.1	18.7	0.3	0.3	12.4	1.6
Avg Speed (mph)	10	14	25	7	8	26	15	27	28	25	30	36
Fuel Used (gal)	1.9	0.2	0.8	0.2	0.1	0.1	1.3	18.6	0.3	0.2	9.6	1.4
Fuel Eff. (mpg)	23.5	27.5	37.6	19.4	21.1	41.5	23.9	27.2	31.7	39.7	38.8	41.1
HC Emissions (g)	13	1	6	0	0	0	14	411	2	1	216	20
CO Emissions (g)	350	24	168	20	17	5	612	12692	108	31	4568	608
NOx Emissions (g)	36	2	18	2	1	1	51	1324	9	6	753	79
Vehicles Entered	230	22	154	22	17	18	80	1363	23	20	894	134
Vehicles Exited	232	21	153	22	17	18	81	1369	22	20	891	134
Hourly Exit Rate	232	21	153	22	17	18	81	1369	22	20	891	134
Input Volume	232	20	154	20	20	20	89	1372	20	20	876	134
% of Volume	100	102	99	107	83	88	91	100	107	98	102	100
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	4	0	1	0	0	0	2	19	0	0	12	2

18: HP Hwy & Olowalu Town Access 1/Mauka Access 1 Performance by movement

Movement	All
Denied Delay (hr)	0.2
Denied Del/Veh (s)	0.3
Total Delay (hr)	15.9
Total Del/Veh (s)	19.0
Stop Delay (hr)	9.3
Stop Del/Veh (s)	11.1
Total Stops	1295
Stop/Veh	0.43
Travel Dist (mi)	1066.8
Travel Time (hr)	42.1
Avg Speed (mph)	25
Fuel Used (gal)	34.4
Fuel Eff. (mpg)	31.0
HC Emissions (g)	685
CO Emissions (g)	19203
NOx Emissions (g)	2283
Vehicles Entered	2977
Vehicles Exited	2980
Hourly Exit Rate	2980
Input Volume	2980
% of Volume	100
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	588
Occupancy (veh)	42

20: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	2.3	2.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.5	0.5
Total Stops	3	3
Stop/Veh	0.05	0.05
Travel Dist (mi)	9.8	9.8
Travel Time (hr)	0.4	0.4
Avg Speed (mph)	24	24
Fuel Used (gal)	0.4	0.4
Fuel Eff. (mpg)	22.5	22.5
HC Emissions (g)	3	3
CO Emissions (g)	158	158
NOx Emissions (g)	12	12
Vehicles Entered	64	64
Vehicles Exited	64	64
Hourly Exit Rate	64	64
Input Volume	62	62
% of Volume	104	104
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

25: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.6	0.6
Total Del/Veh (s)	2.1	2.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	249.0	249.0
Travel Time (hr)	6.2	6.2
Avg Speed (mph)	40	40
Fuel Used (gal)	6.8	6.8
Fuel Eff. (mpg)	36.7	36.7
HC Emissions (g)	152	152
CO Emissions (g)	3671	3671
NOx Emissions (g)	540	540
Vehicles Entered	1079	1079
Vehicles Exited	1077	1077
Hourly Exit Rate	1077	1077
Input Volume	1074	1074
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	6	6

28: HP Hwy & Ehehene St Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.6	0.0	0.0	0.0	0.6
Denied Del/Veh (s)	0.1	4.5	1.8	2.4	0.0	0.0	1.0
Total Delay (hr)	0.1	0.0	0.7	0.0	0.0	0.8	1.6
Total Del/Veh (s)	58.0	20.8	2.1	0.3	18.7	2.7	2.5
Stop Delay (hr)	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	56.3	21.0	0.0	0.0	15.1	0.0	0.2
Total Stops	4	6	0	0	1	0	11
Stop/Veh	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Travel Dist (mi)	0.3	0.5	274.6	0.7	0.5	358.0	634.5
Travel Time (hr)	0.1	0.1	7.5	0.0	0.0	8.8	16.5
Avg Speed (mph)	4	9	40	37	28	41	40
Fuel Used (gal)	0.0	0.0	7.4	0.0	0.0	8.7	16.2
Fuel Eff. (mpg)	14.3	24.3	37.2	43.3	44.5	41.0	39.2
HC Emissions (g)	0	0	168	0	0	205	374
CO Emissions (g)	2	2	3397	4	1	3718	7124
NOx Emissions (g)	0	0	602	0	0	749	1353
Vehicles Entered	4	6	1254	3	1	1082	2350
Vehicles Exited	4	6	1256	3	1	1076	2346
Hourly Exit Rate	4	6	1256	3	1	1076	2346
Input Volume	5	6	1271	2	2	1070	2356
% of Volume	80	96	99	150	50	101	100
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Density (ft/veh)							414
Occupancy (veh)	0	0	7	0	0	9	16

29: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.4	0.4
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.2	0.2
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.5	0.5
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	19	19
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	12.8	12.8
HC Emissions (g)	0	0
CO Emissions (g)	22	22
NOx Emissions (g)	1	1
Vehicles Entered	10	10
Vehicles Exited	10	10
Hourly Exit Rate	10	10
Input Volume	10	10
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

32: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.4	0.4
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.2	0.2
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.4	0.4
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	23	23
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	17.0	17.0
HC Emissions (g)	0	0
CO Emissions (g)	10	10
NOx Emissions (g)	1	1
Vehicles Entered	4	4
Vehicles Exited	4	4
Hourly Exit Rate	4	4
Input Volume	4	4
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

33: HP Hwy & Transfer Station Performance by movement

Movement	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.1	0.1
Denied Del/Veh (s)	0.1	0.0	0.0	2.5	0.2	0.1
Total Delay (hr)	0.0	2.6	0.0	0.0	0.1	2.7
Total Del/Veh (s)	7.0	5.8	5.2	13.5	0.5	3.7
Stop Delay (hr)	0.0	0.1	0.0	0.0	0.0	0.1
Stop Del/Veh (s)	7.1	0.2	0.1	12.5	0.0	0.2
Total Stops	1	15	0	5	0	21
Stop/Veh	1.00	0.01	0.00	1.00	0.00	0.01
Travel Dist (mi)	0.1	661.0	2.0	0.8	171.0	834.9
Travel Time (hr)	0.0	17.8	0.1	0.0	4.0	21.9
Avg Speed (mph)	11	37	33	20	43	38
Fuel Used (gal)	0.0	23.6	0.1	0.0	4.8	28.5
Fuel Eff. (mpg)	44.5	28.0	30.5	36.6	35.4	29.3
HC Emissions (g)	0	568	0	0	113	681
CO Emissions (g)	0	15916	20	7	2878	18821
NOx Emissions (g)	0	1959	2	1	411	2373
Vehicles Entered	1	1571	5	5	1044	2626
Vehicles Exited	1	1559	5	5	1044	2614
Hourly Exit Rate	1	1559	5	5	1044	2614
Input Volume	2	1575	5	5	1026	2613
% of Volume	50	99	100	100	102	100
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Density (ft/veh)						441
Occupancy (veh)	0	18	0	0	4	22

34: External Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	273.4	273.4
Travel Time (hr)	6.6	6.6
Avg Speed (mph)	42	42
Fuel Used (gal)	7.7	7.7
Fuel Eff. (mpg)	35.6	35.6
HC Emissions (g)	189	189
CO Emissions (g)	4539	4539
NOx Emissions (g)	671	671
Vehicles Entered	1556	1556
Vehicles Exited	1553	1553
Hourly Exit Rate	1553	1553
Input Volume	1574	1574
% of Volume	99	99
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	7	7

Total Network Performance

Denied Delay (hr)	1.3
Denied Del/Veh (s)	1.3
Total Delay (hr)	46.4
Total Del/Veh (s)	45.1
Stop Delay (hr)	22.9
Stop Del/Veh (s)	22.3
Total Stops	3197
Stop/Veh	0.86
Travel Dist (mi)	5495.6
Travel Time (hr)	179.2
Avg Speed (mph)	31
Fuel Used (gal)	174.0
Fuel Eff. (mpg)	31.6
HC Emissions (g)	3676
CO Emissions (g)	98023
NOx Emissions (g)	12676
Vehicles Entered	3542
Vehicles Exited	3519
Hourly Exit Rate	3519
Input Volume	21475
% of Volume	16
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	410
Occupancy (veh)	178

Arterial Level of Service: NB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Ehehene St	28	2.1	21.4	0.2	41
	9	2.9	29.7	0.3	40
	4	1.2	11.2	0.1	39
RIRO Access 3	1	0.9	16.5	0.2	43
Mauka Access 2	5	14.2	33.4	0.2	26
Mauka Access 1	18	20.8	50.2	0.4	27
Transfer Station	33	6.3	40.0	0.4	38
Total		48.3	202.4	1.9	34

Arterial Level of Service: SB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Transfer Station	33	0.5	13.8	0.2	45
Olowalu Town Access	18	16.2	49.6	0.4	31
Olowalu Town Access	5	17.0	46.5	0.4	29
RIRO Access 3	1	4.3	23.6	0.2	37
	4	8.3	24.2	0.2	29
	9	4.3	13.9	0.1	32
Ehehene St	28	2.7	29.2	0.3	41
Total		53.2	200.9	1.9	33

Intersection: 1: HP Hwy & RIRO Access 3

Movement	EB
Directions Served	R
Maximum Queue (ft)	56
Average Queue (ft)	22
95th Queue (ft)	49
Link Distance (ft)	1088
Upstream Blk Time (%)	
Queuing Penalty (veh)	
Storage Bay Dist (ft)	
Storage Blk Time (%)	
Queuing Penalty (veh)	

Intersection: 4: HP Hwy

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	202	217
Average Queue (ft)	61	64
95th Queue (ft)	158	174
Link Distance (ft)	994	994
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 5: HP Hwy & Olowalu Town Access 2/Mauka Access 2

Movement	EB	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	L	L	T	T	R	L
Maximum Queue (ft)	222	248	46	116	58	61	109	127	288	304	136	91
Average Queue (ft)	118	154	11	26	17	15	51	71	145	156	9	15
95th Queue (ft)	210	226	34	82	44	44	95	115	246	263	65	59
Link Distance (ft)			1046	1046		1036			1214	1214		
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	400	400			250		400	400			250	250
Storage Blk Time (%)										1	0	
Queuing Penalty (veh)										0	0	

Intersection: 5: HP Hwy & Olowalu Town Access 2/Mauka Access 2

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	300	298	85
Average Queue (ft)	104	114	37
95th Queue (ft)	225	234	73
Link Distance (ft)	1896	1896	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			600
Storage Blk Time (%)	1		
Queuing Penalty (veh)	0		

Intersection: 18: HP Hwy & Olowalu Town Access 1/Mauka Access 1

Movement	EB	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	L	L	T	T	R	L
Maximum Queue (ft)	165	195	51	79	69	52	71	100	362	380	223	50
Average Queue (ft)	57	110	11	11	23	18	25	45	161	173	10	13
95th Queue (ft)	138	171	35	50	58	48	61	83	294	309	84	38
Link Distance (ft)			1001	1001		736			1896	1896		
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	500	500			250		400	400			200	250
Storage Blk Time (%)									0	6	0	
Queuing Penalty (veh)									0	1	0	

Intersection: 18: HP Hwy & Olowalu Town Access 1/Mauka Access 1

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	232	259	72
Average Queue (ft)	123	142	26
95th Queue (ft)	201	224	54
Link Distance (ft)	2146	2146	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			600
Storage Blk Time (%)	0		
Queuing Penalty (veh)	0		

Intersection: 28: HP Hwy & Ehehene St

Movement	WB	WB	SB
Directions Served	L	R	L
Maximum Queue (ft)	34	26	22
Average Queue (ft)	4	4	1
95th Queue (ft)	19	19	10
Link Distance (ft)	407		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		100	200
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 33: HP Hwy & Transfer Station

Movement	WB	SB
Directions Served	R	L
Maximum Queue (ft)	17	32
Average Queue (ft)	1	4
95th Queue (ft)	9	19
Link Distance (ft)	205	
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		250
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 2

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Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	4:57	4:57	4:57	4:57	4:57	4:57
End Time	6:00	6:00	6:00	6:00	6:00	6:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	5	5	5	5	5	5
# of Recorded Intervals	4	4	4	4	4	4
Vehs Entered	4888	4851	4816	4854	4876	4856
Vehs Exited	4647	4623	4648	4688	4629	4648
Starting Vehs	217	198	218	209	221	210
Ending Vehs	458	426	386	375	468	419
Denied Entry Before	5	1	7	18	5	7
Denied Entry After	9	5	1	14	33	12
Travel Distance (mi)	7291	7274	7228	7274	7242	7262
Travel Time (hr)	371.0	333.3	338.6	321.2	359.7	344.7
Total Delay (hr)	195.5	158.7	164.2	145.9	185.5	170.0
Total Stops	7033	6459	6633	5957	6914	6599
Fuel Used (gal)	260.7	254.9	254.7	254.6	258.5	256.7

Interval #0 Information Seeding

Start Time	4:57
End Time	5:00
Total Time (min)	3

Volumes adjusted by PHF, Growth Factors.
No data recorded this interval.

Interval #1 Information Recording

Start Time	5:00
End Time	5:15
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	1217	1203	1162	1197	1159	1186
Vehs Exited	1144	1102	1097	1108	1135	1116
Starting Vehs	217	198	218	209	221	210
Ending Vehs	290	299	283	298	245	280
Denied Entry Before	5	1	7	18	5	7
Denied Entry After	2	6	1	3	1	2
Travel Distance (mi)	1828	1797	1735	1802	1762	1785
Travel Time (hr)	73.5	73.1	65.3	69.3	62.3	68.7
Total Delay (hr)	29.3	29.9	23.4	26.0	19.9	25.7
Total Stops	1483	1410	1388	1378	1143	1355
Fuel Used (gal)	61.7	62.1	57.5	60.8	57.7	60.0

Interval #2 Information

Start Time	5:15
End Time	5:30
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	1228	1156	1200	1150	1268	1201
Vehs Exited	1184	1165	1143	1164	1140	1158
Starting Vehs	290	299	283	298	245	280
Ending Vehs	334	290	340	284	373	321
Denied Entry Before	2	6	1	3	1	2
Denied Entry After	0	0	5	2	1	1
Travel Distance (mi)	1857	1776	1797	1760	1825	1803
Travel Time (hr)	79.4	74.7	76.2	71.6	82.5	76.9
Total Delay (hr)	34.8	32.1	32.9	29.2	38.5	33.5
Total Stops	1566	1348	1495	1410	1679	1501
Fuel Used (gal)	63.4	60.7	60.9	59.6	64.1	61.8

Interval #3 Information

Start Time	5:30
End Time	5:45
Total Time (min)	15

Volumes adjusted by PHF, Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	1306	1288	1260	1278	1269	1281
Vehs Exited	1189	1174	1181	1199	1226	1194
Starting Vehs	334	290	340	284	373	321
Ending Vehs	451	404	419	363	416	408
Denied Entry Before	0	0	5	2	1	1
Denied Entry After	0	1	17	34	0	10
Travel Distance (mi)	1875	1861	1849	1864	1890	1868
Travel Time (hr)	101.7	85.7	96.5	84.3	101.8	94.0
Total Delay (hr)	56.4	41.1	52.0	39.5	56.3	49.0
Total Stops	2036	1755	1821	1589	2156	1873
Fuel Used (gal)	69.1	65.1	68.0	66.2	69.8	67.7

Interval #4 Information

Start Time	5:45
End Time	6:00
Total Time (min)	15

Volumes adjusted by Growth Factors.

Run Number	1	2	3	4	5	Avg
Vehs Entered	1137	1204	1194	1229	1180	1188
Vehs Exited	1130	1182	1227	1217	1128	1179
Starting Vehs	451	404	419	363	416	408
Ending Vehs	458	426	386	375	468	419
Denied Entry Before	0	1	17	34	0	10
Denied Entry After	9	5	1	14	33	12
Travel Distance (mi)	1731	1840	1847	1848	1764	1806
Travel Time (hr)	116.4	99.8	100.5	95.9	113.2	105.2
Total Delay (hr)	75.0	55.6	56.0	51.2	70.8	61.7
Total Stops	1948	1946	1929	1580	1936	1867
Fuel Used (gal)	66.5	67.0	68.2	68.0	66.8	67.3

1: HP Hwy & RIRO Access 3 Performance by movement

Movement	EBR	NBT	SBT	SBR	All
Denied Delay (hr)	0.0	0.0	0.1	0.0	0.1
Denied Del/Veh (s)	0.1	0.0	0.2	0.0	0.1
Total Delay (hr)	0.3	0.4	18.0	0.6	19.3
Total Del/Veh (s)	41.5	0.9	43.4	41.1	21.7
Stop Delay (hr)	0.3	0.0	14.5	0.5	15.3
Stop Del/Veh (s)	41.1	0.0	34.9	34.0	17.2
Total Stops	25	0	565	19	609
Stop/Veh	1.00	0.00	0.38	0.36	0.19
Travel Dist (mi)	5.1	315.1	358.1	12.7	691.0
Travel Time (hr)	0.5	7.5	26.4	1.0	35.4
Avg Speed (mph)	11	42	14	13	20
Fuel Used (gal)	0.2	9.1	16.9	0.6	26.7
Fuel Eff. (mpg)	25.0	34.7	21.2	22.7	25.9
HC Emissions (g)	2	217	312	3	533
CO Emissions (g)	40	5518	9888	195	15642
NOx Emissions (g)	5	775	944	14	1738
Vehicles Entered	25	1619	1484	53	3181
Vehicles Exited	24	1620	1429	51	3124
Hourly Exit Rate	24	1620	1429	51	3124
Input Volume	26	1618	1511	51	3206
% of Volume	94	100	95	100	97
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	1	0	1
Density (ft/veh)					163
Occupancy (veh)	0	7	26	1	35

2: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.2	0.2
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	10.8	10.8
Travel Time (hr)	0.4	0.4
Avg Speed (mph)	26	26
Fuel Used (gal)	0.4	0.4
Fuel Eff. (mpg)	24.9	24.9
HC Emissions (g)	3	3
CO Emissions (g)	138	138
NOx Emissions (g)	11	11
Vehicles Entered	51	51
Vehicles Exited	51	51
Hourly Exit Rate	51	51
Input Volume	51	51
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

3: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.5	1.5
Stop Delay (hr)	0.1	0.1
Stop Del/Veh (s)	0.2	0.2
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	185.0	185.0
Travel Time (hr)	7.4	7.4
Avg Speed (mph)	25	25
Fuel Used (gal)	7.7	7.7
Fuel Eff. (mpg)	24.1	24.1
HC Emissions (g)	68	68
CO Emissions (g)	2494	2494
NOx Emissions (g)	248	248
Vehicles Entered	882	882
Vehicles Exited	880	880
Hourly Exit Rate	880	880
Input Volume	883	883
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	7	7

4: HP Hwy Performance by movement

Movement	NBT	SBT	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	0.6	45.7	46.3
Total Del/Veh (s)	1.4	113.2	54.2
Stop Delay (hr)	0.0	45.4	45.4
Stop Del/Veh (s)	0.0	112.5	53.1
Total Stops	0	1370	1370
Stop/Veh	0.00	0.94	0.45
Travel Dist (mi)	200.9	281.2	482.1
Travel Time (hr)	5.1	52.0	57.2
Avg Speed (mph)	39	5	8
Fuel Used (gal)	5.4	15.5	20.9
Fuel Eff. (mpg)	37.5	18.1	23.1
HC Emissions (g)	118	134	252
CO Emissions (g)	2498	3130	5627
NOx Emissions (g)	419	245	664
Vehicles Entered	1619	1451	3070
Vehicles Exited	1619	1376	2995
Hourly Exit Rate	1619	1376	2995
Input Volume	1618	1535	3153
% of Volume	100	90	95
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (ft/veh)			48
Occupancy (veh)	5	52	57

5: HP Hwy & Olowalu Town Access 2/Mauka Access 2 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	4.5	2.4	1.7	2.8	0.1	0.1	0.1	0.0	0.1	0.3	0.0	0.1
Total Delay (hr)	24.3	0.4	0.6	0.3	0.2	0.0	5.0	4.0	0.0	0.2	15.3	3.3
Total Del/Veh (s)	207.1	73.9	8.5	48.1	45.2	0.7	43.7	11.7	3.8	48.9	42.5	25.7
Stop Delay (hr)	23.6	0.4	0.4	0.2	0.2	0.0	4.3	2.0	0.0	0.2	8.8	1.4
Stop Del/Veh (s)	201.1	68.2	5.8	47.1	43.8	0.0	37.7	5.8	1.3	36.6	24.7	11.1
Total Stops	558	22	94	18	17	0	349	368	7	18	824	307
Stop/Veh	1.32	1.10	0.34	0.95	0.89	0.00	0.85	0.30	0.35	1.00	0.64	0.66
Travel Dist (mi)	80.5	4.0	52.8	3.7	3.8	3.8	97.0	288.0	4.7	6.5	467.5	171.5
Travel Time (hr)	27.7	0.6	2.7	0.5	0.4	0.2	7.6	10.4	0.2	0.4	25.9	7.9
Avg Speed (mph)	3	7	21	8	9	19	13	28	31	16	18	22
Fuel Used (gal)	8.1	0.2	1.6	0.2	0.2	0.1	3.2	7.4	0.1	0.3	20.0	6.6
Fuel Eff. (mpg)	9.9	18.3	33.4	20.6	21.5	31.5	30.0	38.8	47.8	22.5	23.3	26.1
HC Emissions (g)	29	1	16	0	0	0	28	171	0	2	451	39
CO Emissions (g)	1061	44	427	14	13	10	826	3869	18	119	13176	2516
NOx Emissions (g)	84	3	46	1	1	1	96	551	3	8	1384	200
Vehicles Entered	414	20	272	19	19	20	406	1207	20	18	1260	461
Vehicles Exited	381	20	272	19	19	20	400	1205	20	18	1256	462
Hourly Exit Rate	381	20	272	19	19	20	400	1205	20	18	1256	462
Input Volume	413	20	287	20	20	20	400	1211	20	20	1264	463
% of Volume	92	98	95	93	93	98	100	100	98	88	99	100
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	5	0	3	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	27	1	3	0	0	0	8	10	0	0	26	8

5: HP Hwy & Olowalu Town Access 2/Mauka Access 2 Performance by movement

Movement	All
Denied Delay (hr)	0.7
Denied Del/Veh (s)	0.6
Total Delay (hr)	53.7
Total Del/Veh (s)	46.0
Stop Delay (hr)	41.6
Stop Del/Veh (s)	35.7
Total Stops	2582
Stop/Veh	0.61
Travel Dist (mi)	1183.7
Travel Time (hr)	84.4
Avg Speed (mph)	14
Fuel Used (gal)	48.0
Fuel Eff. (mpg)	24.6
HC Emissions (g)	736
CO Emissions (g)	22093
NOx Emissions (g)	2378
Vehicles Entered	4136
Vehicles Exited	4092
Hourly Exit Rate	4092
Input Volume	4160
% of Volume	98
Denied Entry Before	0
Denied Entry After	8
Density (ft/veh)	254
Occupancy (veh)	84

6: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	12.1	12.1
Travel Time (hr)	0.6	0.6
Avg Speed (mph)	19	19
Fuel Used (gal)	0.5	0.5
Fuel Eff. (mpg)	26.4	26.4
HC Emissions (g)	1	1
CO Emissions (g)	58	58
NOx Emissions (g)	7	7
Vehicles Entered	57	57
Vehicles Exited	57	57
Hourly Exit Rate	57	57
Input Volume	62	62
% of Volume	93	93
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	1	1

7: External Performance by approach

Approach	WB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.1	0.1
Total Del/Veh (s)	1.1	1.1
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	99.9	99.9
Travel Time (hr)	3.9	3.9
Avg Speed (mph)	25	25
Fuel Used (gal)	4.2	4.2
Fuel Eff. (mpg)	23.7	23.7
HC Emissions (g)	58	58
CO Emissions (g)	1782	1782
NOx Emissions (g)	186	186
Vehicles Entered	497	497
Vehicles Exited	493	493
Hourly Exit Rate	493	493
Input Volume	513	513
% of Volume	96	96
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	4	4

9: Bend Performance by approach

Approach	NB	SB	All
Denied Delay (hr)	0.0	0.0	0.0
Denied Del/Veh (s)	0.0	0.0	0.0
Total Delay (hr)	1.7	2.6	4.3
Total Del/Veh (s)	3.7	6.8	5.1
Stop Delay (hr)	0.0	0.6	0.6
Stop Del/Veh (s)	0.0	1.6	0.7
Total Stops	0	23	23
Stop/Veh	0.00	0.02	0.01
Travel Dist (mi)	540.4	165.3	705.7
Travel Time (hr)	13.8	6.3	20.1
Avg Speed (mph)	39	26	35
Fuel Used (gal)	13.4	12.1	25.5
Fuel Eff. (mpg)	40.2	13.7	27.7
HC Emissions (g)	299	299	598
CO Emissions (g)	5167	11190	16356
NOx Emissions (g)	1090	944	2034
Vehicles Entered	1616	1376	2992
Vehicles Exited	1617	1372	2989
Hourly Exit Rate	1617	1372	2989
Input Volume	1615	1535	3150
% of Volume	100	89	95
Denied Entry Before	0	0	0
Denied Entry After	0	0	0
Density (ft/veh)	127	101	119
Occupancy (veh)	14	6	20

18: HP Hwy & Olowalu Town Access 1/Mauka Access 1 Performance by movement

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Denied Delay (hr)	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Denied Del/Veh (s)	3.2	0.5	0.2	4.2	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.1
Total Delay (hr)	6.5	0.2	0.2	0.3	0.3	0.0	2.5	6.5	0.1	0.2	11.3	0.7
Total Del/Veh (s)	102.8	37.1	5.2	49.8	49.6	1.2	45.1	16.4	10.6	24.6	26.1	8.6
Stop Delay (hr)	6.3	0.2	0.2	0.3	0.3	0.0	2.1	2.2	0.0	0.1	5.6	0.2
Stop Del/Veh (s)	99.3	34.1	3.4	47.5	46.2	0.0	37.6	5.7	1.1	15.6	12.9	2.8
Total Stops	249	15	47	21	18	0	178	469	2	21	828	116
Stop/Veh	1.09	0.71	0.28	1.00	0.90	0.00	0.88	0.33	0.09	0.91	0.53	0.41
Travel Dist (mi)	42.9	3.8	31.0	3.0	2.7	2.7	74.5	526.7	8.4	9.3	637.8	115.0
Travel Time (hr)	8.3	0.3	1.4	0.4	0.4	0.1	4.5	18.8	0.3	0.4	25.6	3.6
Avg Speed (mph)	5	11	22	7	7	25	17	28	29	24	25	32
Fuel Used (gal)	2.7	0.2	0.9	0.2	0.1	0.1	3.0	18.9	0.3	0.2	17.0	2.9
Fuel Eff. (mpg)	15.7	25.0	35.8	19.3	20.3	41.6	24.6	27.8	31.3	40.2	37.5	39.4
HC Emissions (g)	13	1	10	0	0	0	35	406	2	1	350	44
CO Emissions (g)	414	23	232	23	20	7	1464	12319	103	47	7681	1465
NOx Emissions (g)	36	2	27	2	2	1	130	1337	9	7	1146	154
Vehicles Entered	225	20	166	21	19	20	199	1411	23	23	1535	277
Vehicles Exited	220	20	167	21	20	20	201	1412	23	22	1523	276
Hourly Exit Rate	220	20	167	21	20	20	201	1412	23	22	1523	276
Input Volume	220	20	172	20	20	20	212	1436	20	20	1526	281
% of Volume	100	98	97	102	98	98	95	98	112	107	100	98
Denied Entry Before	0	0	0	0	0	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0	0	0	0	0	0
Density (ft/veh)												
Occupancy (veh)	8	0	1	0	0	0	4	19	0	0	26	4

18: HP Hwy & Olowalu Town Access 1/Mauka Access 1 Performance by movement

Movement	All
Denied Delay (hr)	0.3
Denied Del/Veh (s)	0.2
Total Delay (hr)	28.8
Total Del/Veh (s)	26.0
Stop Delay (hr)	17.5
Stop Del/Veh (s)	15.8
Total Stops	1964
Stop/Veh	0.49
Travel Dist (mi)	1457.7
Travel Time (hr)	64.1
Avg Speed (mph)	23
Fuel Used (gal)	46.5
Fuel Eff. (mpg)	31.4
HC Emissions (g)	862
CO Emissions (g)	23799
NOx Emissions (g)	2852
Vehicles Entered	3939
Vehicles Exited	3925
Hourly Exit Rate	3925
Input Volume	3970
% of Volume	99
Denied Entry Before	0
Denied Entry After	0
Density (ft/veh)	386
Occupancy (veh)	64

20: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	2.3	2.3
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.6	0.6
Total Stops	3	3
Stop/Veh	0.05	0.05
Travel Dist (mi)	10.1	10.1
Travel Time (hr)	0.4	0.4
Avg Speed (mph)	24	24
Fuel Used (gal)	0.4	0.4
Fuel Eff. (mpg)	22.5	22.5
HC Emissions (g)	3	3
CO Emissions (g)	165	165
NOx Emissions (g)	12	12
Vehicles Entered	66	66
Vehicles Exited	65	65
Hourly Exit Rate	65	65
Input Volume	62	62
% of Volume	106	106
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

25: External Performance by approach

Approach	SB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.8	0.8
Total Del/Veh (s)	2.2	2.2
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	318.4	318.4
Travel Time (hr)	8.0	8.0
Avg Speed (mph)	40	40
Fuel Used (gal)	8.7	8.7
Fuel Eff. (mpg)	36.6	36.6
HC Emissions (g)	202	202
CO Emissions (g)	4834	4834
NOx Emissions (g)	704	704
Vehicles Entered	1379	1379
Vehicles Exited	1377	1377
Hourly Exit Rate	1377	1377
Input Volume	1550	1550
% of Volume	89	89
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	8	8

28: HP Hwy & Ehehene St Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	4.8	0.0	0.0	0.0	4.8
Denied Del/Veh (s)	0.1	3.6	10.7	5.7	0.0	0.0	5.8
Total Delay (hr)	1.9	0.2	2.9	0.0	0.0	1.1	6.1
Total Del/Veh (s)	870.2	164.8	6.4	3.2	57.2	2.8	7.3
Stop Delay (hr)	1.9	0.2	0.0	0.0	0.0	0.0	2.1
Stop Del/Veh (s)	867.8	163.3	0.0	0.0	55.4	0.0	2.5
Total Stops	8	4	0	0	2	0	14
Stop/Veh	1.00	1.00	0.00	0.00	1.00	0.00	0.00
Travel Dist (mi)	0.6	0.3	352.6	0.4	0.6	455.7	810.1
Travel Time (hr)	2.0	0.2	15.6	0.0	0.0	11.3	29.1
Avg Speed (mph)	0	1	33	31	13	40	33
Fuel Used (gal)	0.5	0.1	13.2	0.0	0.0	11.2	24.9
Fuel Eff. (mpg)	1.2	5.3	26.8	35.3	31.5	40.7	32.5
HC Emissions (g)	0	0	255	0	0	272	528
CO Emissions (g)	29	6	5091	1	1	4907	10036
NOx Emissions (g)	1	0	922	0	0	976	1899
Vehicles Entered	8	4	1609	2	2	1380	3005
Vehicles Exited	4	3	1613	2	2	1375	2999
Hourly Exit Rate	4	3	1613	2	2	1375	2999
Input Volume	7	3	1612	2	2	1543	3169
% of Volume	55	100	100	100	100	89	95
Denied Entry Before	0	0	7	0	0	0	7
Denied Entry After	0	0	3	0	0	0	3
Density (ft/veh)							270
Occupancy (veh)	2	0	11	0	0	11	24

29: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.6	0.6
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.4	0.4
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.6	0.6
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	19	19
Fuel Used (gal)	0.1	0.1
Fuel Eff. (mpg)	12.3	12.3
HC Emissions (g)	0	0
CO Emissions (g)	27	27
NOx Emissions (g)	2	2
Vehicles Entered	12	12
Vehicles Exited	12	12
Hourly Exit Rate	12	12
Input Volume	11	11
% of Volume	107	107
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

32: External Performance by approach

Approach	EB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.0	0.0
Total Del/Veh (s)	0.5	0.5
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.3	0.3
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	0.3	0.3
Travel Time (hr)	0.0	0.0
Avg Speed (mph)	22	22
Fuel Used (gal)	0.0	0.0
Fuel Eff. (mpg)	17.0	17.0
HC Emissions (g)	0	0
CO Emissions (g)	9	9
NOx Emissions (g)	1	1
Vehicles Entered	4	4
Vehicles Exited	4	4
Hourly Exit Rate	4	4
Input Volume	4	4
% of Volume	100	100
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	0	0

33: HP Hwy & Transfer Station Performance by movement

Movement	WBL	WBR	NBT	NBR	SBL	SBT	All
Denied Delay (hr)	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Denied Del/Veh (s)	0.1	0.1	0.0	0.0	1.9	0.4	0.2
Total Delay (hr)	0.1	0.0	2.7	0.0	0.1	0.7	3.6
Total Del/Veh (s)	250.6	18.0	5.7	4.7	22.0	1.3	3.6
Stop Delay (hr)	0.1	0.0	0.1	0.0	0.1	0.0	0.3
Stop Del/Veh (s)	248.7	18.1	0.2	0.1	20.3	0.0	0.3
Total Stops	2	5	19	0	8	0	34
Stop/Veh	1.00	1.00	0.01	0.00	0.80	0.00	0.01
Travel Dist (mi)	0.1	0.2	702.5	0.9	1.6	295.3	1000.5
Travel Time (hr)	0.1	0.0	18.8	0.0	0.1	7.5	26.6
Avg Speed (mph)	1	6	37	36	15	41	38
Fuel Used (gal)	0.0	0.0	24.6	0.0	0.1	9.2	33.9
Fuel Eff. (mpg)	2.8	23.4	28.5	34.4	27.8	32.2	29.5
HC Emissions (g)	0	0	571	0	0	214	785
CO Emissions (g)	2	1	16107	10	17	5902	22039
NOx Emissions (g)	0	0	1997	1	1	751	2750
Vehicles Entered	2	5	1670	2	10	1803	3492
Vehicles Exited	2	5	1664	2	10	1806	3489
Hourly Exit Rate	2	5	1664	2	10	1806	3489
Input Volume	2	6	1693	2	9	1797	3510
% of Volume	100	80	98	100	108	100	99
Denied Entry Before	0	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0	0
Density (ft/veh)							366
Occupancy (veh)	0	0	19	0	0	7	26

34: External Performance by approach

Approach	NB	All
Denied Delay (hr)	0.0	0.0
Denied Del/Veh (s)	0.0	0.0
Total Delay (hr)	0.4	0.4
Total Del/Veh (s)	1.0	1.0
Stop Delay (hr)	0.0	0.0
Stop Del/Veh (s)	0.0	0.0
Total Stops	0	0
Stop/Veh	0.00	0.00
Travel Dist (mi)	293.5	293.5
Travel Time (hr)	7.0	7.0
Avg Speed (mph)	42	42
Fuel Used (gal)	8.3	8.3
Fuel Eff. (mpg)	35.4	35.4
HC Emissions (g)	200	200
CO Emissions (g)	4919	4919
NOx Emissions (g)	714	714
Vehicles Entered	1670	1670
Vehicles Exited	1668	1668
Hourly Exit Rate	1668	1668
Input Volume	1699	1699
% of Volume	98	98
Denied Entry Before	0	0
Denied Entry After	0	0
Density (ft/veh)		
Occupancy (veh)	7	7

Total Network Performance

Denied Delay (hr)	6.1
Denied Del/Veh (s)	4.5
Total Delay (hr)	163.9
Total Del/Veh (s)	116.4
Stop Delay (hr)	122.9
Stop Del/Veh (s)	87.3
Total Stops	6599
Stop/Veh	1.30
Travel Dist (mi)	7261.6
Travel Time (hr)	344.7
Avg Speed (mph)	21
Fuel Used (gal)	256.7
Fuel Eff. (mpg)	28.3
HC Emissions (g)	4829
CO Emissions (g)	130019
NOx Emissions (g)	16199
Vehicles Entered	4856
Vehicles Exited	4648
Hourly Exit Rate	4648
Input Volume	29153
% of Volume	16
Denied Entry Before	7
Denied Entry After	12
Density (ft/veh)	215
Occupancy (veh)	339

Arterial Level of Service: NB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Ehehene St	28	6.4	34.6	0.2	34
	9	3.7	30.5	0.3	39
	4	1.4	11.4	0.1	38
RIRO Access 3	1	0.9	16.6	0.2	43
Mauka Access 2	5	11.7	30.8	0.2	28
Mauka Access 1	18	18.7	48.2	0.4	28
Transfer Station	33	6.0	39.6	0.4	38
Total		49.0	211.6	1.9	34

Arterial Level of Service: SB HP Hwy

Cross Street	Node	Delay (s/veh)	Travel time (s)	Dist (mi)	Arterial Speed
Transfer Station	33	1.3	14.9	0.2	42
Olowalu Town Access	18	26.1	59.3	0.4	26
Olowalu Town Access	5	40.8	69.9	0.4	19
RIRO Access 3	1	41.2	60.8	0.2	14
	4	113.3	128.9	0.2	5
	9	6.8	16.4	0.1	27
Ehehene St	28	2.8	29.4	0.3	41
Total		232.4	379.8	1.9	18

Intersection: 1: HP Hwy & RIRO Access 3

Movement	EB	SB	SB
Directions Served	R	T	TR
Maximum Queue (ft)	87	870	910
Average Queue (ft)	24	229	232
95th Queue (ft)	70	863	880
Link Distance (ft)	1088	1214	1214
Upstream Blk Time (%)		0	1
Queuing Penalty (veh)		1	10
Storage Bay Dist (ft)			
Storage Blk Time (%)			
Queuing Penalty (veh)			

Intersection: 4: HP Hwy

Movement	SB	SB
Directions Served	T	T
Maximum Queue (ft)	997	1025
Average Queue (ft)	674	683
95th Queue (ft)	1198	1214
Link Distance (ft)	994	994
Upstream Blk Time (%)	4	6
Queuing Penalty (veh)	27	46
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 5: HP Hwy & Olowalu Town Access 2/Mauka Access 2

Movement	EB	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	L	L	T	T	R	L
Maximum Queue (ft)	412	424	894	721	63	51	205	222	326	297	34	188
Average Queue (ft)	293	316	268	139	16	13	122	132	135	140	6	17
95th Queue (ft)	478	486	899	532	46	37	186	198	258	257	25	74
Link Distance (ft)			1046	1046		1036			1214	1214		
Upstream Blk Time (%)			4	0								
Queuing Penalty (veh)			0	0								
Storage Bay Dist (ft)	400	400			250		400	400			250	250
Storage Blk Time (%)	3	25	0						0	1		
Queuing Penalty (veh)	1	5	0						0	0		

Intersection: 5: HP Hwy & Olowalu Town Access 2/Mauka Access 2

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	501	501	245
Average Queue (ft)	265	269	126
95th Queue (ft)	453	458	223
Link Distance (ft)	1896	1896	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			600
Storage Blk Time (%)	17	0	
Queuing Penalty (veh)	3	0	

Intersection: 18: HP Hwy & Olowalu Town Access 1/Mauka Access 1

Movement	EB	EB	EB	EB	WB	WB	NB	NB	NB	NB	NB	SB
Directions Served	L	L	T	R	L	T	L	L	T	T	R	L
Maximum Queue (ft)	234	273	46	140	64	60	145	150	356	370	179	133
Average Queue (ft)	112	148	11	47	21	19	60	77	164	171	13	17
95th Queue (ft)	221	249	32	116	55	48	111	125	304	313	99	73
Link Distance (ft)			1001	1001		736			1896	1896		
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	500	500			250		400	400			200	250
Storage Blk Time (%)									0	5	0	
Queuing Penalty (veh)									0	1	0	

Intersection: 18: HP Hwy & Olowalu Town Access 1/Mauka Access 1

Movement	SB	SB	SB
Directions Served	T	T	R
Maximum Queue (ft)	499	505	216
Average Queue (ft)	261	276	51
95th Queue (ft)	412	433	141
Link Distance (ft)	2146	2146	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			600
Storage Blk Time (%)	8	0	0
Queuing Penalty (veh)	2	0	0

Intersection: 28: HP Hwy & Ehehene St

Movement	WB	WB	SB
Directions Served	L	R	L
Maximum Queue (ft)	124	42	16
Average Queue (ft)	43	4	2
95th Queue (ft)	132	25	13
Link Distance (ft)	407		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		100	200
Storage Blk Time (%)	15		
Queuing Penalty (veh)	0		

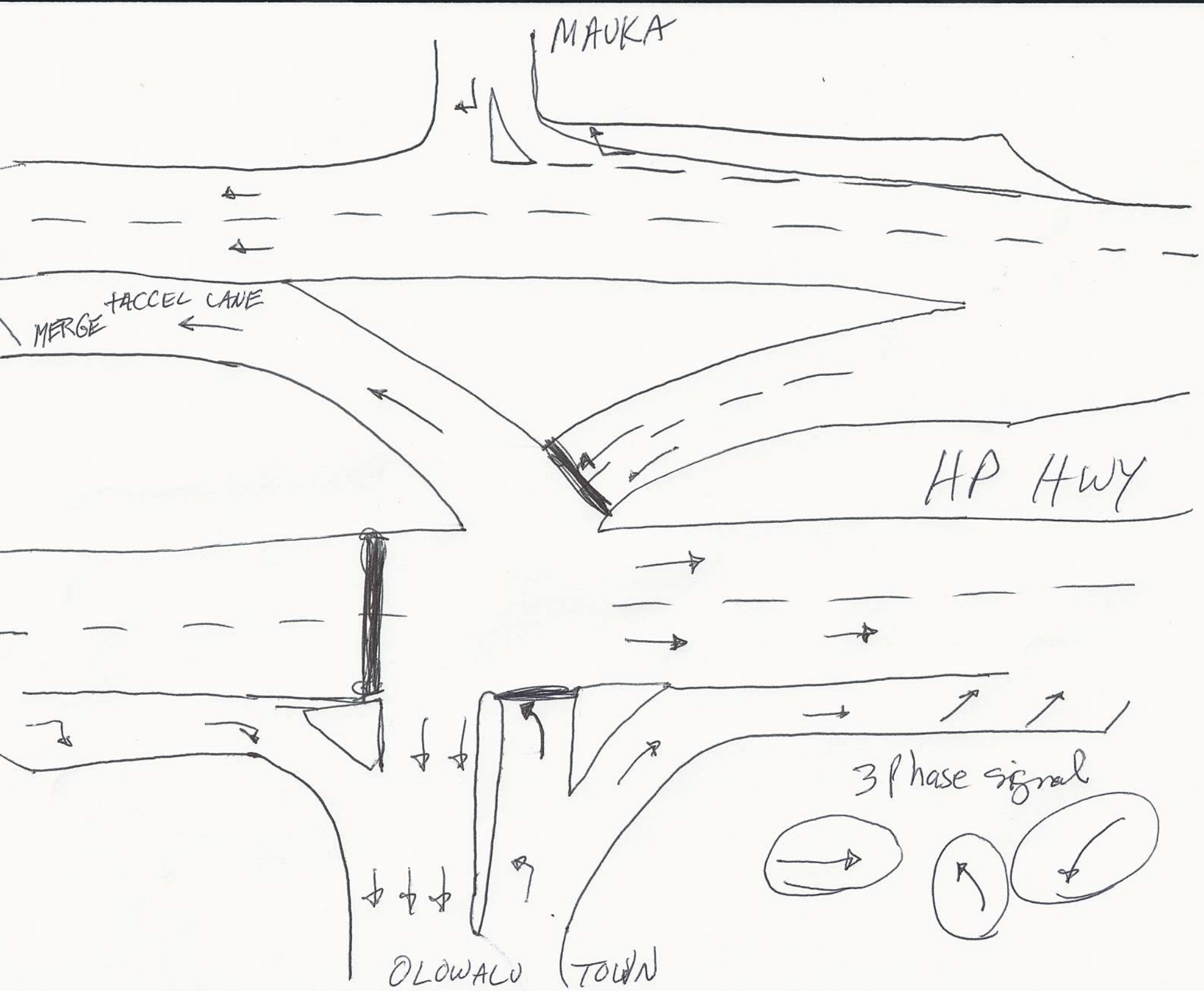
Intersection: 33: HP Hwy & Transfer Station

Movement	WB	WB	SB
Directions Served	L	R	L
Maximum Queue (ft)	29	22	47
Average Queue (ft)	3	3	7
95th Queue (ft)	19	16	31
Link Distance (ft)	205	205	
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)			250
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 98

20


MAUKA
ACCEL LANE
MERGE
HP HWY
3 Phase signal
OLOWALU TOWN

END

APPENDIX P-2.

June 2, 2015 Letter from Roger D. Dyar, Consulting Traffic Engineer

Mr. William Frampton
Mr. David Ward
Olowalu Town LLC
2035 Main Street, Suite 1
Wailuku, HI 96793

June 2, 2015

SUBJECT: Olowalu Town Alternatives – Traffic Impacts

Dear Messrs. Frampton and Ward:

I have reviewed both Alternative 1 (Preferred Alternative) and Alternative 2 (Maui Island Plan Alternative) as requested.

Both alternatives propose similar land uses and densities. Using standard methods of estimation, the total trip generation of both alternatives would be essentially the same.

There would be no significant differences between the trip generation, distribution and assignment of trips to the street and highway network with Alternative 2 versus Alternative 1. Therefore, the findings in the Final Traffic Impact Analysis Report dated April 14, 2015 are applicable to both alternatives.

Sincerely,

Roger D. Dyar

Roger D. Dyar

Roger D. Dyar, P.E.
Consulting Traffic Engineer
231 Tollison Road
Seneca, SC 29672

864-360-7921

cc: Munekiyo Hiraga
Jennifer Lim, Carlsmith Ball LLP

APPENDIX ~~N~~Q.

Wastewater Management Plan

Olowalu Town
Wastewater Management Plan

August 2011

Olowalu Town
Wastewater Management Plan

Prepared for
Olowalu Town, LLC, Wailuku, HI
August 2011

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Signature

April 30, 2012
Expiration Date of License

Brown AND Caldwell
1955 Main Street, Suite 200
Wailuku, HI 96793

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List of Abbreviations

BNR	biological nutrient removal
BOD_5	5-day biochemical oxygen demand
DOH	State of Hawaii Department of Health
EIS	Environmental Impact Statement
FWS	free water surface
gpd	gallons per day
gph	gallons per hour
LEED	Leadership in Energy and Environmental Design
MBR	membrane bioreactor
MF	multi-family
ND	Neighborhood Development
NTU	nephelometric turbidity units
R-O-W	right-of-way
SF	single family
SCADA	supervisory control and data acquisition
TN	total nitrogen
TSS	total suspended solids
WWTP	wastewater treatment plant

Section 1

Introduction

1.1 Olowalu Town Master Plan

The Olowalu Town Master Plan is proposing to re-establish the once thriving village of Olowalu, located on the west side of the island of Maui. The subject property encompasses the lower coastal reaches of Olowalu ahupuaa; between the base of the south-west facing slopes of West Maui Mountains and the shoreline of Olowalu. Olowalu Town will be a small-scale and mixed-use community designed to be a pedestrian-friendly community which will allow residents to live within walking distance of corner stores, schools, parks, employment opportunities, community centers, beaches, and social and civic resources, ultimately reducing reliance on automobiles. The Master Plan is guided by values and principles of sustainability by balancing the needs of Maui's growing population; yet maintaining and respecting our cultural, historical and natural resources.

At final build-out, Olowalu Town will consists of approximately 1,500 residential dwelling units to be built concurrent with appropriate infrastructure in phases spread out over a period of approximately 10 years. There will be a wide variety of single-family and multi-family dwelling types, including houses, apartments, live-work units, cottages, rural homes and farmsteads, to be offered at a wide-range of income levels, including both rental and fee-ownership. A substantial portion of the homes are planned for much-needed affordable housing and senior living.

The design of Olowalu Town incorporates smart growth and sustainable land use principles of New Urbanism. As a result, Olowalu Town's spatial layout of land uses, varying density, connective transportation, parks/greenways, civic/social facilities, housing, employment and other land uses are balanced to create a mixed-use community. Neighborhood town centers provide economic sustainability with a range of business and employment opportunities. Olowalu Town is also designed to meet the certification requirements of *Leadership in Energy and Environmental Design for Neighborhood Development* (LEED ND). As such, the Master Plan will be built using strategies aimed at improving performance in regards to energy savings, water efficiency, reducing CO_2 emissions, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts.

Olowalu Town's proposed infrastructure improvements will be constructed concurrently with the project and will incorporate innovative, efficient, and sustainable technology to minimize adverse impacts upon the natural environment. Olowalu Town's Transportation system includes the relocation of the existing high speed/high volume Honoapiilani highway away from coastal resources to a new mauka alignment, which will be designed to accommodate mass transit or light rail, if needed in future. The existing highway corridor with monkey-pod trees will be preserved and converted to low speed/low volume coastal roadway. The project includes an internal roadway network, as well as, an assortment of interconnected greenways and bikeways links community and supports overall well-being and health of residents; reducing dependency on automobiles.

Additionally, other infrastructure system improvements will require an expansion of both the existing potable and non-potable water system, the likely addition of a second ground water well to supplement the existing well; and an extensive drainage system to capture storm-water runoff.

1.2 Olowalu Town Wastewater Management Planning

The residents and businesses at Olowalu Town will generate wastewater that will be managed in an environmentally-responsible manner. Olowalu Town's location adjacent to one of the most significant, accessible coral reef systems on the island of Maui dictates that a conservative, reliable, and appropriate wastewater management system be implemented. Wastewater typically contains nutrients that can either be an asset or a liability, depending on how the wastewater is managed. There is a growing concern on Maui that nutrients from all sources (including cesspools, septic tank systems, injection wells, agricultural runoff, and stormwater runoff) may have deleterious effects on near-shore reef systems. When the effects of global warming, invasive species and overfishing are added into the environmental scenario there are legitimate concerns for the continued health and well-being of the island's coral reef resources. The combination of all of the environmental stressors put coral reefs at risk of degradation. The Olowalu Town wastewater management plan has been developed with these concerns at the forefront, and effectively and appropriately establishes a system for responsible management of the community's wastewater.

The following goals were established when developing the Olowalu Town wastewater management plan:

- Do not rely on injection wells for effluent disposal purposes.
- Provide for a high degree of water recycling to make the best use of water resources.
- Incorporate nutrient removal technology to protect the environment.
- Incorporate natural treatment systems where feasible and appropriate.
- Use conservative planning assumptions to ensure a high factor of safety.
- Meet or exceed all regulatory requirements.

1.3 Water Recycling

Recycled water is highly treated wastewater that is suitable for non-potable uses like landscape irrigation. Recycled water production, distribution and use are regulated by the State of Hawaii Department of Health to protect public health and the environment. Recycled water is distributed for use through pipes that are completely separate from the potable water supply system. The recycled water piping and appurtenances are colored purple to clearly indicate that they are part of a recycled water system.

The Olowalu Town community will have a state-of-the-art wastewater treatment system that will produce recycled water that meets or exceeds the most stringent State water recycling requirements. The recycled water that is produced will be used to irrigate parks, school fields, highway landscaping, and agricultural fields. During the course of a typical year 90 percent or more of the Olowalu Town's wastewater is expected to be recycled for irrigation purposes, and during eight months of the typical year (March through October) it is anticipated that all of the community's wastewater will be recycled.

1.4 Integrated Water Resources Management

The Olowalu Town wastewater management system will be part of the integrated water resources system that will meet the needs of the community. The integrated water resources system includes:

- Potable groundwater resources
- Non-potable groundwater resources
- Surface water resource
- Recycled water resource

These four water resources will meet the water supply needs of the community, through three separate distribution systems: potable, non-potable, and recycled water. Therefore, the wastewater management

system is designed to use the community's wastewater as an integral part of the community's overall water supply portfolio.

1.5 Nutrient Management

The nutrients found in wastewater can either be an asset or a liability, depending on how they are managed. Living things need nutrients to grow. Nutrients can be an asset when they are present in recycled water that is used for irrigation purposes, because the nutrients act as fertilizer for the vegetation that is being irrigated and reduce or eliminate the need for chemical fertilization. Nutrients can be a liability if they are released into an aquatic environment, because they can support the growth of excessive amounts of algae, causing deleterious effects.

The Olowalu Town wastewater management system has been designed to use wastewater nutrients where they will be an asset, while also reducing the nutrient concentrations as needed to prevent them from being an environmental liability. The wastewater management system includes:

- Biological nutrient removal in the wastewater treatment plant to reduce nutrient concentrations in the recycled water to a level where the recycled water will meet all or most of the fertilizer needs of the irrigated vegetation.
- Natural treatment systems to provide additional polishing treatment of any excess recycled water that requires disposal.

1.6 Natural Treatment Systems

The Olowalu Town wastewater management system will include two natural treatment systems designed to protect the environment by providing additional treatment benefits in the process of disposing of excess recycled water. Natural wastewater treatment systems are processes that depend primarily on natural components (e.g., vegetation, soil, etc.) to achieve the intended results, rather than energy-intensive mechanical equipment. The natural treatment systems include a constructed wetland and a soil aquifer treatment system.

The constructed wetland will provide additional polishing treatment benefits of excess recycled water while also creating bird habitat and a public amenity. Constructed wetlands are treatment systems based on emergent aquatic vegetation like reeds, rushes, and bulrush. Recycled water will be treated as it flows through the Olowalu Town constructed wetland. The polishing treatment benefits that can be realized in constructed wetlands include reduction of nutrients, trace heavy metals, and trace organic compounds prior to disposal. Constructed wetlands can be designed with open water areas designed to attract birds. The Olowalu Town residents will also be attracted to the constructed wetland by the walking paths around the system designed to allow them to view the wildlife. Figure 1-1 is a photo of a constructed wetland in Arcata, California.

A soil aquifer treatment system will be used to dispose of excess recycled water after it has received the additional treatment benefits that the constructed wetland will provide. The soil aquifer treatment system will consist of several shallow basins with earth or sand bottoms. During most months of the year the basins will be dry, but during wet winter months there may be excess recycled water that will flow to the soil aquifer treatment system. Additional treatment benefits – including reduction of nutrients, trace heavy metals, and trace organic compounds – will be realized as the applied water percolates through the media in the bottom of the basins.

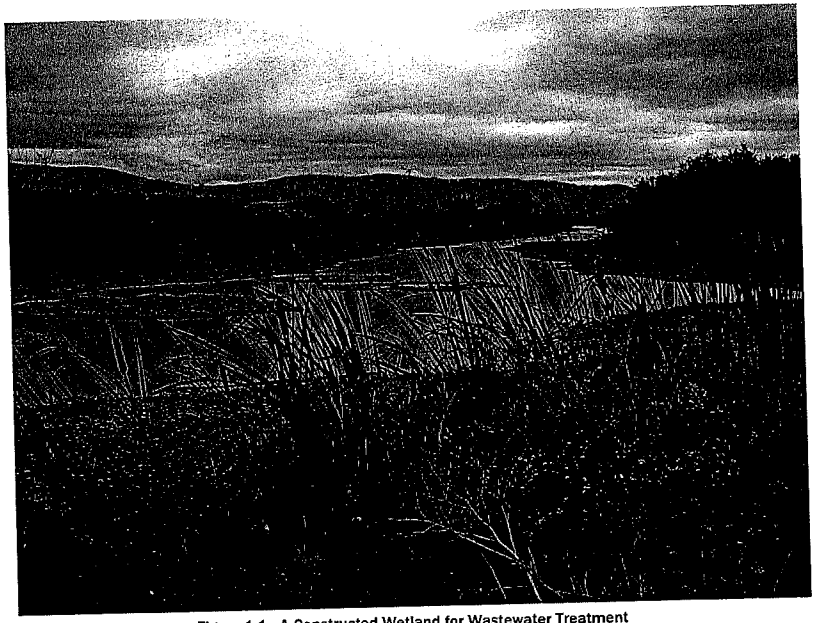

Figure 1-1. A Constructed Wetland for Wastewater Treatment

1.7 Report Organization

This report presents the wastewater management system planned for Olowalu Town. Section 2 presents wastewater flow and load projections for the community. Section 3 provides an overview of the proposed wastewater management system. The proposed wastewater treatment plant is described in Section 4. Section 5 provides important general background information on water recycling, while Section 6 provides specific water recycling analysis results for the Olowalu Town community. Section 7 outlines the management system that will be put into place to ensure water recycling program success. Section 8 outlines the natural treatment systems that will be used to treat and dispose of excess recycled water, and Section 9 provides overall conclusions.

Section 2

Wastewater Flow and Load Projections

This section contains projections of the anticipated wastewater flow and loads for the Olowalu Town development.

2.1 Basis of Flow Projections

Wastewater flow projections were developed using County of Maui Standards (County of Maui Wastewater Reclamation Division, February 2, 2006). The flow standards are conservative, and experience has shown that actual wastewater flows are generally lower than the standards suggest. However, because wastewater treatment incorporates biological treatment processes that are subject to upset if overloaded, the use of conservative flow estimates is appropriate.

Table 2-1 summarizes the unit flows applicable to the Olowalu Town development.

Table 2-1. County of Maui Wastewater Flow Standards

Description	Value	Units
Apartment/condominium	255	gallons per unit per day
Office	20	gallons per employee per day
Residence, subdivision	350	gallons per home per day
Residential occupancy	4	persons per unit
Apartment/condominium occupancy	2.5	persons per unit
Office employees	0.005	employees per square foot of floor area (1 employee per 200 square feet of floor area)
Dry weather infiltration/inflow[a]	5	gallons per capita per day
Wet weather infiltration/inflow[a]	1250	gallons per acre per day

[a] *Wastewater transmission lines laid above the ground water table*

2.2 Development Characteristics

The development plans call for a maximum of 1,500 residential units. The split between single family residential and multifamily residential will be determined by market conditions at the time of development, within the ranges established in the Environmental Impact Statement (EIS). In the interest of conservatism, the housing portfolio that results in the greatest wastewater flow (e.g., maximum number of single family residences) was used for wastewater management planning purposes, as shown in Table 2-2.

Table 2-2. Unit Count Used for Wastewater Management Planning Purposes

Description	Value
Single family residential	920 units
Multi-family residential	580 units
Commercial, retail, business	300,000 square feet

2.3 Average Dry Weather Flow Projections

The average dry weather wastewater flow projections at buildout are summarized in Table 2-3.

Table 2-3. Average Dry Weather Flow Projections at Buildout

Source	Flow (gpd)
Residential	470,000
Commercial, retail, business	23,000
Infiltration/inflow	32,000
Total	525,000

Figure 2-1 presents the projected increase of the average dry weather wastewater flow over time, assuming a 10-year, constant rate buildout period.

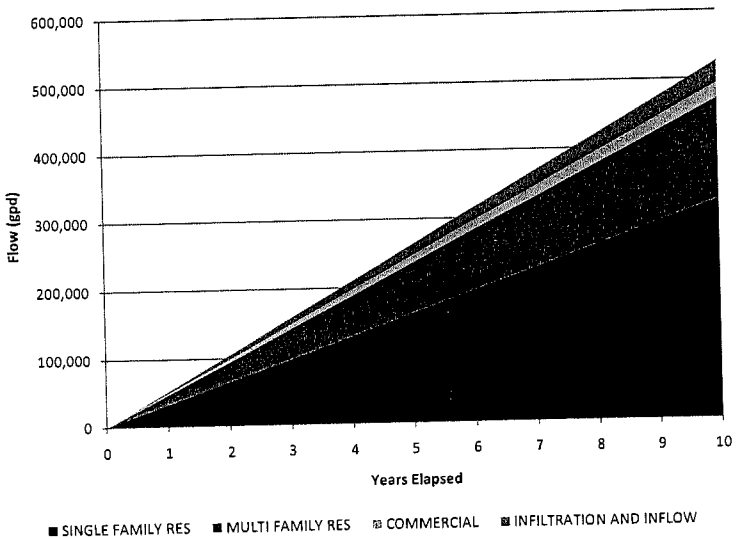

Figure 2-1. Olowalu Town Projected Average Dry Weather Wastewater Flow

2.4 Peak Flow Projections

In addition to average flows, peak day and hour flows are also important for wastewater planning and design purposes.

The peak day dry weather flow was obtained through application of an industry-accepted, published peaking factor. For Olowalu Town, a peak day dry weather peaking factor of 2.5 is appropriate (Crites and Tchobanoglous, 1998).

The peak hour dry weather flow peaking factor of the development is obtained using the Babbitt equation, as required by the County of Maui wastewater flow standards (County of Maui Wastewater Reclamation Division, February 2, 2006). The Babbitt equation is:

$$MF = \frac{5}{p^{0.2}}$$

Where: MF = Maximum flow peaking factor

p = Population, in thousands

The County of Maui wastewater flow standards (County of Maui Wastewater Reclamation Division, February 2, 2006) dry and wet weather infiltration/inflow allowances were then added to obtain the peak flow projections. The peak flow projections are summarized in Table 2-4.

Table 2-4. Peak Flow Projections

Description	Flow (million gallons per day)
Peak day dry weather	1.26
Peak hour dry weather	1.72
Peak day wet weather	2.01
Peak hour wet weather	2.46

2.5 Wastewater Characteristics

Estimates of the strength of the wastewater entering the WWTP (influent) is important for liquid and solids treatment process design of the WWTP. Important characteristics include the concentration of 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), and total nitrogen (TN). BOD_5 and TSS are measures of the organic strength of the wastewater. TN is a measure of the nutrient content of the wastewater, and is important for effluent management planning purposes. Table 2-5 presents the influent characteristics assumptions.

Table 2-5. Influent Wastewater Characteristics Assumptions

Parameter	Concentration (mg/L)
BOD_5	350
TSS	350
TN	60

2.6 Summary of Flows and Loads

Table 2-6 provides a summary of the flows and loads used for planning purposes.

Table 2-6. Influent Wastewater Characteristics

Flow Condition	Flow		Mass Loading (lbs/d)		
	(mgd)	(gpm)	BOD_5	TSS	TN
Average day dry weather	0.525	370	1,530	1,530	260
Peak day dry weather	1.26	880	3,690	3,690	630
Peak hour dry weather	1.72	1,190	-	-	-
Peak hour wet weather	2.46	1,710	-	-	-

Section 3

Olowalu Town Wastewater Management System Overview

3.1 Planning Goals

The following goals were used when developing the Olowalu Town wastewater management plan:

- Do not rely on injection wells for effluent disposal purposes.
- Provide for a high degree of water recycling to make the best use of water resources.
- Incorporate nutrient removal technology to protect the environment.
- Incorporate natural treatment systems where feasible and appropriate.
- Use conservative planning assumptions to ensure a high factor of safety.
- Meet or exceed all regulatory requirements.

3.2 Wastewater Management System Overview

Figure 3-1 is a schematic of the proposed Olowalu Town wastewater management system.

Wastewater generated by Olowalu Town will be collected and pumped to a WWTP, where the wastewater will be treated to State of Hawaii R-1 recycled water standards and TN reduced to less than 10 mg/L. The R-1 water will be pumped to a storage tank for irrigation use. Supplemental groundwater will be added to the storage tank when the R-1 recycled water supply is insufficient to meet the irrigation demands of the users.

During wet weather periods there may be excess recycled water that will require disposal. Excess recycled water will receive additional treatment in a constructed wetland, reducing the TN concentration below 5 mg/L. After the excess recycled water passes through the wetland, it will be flow to a soil aquifer treatment (SAT) system for disposal.

Each element of the wastewater management system is described in more detail in subsequent sections. Figure 3-2 shows the preliminary locations for the facilities.

3.3 Wastewater System Ownership and Operation

The wastewater system will be owned and operated by a private utility company, regulated by the State of Hawaii Public Utilities Commission and the State of Hawaii Department of Health (DOH).

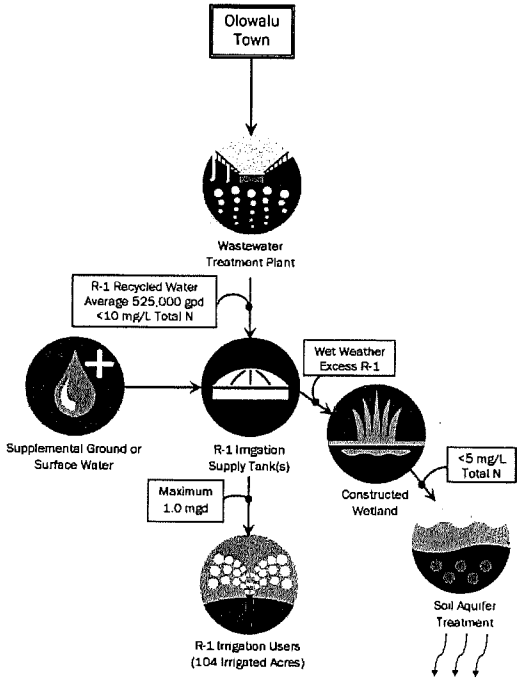

Figure 3-1. Schematic of Olowalu Town Wastewater Management System

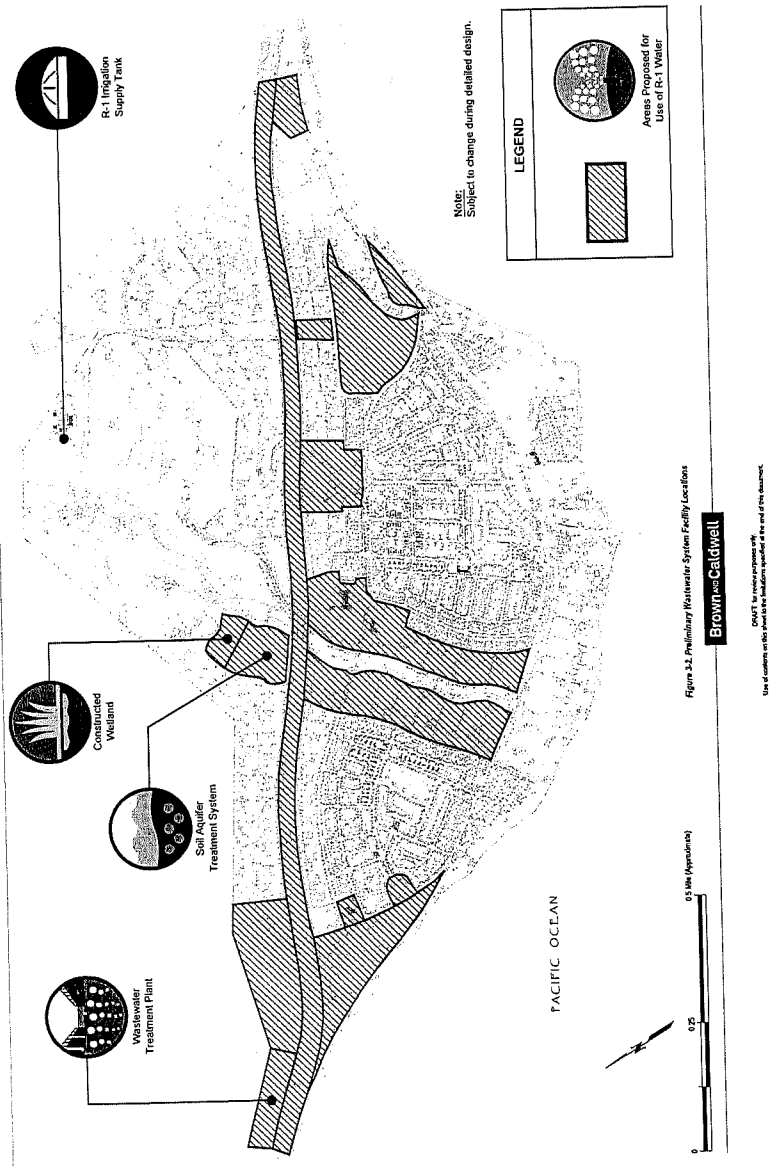

Figure 3-2. Preliminary Wastewater System Facility Locations

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Section 4
Wastewater Treatment Plant

A wastewater treatment plant will be constructed within Olowalu Town to meet the needs of the community, as described in this section. The proposed WWTP location was shown in Figure 3-2.

4.1 Treatment Objectives

The wastewater treatment plant will be designed to provide a high level of treatment. The two treatment objectives are:

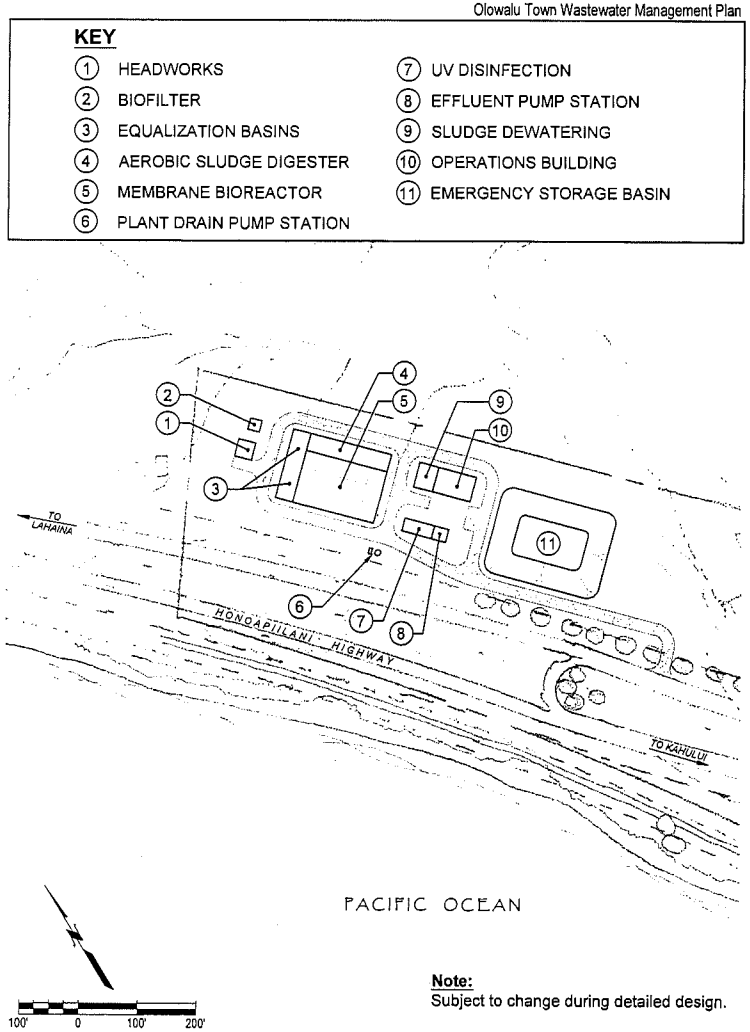
1. Produce recycled water that meets or exceeds State of Hawaii R-1 recycled water standards. R-1 water is treated effluent that is at all times:
   - Oxidized,
   - Filtered, and
   - Disinfected to median fecal coliform density less than 2.2 per 100 mL
2. Reduce TN concentrations to 10 mg/L or less to protect the environment.

4.2 Wastewater Treatment Processes

A number of wastewater treatment processes were considered for Olowalu Town, including:

- Membrane bioreactor (MBR) with biological nutrient removal (BNR)
- BNR activated sludge followed by coagulation and filtration
- Recirculating gravel filters
- Biotextile filters
- Vertical flow wetlands

The discussion that follows assumes that a MBR facility is constructed; however, other processes may be incorporated during the design process that can meet the treatment objectives. Figure 4-1 is a conceptual site plan for the WWTP. Each WWTP element is discussed below.



Note:
Subject to change during detailed design.

Figure 4-1 Conceptual Wastewater Treatment Plant Site Plan

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4.3 Liquid Treatment

The liquid treatment processes are described below.

4.3.1 Headworks

Raw wastewater will enter the WWTP at the headworks, where it will receive preliminary treatment, including:

Influent flow measurement: Continuous influent flow measurement using a Parshall flume, magnetic flow meter, or another suitable device.

Influent sampling: A refrigerated automatic sampler will be provided to allow flow-paced influent composite or discrete sampling.

Coarse screening: Coarse screening to remove large debris.

Fine screening: Fine screening to remove hair and other small debris that can foul the downstream MBR process.

Grit removal: Grit removal to inorganic particles (e.g., sand, coffee grounds, etc.) that can cause premature wear of downstream equipment.

The headworks will be enclosed to facilitate foul air collection. Screenings and grit will be disposed at the Central Maui Landfill.

4.3.2 Equalization Basins

Aerated basins will be provided to equalize the flow rate through the downstream processes.

4.3.3 Membrane Bioreactor

The membrane bioreactor will provide secondary, tertiary, and BNR treatment functions. The MBR process consists of tanks with aerobic and anoxic zones to facilitate biological nutrient removal. Naturally-occurring microorganisms oxidize carbonaceous matter and provide nitrification and denitrification functions. The clean water is separated from the treatment biomass (activated sludge) using microfiltration membranes. The effluent from the MBR process will contain 10 mg/L of TN or less and will have turbidity less than 2.0 nephelometric turbidity units (NTU). Effluent turbidity levels will be continuously monitored to comply with DOH requirements, and if turbidity rises above regulatory limits the effluent will be automatically diverted to the emergency storage basin and an alarm condition will alert the WWTP operators.

4.3.4 UV Disinfection

The treated effluent will be disinfected using UV light. The water will flow through a channel containing UV light bulbs. The UV dose will be sufficient to reduce the median fecal coliform density to less than 2.2 per 100 mL. The UV intensity will be continuously monitored to comply with DOH requirements, and if the UV dose decreases below required levels the effluent will be automatically diverted to the emergency storage basin and an alarm condition will alert the WWTP operators.

After the water has passed through the disinfection process it will meet the R-1 recycled water standards and will contain 10 mg/L or less of TN.

4.3.5 Effluent Pump Station

An effluent pump station will be used to transport the R-1 water to the storage tank. The pump station will include and effluent flow meter and refrigerated composite sampler.

4.3.6 Emergency Storage Basin

A lined open basin will be provided to store water that does not meet R-1 water recycling specifications. Water that enters the emergency storage basin will be pumped back to the treatment process for reprocessing after the deficient treatment condition(s) have been corrected.

4.4 Solids Treatment

Treatment of the residual solids is described below.

4.4.1 Aerobic Digester

Waste solids from the MBR process will be pumped to an aerobic digester, where the solids will receive additional aerobic stabilization and will be thickened via periodic settling and decanting. The solids residence time in the aerobic digester will be 20 days or greater.

4.4.2 Solids Dewatering

The aerobically digested solids will be mechanically dewatered using centrifuges, belt filter presses, screw presses, or other suitable dewatering technology. The dewatered solids will be hauled by truck to the Central Maui Landfill for co-composting with green waste.

4.5 Ancillary Systems

Ancillary systems are described below.

4.5.1 Operations Building

The WWTP will include an operations building to provide employee work space, restrooms, a small process control laboratory, and an electrical equipment room. The solids dewatering system and emergency generator will likely be located in the operations building.

4.5.2 Control System

A supervisory control and data acquisition (SCADA) system will be provided to control the WWTP processes and alert the WWTP operators when an alarm condition occurs.

4.5.3 Emergency Power

An emergency generator will be included to power the WWTP processes in the event of a power failure.

4.5.4 Plant Drain Pump Station

The process tank drains, operations building sewer, and emergency storage basin will be connected to the plant drain pump station that will pump the liquids to the headworks for treatment.

4.5.5 Utility Water Pump Station

A utility water pump station will be provided to deliver R-1 water for in-plant uses like foam sprays, grit and screenings washers, and landscape irrigation.

4.6 Other Considerations

Other important considerations for wastewater treatment plants include odor control, drainage and flood protection, tsunami protection, and visual mitigation.

4.6.1 Odor Control

Wastewater treatment plants can be a source of nuisance odors to the surrounding community if not properly designed and/or operated. Not all processes with a wastewater treatment plant generate odors; nuisance odors are most commonly associated with anaerobic (without oxygen) conditions and with residual solids processing.

The headworks is commonly an odorous process area at wastewater treatment plants because incoming raw wastewater can be anaerobic and the screening and grit removal processes involve solids processing. The Olowalu Town wastewater treatment plant headworks will be enclosed to facilitate foul odor collection. The air removed from the building will be treated in an odor control biofilter (or similar process). Biofilters consist of an engineered bed of compost with distribution piping. The foul air is treated as it flows through the compost media. Biofilters are capable of removing hydrogen sulfide (H_2S) and a wide variety of other odorous compounds from the air.

The liquid treatment processes within the wastewater treatment plant will not be a source of nuisance odors because the process tanks will be aerated to maintain dissolved oxygen concentrations at approximately 2.0 mg/L or greater at all times. Waste solids will be pumped to an aerobic digester for stabilization. The dissolved oxygen concentration in the aerobic digester will be maintained at 2.0 mg/L or greater at all times by aeration. The WWTP will include at least one redundant blower for each aeration system to ensure that aeration air can be provided at all times.

The solids dewatering process is another potential source of odors. The dewatering equipment will be enclosed in a room to facilitate foul air collection. The foul air will be routed to a biofilter for treatment.

4.6.2 Drainage and Flood Protection

Stormwater originating mauka of the wastewater treatment plant parcel will be routed around or piped under the facility to preclude flooding. Stormwater originating on the wastewater treatment plant parcel will be collected and held in an onsite retention basin or will be connected to the stormwater system that is developed for the rest of the Olowalu Town development project.

The tops of the wastewater treatment plant process tanks will set above the 100-year flood elevation to prevent stormwater from entering the tanks, in accordance with State regulations.

4.6.3 Tsunami Protection

The Olowalu Town wastewater treatment plant will be constructed outside of the tsunami inundation zone.

4.6.4 Visual Mitigation

The Olowalu Town wastewater treatment plant will be designed to mitigate visual impacts from the adjacent highway. The visual mitigation measures may include:

- Installation of landscaping like trees and/or hedges
- Visual mitigation berms or walls
- Enclosing process equipment or tanks within structures that are architecturally-consistent with the community.

Section 5

Water Recycling Background

The Olowalu Town Wastewater Management System will incorporate a high level of water recycling. This section introduces recycled water concepts and State DOH recycled water requirements.

5.1 Recycled Water Terminology

The term "recycled water" refers to treated wastewater that is suitable for beneficial use. The term "recycled water" is synonymous with the terms "reclaimed water" and "treated effluent."

The terms "water recycling", "water reclamation", and "water reuse" all refer to the use of recycled water for appropriate beneficial purposes. The terms "recycled water" and "water recycling" will be used in this report from this point forward for consistency with general industry practice and DOH regulations.

5.2 Types of Recycled Water

DOH has developed regulations and guidelines to ensure the protection of public health and the environment when recycled water is used. DOH has established three classifications for recycled water within Hawaii, based on the level of treatment provided as summarized in Table 5-1. Recycled water meeting the R-1 requirements has received the highest level of treatment of the three categories. The water recycling assessment presented in this section is based on treatment of Olowalu Town wastewater to meet or exceed R-1 recycled water standards.

Table 5-1. Recycled Water Classifications

Classification	Alternate Designation	Summary of Required Treatment
R-1	Significant reduction in viral and bacterial pathogens	• Oxidized • Filtered • Disinfected to median fecal coliform density less than 2.2 per 100 mL
R-2	Disinfected secondary-23 recycled water	• Oxidized • Disinfected to median fecal coliform density less than 23 per 100 mL
R-3	Undisinfected secondary recycled water	• Oxidized

5.3 Recycled Water Uses

The acceptable uses for recycled water are directly linked to the amount of treatment the water has received; higher levels of treatment results in fewer restrictions on use. Acceptable uses for R-1 water are summarized in Table 5-2.

Table 5-2. R-1 Recycled Water Uses

Landscape Irrigation	Agricultural Irrigation	Industrial	Other
• Golf courses • Parks • Playgrounds • School yards • Athletic fields • Road sides and medians • Residential property (if managed by an irrigation supervisor)	• Food, fodder, and fiber crops • Ornamental crops • Pasture, including milking animals • Drinking water for animals (except dairy animals) • Vineyards and orchards	• Fire fighting from outdoor hydrants, fire trucks, or aircraft • Cooling saws while cutting pavement • Spray washing of electric insulators on utility poles • High pressure water blasting to clean surfaces • Commercial and public laundries • Industrial cooling • Industrial process water • Fish hatchery basin supply	• Toilet and urinal flushing in buildings with dual water systems • Decorative fountains • Restricted recreation impoundments (non-body contact activities) • Washing of parking lots and sidewalks • Street sweeping • Dust control • Water jetting of pipelines during construction • Earthwork

5.4 Regulatory Requirements

The production and use of recycled water is regulated by the DOH. The DOH has established requirements applicable to facilities producing recycled water and for systems used to convey recycled water to points of use. In addition, the DOH has established requirements applicable to sites where recycled water is used. Applicable requirements are briefly summarized below.

5.4.1 Recycled Water Production Requirements

The DOH has established minimum requirements for wastewater treatment facilities that produce recycled water, as briefly summarized in Table 5-3.

Table 5-3. Summary of Recycled Water Production Requirements

Category	Summary of Requirements
Treatment process design	Specific requirements are established for unit process design, including: • Chemical mixing • Flocculation • Filtration • Disinfection
Permitting	A permit must be obtained from DOH to construct and operate a recycled water facility. The application process includes submittal of a basis of design report that describes the facility in detail.
Monitoring and reporting	Process monitoring is required to demonstrate compliance with recycled water quality requirements. Results must be periodically reported to DOH.
Reliability	Requirements are established to ensure the reliability of the recycled water production facility, including: • Multiple process units are required to ensure continued operations when units are taken out of service for maintenance • Standby power is required to ensure continued operation if the primary power source fails • Emergency storage or disposal provisions must be provided to manage water that does not meet R-1 standards
Alarms	Appropriate alarm systems must be provided to alert the facility operators of abnormal conditions.

Source: DOH, May 15, 2002

5.4.2 Recycled Water Distribution Requirements

Recycled water is distributed in piping systems that are completely separate from potable water distribution piping systems. The DOH has established requirements for piping systems used to distribute recycled water to the points of use. The requirements are designed to reduce the risk of accidental cross-connection between potable and non-potable systems. The requirements are briefly summarized in Table 5-4.

Table 5-4. Summary of Recycled Water Distribution Requirements

Category	Summary of Requirements
Piping materials	Pipes carrying recycled water are colored purple or are marked with purple identification tapes.
Separation distances	Minimum horizontal and vertical separation distances between potable and non-potable distribution piping have been established.
Valve boxes	Valve boxes for recycled water distribution systems must be shaped and labeled differently from those for potable water distribution systems.
Above ground appurtenances	Above-ground piping and appurtenances for recycled water distribution systems are colored purple or are clearly marked to differentiate them from potable water systems.
Supplemental water connections	An air gap must be provided where potable water will be used to supplement recycled water supplies. The air gap prevents recycled water from entering the potable water system.
Hose bibs	Hose bibs are not allowed on recycled water systems. Quick couplers may be used on recycled water systems, but they must be of different design than those used on the potable water system, and appropriate signs must be provided. Hoses used with recycled water systems must be colored purple and will not be used with potable systems.

Source: DOH, May 15, 2002

5.4.3 Recycled Water Use Requirements

DOH also regulates recycled water at the point of use. Table 5-5 provides a brief summary of some of the requirements.

Table 5-5. Summary of Recycled Water Use Requirements

Category	Summary of Requirements
Permitting	A permit must be obtained from DOH to construct and operate a recycled water project; i.e., a site where recycled water will be used. The application process includes submittal of report(s) that describes the reuse area, systems, and procedures in detail.
Irrigation	An irrigation plan must be submitted to DOH. The amount of irrigation water applied must be tailored to the needs of the vegetation. Runoff and ponding must be minimized. Recycled water spray must be kept away from drinking fountains and food preparation and eating areas.
Management	A management plan must be submitted to DOH. The management plan delineates the responsibilities for operation and maintenance of the reuse system. The management plan includes designation of the recycled water user supervisor for the site.
Public education	A public education plan must be prepared. The public education plan establishes how persons at the site will be informed of the use of recycled water, including appropriate signs, public information tours, etc.
Employee training	An employee training plan must be prepared. Employees must be trained in recycled water use procedures.
Vector control	If recycled water is to be stored in an impoundment or constructed wetland then a vector control plan must be prepared that addresses mosquito control measures.

Section 6

Olowalu Town Recycled Water Irrigation Analysis

The primary use of recycled water at Olowalu Town will be for irrigation purposes. This section provides a detailed analysis of irrigation with recycled water at Olowalu Town.

6.1 Irrigation Needs Estimates

Irrigation is the most common use for recycled water. Irrigation needs are a function of the site climate and the type of vegetation that is irrigated. Recycled water will be used to irrigate Olowalu Town park fields and landscape, school fields and landscape, streetscapes, and agricultural lots. The vegetation for these areas will consist largely of native plants, turf and ornamental plantings. Vegetation uses water to survive and grow, through a process called "evapotranspiration". Irrigation water must be applied to meet the evapotranspiration rate of the vegetation, minus any precipitation. During wet years less irrigation water is required, compared to average or dry years. Average and wet year irrigation needs are developed below.

6.1.1 Average Year Irrigation Needs

Table 6-1 presents the estimated Olowalu Town irrigation needs during an average precipitation year. Evapotranspiration estimates are developed by applying appropriate coefficients to pan evaporation data obtained from weather stations. The irrigation need for a given month is the estimated evapotranspiration minus the precipitation, multiplied by appropriate factors to account for irrigation distribution efficiency and the need to slightly over-irrigate to leach applied salts below the root zone of the crop.

Table 6-1. Average Precipitation Year Irrigation Demand

Month	Precipitation [a] (inches)	Pan Evaporation [b] (inches)	Evapotranspiration [c] (inches)	Estimated Irrigation Needs [d]	
				(inches)	(gpd/acre)
January	3.16	5.95	5.36	3.02	1,927
February	1.86	5.95	5.36	4.81	3,867
March	1.40	6.80	6.12	6.49	4,866
April	0.54	6.80	6.12	7.67	6,098
May	0.35	8.50	7.65	10.0	7,768
June	0.03	7.65	6.89	9.43	7,579
July	0.05	8.50	7.65	10.5	8,129
August	0.08	8.50	7.65	10.4	8,093
September	0.15	7.65	6.89	9.26	7,430
October	0.81	6.80	6.12	7.30	5,576
November	1.43	5.95	5.36	5.40	4,144
December	2.40	5.10	4.59	3.01	2,023
Totals	**12.26**	**84.15**	**75.74**	**87.28**	**77,824**

[a] *Source: NOAA, April 2005. Station 296.1, Olowalu. Period of record 1971-2000.*

[b] *Source: Engott and Vana, 2007.*

[c] *Assumes pan coefficient = 1.0 and crop coefficient = 0.90 to represent a mixture of park landscape and agricultural crops.*

[d] *Assumes irrigation efficiency = 80 percent and leaching fraction = 10 percent.*

Figure 6-1 presents the data from Table 6-1 in graphical form. The figure shows that peak irrigation needs occur during the dry summer months, and significantly less irrigation is required during the wet winter months.

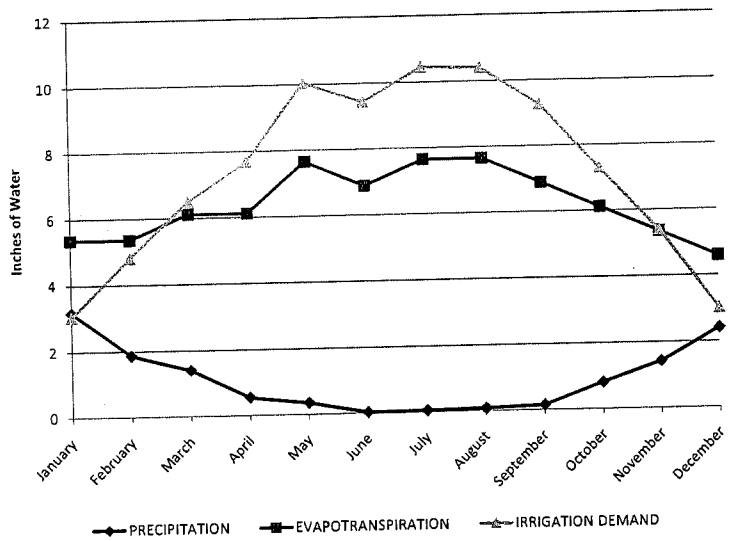

Figure 6-1. Average Year Irrigation Demand

6.1.2 Wet Year Irrigation Needs

Less irrigation water is required during years with above-average precipitation. Statistics are used to evaluate the probability of high precipitation occurring in a given year. For purposes of this water recycling analysis, a wet year will be defined as having a 5 percent probability of occurring during a given year. This can also be called "20-year" annual precipitation, because the probability of occurrence in any given year is one in twenty. Table 6-2 provides an estimate of the 20-year annual precipitation for the site and estimates of the corresponding irrigation needs.

Table 6-2. Wet Precipitation Year (1 in 20) Irrigation Demand

Month	Precipitation [a] (inches)	Pan Evaporation [b] (inches)	Evapotranspiration [c] (inches)	Estimated Irrigation Needs [d]	
				(inches)	(gpd/acre)
January	6.43	5.95	5.36	0	0
February	3.60	5.95	5.36	2.42	2,345
March	2.77	6.80	6.12	4.61	4,037
April	1.26	6.80	6.12	6.68	6,045
May	0.99	8.50	7.65	9.16	8,025
June	0.11	7.65	6.89	9.32	8,435
July	0.13	8.50	7.65	10.3	9,057
August	0.23	8.50	7.65	10.2	8,942
September	0.40	7.65	6.89	8.92	8,070
October	2.16	6.80	6.12	5.45	4,771
November	3.07	5.95	5.36	3.15	2,848
December	5.61	5.10	4.59	0	0
Totals	**26.74**	**64.15**	**75.74**	**70.25**	**62,576**

[a] *Source: NOAA, April 2005. Station 296.1, Olowalu. Period of record 1971-2000.*
[b] *Source: Engott and Vana. 2007.*
[c] *Assumes pan coefficient = 1.0 and crop coefficient = 0.90 to represent a mixture of park landscape and agricultural crops.*
[d] *Assumes irrigation efficiency = 80 percent and leaching fraction = 10 percent.*

Figure 6-2 presents the data from Table 6-2 in graphical form. Note that during the month of January there is no need to apply irrigation water, because the amount of precipitation exceeds the evapotranspiration needs of the vegetation. The implication is that during periods of wet weather there can be little or no demand for recycled water, and the recycled water that is produced during those periods must be disposed of in some manner. The Olowalu Town wastewater management system includes natural treatment systems (described in Section 8) to provide an environmentally sound method for disposing of excess recycled water.

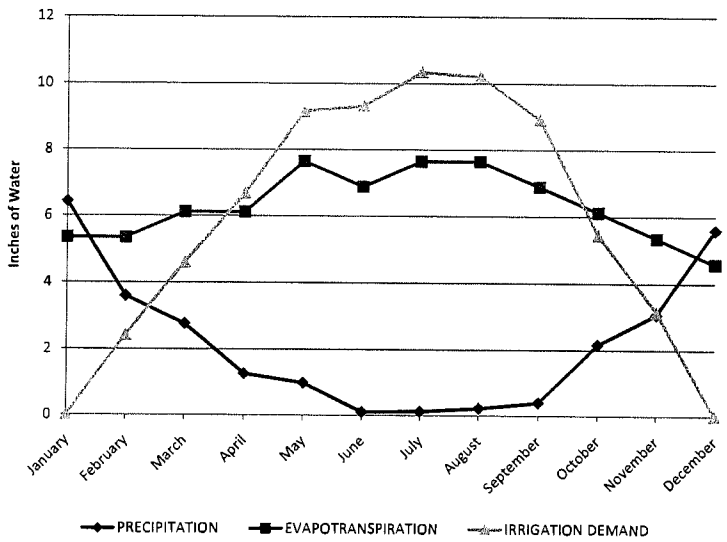

Figure 6-2. Wet Year (1 in 20) Irrigation Needs

6.2 Olowalu Town Irrigated Acreage

Irrigation will be the primary use for the R-1 recycled water at Olowalu Town. Olowalu Town will include ample green areas. Figure 3-2 showed the parcels that have preliminarily identified as users of the R-1 recycled water. The parcels include parks and open space, public areas, agricultural lots, and the highway right-of-way.

Table 6-3 summarizes the gross and net acreage by land use where recycled water will be used. Figure 6-3 provides a graphical presentation of the percentage of anticipated recycled water use by land use designation.

Table 6-3. Olowalu Town Areas Irrigated With Recycled Water

Land Use	Gross Acres	Net Irrigated Acres
Park/Open Space	71	45
Civic/Public/Quasi-Public	19	7
Agricultural	36	27
Highway Right of Way	50	25
TOTALS	176	104

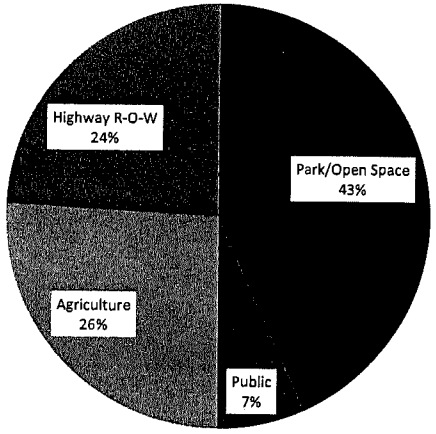

Figure 6-3. Recycled Water Use Areas

6.3 Recycled Water Supply and Demand Analysis

Evaluations were prepared to compare the supply and demand patterns for recycled water at Olowalu Town throughout a year with average precipitation and throughout a wet (1 in 20) year of precipitation to assess the annual needs for supplemental water and volume of excess recycled water that will be expected.

6.3.1 Average Precipitation Year Supply and Demand

The evaluation results for the average precipitation year are presented graphically in Figure 6-4. The horizontal purple line indicates the quantity of recycled water that is expected to be produced throughout the year, while the green line shows the irrigation water demand for a net 104 irrigated acres.

The graph shows that from March through October of an average precipitation year the supply of recycled water is expected to be less than the demand, and the addition of supplemental water will be required to meet the irrigation demand. In the wetter winter months of November through February, there is decreased irrigation demand, and the there may be excess R-1 water will require disposal. The supply and demand analysis for the average precipitation year scenario indicates that over 90 percent of the annual recycled water production will be used, and only 10 percent will require disposal.

During years that are drier than average the volume of excess R-1 water will be less than shown in the figure. Similarly, if the production of R-1 recycled water is less than the design flow rate (525,000 gpd) then there will be less excess R-1 water that requires disposal. The County wastewater standards tend to overestimate wastewater flow in the interest of conservatism, so the latter condition is likely, and

therefore greater than 90 percent of the R-1 recycled water will likely be used over the course of an average or dry precipitation year.

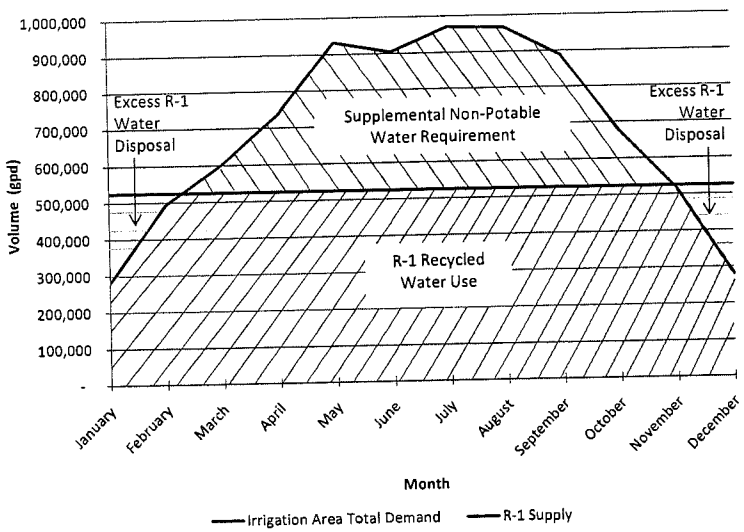

Figure 6-4. Recycled Water Supply and Demand Analysis for Average Precipitation Year

6.3.2 Wet Precipitation Year Supply and Demand

A similar supply and demand analysis was completed for a wet precipitation year. The overall trends are the same as for the average precipitation year; supplemental water is needed during the dry season, and there may be excess R-1 water that will require disposal in the wet season. However, in a wet precipitation year the wet season irrigation demand is lower than during an average precipitation year because the precipitation is greater. This increases the amount of excess R-1 water during the winter months that will require disposal. Supplemental water will continue to be required from April through September, and excess R-1 water disposal occurs in October through March. The supply and demand analysis for the wet precipitation year scenario indicates that approximately 70 percent of the annual recycled water production will be used, and 30 percent will require disposal if R-1 production is equal to 525,000 gpd.

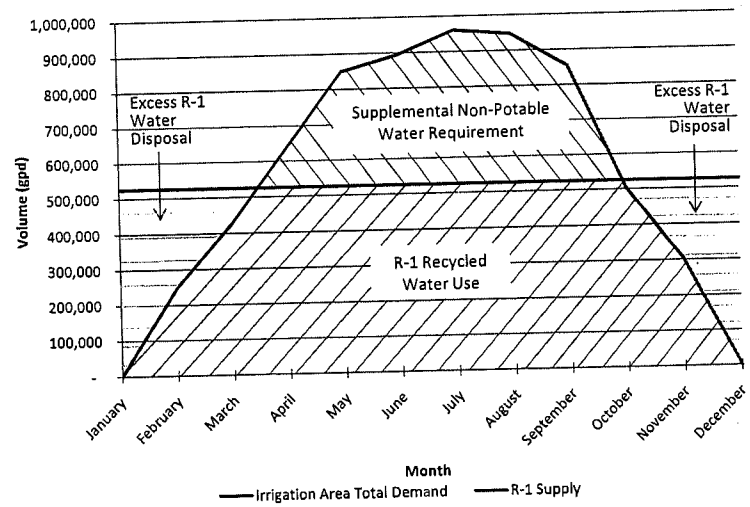

Figure 6-5. Recycled Water Supply and Demand Analysis for Wet Precipitation Year

6.4 Nitrogen Loading Rates

Recycled water typically contains higher nitrogen concentrations than ground or surface water. Nitrogen is a plant nutrient, and recycled water can provide some or all of the nitrogen required for vegetation to grow, reducing or eliminating the need to apply supplemental fertilization. The nutrient uptake by vegetation is a benefit of a water recycling approach for wastewater effluent management; nutrients are put to beneficial use rather than being discharged to the environment.

The amount of nitrogen applied with the recycled water must be balanced with the nutrient uptake of the crop to avoid over-application of nitrogen. As described in Section 4, the Olowalu Town wastewater treatment plant will be designed to reduce the total nitrogen concentration in the R-1 recycled water to 10 mg/L or less. The average precipitation year supply and demand analysis shown in Figure 6-4 indicates an application rate of 1.69 million gallons per acre of R-1 recycled water can be expected during a typical year. The nitrogen loading rate from the recycled water containing 10 mg/L TN would be 141 lbs/acre. Table 6-4 lists some typical crops and their corresponding nitrogen requirements. As shown in the table, the typical crop nitrogen fertilizer requirements exceed the anticipated nitrogen loading rate from the R-1 recycled water application, and so application of supplemental nitrogen fertilizer may be required to obtain optimal growth, but the use of recycled water for irrigation purposes will not result in excess application of nitrogen. As outlined in the next section, recycled water irrigation supervisors will be trained in the proper use of recycled water, including nitrogen management so that excess supplemental nitrogen fertilizer is not applied.

Table 6-4. Nitrogen Fertilizer Requirements of Typical Crops

Crop	Typical Nitrogen Fertilizer Requirements (lbs/acre/year)
Bermuda grass turf	500
Seashore paspalum turf	350
Papaya	350
Pineapple	350
Banana	300
Tomatoes	180
Sweet potatoes	155

Section 7

Olowalu Town Recycled Water Management Program

The following section describes the irrigation management program which shall be implemented at Olowalu Town to comply with the recycled water distribution and use requirements as discussed in Section 5.

7.1 Program Framework

The Olowalu Town recycled water program will be structured to assure the safe use of recycled water in compliance with DOH guidelines. The wastewater utility will designate a recycled water manager who will be responsible for the Olowalu Town recycled water system. In addition, each parcel which uses recycled water will be required to have a designated irrigation manager. Figure 7-1 illustrates the relationships between the DOH, recycled water manager, and irrigation supervisors.

7.2 Recycled Water Manager

The recycled water manager will oversee operation of the recycled water irrigation system at Olowalu Town. He or she will be responsible for ensuring that the DOH guidelines for recycled water distribution and use are adhered to. Key duties will include:

- Monitoring recycled water use
- Training irrigation supervisors
- Inspecting new connections and modifications to the R-1 system
- Reviewing site use plans
- Cross-connection testing
- Reporting program performance to DOH
- Public education
- Records maintenance

7.3 Irrigation Supervisors

Every site where recycled water is used will have a designated irrigation supervisor. It is possible that multiple parcels may be supervised by a single irrigation supervisor (e.g., parks). The irrigation supervisors will be trained in the use of recycled water by the recycled water manager. Operation of the irrigation systems on individual sites will be accomplished by the irrigation supervisors or their employees.

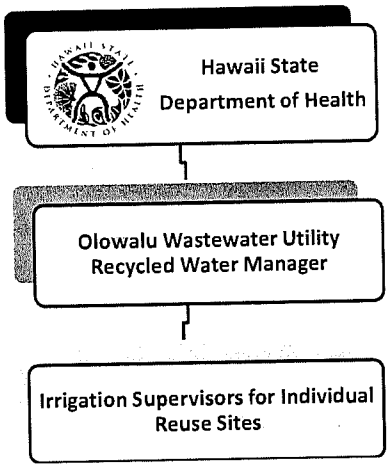

Figure 7-1. Olowalu Town Irrigation Management Program Organization Chart

Section 8

Excess Recycled Water Disposal

The water recycling analysis (Section 6) showed that during the wet season there will be excess R-1 water that will require disposal. This section presents the recycled water disposal components of the Olowalu Town wastewater management system, consisting of a constructed wetland followed by a soil aquifer treatment system. The disposal system will be sized to allow disposal of 100 percent of the peak day wet weather flow from the wastewater treatment plant, in the event of the rare extended wet weather period that reduces recycled water demand to zero.

8.1 Constructed Wetland

Constructed wetlands are engineered wastewater treatment systems that are based on the use of emergent wetland vegetation such as reeds, rushes, and bulrush. The Olowalu Town constructed wetland will be used to further improve the quality of the excess R-1 recycled water prior to disposal.

The type of constructed wetland discussed in this section is the free water surface system. In free water surface (FWS) wetlands, the emergent vegetation is flooded to a depth of 4 to 18 inches, as illustrated in Figure 8-1. The wastewater is treated as it flows through the wetland by naturally-occurring bacteria attached to the submerged vegetation, as well as by physical and chemical processes. Nitrification and denitrification are the responsible processes for nitrogen reduction. Denitrification performance can be excellent due to the presence of carbon from decaying plant litter and anoxic conditions (Crites, et. al., 2006).

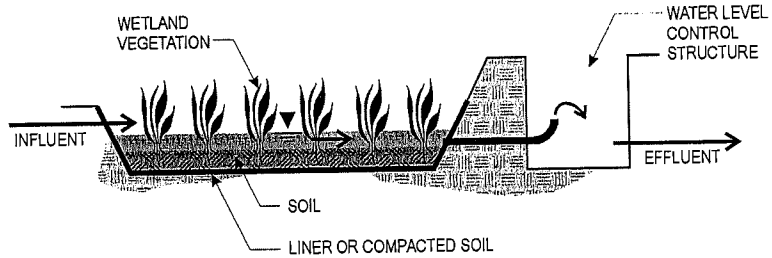

Figure 8-1. Schematic of Free Water Surface Wetland

The amount of treatment that occurs in a FWS wetland is a function of the hydraulic detention time and temperature. Nitrogen reduction via denitrification would be the treatment objective for the Olowalu Town application. The total nitrogen removal rate in a polishing wetland is dependant on the partitioning of the influent nitrogen species; better nitrification in the upstream wastewater treatment process will result in better total nitrogen removal in the wetland. The Olowalu Town wastewater treatment plant will be designed to produce a well-nitrified effluent, so denitrification performance of the wetland will be excellent.

If R-1 water is supplied to the wetland then there would be no need to restrict public access to the water system for public health reasons. FWS wetlands can be designed to provide effluent polishing while also providing habitat for native flora and fauna. Trails or paths can potentially be provided for public access. Figure 8-2 is a photo of a constructed wetland located in the State of Washington that provides polishing treatment and wildlife habitat.

Figure 8-2. A Constructed Wetland for Polishing Treatment and Wildlife Habitat

The wetland for Olowalu Town would have a surface area of approximately 2 acres. The wetland will be sufficient to reduce the nitrogen level of the recycled water from 10 mg/L to 5 mg/L or less prior to flowing to the soil aquifer treatment system. Figure 3-2 showed the preliminary location of the constructed wetland. Table 8-1 lists some native Hawaiian plants that could potentially be used in the Olowalu Town constructed wetland.

Table 8-1. Potential Hawaiian Constructed Wetland Vegetation

Hawaiian Name	Common Name	Scientific Name
'Ae 'ae	Water hyssop	Bacopa monnieri
'Aka 'akai	Softstem bulrush	Schoenoplectus tabernaemontani
Ahu 'awa	Javanese flatsedge	Cyperus javanicus Houtt.
Kaluha	Alkali bulrush	Schoenoplectus maritimus
Makaloa	Smooth flatsedge	Cyperus laevigatus
Mau'u 'aki 'aki	Tropical fimbry	Fimbristylis cymosa

Source: Pagen, et. al., 2008

8.2 Soil Aquifer Treatment System

Soil aquifer treatment is a natural treatment process whereby wastewater is treated as it infiltrates and percolates through a soil matrix to groundwater. The treatment mechanisms are physical, chemical, and biological. Treatment benefits can include nitrogen and phosphorus removal, heavy metal and trace organic removal, and removal of endocrine disrupting chemicals. The system consists of multiple basins constructed in porous soil. Excess recycled water that has received additional treatment in the constructed wetland would be intermittently dosed to the basins, resulting in saturated soil conditions followed by unsaturated (resting) conditions. The application periods are designed for specific treatment objectives, and can range from 1 day to 12 days depending on the climate, pretreatment, and treatment goals (Crites, et. al., 2006).

The Olowalu Town soil aquifer treatment system will consist of multiple basins at the location that was shown in Figure 3-2. The required total basin area has been preliminarily established at 4.7 acres, but geotechnical evaluations will be required during the design phase to establish the final system size. The basins will be dry for most of the year when recycled water demand exceeds supply. But during the wet winter months (November through February) highly treated excess recycled water from the constructed wetland will be discharged to the soil aquifer treatment system basins for disposal via percolation.

Soil aquifer treatment systems are not injection wells. Injection wells are used to discharge fluids directly into the groundwater aquifer and do not provide the additional treatment benefits as the fluid flows from the surface to the groundwater aquifer. Soil aquifer treatment systems are a form of surface disposal, and additional treatment is provided as the discharged water percolates from the ground surface to the groundwater aquifer.

Section 9

Conclusions

The Olowalu Town wastewater management system will use innovative, efficient, and sustainable technology to minimize adverse impacts upon the natural environment. The wastewater that Olowalu Town residents and businesses will generate will be managed in an environmentally-responsible manner. Olowalu Town's location adjacent to a significant and accessible coral reef system dictates that a conservative, reliable, and appropriate wastewater management system be implemented. The Olowalu Town wastewater management plan has been developed with environmental concerns at the forefront, and effectively and appropriately establishes a system for responsible management of the community's wastewater. Conservative planning assumptions have been used to develop a wastewater management plan that will ensure a high factor of safety for protection of human health and the environment, and will meet or exceed all regulatory requirements.

The proposed Olowalu Town wastewater management system will:

- Not rely on injection wells for effluent disposal purposes. The small percentage of recycled water that requires disposal will be discharged to a soil aquifer treatment system after passing through the constructed wetland. The soil aquifer treatment system is a surface disposal system that allows additional treatment benefits as the discharged water percolates to the groundwater aquifer.
- Provide for a high degree of water recycling to make the best use of water resources. The wastewater management system will be an important part of the integrated water resources system for the community. All of the Town's wastewater will be treated to the highest DOH water recycling standards to allow reuse for irrigation of parks, schools, public areas, agricultural land, and highway landscaping. In a typical year 90 percent or more of the town's wastewater will be recycled for irrigation purposes.
- Incorporate nutrient removal technology to protect the environment. The Olowalu Town wastewater treatment plant will include biological nutrient removal processes to reduce total nitrogen concentrations to 10 mg/L or less. The constructed wetland will further reduce total nitrogen concentrations of excess R-1 recycled water to 5 mg/L or less prior to disposal. These two nutrient removal systems will provide a level of environmental protection that is unsurpassed in Hawaii.
- Incorporate natural treatment systems where feasible and appropriate. Excess R-1 recycled water will receive additional treatment in a constructed wetland prior to disposal via the soil aquifer treatment system. Both of these system elements are natural wastewater treatment systems. The constructed wetland will provide wildlife habitat and will be a public amenity.

Section 10

Limitations

This document was prepared solely for Olowalu Town, LLC in accordance with professional standards at the time the services were performed and in accordance with the contract between Olowalu Town, LLC and Brown and Caldwell dated September 30, 2010. This document is governed by the specific scope of work authorized by Olowalu Town, LLC; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Olowalu Town, LLC and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

References

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APPENDIX Q-1.

August 25, 2015 Letter from Brown and Caldwell

1955 Main Street, Suite 200
Wailuku, HI 96793

T: 808.244.7005
F: 808.244.9026

Brown AND Caldwell

August 25, 2015

Mr. Bill Frampton and Mr. Dave Ward
Olowalu Town, LLC
2035 Main Street, Suite No. 1
Wailuku, Hawaii 96793

143089.001

Subject: Olowalu Town Wastewater Management Plan Report (Dated October, 2011) and Olowalu Town Stormwater Quality Enhancements Report (Dated October, 2011)

Dear Mr. Frampton and Mr. Ward:

At your request, Brown and Caldwell prepared the subject reports for inclusion in the Olowalu Town Master Plan Environmental Impact Statement. Both reports addressed Alternative 1, the Preferred Alternative. With the adoption of the Maui Island Plan (MIP) in December 2012, Alternative 2 was introduced as a second alternative within the realm of implementation potential. Alternative 2 reflects a master plan concept which follows the MIP's growth boundaries. That is, lands makai of Honoapiilani Highway are not included as part of the Master Plan. Both Alternatives 1 and 2 call for the development of up to 1,500 residential units and between 300,000 to 375,000 square feet of commercial space.

The Stormwater Quality Enhancement Report identifies Best Management Practices (BMPs) that will support Olowalu Town's sustainability objectives, including residential BMPs, commercial and public facility BMPs, and green space/recreational area BMPs. The BMPs identified in our report are state-of-the-art recommendations which continue to be valid and appropriate today, as they were in 2011. The BMPs would apply equally to both Alternative 1 and Alternative 2.

Similarly, the Wastewater Management Plan's analysis and recommendations, including our discussion on the proposed wastewater treatment plant facility and processes remain current in terms of technology and design parameters. The engineering elements of the wastewater treatment facility would serve both Alternative 1 and Alternative 2 in the same capacity with equal results.

No new circumstances have arisen with respect to the subject project or property that will result in different or likely increased environmental impacts not previously dealt with in our 2011 reports. Accordingly, we confirm that the analysis, conclusions, and recommendations presented in the foregoing reports remain applicable and are valid for both Alternative 1 and Alternative 2.

Very truly yours,

Brown and Caldwell

Craig C. Lekven, P.E
Supervising Engineer
Project Manager

CCL:ic

cc: Colleen Suyama, Munekiyo Hiraga

APPENDIX ~~O~~R.

Maui Island Plan Directed Growth Maps

GPAC Directed Growth Map

Olowalu

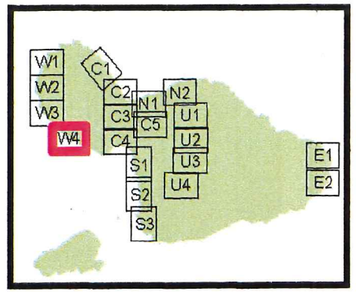
W4

Legend

Primary Road

Growth Boundaries: GPAC Version

- Urban Town
- Country Town
- Rural Service Center
- Rural Residential
- Land Use -- Preservation
- Land Use -- Regional Park
- Urban Form -- Greenbelt
- Urban Form -- Greenway



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County of Maui
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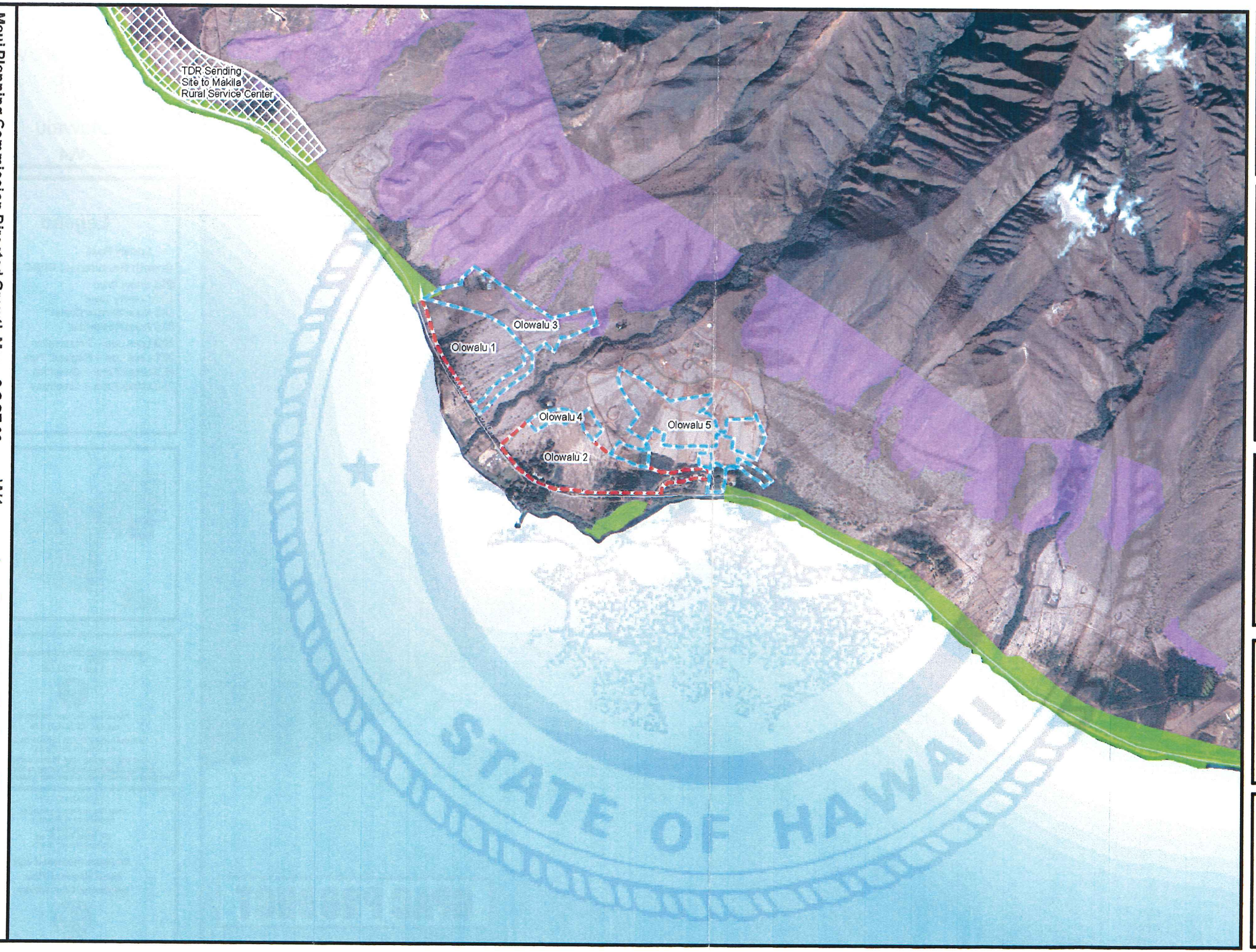
Wailuku, Hawaii 96793

As Recommended By:
Maui General Plan Advisory Committee

Maui Planning Commission Directed Growth Map - 2 OCT 09 W4 Long Range Planning Div. - Dept. of Planning - County of Maui



Maui Planning Commission Directed Growth Map

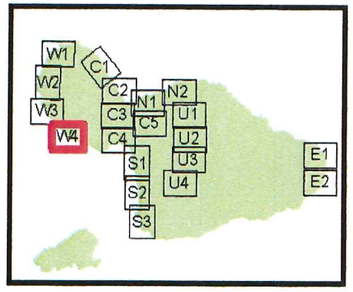
Olowalu

W4

Legend

Growth Boundaries: MPC
- Urban Growth Boundary
- Rural Growth Boundary
- Country Town
- Rural Service Center

Other Land Use Elements
- Land Use -- Preservation
- Land Use -- Regional Park
- Urban Form -- Greenbelt
- Urban Form -- Greenway
- Sensitive Lands
- Primary Road



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Planning Department Directed Growth Map - 2 OCT 09

W4

Long Range Planning Div. - Dept. of Planning - County of Maui

Planning Department Directed Growth Map

Olowalu

W4

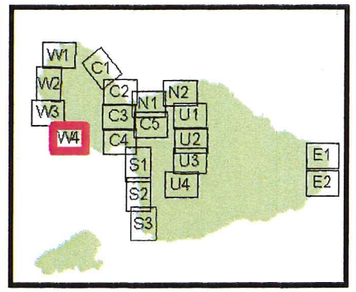
Legend

Growth Boundaries: Planning Dept.

- Urban Growth Boundary
- Rural Growth Boundary
- Country Town
- Rural Service Center
- Urban Reserve

Other Land Use Elements

- Land Use -- Preservation
- Land Use -- Regional Park
- Urban Form -- Greenbelt
- Urban Form -- Greenway
- Sensitive Lands
- Primary Road



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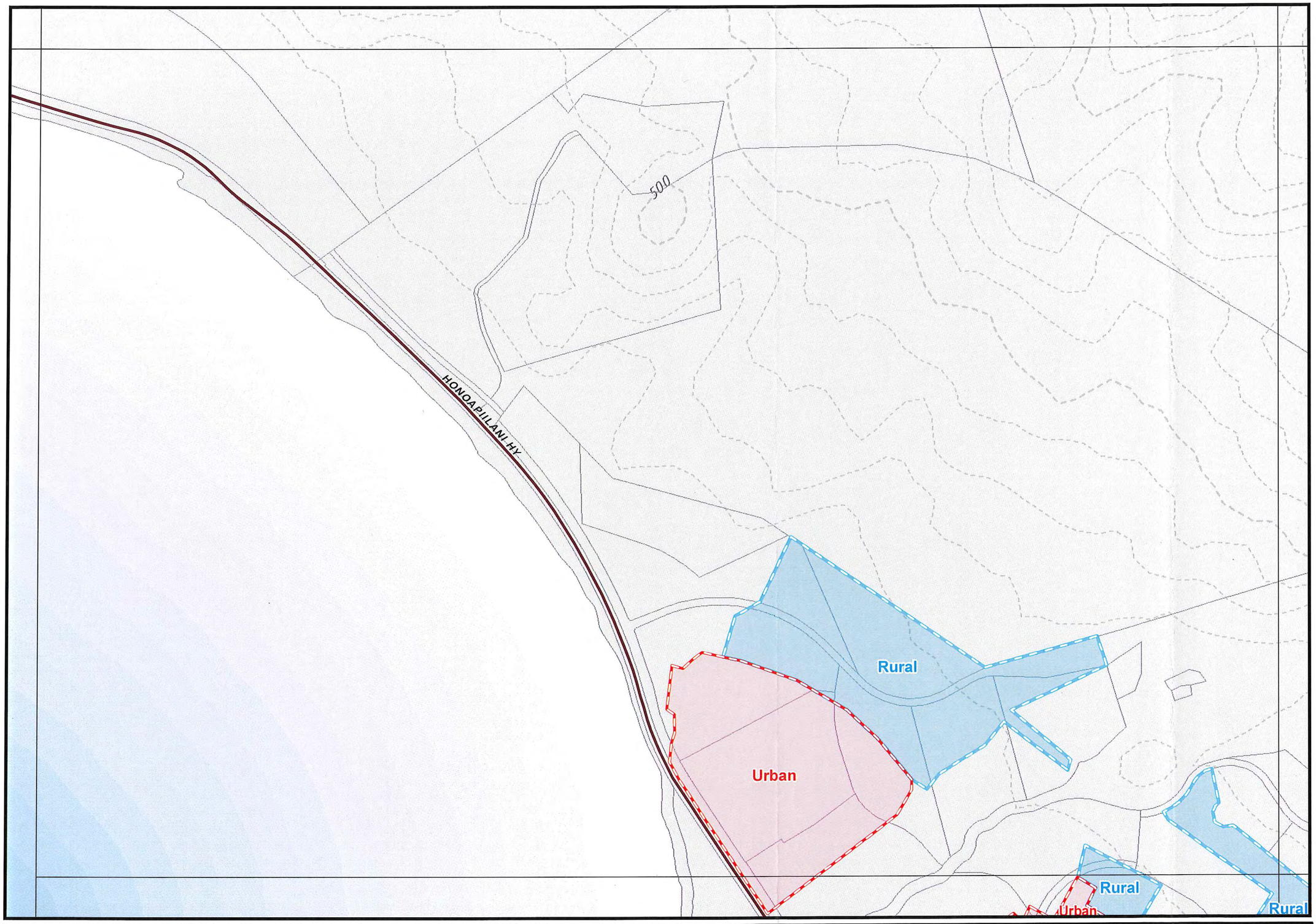
Maui Island Plan Directed Growth Boundaries



Legend

Growth Boundaries

- Urban
- Small Town
- Rural

Reference

- Primary Roads
- 2011 Parcels
- 100 Ft. Contours

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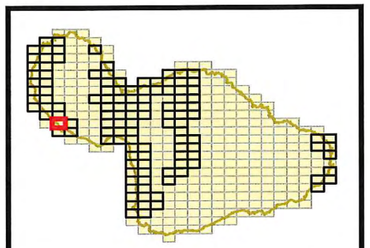

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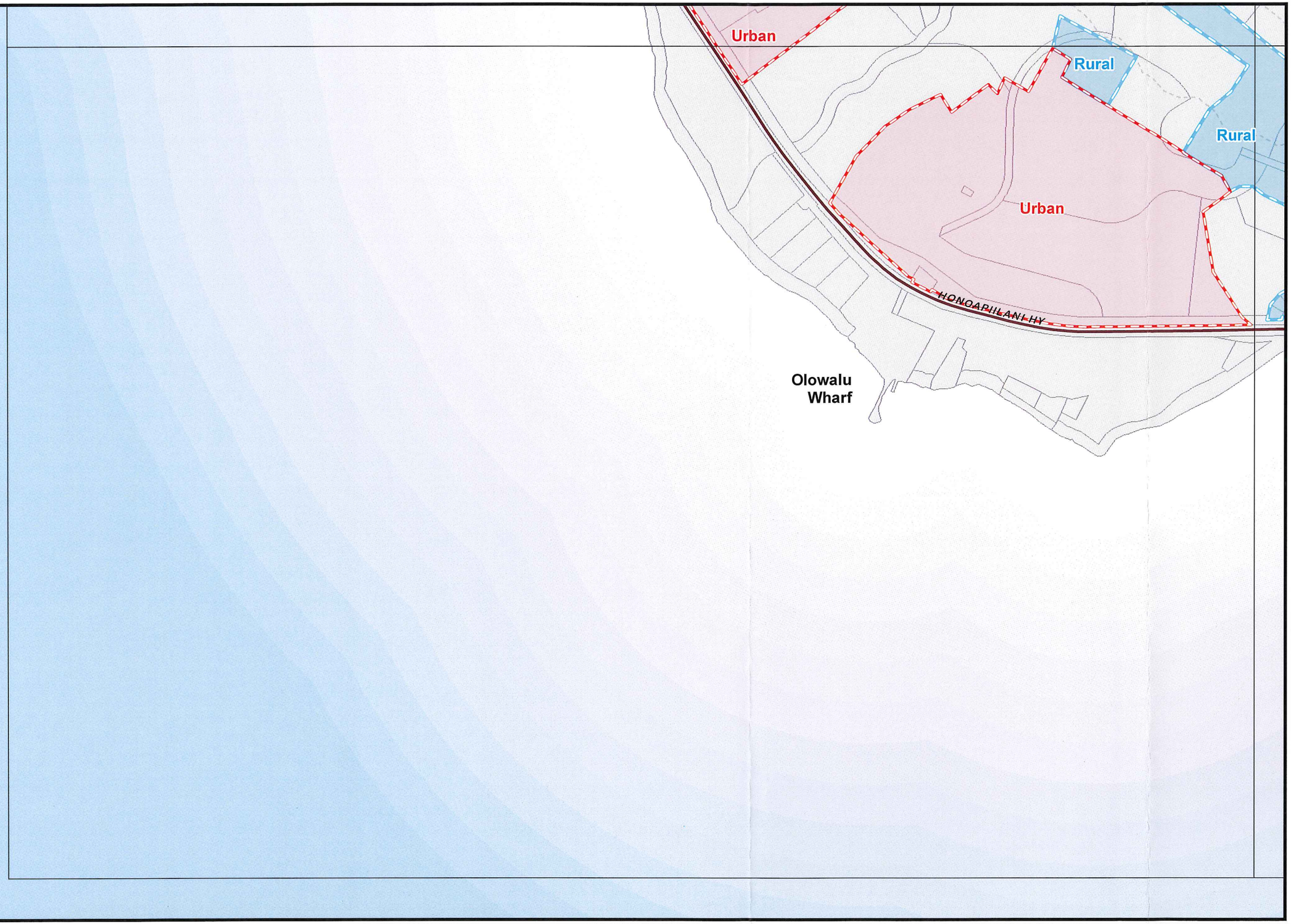

Maui Island Plan Directed Growth Boundaries

Legend

Growth Boundaries

- Urban
- Small Town
- Rural

Reference

- Primary Roads
- 2011 Parcels
- 100 Ft. Contours

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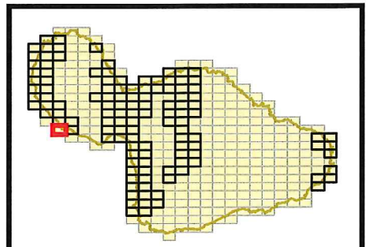

C-13

Olowalu

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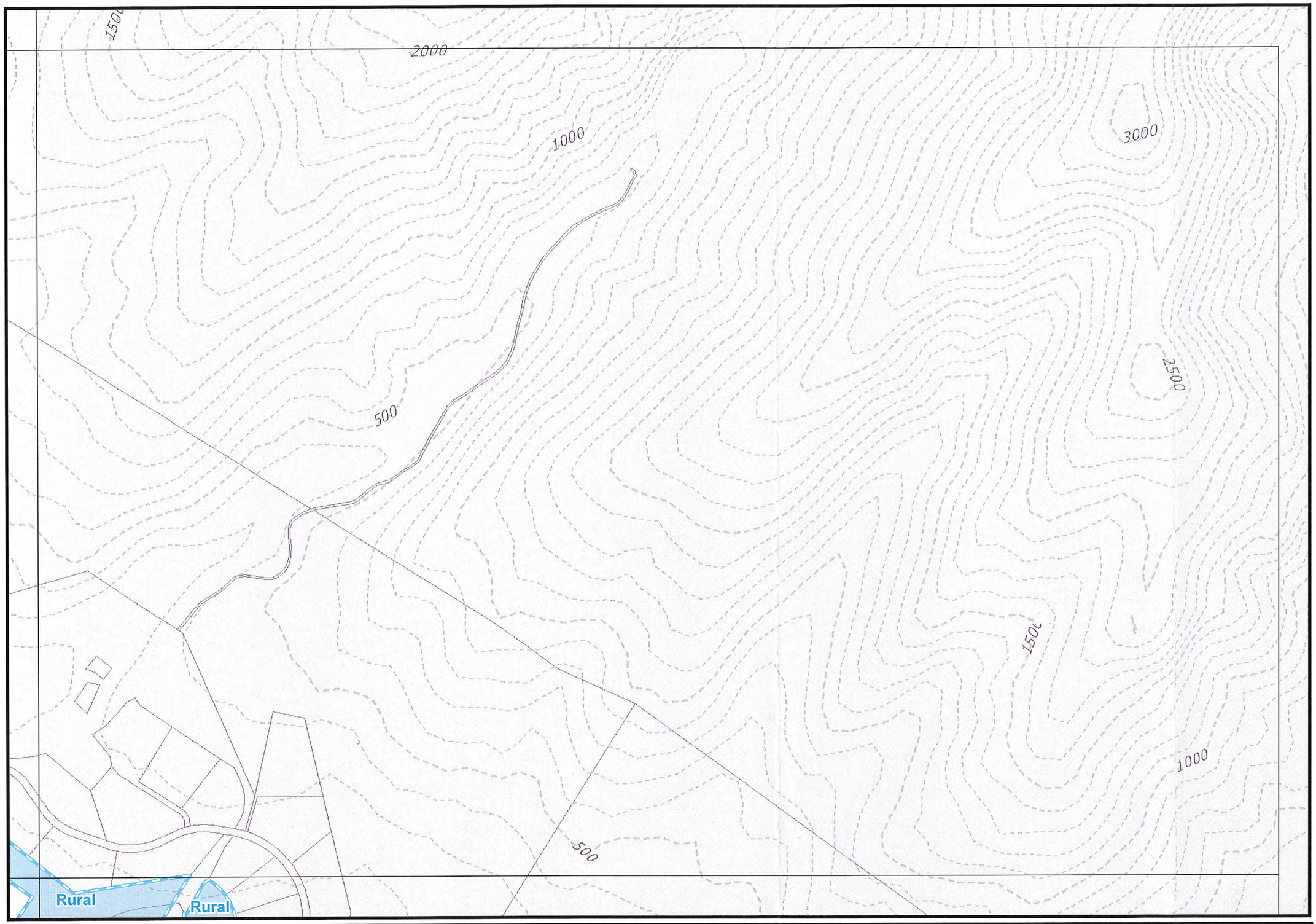
Maui Island Plan Directed Growth Boundaries



Legend

Growth Boundaries

- Urban
- Small Town
- Rural

Reference

- Primary Roads
- 2011 Parcels
- 100 Ft. Contours

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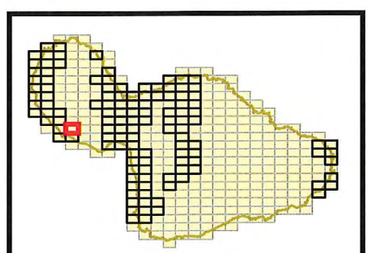

D-12

Ko`ai

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Department of Planning, County of Maui
250 South High Street, Wailuku, Hawaii 96793

Feet
0 1,000 2,000 4,000

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Maui Island Plan Directed Growth Boundaries

Legend

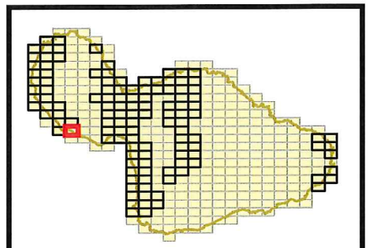
Growth Boundaries

- Urban
- Small Town
- Rural

Reference

- Primary Roads
- 2011 Parcels
- 100 Ft. Contours

This is not a zoning map.
Please contact the Planning
Department for zoning confirmation



D-13

Ka`ili`ili

Prepared by: Long Range Planning Division
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250 South High Street, Wailuku, Hawaii 96793

Feet
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APPENDIX PS.

Special Management Area Permit No. SM1 990021

JAMES "KIMO" APANA
Mayor

JOHN E. MIN
Director

CLAYTON I. YOSHIDA
Deputy Director

COUNTY OF MAUI
DEPARTMENT OF PLANNING

RECEIVED BY DATE 9/21/00

September 19, 2000

Mr. Robert Horcajo
Olowalu Elua Associates, LLC
173 Ho Ohana Street, Suite 201
Kahului, Hawaii 96732

Dear Mr. Horcajo:

RE: Special Management Area (SMA) Use Permit for the Proposed Olowalu Subdivision at TMK: 4-8-003:5, 10 (Por.), 41, 42, 43, 50 (Por.), 63 (Por.), and 78 (Por.) and 4-8-004:11, 12, 13, 14, 15, and 16 at Olowalu, Maui, Hawaii (SM1 990021)

At its regular meeting on September 12, 2000, the Maui Planning Commission (Commission) conducted a public hearing on the above-referenced application. At the meeting, the Commission clarified the record as follows:

1. Commissioner Star Medeiros who was a member of the Citizens Advisory Committee (CAC) for the West Maui Community Plan clerified the park designation and language. During the CAC's discussions on the park site at Olowalu, the reduction of 50 percent of agriculture related to the reduction of sugar cane cultivation and not to other agricultural crops that could be grown on the site. As such, the 50 percent reduction of agriculture has occurred. Based on the language, the applicant is advised that a 30-acre park should be reserved on the Camp Pecusa side of the makai lands in Olowalu.

2. Commissioner Joe Bertram III requested that the applicant work with Maui Electric Company to encourage energy efficiency in the project and use of alternative energy options such as solar panels.

The Commission, after due deliberation, voted to grant approval of the Special Management Area Use Permit, subject to the following conditions:

STANDARD CONDITIONS:

1. That construction of the proposed project shall be initiated by **September 30, 2002.** Initiation of construction shall be determined as construction of offsite improvements, issuance of a foundation permit and initiation of construction of the foundation, or issuance of a building permit and initiation of building construction, whichever occurs first. Failure to comply

250 SOUTH HIGH STREET, WAILUKU, MAUI, HAWAII 96793
PLANNING DIVISION (808) 270-7735; ZONING DIVISION (808) 270-7253; FACSIMILE (808) 270-7634

within this two (2) year period will automatically terminate this Special Management Area Use Permit unless a time extension is requested no later than ninety (90) days prior to the expiration of said two (2) year period. The Planning Director shall review and approve a time-extension request but may forward said request to the Maui Planning Commission for review and approval.

2. That the construction of the project shall be completed within five (5) years after the date of its initiation. Failure to complete construction of this project will automatically terminate the subject Special Management Area Use Permit. A time extension shall be requested no later than ninety (90) days prior to the completion deadline. The Planning Director shall review and approve a time-extension request but may forward said request to the Maui Planning Commission for review and approval.

3. The permit holder or any aggrieved person may appeal to the Maui Planning Commission any action taken by the Planning Director on the subject permit no later than ten (10) days from the date the Director's action is reported to the Commission.

4. That final construction shall be in accordance with preliminary subdivision plans included in the submittal received on November 9, 1999.

5. That appropriate measures shall be taken during construction to mitigate the short-term impacts of the project relative to soil erosion from wind and water, ambient noise levels, and traffic disruptions.

6. That the subject Special Management Area Use Permit shall not be transferred without prior written approval in accordance with Section 12-202-17(d) of the Special Management Area Rules of the Maui Planning Commission. However, in the event that a contested case hearing preceded issuance of said Special Management Area Use Permit, a public hearing shall be held upon due published notice, including actual written notice to the last known addresses of parties to said contested case and their counsel.

7. That the applicant, its successors and permitted assigns shall exercise reasonable due care as to third parties with respect to all areas affected by subject Special Management Area Use Permit and shall procure at its own cost and expense, and shall maintain during the entire period of this Special Management Area Use Permit, a policy or policies of comprehensive liability insurance in the minimum amount of ONE MILLION AND NO/100 DOLLARS ($1,000,000.00) naming the County of Maui as an additional named insured, insuring and defending the applicant and County

of Maui against any and all claims or demands for property damage, personal injury and/or death arising out of this permit, including, but not limited to: (1) claims from any accident in connection with the permitted use, or occasioned by any act or nuisance made or suffered in connection with the permitted use in the exercise by the applicant of said rights; and (2) all actions, suits, damages and claims by whomsoever brought or made by reason of the nonobservance or nonperformance of any of the terms and conditions of this permit. Proof of a policy naming County of Maui as an additional named insured shall be submitted to the Planning Department within ninety (90) calendar days from the date of transmittal of the decision and order.

8. That full compliance with all applicable governmental requirements shall be rendered.

9. That the applicant shall submit plans regarding the location of any construction-related structures such as, but not limited to trailers, sheds, equipment and storage areas and fencing to be used during the construction phase to the Maui Planning Department for review and approval.

10. That the applicant shall submit to the Planning Department five (5) copies of a detailed report addressing its compliance with the conditions established with the subject Special Management Area Use Permit. A preliminary report shall be reviewed and approved by the Planning Department prior to issuance of a grading permit. A final compliance report shall be submitted thirty (30) days after the completion of the subdivision to the Planning Department for review and approval.

11. That the applicant shall develop the property in substantial compliance with the representations made to the Commission in obtaining the Special Management Area Use Permit. Failure to so develop the property may result in the revocation of the permit.

PROJECT SPECIFIC CONDITIONS:

12. That the applicant shall be responsible for all required infrastructural improvements including, but not limited to water source and system improvements for both domestic and fire protection, drainage improvements, traffic-related improvements, wastewater system improvements, and utility upgrades. Said improvements shall be constructed concurrently with the development and shall be completed prior to final subdivision approval or bonded in accordance with Title 18, Maui County Code, relating to the subdivision ordinance.

13. That as represented by the applicant, an approximate 54-acre cultural reserve for historic and cultural preservation operated and managed by the Olowalu Cultural Reserve, a non-profit organization, shall be established in perpetuity to ensure preservation of historic and cultural resources, as well as to perpetuate the Hawaiian culture and continued access to Native Hawaiians to "gather", to perform religious practices, and to attend to their own kuleana. Access to the cultural reserve shall be open to the general public as a cultural reserve. Access for recreational purposes shall be as approved by the Olowalu Cultural Reserve (as amended).

14. As represented by the applicant, the roadways for the proposed subdivisions shall be constructed in substantial compliance with the proposed greenway plan identified in the application. For each phase of development, final plans for the applicable increments of the approximate sixty (60) acres of greenways shall be submitted to the Maui Planning Department for review and approval. Said greenway areas shall be regularly maintained and access to the greenways shall be open to the general public for access and recreational purposes (as amended).

15. That the applicant shall establish an irrigation system for the proposed agricultural subdivisions which addresses the supply, storage, and distribution of irrigation water to the proposed lots, and is secured in terms of permit acquisition, quality, quantity, availability, and year-round operations and maintenance. Documentation that the irrigation system has been established shall be submitted to the Maui Planning Department within ninety (90) days of construction of the subdivision.

16. That the applicant shall prepare a dust- and erosion-control plan for review and approval by the Maui Planning Department to ensure that any fallow agricultural lands do not create future adverse dust and erosion impacts on the surrounding area. Said plan shall be reviewed and approved by the appropriate State of Hawaii agencies and implemented as soon as practicable by the applicant and its assigns and successors. A copy of the approved dust- and erosion-control plan for the agricultural lands shall be submitted to the Maui Planning Department and the Department of Public Works and Waste Management for our records (as amended).

17. That potential buyers will be advised that the lots are for sale as commercial agricultural lots and of Hawaii's Right to Farm Act which prohibits conditions, covenants, and restrictions that will prevent or impede reasonable agricultural use of the lots.

18. That the Maui/Lanai Islands Burial Council shall review the mitigation proposals for all burials.

19. That the applicant shall submit a detailed preservation plan (scope of work) for the sites identified for preservation to the Department of Land and Natural Resources, State Historic Preservation Division (SHPD), for approval. This plan will include buffer zones, interim protection measures (as needed), and long-range preservation plans. No land alteration may occur in the vicinity of these sites until minimally the buffer zones and interim protection measures are approved and the SHPD verifies the interim protection measures are in place. No preservation activities may occur in these sites until the preservation plan is approved. The SHPD shall verify in writing to the County when the plan has been successfully executed.

20. That archaeological data recovery shall occur at the sites identified in the survey reports. The applicant shall submit an archaeological data recovery plan (scope of work) for these sites to the SHPD for approval. The SHPD shall verify in writing to the County when the plan has been successfully executed. Further, as noted, the gleyed marsh soils shall also undergo archaeological data recovery. Minimally, data recovery fieldwork must be successfully concluded (and verified in writing by SHPD) prior to land alteration in this part of the project area. The SHPD shall verify in writing to the permitting agencies when the plan has been successfully completed.

21. That archaeological monitoring of land-altering construction in the sand areas along the shore shall occur, as a contingency to identify, document, and treat any burials that might be found. A monitoring plan (scope of work) shall be submitted to and be approved by the SHPD prior to the beginning of the monitoring. This plan must specify how any burials that are found will be documented archaeologically, notification procedures, and treatment measures that will be taken. This scope should be completed before a monitoring contract is negotiated.

22. All preservation areas and buffer zones shall be clearly marked on the subdivision plans and recorded with the property documents to ensure that future owners of the lots are aware of these restrictions to the lots.

23. That as represented by the applicant, the oral history work shall be expanded to include more people of the Olowalu area, such as existing and former residents, persons who have knowledge of their ancestors living in the area, and the kupunas.

24. That adequate buffers between the cultural preserve areas and the agricultural lots shall be established to ensure that the cultural experience is not impacted by the agricultural use and structures on the adjoining lots. Mitigation measures from high boundary

walls, residences, farm buildings, and operations shall be submitted to the Maui Planning Department for review and approval.

25. Unless removal is necessary for intersection improvements, to the extent practicable, the Monkey Pod trees within the subject property on both sides of Honoapiilani Highway shall be retained and consideration shall be given to extending the Monkey Pod trees as part of the cultural landscape (as amended).

26. That structures located within the floodway Flood Zone AO and A4 shall be constructed above the flood elevation. Measures such as post and pier construction shall be considered to conform to the Flood Hazard District and to allow flood waters to continue to traverse the property (as amended).

27. That future buyers of lots shall be informed that development within flood hazard areas shall be implemented in accordance with Chapter 19.62, Maui County Code (as amended).

28. That use of soil as fill is prohibited within the Shoreline Setback Area, except for clean sand. Further, any grading or mining of a coastal dune is prohibited.

29. That a minimum shoreline setback of 150 ft. from the certified shoreline shall be established for all lots on the makai portion of the subdivision regardless of a government beach reserve fronting the subdivided lots. No structures shall encroach into the Shoreline Setback Area to ensure that future shoreline erosion and storm-wave action will not adversely affect structural development on the properties.

30. That public lateral pedestrian access along the shoreline within the Shoreline Setback Area shall be provided. Landscaping in the area within 50 ft. of the shoreline should be spaced far enough apart so as not to interfere with lateral access. Further, as represented by the applicant, mauka/makai public shoreline access from Honoapiilani Highway and public beach parking shall be provided near the Olowalu Mill site to Olowalu Landing, as well as access points to the shoreline from both ends of the makai Olowalu lands. Documentation that access, as required, has been provided shall be filed with the Departments of Public Works and Waste Management, Parks and Recreation, and Planning prior to final subdivision approval (as amended).

31. As represented by the applicant, the existing cane haul road (approximately 80 ft. wide) on the mauka side of Honoapiilani Highway shall be set aside as a reserve (Roadway Lot 39) for

future roadway expansion or relocation of Honoapiilani Highway (as amended).

32. That roadway improvements to Honoapiilani Highway, including left-turn storage lanes, acceleration and deceleration lanes, driveway connections, etc., as identified in the applicant's Traffic Impact Assessment Report (TIAR), and as required by the Department of Transportation shall be provided in conjunction with the development of the subdivision. The roadway improvements shall be reviewed and approved by the Department of Transportation. Construction of the improvements shall be completed prior to occupancy of the agricultural lots unless a phasing plan for the improvements is reviewed and approved by the Department of Transportation.

33. That the outdoor lighting plans for the subdivision shall be submitted to the Maui Planning Department for review and approval to reduce the negative impacts on seabirds, especially the dark-rumped petrel (Pterodroma phaeopygia sandwichensis) which is a federally endangered species. All potential owners of the lots shall be informed that appropriate measures approved by the Maui Planning Department shall be taken to reduce the negative impacts of night lights (as amended).

34. That future buyers of the lots shall be informed that there may be potential waste from the old mill site (Olowalu Mill) and other vacated agricultural industrial areas. Remedial cleanup must be conducted before any new development occurs.

35. That future buyers of the lots shall be informed of the survey monuments located within the boundaries of their lots which need to be protected from any development activities. Further, in the event the survey monuments are disturbed or destroyed during development of the subdivision or properties, it will be the responsibility of the applicant, assigns or successors to reference and replace the monuments.

36. That Condition Nos. 16, 17, 21, 24, 25, 26, 27, 28, 29, 30, 31, 33, 34, and 35 shall run with the land and shall be set forth in a unilateral agreement recorded by the applicant with the Bureau of Conveyances within sixty (60) days from the date of receipt of this decision. A copy of the recorded unilateral agreement shall be filed with the Planning Director and the Director of the Department of Public Works and Waste Management within ten (10) days of recordation.

The conditions of this Special Management Area Use Permit shall be enforced pursuant to Sections 12-202-23 and 12-202-25 of the Special Management Area Rules for the Maui Planning Commission.

Further, the Commission adopted as its Findings of Fact, Conclusions of Law, Decision and Order the Planning Department's Report and Recommendation Report prepared for the September 12, 2000 meeting and authorized the Planning Director to transmit said Decision and Order for the Commission.

Thank you for your cooperation. If additional clarification is required, please contact Ms. Colleen Suyama, Staff Planner, of this office at 270-7735.

Very truly yours,

JOHN E. MIN
Planning Director

JEM:CMS:cmb
c: Clayton Yoshida, AICP, Deputy Planning Director
Aaron Shinmoto, Planning Program Administrator (2)
LUCA (2)
Department of Water Supply
Michael Munekiyo, AICP, Munekiyo, Arakawa & Hiraga, Inc.
Patricia Nishiyama, Na Kupuna O Maui
Ed Lindsey
Buck Buchanan
Timothy Johns, Department of Land and Natural Resources
Kazu Hayashida, Department of Transportation
James Nakatani, Department of Agriculture
Gary Gill, Department of Health
Colleen Suyama, Staff Planner
Project File
General File
(K:\\Planning\SM1\99SM121\99SM121v)

APPENDIX ~~Q~~T.

Community Meetings

OLOWALU TALK STORY

Vol. 1 No. 1 November 2005 Olowalu.net

Olowalu is one of the larger valleys in West Maui. Photo circa 1998

A COMMUNITY-BASED PLANNING WORKSHOP

Bill Frampton

By Bill Frampton

ALOHA

Thank you for taking the time to read this message that has been mailed to your home by our newly formed company, Olowalu Town, LLC. The purpose of this newspaper is to respectfully request that you join us for "Olowalu Talk Story: Community Based Planning Workshop" to provide your thoughts on re-establishing a sustainable community at Olowalu.

WE GREW UP IN SMALL TOWNS

First, we would like to introduce ourselves. We are Bill Frampton and Dave Ward. Both of us come from small towns. Dave was raised in New Bern, North Carolina and I was raised here on Maui in Kula. The two of us met many years ago during our days of canoe racing together at the Hawaiian Canoe Club and have since become great friends, as well as, business partners.

Historically, Maui has been an island of separate and distinct communities. However, many of us have watched over the years as distinct small towns and communities have become blurred together, traffic has become more and more congested, and questions have been raised about a future where we do not know our neighbors, affordable housing is scarce and there are no stores or parks that we can walk to.

Dave Ward

We honestly believe there is a better way - a way to balance the need for homes and jobs with a respect for the natural environment and our irreplaceable culture. Subdivisions should not sprawl between communities; instead separate and distinct communities should be established that have multiple types of housing (affordable, senior, market), schools, civic centers, fire and police stations, medical facilities, childcare, parks, recreational opportunities, walkways, bike paths, and neighborhood businesses.

COMMUNITY DRIVEN PROCESS

This opportunity to work together to create a livable community is right now before us; however, this needs to be done right. It needs to involve a sincere public outreach process from the start, it requires that both private and public professionals work together. Also, the update of the County's General Plan needs to be recognized and taken into account. A proposed community-based planning process could produce an informative plan which, along with various land use studies, can be used to compliment the General Plan update process. Informed decisions can then be made with a plan that is driven by sincere community input.

We believe that now is the time to work together with the County for the establishment of a sustainable and livable community.

This new company, Olowalu Town, LLC, is committed to creating a community at Olowalu based on the above ideas. Dave and I have formed Olowalu Town, LLC with the existing owners of Olowalu. In this new company, Dave and I are the "developers" or the decision makers in the company. Right away, we recognized that we needed to bring in a professional with specific expertise in planning and design of sustainable communities. As such, we hired a distinguished planner: Mr. Andres Duany of Duany Plater-Zyberk & Company (DPZ).

DPZ will be leading our week long community based planning workshop. DPZ is a world-class firm that has designed and planned over 300 communities nationally and internationally. DPZ is very much looking forward to being our lead design team and they are hopeful to have significant participation from the community. As such, we are requesting your assistance to provide our design team with valuable information regarding what is important to all of us on Maui.

YOUR KOKUA IS MUCH APPRECIATED

We are respectfully requesting that you consider joining us for the planning workshops. The planning workshops will be held over several days beginning on Tuesday, November 15th, with our opening session from 5:30 PM to 7:30 PM, at the King Kamehameha Clubhouse on Hono'opiliani Highway in Waikapu, and ending with the Closing Presentation on Monday, November 21st, from 5:30 PM to 7:30 PM, at the same location. Pupus and refreshments will be served at each event. A full schedule of all sessions and meetings is included on Page 8 in this paper (Back Page). All sessions and meetings are free and absolutely open to the public.

Again, Dave and I are pleased to invite you to attend our planning workshops to share and provide our design team with valuable information regarding what is important to you in creating a community at Olowalu. The future of Olowalu will come from the suggestions and ideas that arise as a result of your participation in this unique event.

Thank you for your time and consideration. If you have any questions or would like additional information, please feel free to contact us at 249-2930. A hui hou.

MAHALO

FROM AHUPUA'A TO PLANTATION:

A HISTORY OF OLOWALU

For centuries, the ancient Hawaiians of Olowalu Valley flourished as a community based on the Hawaiian concept of Ahupua'a, a land division extending from the mountains to the sea.

Learn more about Olowalu's history at: OLOWALU.net

Mr. Kyutaro Kawasaki and family, proprietor of the Olowalu Nihonjin Shokai (Japanese Store).

Students and teacher, Richard Ho'opi'i, of the Olowalu School, circa 1915. Ray Jerome Baker, Bishop Museum

By Gail Ainsworth

The Ahupua'a system allowed Hawaiians to thrive as they were able to grow breadfruit and taro in the higher areas and sweet potato and coconuts closer to shore. The sea provided fish and the forest supplied wood for canoes and housing. A Hawaiian born in the valley could learn a skill, raise a family, trade, play, work, and worship within the Olowalu Ahupua'a.

An incident at Olowalu turned the tide of post-contact Hawaiian history. In 1790 Hawaiians stole a boat from the American ship Eleanora and killed a sailor, infuriating Captain Simon Metcalfe. To retaliate, Metcalfe sailed to Olowalu, assured the villagers of peaceful trading, and then opened fire killing more than 100 Hawaiians. This tragedy, termed the Olowalu Massacre, set into motion a series of events which left two Western seamen and a ship in the hands of the ambitious Big Island chief Kamehameha. With these advantages, Kamehameha ultimately triumphed in the race to unite the Hawaiian Islands.

MISSIONARIES AND SUGAR

Both Protestant religion and education came to Olowalu in the 1820s when the Reverends William Richards and Charles Stewart traveled from Lahaina by canoe to preach and teach. In 1835 Reverend Ephraim Spaulding built the first church, a small adobe structure which was later replaced by one made of stone. A decade after the Protestants' arrival, Father Modest Favens baptized Catholic converts at Olowalu, although it would not be until 1916 that the permanent St. Joseph Church was built.

The sugar industry came early to Olowalu. In 1864 King Kamehameha V, then ruler of the Hawaiian Kingdom, invested in the newly-formed West Maui Sugar Company. He was only one of many subsequent owners of the plantation, later called the Olowalu Sugar Company. The company boomed, requiring the hiring of Chinese workers, followed by Portuguese, South Sea Islanders, Germans and Japanese.

King Kamehameha V — R.L. Chase, Bishop Museum

CULTURAL MIX

The ethnic mix changed again in the 20th century with the importation of Puerto Rican, Korean and Filipino workers.

The multi-cultural residents of Olowalu shopped at the Olowalu Nihonjin Shokai (Olowalu Japanese Store) and C. Sam Lung & Company, a general store and coffee saloon. Students attended the one-room Olowalu School, and the Olowalu Japanese Language School taught Japanese children the culture of their homeland.

The sea provided the primary contact with the outside world. For decades, the Inter-Island Steamship Company picked up and delivered mail, freight and passengers at Olowalu Landing. The world also entered the Olowalu community through regular showings at the Olowalu Theater.

The 1930s brought more change to Olowalu. In 1931 Pioneer Mill Company purchased Olowalu Sugar Company; Olowalu School closed, requiring children to travel to Kamehameha III School in Lahaina; and M. Ichiki Store replaced the C. Sam Lung Store.

FAMILY

Despite many changes over the years, the community remained close. Workers lived in small camps with names such as Filipino Camp, Beach Camp, and Makimoto Camp. Much of the community was sports-crazy, children and adults alike. Plantation families worked hard and lived a frugal life, many of them growing vegetables and fruit trees, raising chickens and fishing. Everyone knew each other; neighbors shared and took care of those in need.

Most of the community dispersed when company housing was phased out. Even though the plantation camps had disappeared, professional sports hero Wally Yonamine returned often to his hometown of Olowalu because, he said, "When I go there, it helps me look back over time. Olowalu still makes me feel humble."

Olowalu Sugar Mill and Oceanside Camp. Hawaii State Archives

Illustration from The Hawaiian Thatched House by Russell A. Apple.

SUSTAINABLE DEVELOPMENT IS NOT NEW TO HAWAI'I, LEARNING FROM THE PAST CAN HELP US PLAN A BETTER MAUI

By Bill Frampton

The delicate balance of "Environment and Sustainable Development" is a key concept that provides an answer to the question of how humankind can coexist in harmony with nature. Not surprisingly, this concept is nothing new to the Islands; sustainability was a way of life for the ancient Hawaiian societies. One way this was exemplified was the Ahupua'a, the genius organizational structure designed by the Hawaiian culture as self-supporting communities. Ahupua'a were planned and managed with great care, sensitivity and wisdom to ensure the prolonged existence of natural and cultural resources.

John Kaimikaua, Kumu Hula and educator from O'ahu, explains the guiding principles of managing the ancient Ahupua'a[1] as follows:

Kai Moana
Preserve all life in the ocean, from the shoreline to the horizon.

Makai
Respect for the land and resources extending from the shoreline to the sand's reach.

Mauka
Respect for the land and resources extending from the sand's edge to the highest mountain peak.

Kamolewai
Respect for all water resources including rivers, streams, and springs and the life within.

Kanakahonua
Preserve and respect the laws of the land and each other to insure the community's health, safety and welfare.

Kalewalani
Respect for the elements that float in the sky including the sky, moon, clouds, stars, wind and rain which guide the planting and fishing seasons, provide water and create the tides and directions for ocean navigation.

Kapahelolona
Preservation of the knowledge of practitioners.

Ke'ihi
Preservation and respect for the sacred elements including deities, ancestors, the forces of nature and ceremonial activities.

Notes:

[1] John Kaimikaua's principles can be found at: hawaii.gov/dbedt/czm/todays_challenges/principles.html.

For more information on the Ahupua'a and Green development please visit: Olowalu.net

Planning for a Better Maui

The planning of a sustainable community at Olowalu presents an incredible opportunity to interpret the ancient principles of the Ahupua'a within a contemporary context. Ironically, today's principles of "Smart Growth" and/or "Traditional Neighborhood Design" are very similar or identical to the land stewardship principles of mālama 'aina, or having great care and respect for the land. Sustainability is defined as: creating a healthy balance between the needs of our culture, our economy, and the environment so that the rights for a healthy future for all living things are protected and nourished. We are committed to creating and developing a community that is founded upon sustainable land use principles.

Why Green Development?

"Many developers fear that following a green agenda will delay project schedules and raise costs. ... The reality, however, is that well-executed green development projects... perform extremely well financially. In fact, even though many of the leading-edge developers... have strong environmental backgrounds and ideals, the financial rewards of green development are now bringing mainstream developers into the fold at an increasing pace. It is possible - indeed it is the norm - to do well financially by doing the right thing environmentally. For example, project costs can be reduced, buyers or renters will spend less to operate green buildings, and developers can differentiate themselves from the crowd - getting a big marketing boost".

Source: Rocky Mountain Institute

By DPZ Staff

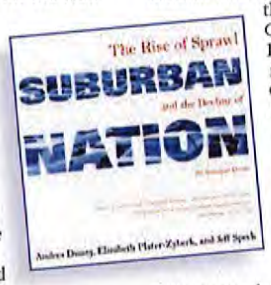
About DPZ

DUANY PLATER-ZYBERK & CO.

Mr. Andres Duany

Celebrating its 25th year in 2005, Duany Plater-Zyberk & Company (DPZ) is a major leader in the practice and direction of urban planning, having designed over 300 new and existing communities in the United States and overseas.

DPZ's projects have received numerous awards, including 2 National AIA Awards and 2 Governor's Urban Design Awards for Excellence. The firm is led by its Principals, Andres Duany and Elizabeth Plater-Zyberk, who are co-founders of the Congress for the New Urbanism (CNU), recognized by the New York Times as "the most important collective architectural movement in the United States in the past fifty years." The movement, currently over 3,000 strong, marked a turning point from the segregated planning and architecture of post-war America; instead, they advocated and promoted the universal and time-tested principles of planning and design that created the best-loved and most-enduring places throughout the world.



Duany and Plater-Zyberk's recent book, Suburban Nation, written with Jeff Speck, was hailed as "an essential text for our time," and "a major literary event," in the national media. In 2004, Builder Magazine recognized Duany as the 5th most influential person in home building, the ranks of which included economists, bankers and developers, apart from architects, planners and builders. Duany was ranked after Alan Greenspan, Franklin Rainee, George W. Bush and Jerry Howard, earning Duany the distinction of being the top ranking individual from the private sector. Duany sits on the board of the National Town Builders Association, and Plater-Zyberk shepherds the Knight Program in Community Building, a program that brings an interdisciplinary approach to the revitalization of inner cities. These and other efforts have earned Duany, Plater-Zyberk, and the firm at large international recognition and dozens of local and national awards, including the Thomas Jefferson Medal and the Vincent Scully Prize from the National Building Museum in recognition of their contributions to the American built environment.

Most recently, in response to the devastation of Hurricane Katrina and upon the request of Mississippi Governor Haley Barbour, DPZ is coordinating the rebuilding of eleven Gulf Coast towns for the CNU. Duany is heading the effort, and has organized a task force of over 100 New Urbanists, as well as local experts and officials. These professionals – including architects, planners, and transportation specialists – are currently completing a workshop dedicated to the renewal of the Mississippi coast. All are working at little or no cost. To find out more about DPZ please visit www.DPZ.com

DPZ's Miami Office.

"DPZ will set up a fully equipped design studio to draw up the concepts discussed by the community during the planning workshops. The illustrations are then presented back to the community for their immediate feedback and refinement. This 'real time' communal planning process is one of the reasons we are bringing DPZ to Maui."

Bill Frampton

THE WORKSHOP

Olowalu Talk Story Community-Based Planning Workshop

By Dave Ward and DPZ Staff

This Planning Workshop is an intensive one-week planning session where Maui citizens, public agencies, world-class town designers, and other interested groups collaborate to create a vision for re-establishing a sustainable community at Olowalu. Everyone on Maui is invited and encouraged to participate in the workshop. It provides a forum for ideas and offers the unique advantage of giving immediate feedback to both the designers and workshop participants. More importantly, it allows everyone who participates to be a mutual author in the plan to re-establish Olowalu.

Olowalu Talk Story will be held from November 15th-21st at the King Kamehameha Clubhouse (former Grand Waikapu Country Club) in Waikapu. The team of design experts and consultants will set up a full working office, complete with drafting equipment, supplies, computers, copy machines, fax machines, and telephones. Members of Duany Plater-Zyberk & Company will lead public meetings throughout the week focusing on important land use topics. Additionally, everyone is invited to participate in informal "open design meetings" while plans are actively being developed.

Through brainstorming and design activity, many goals are accomplished during the Planning Workshop. First, each individual who participates cultivates a personal stake in the ultimate vision. Second, the world-class design team obtains critical information about "how we live on Maui" to produce a plan and accompanying documents that address our local culture and aspirations apart from the physical aspects of design. Finally, since the input of various groups is gathered at one event, it is possible to hear many concerns, swiftly resolve issues, forge a common way forward and create a balanced plan during the workshop.

Ultimately, the purpose of Olowalu Talk Story is to establish a plan for Olowalu that reflects the collaboration of Maui's community ideas with world-class design concepts. Such a plan may be utilized in making sound decisions for future planning processes.

We need your help to integrate community ideas into a plan to re-establish a sustainable community at Olowalu. Food and refreshments will be provided at the meetings so bring your stories, ideas, dreams, and concerns to participate in Olowalu Talk Story.

Olowalu Stream.

"FLOWERS THRIVE WHERE THERE IS WATER"

By Senen Antonio, Architect and Planner, DPZ

There is a Hawaiian saying that goes "Mohala i ka wai ka maka o ka pua". Translated, it means "Flowers thrive where there is water", or "Thriving people are found where living conditions are good."[1] The pattern of human settlement in Maui and the other islands, as evidenced by early Ahupua'a, had historically been influenced by this tenet, which suggests not only environmental sustainability, but social and cultural sustainability as well.

Unfortunately, many of the more recently developed communities in the islands have not always been guided by this philosophy.

Maui, and Hawaii at large, is continually evolving, as social, economic, political and technological changes and advancements demand new or altered forms and functions for places. These random demands of modern life increasingly threaten the fabric, and eventually the livability, of our towns and cities. Population growth and migration, transportation and infrastructure demands and expectations for a higher standard of life bear upon the quality of the built environment, and, until recently, often with unsatisfactory results.

In response to these pressures, several concerned architects, urban designers and planners banded in the late 1980s with the goal of reforming the built environment through a return to Traditional Neighborhood Development (TND). Their response brought attention to the crisis of ad hoc urban development, and in turn they proposed a less wasteful alternative to suburban sprawl. Some twenty years later, TNDs can now be seen on the ground in the United States, and indeed around the world in new communities, in the revitalization of older neighborhoods and downtown districts, in metropolitan and regional growth plans, and even in the retrofitting of suburban shopping centers.

The basic principles behind the movement are universal. They promote the creation of real communities with pedestrian-oriented neighborhoods, mixed uses and streets shaped by buildings and landscape. The movement has grown to broad application, its principles extending to a wide range of development contexts, densities and design. The principles project an ideal of a sustainable quality of life that competes with the American suburban dream.

At the regional level the movement promotes environmental and agricultural conservation, as well as the equitable distribution of public transportation and housing, so that important destinations such as employment, cultural and recreational centers are served by public transit. At the neighborhood level TNDs promote compact, mixed-use, mixed-income, pedestrian-friendly increments of community building. Appropriate detailing of public space such as streets, and their interface with private buildings, is important to ensure the comfort and safety of the pedestrian. The varying degrees of density and their corresponding built forms are governed by the Transect — an organizational concept which proposes appropriate detailing (lot sizes, road widths, building form and function, etc.) according to each development's classification within a continuum from a more rural to more urban context.

Traditional Neighborhood Development in the Hawaiian context, via a strong focus on traditional neighborhood development and the public engagement process, offers unique opportunities for capitalizing upon and reinforcing the innate sense and feeling of community. This is achieved by focusing on the unique story of each community towards developing and nurturing the special, appropriate balance of uses and activities in the area; leveraging investments in projects like civic/community facilities and spaces to complement and enhance private initiatives; strengthening the existing and emerging development context; and protecting culturally and environmentally significant sites and areas. Our towns and cities should present a mix of uses and activities for the neighborhood, where residents, workers and visitors can walk the streets, meet and engage each other and walk between destinations. They must offer places to live, work, shop and eat; provide opportunities for cultural enrichment, learning and recreation; and present each community at large with an identifiable center, a gathering place and a common ground for celebrating and sharing stories.

Traditional Neighborhood Development in Hawaii brings the tremendous opportunity to mitigate the threat of continued sprawl on the islands and instead create and enhance compact communities that are great places to live, work, visit and recreate; that become important foci of community pride and are economically successful, as well as environmentally and culturally sustainable, developments.

Olowalu provides a dramatic setting for the proposed development like no other locale: set against the emerald lushness of West Maui Mountains, from which the Olowalu Stream emerges and meanders through the site, before finally reaching the blue expanse of the Au'au Channel on the site's edge, all under a perfect azure canopy of sky. Olowalu presents the opportunity to create a new town guided by principles of sound development and growth, and by a strong sense of community life responsive to the land and local culture, all in the spirit of caring for Olowalu's future.

[1] From 'Olelo No'eau: Hawaiian Proverbs and Poetical Sayings, No 2178. Collected, translated and annotated by Mary Kawena Puku'i, 1983.

Hawaiian Hale, Iao Valley State Park.

Olowalu Petroglyphs. Maui Historical Society, Bailey House Museum

FOCUS MAUI NUI

By Bill Frampton — Focus Maui Nui (FMN) provided a unique opportunity for Maui County residents to define a common vision for the future of Maui. FMN was a successful grass-roots effort in which the community voiced their goals, desires, and needs regarding the future of Maui County. FMN was able to reach approximately 1,700 residents who represented a statistical, cultural, political and demographic cross section of the community. With this information, FMN produced "Recommended Strategies" and "Core Values" which can be utilized to help guide the future growth and direction of Maui. The vision and planning of a new livable and sustainable community in Olowalu will draw on FMN's "Recommended Strategies" and "Core Values" listed below:

RECOMMENDED STRATEGIES:

- Improve Education;
- Protect the Natural Environment;
- Addressing Infrastructure Challenges, especially Transportation and Housing;
- Strengthening the Economy; and
- Preserving Local Culture and Traditions, Addressing Human Needs.

CORE VALUES:

- Stewardship of Natural and Cultural Resources;
- Compassion and Understanding;
- Respect for Diversity;
- Engagement and Empowerment of Local People;
- Honoring Cultural Traditions and History;
- Consideration of the Needs of Future Generations;
- Commitment to Local Self-sufficiency;
- Wisdom and Balance in Decision Making; and
- Thoughtful, Island-appropriate Innovation.

Check out FMN at: FOCUSMAUINUI.com

DPZ'S MAUI HOLOHOLO

By Dave Ward — Duany Plater-Zyberk (DPZ) understands that Maui has a unique cultural, recreational, environmental, and architectural heritage to integrate into the Olowalu town design.

In late August, three members of DPZ's design team made a week long trip to Maui. The team visited Lahaina, Pa'ia, Wailuku, Makawao and various other Maui communities, attended a class on the Hawaiian culture/language, met with various members of the community, and explored Olowalu.

Aside from these activities, the team gathered a bunch of books and even a Rap Reiplinger DVD to share with other designers in preparation for the November Community-based Planning Workshop.

When the DPZ team arrives in November, the entire 12-member team will holoholo to enlighten DPZ's appreciation of Maui's special sense of place. Planned activities for the team include:

- Participate in Blessing Ceremony for the Workshop
- Tour the Olowalu site to view existing uses and the physical characteristics of the land
- Guided hike thru Honokowai Valley to better understand the environment, history, and culture of Maui
- Meet with Olowalu Residents
- Attend a Cultural Class by local cultural/historical advisors
- Tour Wailuku, Pa'ia, Makawao, Lahaina, and Upcountry with local architects
- Attend a presentation on results of Focus Maui Nui

The DPZ team is looking forward to working with the Maui community to ensure that Maui's special qualities are incorporated into a plan for Olowalu.

Boys playing at Kula Community Park.

East Maui from Olowalu beach.

Maui homes, circa 1902-1903. Kittie Gay Burkland (Hawaii State Archives)

Makawao's landmark store.

TRADITIONAL TOWN PLANNING CONCEPTS

By Tom Low, DPZ — Certain physical and organizational characteristics result in social and environmental benefits of Traditional Neighborhood Developments (TND). These characteristics include most of the following:

1. The Neighborhood has a discernible center. This is often a square or green, and sometimes a busy or memorable street intersection. A transit stop may be located at this center.
2. Most of the dwellings are within a five-minute walk of the center. This distance averages one-quarter of a mile.
3. There are a variety of dwelling types within the Neighborhood. These usually take the form of houses, rowhouses and apartments, such that younger and older people, singles and families, the poor and the wealthy, may find places to live.
4. There are shops and offices at the edge of the Neighborhood. The shops should be sufficiently varied to supply the weekly needs of a household. A convenience store is the most important among them.
5. A small ancillary building is permitted within the backyard of each house. It may be used as one rental unit, or as a place to work.
6. There may be an elementary school in the Neighborhood. The school should be close enough for most children to walk from their homes.
7. There are small playgrounds quite near every dwelling. This distance should not be more than one-eighth of a mile.
8. The streets within the Neighborhood are a connected network. This provides a variety of itineraries and disperses traffic congestion.
9. The streets are relatively narrow and shaded by rows of trees. This slows down the traffic, creating an environment for the pedestrian and the bicycle.
10. Buildings at the Neighborhood center are placed close to the street. This creates a strong sense of place.
11. Parking lots and garage doors rarely enfront the streets. Parking is relegated to the rear of buildings, sometimes accessed by alleys.
12. Certain prominent sites are reserved for civic buildings. Buildings for meeting, education, religion or culture are located at the termination of street vistas or at the Neighborhood center.
13. The Neighborhood is organized to be self-governing. A formal association debates and decides on matters of maintenance, security and physical change (but not on taxation which should be the responsibility of the larger community).

Learn more about Olowalu at: OLOWALU.net

Makawao; mixed use makes for a lively Town Center.

Keopuolani Regional Park. Linn Nishikawa

OLOWALU TALK STORY

Come help re-establish a sustainable community at Olowalu. www.olowalu.net

Olowalu Town, LLC
2073 Wells Street
Suite 101
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NOVEMBER

15 TUESDAY

OPENING PRESENTATION
5:30 p.m. - 7:30 p.m.
Public meeting. Opening ceremony, introduction of the consultant team, discussion of Traditional Neighborhood Design, and overview of the format of the planning workshops. Heavy pupus/snacks & refreshments.

All meetings will be held at the at the Kamehameha Country Club, (formerly the Grand Waikapu Country Club)

To talk story with Bill or Dave, please use the contact information below:

Olowalu Town, LLC
2073 Wells Street
Suite 101
Wailuku, HI 96793

Phone: 808-249-2930
E-mail: talkstory@olowalu.net
Web Site: www.olowalu.net

16 WEDNESDAY

Highway Traffic
9:30 a.m. - 11:30 a.m.
Public discussion of traffic issues, concerns, solutions, possible relocation of Honoapi'ilani Highway, Access Management Plan, Light food/snacks & refreshments.

Open Design
1:30 p.m. - 4:00 p.m.
Informal review period open to the community, Public encouraged to browse and observe physical drafting of plans/concepts, Team available for questions, Light food/snacks & refreshments.

Recreational Resources
4:30 p.m. - 6:30 p.m.
Public discussion of need for recreational resources, parks, shoreline access, fishing, surfing, camping, open-space, snorkeling. Light food/snacks & refreshments.

17 THURSDAY

Infrastructure Systems
9:30 a.m. - 11:30 a.m.
Public discussion of infrastructure needs, vehicular and pedestrian ways; street size/widths, water, wastewater, utilities, private and public systems, Light food/snacks & refreshments.

Open Design
1:30 p.m. - 4:00 p.m.
Informal review period open to the community, Public encouraged to browse and observe physical drafting of plans/concepts, Team available for questions, Light food/snacks & refreshments.

PROGRESS REPORT PRESENTATION
5:30 p.m. - 7:30 p.m.
Public presentation of current plans based on workshops held to date, Plans to be reviewed and discussed, Receive feedback from participants, Light food/ snacks and refreshments.

18 FRIDAY

Public Facilities, Social & Civic Amenities
9:30 a.m. - 11:30 a.m.
Public discussion of need for public services, social & civic amenities, school, medical, fire/police, Public and Private services and amenities. Light food/ snacks & refreshments.

Country-town Business / Commercial
1:30 p.m. - 3:30 p.m.
Public discussion of business & commercial needs, location, types and size. Light food/snacks & refreshments.

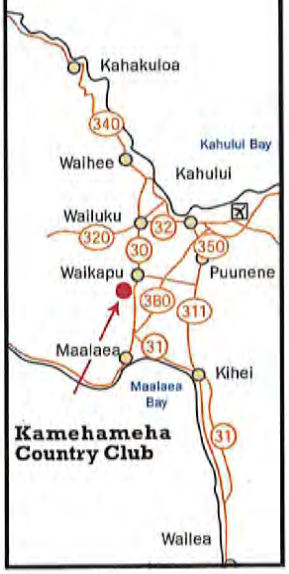
Residential
4:30 p.m. - 6:30 p.m.
Public discussion of residential needs, affordable, senior, market, rental, multi-family and single-family. Light food/ snacks & refreshments.

19 Saturday - Off

20 Sunday - Off

21 MONDAY

ALOHA PRESENTATION
5:30 p.m. - 7:30 p.m.
Public presentation of the Olowalu plan based on planning workshops, Discussion: Where Do We Go From Here? Heavy pupus/snacks & refreshments.



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Olowalu Town
BY MAUI, FOR MAUI

SPRING/SUMMER 2007 | VOL. 2 NO. 1 OLOWALU TOWN, LLC LEARN MORE AT OLOWALU.NET

A Community for Maui's Families

Aloha

In November 2005, we invited the residents of Maui to attend Olowalu Talk Story, a weeklong community-based planning workshop. The purpose of the workshop was to provide the residents of Maui with an opportunity to come together to discuss the reestablishment of a community at Olowalu.

The workshop did not begin with a pre-determined town plan; rather it began with a blank slate. Our hope was to work with the community to create a plan for Olowalu that reflected both Maui's small town values and innovative design concepts. Over 1,350 participants came to Olowalu Talk Story and made our workshop a successful community-based planning effort.

A Town for Maui Residents

At Olowalu Town, we have pledged to develop a community where Maui's residents can afford to live and raise families. A community where schools, stores, community centers, parks, ball fields, beaches/shoreline, and other civic resources will be within walking distance of residents' homes. A place designed to offer residents an opportunity to live and work in the same community, minimizing reliance upon cars.

Small Town Maui

Historically, Maui's small towns have been defined by distinct boundaries that helped maintain the size, scale, and unique character of each community. Each town and community had its own sense of place. People knew their neighbors and could walk to stores, parks, and schools. These towns helped bring us together and families looked out for each other.

However, over the past several decades, our towns have grown outward into the surrounding agricultural lands and open space. The distinct sense of place which characterized many of our small towns has become blurred by this development trend, also known as suburban sprawl. If allowed to continue, suburban sprawl will have adverse effects on our cultural and social settings, traffic congestion, housing for local residents, economic conditions, and natural resources.

Stopping Sprawl

There is a solution to suburban sprawl. There is a better way to plan for the future of Maui. Our lead architect, Andrés Duany, has successfully utilized the design principles of Traditional Neighborhood Design (TND) to prevent or halt suburban sprawl in locations across the country. In doing so, he has preserved and created a number of unique communities. These design principles promote the development of communities that are pedestrian friendly, offer a wide range of housing opportunities, and allow residents to live within walking distance to corner stores, schools, parks, and community centers. Our hope is to adapt these successful design principles to guide the reestablishment of a community at Olowalu that will reflect our island environment, native architectural traditions, and local building techniques.

What We Believe

We both grew up in small towns and we share small town values. Our families are here and this is where we are raising our children. We believe that our island should be focused on building communities for the residents of Maui, as opposed to only constructing new housing units. In the larger picture we are hopeful that our Olowalu Town project will help change how all of us manage growth and make decisions regarding the future of Maui.

We recognize and greatly respect that changing our ways is a bold proposal; however, we believe that it is necessary to step back and reconsider how we plan for growth and development on Maui. We need to be asking the hard questions: What are we doing to preserve the character of Maui? Are we building communities, or are we just continuing to encourage sprawl? Are we serious about creating a sustainable island? How do we manage and protect our natural resources, yet continue to sustain a healthy and viable economy for future generations to come?

E Komo Mai

We sincerely appreciate you taking the time to read our newspaper, and we hope that it informs you about our vision and conceptual plans for Olowalu Town. We are committed to continuing our community-based planning efforts to help further refine the conceptual plans. We welcome your comments and encourage discussion of our plans. Please contact us by email at: talkstory@Olowalu.net or call us at 249-2930. You can also visit our website at: www.Olowalu.net. Ahui Hou.

Mahalo,
Bill Frampton and Dave Ward

Island of Small Towns 2

Olowalu is based on the tradition of Maui's small towns that historically have helped shape our values and principles and define who we are.

Housing for Everyone 6

Olowalu Town will offer a wide range of housing for Maui residents, including affordable, gap-group, below market, senior, live-work, market, single-family, multi-family, and rentals.

Traffic Relief 8

Olowalu Town will help reduce traffic by being a community where residents can walk to stores, parks, schools, civic centers and even to work. Our plans include building a new mauka Honoapi'ilani Highway through Olowalu.

Parks and Open Space 9

Over 200 acres of parks, open space, beaches, greenways, trails, and bikeways will make Olowalu a healthy community. Public access to the shoreline for surfing, fishing and enjoyment will be preserved and enhanced.

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Makawao, Wailuku, and Pala are good examples of sustainable communities that provide residents with daily needs and services, while maintaining their small-town character.

Sustainable Communities are Not New to Maui

Maui is an island of small towns and communities, each separate and distinct.

Pala, Makawao, Wailuku, Lāna'i City, and Lahaina Town are good examples of sustainable communities that provide residents with their daily needs and services while maintaining their small-town character. Until recently, these communities were surrounded by large tracts of agricultural land and open space.

Historically, our host Hawaiian culture demonstrated how to build sustainable communities that respect natural resources through the ahupua'a system. The Hawaiians developed the ahupua'a system in order to balance the needs of the environment, community, and economy.

Over the past few decades grass roots planning efforts in Maui County, such as Decisions Maui, Focus Maui Nui, and other events, have reiterated that our residents desire to balance stewardship of natural resources with community and economic needs.

"In the midst of today's intensity, refreshing effort is being made to capture by design the healthy attributes of the village."

In the days when villages dotted the hillsides and valleys and un-trampled meadows stretched for miles, human spirits were nourished by their lush and inviting surroundings. Such tranquility could only lead to serene, peaceful, creative inhabitants.

In the midst of today's intensity, refreshing effort is being made to capture by design the healthy attributes of the village. Beginning with the involvement of Maui's people, the conceptual process encouraged cooperation and emotional ownership of a new attitude for future development on this island of limited space and abundant beauty."

Maui is ready for such a place. Let us anticipate with pleasure and hope the reawakening of community in the wholeness of a village.

Olowalu Village, we welcome you.

– ELIZABETH AYSON
Retired Principal; Iao Intermediate School

Preserving Maui's small towns and communities ensures that communities will be here for generations to come. By utilizing sustainable values and principles from the past and listening to Maui's residents, Olowalu Town hopes to balance the needs of Maui's growing families while maintaining our island's character and respecting the natural resources.

Sustainability: Balancing the needs of Community, Economy, and Nature. Olowalu Town proposes to reestablish a sustainable community by incorporating these design-related values and principles.

COMMUNITY

- Design small scale neighborhoods where you know your neighbors
- Provide wide range of housing types for all income levels and all stages of life
- Include community centers, meeting halls, and educational facilities close to homes
- Preserve historic and cultural resources to learn from the past
- Include social services, civic amenities, non-profits, and emergency services

ECONOMY

- Promote small shops, offices, and services that serve the daily needs of the community
- Include live/work units, office rentals, and office support systems
- Provide financial incentives for desired locally owned stores and emphasis on selling local goods
- Incorporate state of the art technology, communications, and high-speed connectivity

NATURE

- Provide recreational opportunities for good health and well being
- Include innovative green infrastructure systems to minimize impacts upon natural resources
- Utilize efficient land use that preserves open space and reduces the community's ecological footprint
- Exceed governmental storm water requirements to protect near-shore water quality and shoreline ecosystems
- Encourage landscaping with native plants that require less water
- Incorporate U.S. Green Building Standards (LEED) help conserve energy, fuel, and operation costs

Olowalu Talk Story Values

The Olowalu Talk Story Planning Workshop attracted 1,350 participants. The workshops asked the community to help design a small town at Olowalu. Through surveys and general discussions, the Talk Story participants confirmed that the following values and principles should help guide the Olowalu Town planning process:

- Protect the environment
- Preserve culture
- Improve infrastructure
- Address water needs
- Build affordable housing
- Improve public facilities
- Strengthen island economy
- Preserve and enhance shoreline access

Grass Roots Planning

The Olowalu Talk Story values are very similar to other resident responses from successful community-wide grass roots efforts over the past several decades on Maui including:

Focus Maui Nui (2004): A public planning effort that produced the community's goals, desires, and needs regarding the future of Maui County. The "Recommended Strategies" and "Core Values" are being utilized to help guide the update of the County's General Plan.

Decisions Maui (1990): A grass-roots planning effort, which arrived at core community values and priorities, ultimately helped to guide the update of Maui County's 1990 General Plan.

County of Maui Benchmark Study (2002): A household survey of residents countywide which arrived at seven top concerns for the county and local families.

Maui County Vision for Smart Growth (2001): Conducted by the Smart Growth Advisory Committee; arrived at twelve guiding principles to help achieve the smart growth vision.

Many overlapping themes and values identified in the above noted efforts included stewardship of natural and cultural resources, local self-sufficiency, respect for cultural traditions and history, and compassion and wisdom in decision-making.

Olowalu Town Community Benefits

Our goal for Olowalu Town is to reestablish a small town community that reflects the vision, values and goals of Maui's citizens and families.

1. A community where Maui's families can afford to live
2. A mixed-use community with homes close to parks, schools, corner stores, beaches, community centers, town centers, etc.
3. A wide range of housing types for all ages and all income levels
4. Plans include the construction of bypass highway through Olowalu, in conjunction with first phase
5. Over 200 acres of parks and open space (1/3 of the project) including preservation and enhancement of public shoreline access
6. Infrastructure systems at no cost to the County
7. Neighborhood town centers to provide community with economic sustainability, employment opportunities, and local business opportunities
8. Innovative infrastructure systems designed to have minimal adverse impacts upon the environmental resources
9. Exceed government regulations for drainage and storm water runoff to protect shoreline ecosystems
10. Innovative "O-Turn" on bypass highway allows cars to flow without stopping with no street lights or over/under passes
11. New bypass highway designed to accommodate light rail or mass transit
12. Existing Olowalu Cultural Reserve along stream expanded and enhanced to include mauka and makai trail system with educational/interpretive program
13. Walkable town reduces the number and length of automobile trips, reduces traffic congestion, conserves fuel/energy, and lowers emissions
14. Design team and architects certified by U.S. Green Building Council for Leadership in Energy Efficiency Design (LEED)

This project is planned to be a LEED-certified Neighborhood Development. The LEED for Neighborhood Development Rating System integrates the principles of smart growth, new urbanism, and green building. Certification provides independent, third party verification that the development's location and design meet accepted high standards for environmental responsibility and sustainable development. You can learn more at www.usgbc.org

Planning and Construction Timeline

2005-2007

Community-Based Planning

Early Consultation with Key Groups/People

Olowalu Talk Story

Community Outreach

In-House Conceptual Review

General Plan Advisory Committee Recommendation for Urban Boundaries

2008-2012

Permitting and Entitlement Process

Early Consultation and Notice of Environmental Impact Statement

Development of Technical Studies for Environmental Impact Statement

Public Review of EIS

Government Approval Process for Land Use Entitlements

Final Approval of Governmental Land Use Entitlements and Permits

2013-2018

Infrastructure Design And Construction

Final Design of Infrastructure

Construction of Initial Infrastructure Improvements Including: Phase 1 Water Improvements, Decentralized Wastewater Treatment, Drainage Systems

Construction of relocated Honoapiilani Highway at Olowalu

Occupancy of First New Residents at Olowalu

2019-2028

First Neighborhood Construction Phase

Residents live and work in Olowalu's first neighborhood center

Neighborhood stores, parks, educational facilities within walking distance

Affordable, rental, senior, single-family, multi-family, apartment housing options

2029-2038

Second Neighborhood Construction Phase

Residents live and work around Olowalu's second neighborhood center

Additional infrastructure improvements

Expansion of civic, social and community services

Continued Suggestions Improve Town Plan

We would like to thank the following groups, associations, and community leaders listed below for helping to improve our plans for Olowalu Town.

Over the past 18 months they have provided us with opportunities to share our plans with them.

Please note that those listed below have not provided us with official endorsements or approvals; rather, they have kindly provided us with valuable feedback and suggestions on how to improve our plans.

- American Institute of Architects
- County Department of Transportation
- County Mayor and Administration
- County Planning Department
- County Public Works Department and Environmental Management
- Filipino Centennial Chair
- Governor's Office
- Hawai'i Carpenter's Union Reps.
- Island Of the Worlds Conference on Sustainability
- Kahului Rotary
- Kihei-Wailea Rotary
- Lahaina Rotary
- Maui Chamber of Commerce - West Side
- Maui Coastal Land Trust
- Maui Contractor's Association
- Maui County Council Members
- Maui Economic Development Board
- Maui Economic Opportunity
- Maui Tomorrow Board of Directors
- Maui Young Business Round Table Leaders
- Maui Nui Housing Task Force First Time Home Buyers Conference
- Na Kupuna O Maui
- Office of Hawaiian Affairs
- Sierra Club Executive Committee
- State Association of Professional Engineers
- State Department of Transportation - Highways Division
- State Senators and House Members
- Tri-Isle Main Street Resource Center
- Wailuku Rotary
- Lahaina-Honolua Senoir Citizen Club
- West Maui Taxpayers Association
- West Maui Mountains Watershed Partnership

The First Steps of a Long Journey

We are currently completing the first steps of a long journey. The Olowalu Town project will be entitled and constructed over the next 25 to 30 years.

Community-based Planning phase. Highlights of this phase include:

- Olowalu Talk Story: 1,350 participants openly exchanged ideas with our design team during a weeklong event to help create the Conceptual Master Plan for Olowalu Town.
- Feedback: Presentations of plans have been made over past 18 months to various groups, associations, and community leaders. The purpose of these meetings was not to seek any endorsements or approvals, rather, the purpose was to seek suggestions on how to improve the plan.
- GPAC Process: We have committed not to begin our Entitlement and Permitting Phase until the General Plan Advisory Committee (GPAC) has reviewed and approved a Maui Island Plan.

Permitting and Entitlement: The next phase of the project is the Permitting and Entitlement Process which will include a request to change the existing land use designations from Agriculture to Project District (includes Urban and Rural Designations). Accordingly, this phase will involve a thorough public review and approval process, including:

- Preparation and Acceptance of an Environmental Impact Statement (EIS) Detailed and comprehensive review of project, technical studies, public meetings, and full disclosure of project's impacts upon natural and human environment.
- Land Use Entitlements Review and approval by the State Land Use Commission, the County Council, and Maui Planning Commission, with many public hearings and meetings.

Infrastructure Design and Construction: Once entitled, the project will begin infrastructure design and construction including the new mauka Honoapi'ilani Highway at Olowalu, internal roadways, parks/greenways, and water and wastewater systems. Ultimately, this phase will include families moving into a range of affordable, below market, and market homes.

Future Neighborhood Construction: With initial infrastructure in place, neighborhoods will begin to be established. Future construction of the project will include additional homes, business/commercial establishments, neighborhood town centers, additional infrastructure systems, space for civic/social services, and educational facilities.

Mahalo for taking time to read our paper. We hope that this report will provide you with helpful information that you can use as we continue our planning process for Olowalu Town.

Feedback: Your comments and feedback regarding Olowalu Town are welcome at our website at: www.Olowalu.net or by writing us at: Olowalu Town, 2073 Wells Street, Suite 101, Wailuku, Hawai'i 96793.

"It's a community where you can afford to live and raise a family."

I grew up in a small town where we know our neighbors, we looked out for each other, and we could safely walk or ride our bikes to the store, school, or church. Our pace of life was not so hectic; the quality of life on Maui was good. I know that Bill and Dave are concerned about the changes to our island, especially about the changes to our small towns and communities. Olowalu Town is designed to be a small town like the one I grew up in, a community where you can afford to live and raise a family.

– JON SANTOS
Raised in Haiku

Learning From The Past Can Help Us Plan For a Better Future

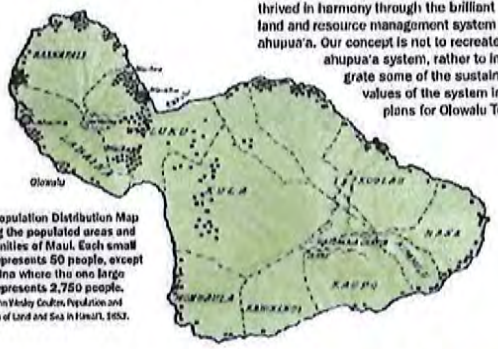
Olowalu: A Historic Population Center

It is clear from studying the historic settlement patterns of Maui that Olowalu has always been a location where people have chosen to live. Prior to Western contact, it is estimated that up to 2,000 Hawaiians were living and thriving in Olowalu. The Olowalu Ahupua'a had an abundance of natural resources. Hawaiians were able to grow breadfruit and taro in the higher areas and sweet potato and coconuts closer to the shore. The sea provided fish and the forest supplied wood for canoes and housing. A person born in the valley could learn a skill, raise a family, trade, play, and worship within the Olowalu Ahupua'a.

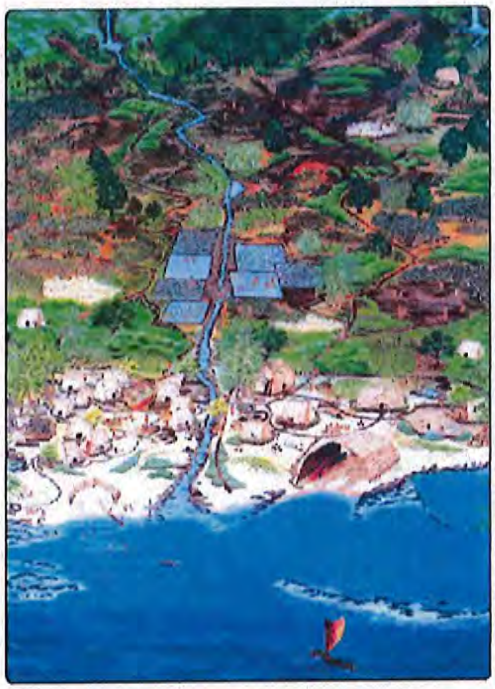
From historic times through the plantations days (see below), Olowalu has been a traditional location for a community. Only in recent times - because of the closure of the sugar mill - did Olowalu see its historic importance as a traditional population center decline. For more information about Olowalu's history please visit our website at www.olowalu.net

Learning From The Ahupua'a System

Sustainable development is not a new idea at Olowalu. For hundreds of years at Olowalu, a population of several thousand lived and thrived in harmony through the brilliant land and resource management system of ahupua'a. Our concept is not to recreate an ahupua'a system, rather to integrate some of the sustainable values of the system into the plans for Olowalu Town.



1853 Population Distribution Map showing the populated areas and communities of Maui. Each small circle represents 50 people, except in Lahaina where the one large circle represents 2,750 people. Source: John Wesley Coulter, Population and Utilization of Land and Sea in Hawai'i, 1853.



Ahupua'a Poster by Marilyn Kalahiwa, reprinted with permission of Kamehameha Schools Press. © 1992, 1993 by Kamehameha Schools. All rights reserved.

Eight Principles For Understanding And Managing The Ahupua'a

John Kaimikaua, the late kumu hula and educator from O'ahu, tells the story of how the ahupua'a evolved as a solution to the hardship and strife resulting from the depletion of natural resources. Communities had to learn to work together to take care of the land, and they formed the first stewardship organizations call the 'aha ki'ole, or people's councils.

This approach centers around the preservation of and respect for the natural resources that sustain a community over time. These concepts provide insight for the reestablishment of Olowalu Town.

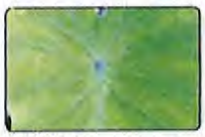
Learn more about John Kaimikaua's teachings at: Hawai'i.gov/dbedt/ezm/todays_challenges/principles.html.

KAI MOANA
Preserve all life in the ocean, from the shoreline to the horizon.

MAKAI
Respect the land and resources extending from the shoreline to the sand's reach.

MAUKA
Respect the land and resources extending from the sand's edge to the highest mountain peak.

KAMOLEWAI
Respect all water resources including rivers, streams, and springs and the life within.



KANAKAHONUA
Preserve and respect the laws of the land and each other to insure the community's health, safety, and welfare.

KALEWALANI
Respect elements that float in the sky including the sky, moon, clouds, stars, wind, and rain which guide the planting and fishing seasons, provide water, and create the tides and directions for ocean navigation.

KAPAHELOLONA
Preserve the knowledge of practitioners.

KE'IHI
Preserve and respect the sacred elements including deities, ancestors, the forces of nature, and ceremonial activities.

Learning from Plantation Days

The core values and principles of small town sustainability and balance were also found in plantation villages. As recently as 1930, Olowalu was a complete thriving plantation town including housing for employees, a school, medical facilities, stores, theater, athletic programs, and places of worship. Olowalu's plantation town integrated multi-cultural practices into daily life and was a multi-generational community where everyone knew each other, shared, and took care of those in need.

In the 1931 Olowalu plantation town, homes, jobs, and community services were all within a ¼ mile radius. This distance equates to a 5-minute walk.

The Land Guides Olowalu's Design

Olowalu Talk Story was a community-based Planning Process. It began with a blank slate, there was no predetermined plan.

As planning for the proposed community began, the design team learned about existing land conditions, natural resources, archaeological and historic sites, drainage patterns, climate, scenic resources, and other critical components. This information was then used as a framework for town planning.

Long-time families of Olowalu and some of Maui's most respected cultural and professional experts provided our Lead Architect and Planner, Andrés Duany, and his design team with invaluable information related to Maui's small town communities, natural environment, and cultural history. This information helped the design team appreciate and recognize the significance of Olowalu.

Geographic Boundaries

The steep valleys and slopes surrounding Olowalu serve as natural boundaries and help establish the size and scale of the community. The project site is situated at the foothills of the West Maui Mountains. The 620-acre project site is approximately 12% of the ever 5,000 acre Olowalu Ahupua'a.

Natural Resources

The design of Olowalu Town requires careful consideration of existing natural resources: the Olowalu Stream, a healthy shoreline ecosystem, abundant ocean resources, and recreational sites for surfing, fishing, diving, and snorkeling.

Historical and Cultural Resources

Olowalu area contains many significant archaeological sites and historical features including Ka'iwaloa (Kawalloa) heiau, Awalua Cemetery, historic burials, Pu'u Kilioa, petroglyphs, Kapaiki Village, the historic Olowalu Church, the Olowalu General Store, Olowalu Wharf, and the old Olowalu Sugar Mill. The preservation, enhancement, and protection of these sites and features shall be incorporated into the community design.

Cultural Reserve

The current Olowalu Cultural Reserve is approximately 75 acres. Plans include expanding the Cult ural Reserve to increase mauka to makai access and enhance educational opportunities.

1,350 Residents Participate in "Olowalu Talk Story"

"Olowalu Talk Story," a week-long series of workshops and general sessions attracted 1,350 participants.

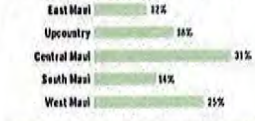
The workshops asked the community to help design a Small Town at Olowalu.

This was a significant first step in the continuing effort to maintain a dialogue between Maui residents, town planners, public officials and others.

WORKSHOP ATTENDANCE

SESSION	ATTENDANCE
Opening Session	420
Highway Traffic	105
Recreational Resources	60
Infrastructure Systems	100
Mid-Point Presentation	100
Public Facilities	35
Business / Commercial	40
Residential	110
Aloha Closing Session	380
Total Attendance	1,350

Where Participants Live on Maui



Participant Residency on Maui

Hokulani Holt-Padilla provided the design team with valuable knowledge of Hawaiian history, language, and culture.

Local Architects provided the design team with tours of Lahaina, Paia, Wailuku, and Makawao.

Reverend Earl Kukahiko conducted a Blessing prior to the planning workshop with the design team and the Olowalu residents.

Ed Lindsey led a tour of Honokowai Valley describing the natural environment, cultural history, and native plants.

The People Guide The Town Plan

During the Olowalu Talk Story workshop, participants and town planners exchanged valuable knowledge and experiences.

A town for Maui should be designed with insights from the people of Maui. Town planners learned essential information about Maui's culture and lifestyle, including the need to preserve our quality of life, provide affordable housing for Maui's residents, and preserve our natural resources.

The original Olowalu Talk Story newsletter informed and invited participants to the week-long community-based planning workshop. It was mailed to everyone on Maui.

An Evolving Design Process

Important Design Components:
Throughout the planning workshop, a number of alternative designs were presented to participants for review, comment, and feedback. The site plans were continuously evaluated, assessed, and updated to incorporate the following design components:

Streets/Circulation
Pedestrian-friendly, tree-lined roadways and connective street network.

Residential
A wide variety of housing types, including affordable, senior, market, single-family, multi-family, and rental.

Recreational Resources
Easy access to open spaces, parks, beaches, greenways, trails, and bike ways.

Infrastructure Systems
Environmentally sensitive infrastructure systems, at no cost to public, to include roadways, water, wastewater, and utility systems

Public/Civic Facilities
Sites for community centers, social services, schools, police, fire, and medical facilities.

Business/Commercial
Neighborhood town centers for local businesses with economic opportunities for residents, including live/work units and access to daily services.

Plans were created based on various neighborhood locations. Each neighborhood is defined by the 5-minute walk.

Traditional Neighborhoods for People, Not Cars

Mixed-Use Neighborhoods
The basic building block for Olowalu Town is the mixed-use neighborhood. Neighborhoods will have defined centers, shops and stores to satisfy daily household needs, and a variety of places to live and work.

Small Walkable Neighborhoods
The ideal size or scale of a walkable neighborhood is measured by a **5-Minute Walk*** with only a ¼ mile from center to edge. The neighborhood center is a gathering place, such as a town square, a park, town center, or green space.

*Defined as a Pedestrian Shed

"The planning and growth of a small town community is just like that of a family."

"The planning and growth of a small town community is just like that of a family. What you nurture from the very beginning of its conception and continue to nurture has a direct result on its presence to the world. People and things that are close to the family and hold it dear to their heart will inevitably look out for its best interests. So, too, with town planning. Success is achieved with knowing and respecting the environment, the needs of the people, and the purpose of preparing a healthy future."

GEORGE RIXEY
Past President of the American Institute of Architects Maui, Past President of the Kihei Community Association

Olowalu Talk Story started with a 'blank slate.' All design occurred in sessions open to the public where participants were encouraged to review and comment. The plans were continuously updated and modified based on participant's feedback.

Olowalu Town: A Traditional Maui Community

"Olowalu reminds me of the small towns that I knew as a youngster growing up on Maui."

"How Maui will grow to meet the housing needs of our working families is an important question facing us. Olowalu Town answers that question by proposing to build a true community with a mix of housing, beach access and with planning for local neighborhood businesses, schools, and community facilities. Olowalu reminds me of the small towns that I knew as a youngster growing up on Maui."

BILL KAMAI
Senior Service Representative, Hawai'i Carpenters Union, Maui Office

Conceptual plans for Olowalu Town reflect the reestablishment of a community at Olowalu where Maui's residents can afford to live.

Housing will be provided in many forms including affordable, senior, apartments, below market, single family, multi-family, and live/work opportunities.

Stores, schools, parks, beaches, and community services will be integrated within walking distance of homes. Town centers will provide business and commercial opportunities for residents to live and work in the same community.

These plans are being developed based on the information gathered in the Olowalu Talk Story Community-based Planning Event and community input over the past 18 months.

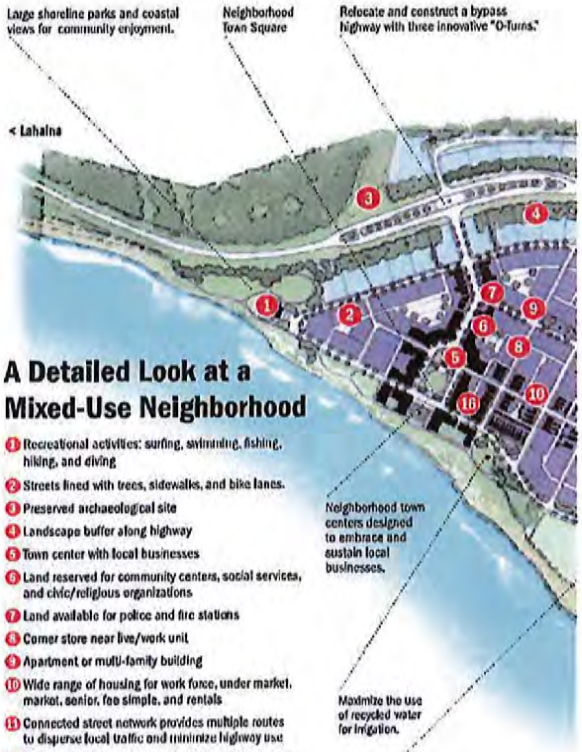
The conceptual drawings and charts provide more detail about living in this community. We look forward to finalizing these plans based upon continued dialogue with the public.

Financial Feasibility

The Olowalu Town Project will need to be financially feasible in order to become reality. Under current conceptual plans, Olowalu Town will provide roughly:

- 500 affordable housing units (less than 120% median income)
- 500 sub-market housing units (below existing average market prices)
- 500 market rate housing units (above average market prices)

As designed, this plan would meet or exceed Maui's existing Workforce Housing Ordinance. As proposed, the market rate housing units will help to finance the affordable housing units and the costly infrastructure improvements.



A Detailed Look at a Mixed-Use Neighborhood

1. Recreational activities: surfing, swimming, fishing, hiking, and diving
2. Streets lined with trees, sidewalks, and bike lanes.
3. Preserved archaeological site
4. Landscape buffer along highway
5. Town center with local businesses
6. Land reserved for community centers, social services, and civic/religious organizations
7. Land available for police and fire stations
8. Corner store near live/work unit
9. Apartment or multi-family building
10. Wide range of housing for work force, under market, market, senior, fee simple, and rentals
11. Connected street network provides multiple routes to disperse local traffic and minimize highway use
12. Homes within five-minute walk (1/4 mile) from parks, school, coastline, stores and work centers
13. Historic cemetery
14. Rural house lots
15. Farmstead homes
16. Bed & breakfast, inn, or lodge

Homes in Olowalu Town

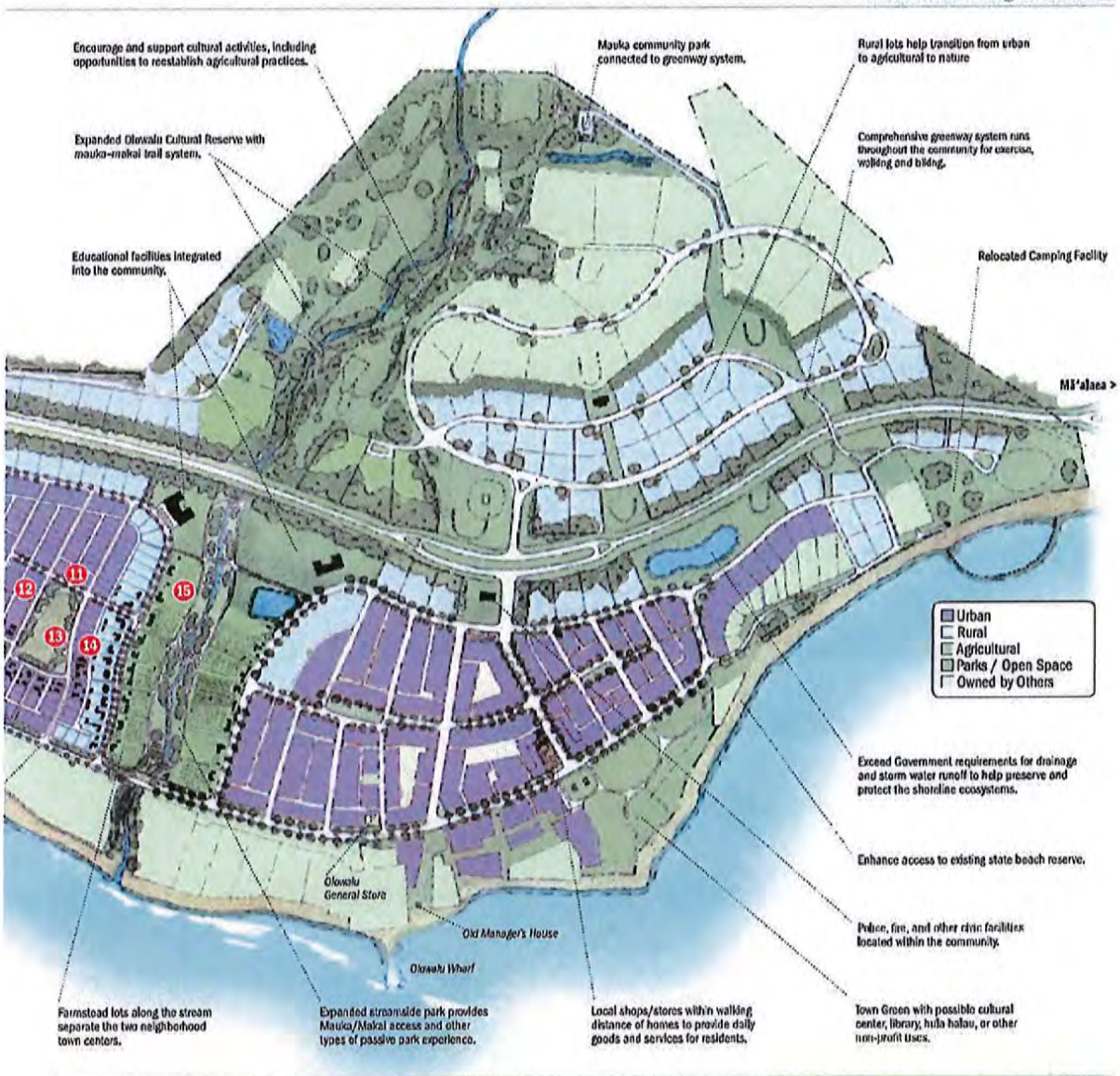
Olowalu will offer a wide range of housing for all ages and income levels — young singles, families, service workers, working farmers, entrepreneurs, and retirees. From single-family lots to live/work units, Olowalu homes will be dignified and close to the town center, parks, and beaches.

A. Rural Residential
Single-family homes on minimum one-half acre lot with rural character.

B. Urban Residential
Single-family homes on smaller lots, closer to neighborhood town centers.

C. Urban Live/Work Units
Residential living space above, small family business or commercial use on street level.

D. Urban Town Houses
Multi-Family units create higher density located near neighborhood town centers.



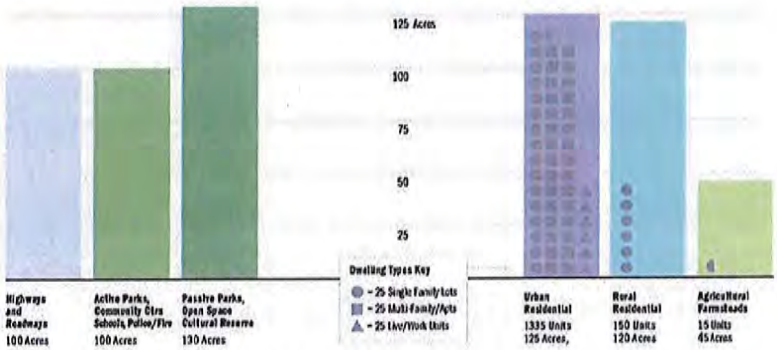
Olowalu Town Land Use Breakdown

Parks, Open Space & Community Space: 53%

- Passive Parks, Open Space, Cultural Reserve: 20%
- Active Parks, Community Center, Schools, Police/Fire: 17%
- Highway and Roadway Corridors: 16%

Residential Land Use: 47%

- Urban Residential and Commercial Business: 20%
- Rural Residential: 20%
- Agricultural Farmsteads: 7%



Note: Preliminary figures based upon conceptual master plan.

Olowalu Acreage

Olowalu Town	620 acres
Parks, Open Space and Community Space	330 acres
Residential Use	290 acres

Passive Parks and Open Space

Streamside Park, Pocket Parks, Cultural Preserve, Archaeological Sites, Neighborhood Parks

Active Parks/Community Services

Coastal Parks, Schools, Community Centers, Police / Fire Facilities

Roadway Corridors

Tree Lined Roadway, Alleys, Greenways, Bikeways, Relocated Highway, Trails, Streets

Number of Units by Type

Single Family Lots	565
Multi-Family / Apartments	785
Live/Work Units	150

Commercial Business Space

25,000 sf in the Town Centers for:

Surf Shops, Doctors, Cafés, Restaurants, Dentists, Book Store, Markets, Video Stores, Hardware Store, Drug Stores, Bakeries, Bar

"Bill and Dave did a beautiful job working and talking with us. I've seen what the community came up with and it is a good project."

– KATHERINE D. KING - Born and Raised in Olowalu

Sustainable Infrastructure

Learn from our natural resources, use the best available technologies, and build independent infrastructure.

Respect Our Natural Resources

Olowalu Town will build innovative infrastructure systems that are based upon sustainable technologies which minimize adverse impacts upon the natural environment. Efficient "green" technologies modeled from natural systems are planned at Olowalu Town with emphasis on conservation, cleaning, and recycling. Compact decentralized infrastructure systems are both economically and environmentally friendly. These systems create a smaller, less intensive "ecological footprint" than larger centralized systems.

Healthy Communities

Olowalu Town's residents will utilize walking for many daily needs thus reducing the number of daily car trips. Not only will residents reduce their reliance on imported gasoline and cut down on vehicle emissions, Olowalu Town will provide residents access to beach parks, playgrounds, hiking, and biking from their homes. Walkable communities also increase interaction with neighbors and lead to physically and socially healthy communities.

Independent Infrastructure

Olowalu Town will be supported by privately funded, independent infrastructure. The water, wastewater, and drainage systems will be sized appropriately to support the town's needs. In many cases, these infrastructure systems will be decentralized which allows for less impact on the environment. Olowalu Town has also reserved sites for community services including educational, police, and fire facilities. The relocation of Honoapi'ilani Highway at Olowalu will be constructed in conjunction with the first phase of reestablishing the Olowalu Community.

Water and Wastewater

Through the use of Integrated Resource Planning, Olowalu's Natural Resource Engineers carefully assessed and examined innovative alternatives for water, wastewater, and drainage systems.

Drinking Water

The drinking water (potable water) requirement to support Olowalu Town is roughly 600,000 gallons per day. The Olowalu aquifer's sustainable yield is estimated at 3 million gallons per day. The Olowalu Town Plan is designed to utilize only 20% of the aquifer's sustainable yield.

Water Used Wisely The Olowalu water treatment plant will reclaim wastewater from households and make it reusable for irrigation keeping more stream water in Olowalu Stream.

Wastewater

State-of-the-art wastewater treatment plants are relatively small and have little odor or other effect on the environment. These plants efficiently produce clean recycled water for irrigation use.

Irrigation Water

Irrigation water (non-potable water) will be provided by a combination of recycled wastewater, stream water and possibly captured storm water. Use of native plants will reduce overall irrigation water demands.

Stream Water Restoration

The integrated irrigation water system will provide opportunities to significantly reduce the amount of stream water currently being utilized for irrigation.

Drainage/Storm Water

Olowalu Town will use best management practices (BMPs) to design and build drainage systems that protect the health of residents and their homes, preserve and enhance the natural environment, and protect shoreline water quality. The BMP standards will protect the surrounding environment from soil erosion, sediment production, and other non-point source pollutants. Drainage systems will exceed government requirements to ensure protection of near-shore water quality.

Fewer Trips, Better Flow, Less Traffic

Instead of just planning streets for cars, Olowalu Town is designed to provide many modes of transportation for people including walking, biking, mass transit, and automobiles.

These different modes of transportation address movement within the neighborhood (circulation), between neighborhoods (connectivity), and to different parts of the island (regional transportation).

Connectivity

Olowalu Town is designed with interconnected streets that include trees and sidewalks that slow down automobiles and encourage walking and biking. This well-connected network of narrow streets provides better mobility and is safer and more efficient than poorly-connected network of wide streets. Olowalu Town's neighborhood block system shortens travel routes and encourages alternatives to automobiles.

Planning for neighborhood stores, parks, community centers, and educational facilities within walking distance of neighborhoods will reduce the number of automobile vehicular trips and encourage the casual meeting of residents that form the bonds of a community.

Circulation

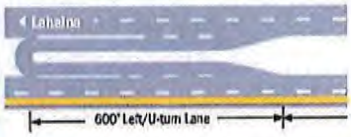
Internal roadway systems connecting Olowalu's neighborhoods will provide additional ways to move people throughout the community. The monkeypod-lined portion of the existing Honoapi'ilani Highway will be preserved and utilized as a lower volume connector road between the Olowalu neighborhoods. In the case of an emergency on Honoapi'ilani Highway, this thoroughfare could be used to route highway traffic through Olowalu. Bike and walking paths will also serve as another connection between neighborhoods and allow people easy access to beach parks, shops, and homes.

Regional Transportation

Olowalu Town will also greatly improve regional transportation. The construction of the Olowalu portion of the relocated Honoapi'ilani Highway in conjunction with the first phase of Olowalu Town will greatly improve regional transportation to West Maui. Additionally, Olowalu Town residents will have safe and easy access to necessary regional transportation. The highway corridor is designed to conveniently accommodate mass transit alternatives when available. Olowalu transit stops have been designed to be within walking distance of the neighborhoods to increase personal travel choices and reduce reliance on the automobile.

Honoapi'ilani Highway

During the Olowalu Talk Story workshop, options to improve Honoapi'ilani Highway evolved from simply widening the existing road to considering various alternatives, including the ones shown at right. The alignment favored by workshop participants (far right) provided the best opportunity to serve a small town at Olowalu and to enhance the free flow of highway traffic.



Actual rendering and 3-mm diagram not to scale.

Access to beaches, surfing, parks, and play areas.

Neighborhood parks provide "back yards" for children.

Series of interconnected greenways/ bikeways for walking or biking.

Places where residents can just hang out with friends, sit and relax.

200+ Acres of Parks and Open Space

The design of Olowalu Town includes over 200 acres of parks, beaches, greenways, ball fields, community gathering areas, and open space. Healthy and active communities help provide for the social, spiritual, and cultural needs of its residents, and enhance our quality of life.

Olowalu Cultural Reserve will be increased in size and enhanced with trail systems.

Homes are situated within easy walking distance to recreational facilities.

Easy access to civic, religious, and non-profit facilities.

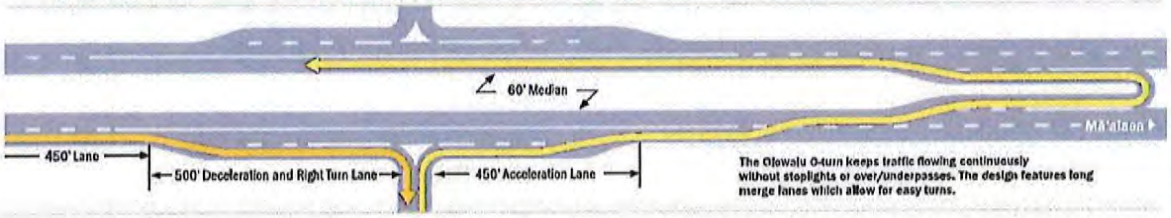
Preserve and enhance public access to shoreline resources.

Camping facilities.

Relocation Process and The Innovative Olowalu O-Turn

Relocation Highlights

- Highway constructed in conjunction with first phase of development
- Three separate O-Turns provide access to town and disperse traffic and allow left turns without delays
- Medians designed to accommodate light rail or other mass transit system, as it becomes available
- Public access to larger beach parks between the relocated highway and the ocean



The Olowalu O-turn keeps traffic flowing continuously without stoplights or over/underpasses. The design features long merge lanes which allow for easy turns.

How the O-Turn Works

The Olowalu Turn or O-Turn works by preventing drivers from making left turns across traffic. Drivers safely take a U-turn with the assist of merge lanes and enter into the flow of traffic going in the reverse direction. Then, by merging to the right lane, drivers may turn right and reach their destination. Meetings with the Department of Transportation have been productive and they have been receptive to these innovative ideas.

No Stoplights, Continuous Flow

One of the problems with the existing flow of traffic through Olowalu is that cars making turns off the highway – especially left-turns – invariably slow the overall flow of the traffic. Our mainland and local traffic engineers at the workshop introduced a new approach to Maui which we call the "O-Turn." It is an efficient solution that allows for easy and safe turns without interrupting the flow of traffic and is successfully being used in other states. Our traffic engineers have designed it to accommodate the existing and future traffic volumes on Honoapi'ilani Highway.

O-Turn Benefits

- No stoplights
- No under/overpass
- Easy turns
- Long on/off lanes
- Continuous traffic flow

"One advantage that Maui has is the island still has a number of traditional towns. These small towns represent the model of sustainable communities that are compact, connected and complete."

ANDRÉS DUANY Lead Architect of Olowalu Town

Olowalu's Urban Growth Boundaries combined with the natural land features create a combination of restrictions that will prevent Olowalu Town from sprawling into other communities.

A Message from Andrés Duany:

A Small Town for Maui

Andrés Duany discussing early site plans during the Olowalu Talk Story Community-Based Planning Workshop

Today, Maui has the opportunity to chart its own future and determine the manner and form of development that will occur on the island for many years to come.

The plan for Olowalu Town returns to the original Maui small town model of complete and compact communities, where most, if not all, daily needs can be met within a five-minute walk of one's home.

Until recently what has proliferated on Maui and in Hawai'i is the conventional suburban planning imported wholesale from the mainland. This development model comes with a number of disadvantages, penalties, and inconveniences, such as larger land consumption, segregated and isolated pockets of development, traffic congestion, pollution, and loss of open space, and public amenities.

Olowalu Town's layout, structures, density, and land use all contribute to create a compact, walkable environment. Olowalu will have a wide range of housing types, including townhouses, apartments, bungalows, cottages and large houses on farmsteads, with a substantial portion given to much-needed affordable housing.

There will be live/work units to encourage people to start new businesses, which would help reduce the need to commute to work and create a wider, more diverse, economic base. Two town centers will feature facilities and amenities for the larger community, including retail and commercial spaces, civic buildings, and public open space.

The building of Olowalu Town will be guided and framed by a new design code. This new code marries traditional settlement patterns with sustainable ecological strategies, and is proposed to overlap and simplify the existing zoning code, with the creation of livable streets at a variety of densities, uses, and residential unit types.

Olowalu Town is the model for a new opportunity to re-build communities on the island of Maui.

Maui County's General Plan And The Future Of Maui

The Maui County General Plan is currently being updated. The 2030 General Plan will establish the overall vision that will guide the growth and development of Maui County for the next 20 years. One of the key components of the General Plan will include the establishment of Urban and Rural growth boundaries. Future growth and development within these identified Urban and Rural boundaries will be encouraged; growth in areas located outside of these boundaries will be discouraged. The 2030 General Plan will be comprehensive and address the social, economic, and physical environment through a community-driven process to collectively define values, goals, and objectives.

Long Range Effects

When ultimately adopted by the Maui County Council, the 2030 General Plan has the potential to affect almost every decision we will make about where to live, work, send our children to school and prepare our families for a better life in the years ahead. We encourage you to stay informed and participate in this vital work.

Participate Now

You can send your ideas to the Long Range Planning Division online at www.generalplan2030@mauicounty.gov or by phone at 270-733. All of the meetings relating to the development of the General Plan, including those of the current General Plan Advisory Committee (made up of 25 dedicated citizen-volunteers), the Planning Commission and the County Council are open to the public. The notice of meetings is published on the Maui County government website www.mauicounty.gov.

Talk To Maui's Long Range Planning Division
Phone: 270-7335 | Online: www.mauicounty.gov

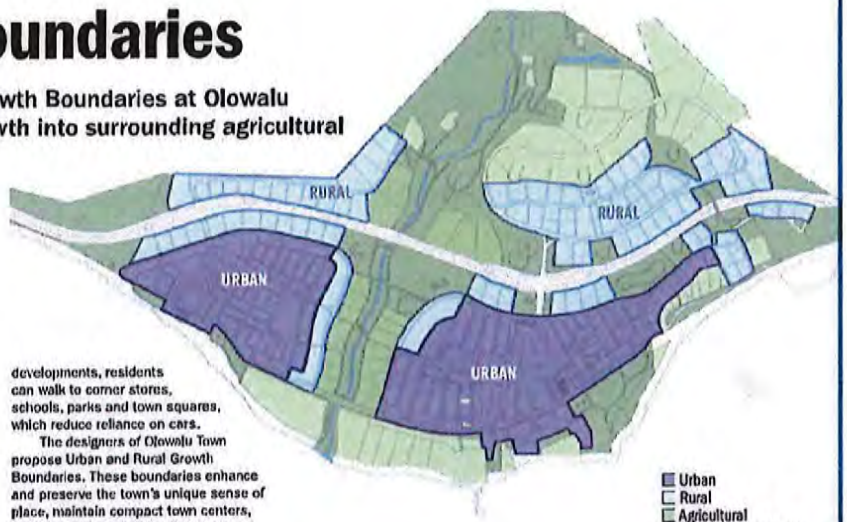
Suburban Sprawl vs Traditional

Suburban Sprawl	General Characteristics	Traditional Neighborhood Design
• Segregated land uses • Congested roadways • Continuous outward growth of communities • Inefficient use of resources		• Mixed-use communities • Pedestrian-friendly • Wide range of housing for all income levels • Environmentally sustainable
	Traffic & Roadways	
• Designed for cars and unsafe for pedestrians • Congested connector roads • High-speed streets, wide and open • Dead end, cut-de-sacs		• Designed for people, not cars • Multiple connected and parallel roadways • Low-speed streets, lined with trees and sidewalks
	Community	
• Sprawling sub-urban developments • Require car to get to services and schools • Social and civic facilities an afterthought		• Multi-generational communities • Walking distance to schools and parks • Social and civic facilities planned within town
	Land Use	
• Sprawling suburbs and isolated land use • No sense of community • Reduced open-space and uncontainable growth		• Smaller neighborhoods and efficient land use • Distinct sense of place • Open-space and urban boundaries
	Infrastructure	
• Large, expensive infrastructure systems • Extensive transmission lines		• Efficient, small-scale infrastructure systems • Fewer transmission lines
	Environmental Resources	
• Low-density developments pave over open-space • Large development footprint • Many car trips required per day		• Clustered, higher-density communities • Small urban footprint on environment • Designed to encourage walking, reduce car trips

Olowalu Town's proposed Urban Growth Boundaries are shown in relation with existing and proposed neighboring urban areas.

Growth Boundaries

The Urban and Rural Growth Boundaries at Olowalu will prevent outward growth into surrounding agricultural and open space areas.



Once established, these growth boundaries will maintain Olowalu's small town scale, ensuring its continued sense of place.

Over the past 40 to 50 years our Island's urban areas have grown and expanded outward, blending together and reducing farmland and open space.

In an effort to prevent this suburban sprawl, many communities across the country have begun to create Urban Growth Boundaries. An Urban Growth Boundary is a line drawn around an existing or proposed urban area beyond which urbanization cannot occur. Once established, growth must take place only within this area. Rural Growth Boundaries soften the transition from these urban areas to agricultural and natural areas.

Olowalu's Urban boundaries will encourage higher density mixed-use development resulting in increased land use efficiency. In mixed use developments, residents can walk to corner stores, schools, parks and town squares, which reduce reliance on cars.

The designers of Olowalu Town propose Urban and Rural Growth Boundaries. These boundaries enhance and preserve the town's unique sense of place, maintain compact town centers, preserve pedestrian-friendly streets, prevent sprawl, and ensure natural habitats are preserved and protected.

Neighborhood Design (TND)

Suburban sprawl is the result of mainland "zoning" concepts that strictly separate uses and activities into single locations.

It is typically composed of subdivisions of homes without community services; local stores, parks and amenities.

As a result the automobile dominates the setting, thus requiring more and more roads that repeatedly fill up with traffic. This form of growth is a wasteful use of precious resources.

Principles of TND

The master plan for Olowalu Town is compatible with Maui's small town traditions and ensures that a meaningful and distinctive community is created.

At Olowalu, we are committed to Traditional Neighborhood Design (TND). This innovative concept uses specific planning and design tools to guide the environment for existing and new communities, with the ultimate objective to build towns and communities that are pedestrian-friendly, comfortable, safe, and ecologically and economically sustainable.

Traditional Neighborhood Design Principles

1 The basic increment or building block will be the mixed-use neighborhood ("pedestrian sheds"), and neighborhoods will be designed and sized to be walkable.

2 Each mixed-use neighborhood shall have a discernible center to serve as a community gathering place. This center will also contain a transit stop.

3 The neighborhood will be of small size and scale with a maximum standard of a 5-minute walk from the edge to the center. This distance averages one-quarter of a mile.

4 Shops and stores within close proximity to neighborhoods will be sufficiently varied to satisfy ordinary daily household needs, such as a convenience store.

5 The neighborhood shall incorporate a variety of places to work, including live-work units.

6 Neighborhoods shall include a variety of dwelling types, such that younger and older persons, single households and families may be housed.

7 Educational facilities shall be available, or a site reserved, within walking distance of most dwellings.

8 Small playgrounds or neighborhood parks will be situated within one-eighth of a mile to all dwellings, not more than a 2- to 3-minute walk.

9 Thoroughfares and roadways shall be designed as a network, with emphasis on connecting adjacent thoroughfares wherever possible to provide drivers with options to disperse traffic.

10 Thoroughfares shall be designed to slow traffic, creating an environment appropriate for pedestrians, bicyclists, and automobiles.

11 Building frontages shall collectively support pedestrian streetscapes, parking lots to be located behind buildings.

12 Sensitive natural resources and cultural areas are preserved as permanent open-space.

13 Exceptional sites or special locations to be reserved for community uses or civic buildings.

14 Buildings for meetings, education, religion, or culture will be located at the termination of street vistas or within the Neighborhood centers.

15 Youth and seniors benefit because walkable neighborhoods are not dependent on automobile transportation.

The Value of Boundaries as a Design Tool

Kahului and Wailuku used to be compact and complete communities separated by agricultural and open space. With the establishment of zoning and subdivision laws in the 1950's, these communities began to merge together. At Olowalu, Urban and Rural Growth Boundaries are designed to maintain its small town scale.

Source: Maui County Planning Department

Olowalu Town Community Benefits

Our goal for Olowalu Town is to reestablish a small town community that reflects the vision, values and goals of Maui's citizens and families.

1. A community where Maui's families can afford to live
2. A mixed-use community with homes close to parks, schools, corner stores, beaches, community centers, town centers, etc.
3. A wide range of housing types for all ages and all income levels
4. Plans include the construction of bypass highway through Olowalu, in conjunction with first phase
5. Over 200 acres of parks and open space (1/3 of the project) including preservation and enhancement of public shoreline access
6. Infrastructure systems at no cost to the County
7. Neighborhood town centers to provide community with economic sustainability, employment opportunities, and local business opportunities
8. Innovative infrastructure systems designed to have minimal adverse impacts upon the environmental resources
9. Exceed government regulations for drainage and storm water runoff to protect shoreline ecosystems
10. Innovative "O-Turn" on bypass highway allows cars to flow without stopping with no street lights or over/under passes
11. New bypass highway designed to accommodate light rail or mass transit
12. Existing Olowalu Cultural Reserve along stream expanded and enhanced to include mauka and makai trail system with educational/interpretive program
13. Walkable town reduces the number and length of automobile trips, reduces traffic congestion, conserves fuel/energy, and lowers emissions
14. Design team and architects certified by U.S. Green Building Council for Leadership in Energy Efficiency Design (LEED)

This project is planned to be a LEED-certified Neighborhood Development. The LEED for Neighborhood Development Rating System integrates the principles of smart growth, new urbanism, and green building. Certification provides independent, third party verification that the development's location and design meet accepted high standards for environmental responsibility and sustainable development. You can learn more at www.usgbc.org

Planning and Construction Timeline

2005-2007

Community-Based Planning

Early Consultation with Key Groups/People

Olowalu Talk Story

Community Outreach

In-House Conceptual Review

General Plan Advisory Committee Recommendation for Urban Boundaries

2008-2012

Permitting and Entitlement Process

Early Consultation and Notice of Environmental Impact Statement

Development of Technical Studies for Environmental Impact Statement

Public Review of EIS

Government Approval Process for Land Use Entitlements

Final Approval of Governmental Land Use Entitlements and Permits

2013-2018

Infrastructure Design And Construction

Final Design of Infrastructure

Construction of Initial Infrastructure Improvements Including: Phase 1 Water Improvements, Decentralized Wastewater Treatment, Drainage Systems

Construction of relocated Honoapiilani Highway at Olowalu

Occupancy of First New Residents at Olowalu

2019-2028

First Neighborhood Construction Phase

Residents live and work in Olowalu's first neighborhood center

Neighborhood stores, parks, educational facilities within walking distance

Affordable, rental, senior, single-family, multi-family, apartment housing options

2029-2038

Second Neighborhood Construction Phase

Residents live and work around Olowalu's second neighborhood center

Additional infrastructure improvements

Expansion of civic, social and community services

Continued Suggestions Improve Town Plan

We would like to thank the following groups, associations, and community leaders listed below for helping to improve our plans for Olowalu Town.

Over the past 18 months they have provided us with opportunities to share our plans with them.

Please note that those listed below have not provided us with official endorsements or approvals; rather, they have kindly provided us with valuable feedback and suggestions on how to improve our plans.

- American Institute of Architects
- County Department of Transportation
- County Mayor and Administration
- County Planning Department
- County Public Works Department and Environmental Management
- Filipino Centennial Chair
- Governor's Office
- Hawai'i Carpenter's Union Reps.
- Island Of the Worlds Conference on Sustainability
- Kahului Rotary
- Kihei-Wailea Rotary
- Lahaina Rotary
- Maui Chamber of Commerce - West Side
- Maui Coastal Land Trust
- Maui Contractor's Association
- Maui County Council Members
- Maui Economic Development Board
- Maui Economic Opportunity
- Maui Tomorrow Board of Directors
- Maui Young Business Round Table Leaders
- Maui Nui Housing Task Force First Time Home Buyers Conference
- Na Kupuna O Maui
- Office of Hawaiian Affairs
- Sierra Club Executive Committee
- State Association of Professional Engineers
- State Department of Transportation - Highways Division
- State Senators and House Members
- Tri-Isle Main Street Resource Center
- Wailuku Rotary
- Lahaina-Honolua Senoir Citizen Club
- West Maui Taxpayers Association
- West Maui Mountains Watershed Partnership

The First Steps of a Long Journey

We are currently completing the first steps of a long journey. The Olowalu Town project will be entitled and constructed over the next 25 to 30 years.

Community-based Planning phase. Highlights of this phase include:

- Olowalu Talk Story: 1,350 participants openly exchanged ideas with our design team during a weeklong event to help create the Conceptual Master Plan for Olowalu Town.
- Feedback: Presentations of plans have been made over past 18 months to various groups, associations, and community leaders. The purpose of these meetings was not to seek any endorsements or approvals, rather, the purpose was to seek suggestions on how to improve the plan.
- GPAC Process: We have committed not to begin our Entitlement and Permitting Phase until the General Plan Advisory Committee (GPAC) has reviewed and approved a Maui Island Plan.

Permitting and Entitlement: The next phase of the project is the Permitting and Entitlement Process which will include a request to change the existing land use designations from Agriculture to Project District (includes Urban and Rural Designations). Accordingly, this phase will involve a thorough public review and approval process, including:

- Preparation and Acceptance of an Environmental Impact Statement (EIS) Detailed and comprehensive review of project, technical studies, public meetings, and full disclosure of project's impacts upon natural and human environment.
- Land Use Entitlements Review and approval by the State Land Use Commission, the County Council, and Maui Planning Commission, with many public hearings and meetings.

Infrastructure Design and Construction: Once entitled, the project will begin infrastructure design and construction including the new mauka Honoapi'ilani Highway at Olowalu, internal roadways, parks/greenways, and water and wastewater systems. Ultimately, this phase will include families moving into a range of affordable, below market, and market homes.

Future Neighborhood Construction: With initial infrastructure in place, neighborhoods will begin to be established. Future construction of the project will include additional homes, business/commercial establishments, neighborhood town centers, additional infrastructure systems, space for civic/social services, and educational facilities.

Mahalo for taking time to read our paper. We hope that this report will provide you with helpful information that you can use as we continue our planning process for Olowalu Town.

Feedback: Your comments and feedback regarding Olowalu Town are welcome at our website at: www.Olowalu.net or by writing us at: Olowalu Town, 2073 Wells Street, Suite 101, Wailuku, Hawai'i 96793.

"It's a community where you can afford to live and raise a family."

I grew up in a small town where we know our neighbors, we looked out for each other, and we could safely walk or ride our bikes to the store, school, or church. Our pace of life was not so hectic; the quality of life on Maui was good. I know that Bill and Dave are concerned about the changes to our island, especially about the changes to our small towns and communities. Olowalu Town is designed to be a small town like the one I grew up in, a community where you can afford to live and raise a family.

– JON SANTOS
Raised in Haiku

OLOWALU TOWN MASTER PLAN

EARLY CONSULTATION MEETINGS

(Before & After Nov. 2005 Talk-Story Planning Workshop)

In addition to the week-long Olowalu Talk Story planning workshop in November 2005, a significant component of Olowalu Town's community-based planning process involved an extensive number of *Early Consultation* meetings with both public and private agencies/groups, as well as, concerned individuals of the community. The purpose and intent of the meetings were not to seek approval or support of the Master Plan; rather, the meetings provided an opportunity for the project managers to share and discuss the conceptual Master Plan, and more importantly, receive valuable feedback and suggestions related to possible issues and/or concerns. Since mid-2005 thru December 2009, the project developers have met with a wide range of groups or entities, including Maui's residents, associations, community leaders, and public officials. The following is a brief listing of these groups/entities:

DATE	GROUP/ENTITY	LOCATION
• July 2005	Maui County General Plan Planning Consultant	Honolulu, Oahu
• August 2005	Maui Tomorrow Foundation	Makawao, Maui
• August 2005	Sierra Club, Maui Chapter, Executive Committee	Paia, Maui
• September 2005	Olowalu Village Residents	Olowalu, Maui
• September 2005	West Maui Residents & Other Maui Residents	Olowalu, Maui
• September 2005 December 2005 September 2006	State Department of Transportation - Highways Division same as above (2nd meeting) same as above (3rd meeting)	Honolulu, Oahu Honolulu, Oahu Honolulu, Oahu
• September 2005	Hawaii Carpenter Union, Maui Office Representative	Wailuku, Maui
• September 2005	Maui Chamber of Commerce	Wailuku, Maui
• September 2005	U.S. Green Building Council & LEED Rep.	Wailuku, Maui
• September 2005 March 2006	Maui Coastal Land Trust same as above (2nd meeting)	Wailuku, Maui Olowalu, Maui
• September 2005	Maui County Council Member, Charmaine Tavares	Wailuku, Maui
• September 2005 February 2007 April 2007 February 2008	Maui County Planning Department, Director, Deputy, and Staff same as above (2nd meeting) same as above (3rd meeting) same as above (4th meeting)	Wailuku, Maui Wailuku, Maui Wailuku, Maui Wailuku, Maui
• September 2005	Executive Assistants for former Mayor of Maui	Wailuku, Maui
• September 2005	Maui County Environmental Coordinator	Wailuku, Maui
• September 2005	Tri-Isle Main Street Resource Center/Wailuku Main St. Assoc.	Wailuku, Maui

• September 2005	Greenways Maui	Wailuku, Maui
• September 2005	M.E.D.B Executive Director	Wailuku, Maui
• September 2005 November 2005 February 2006	Former Maui County Mayor, Alan Arakawa same as above (2nd meeting) same as above (3rd meeting)	Wailuku, Maui Kahului, Maui Kahului, Maui
• September 2005	American Institute of Architects, Maui Chapter	Wailuku, Maui
• September 2005	Public Works/Environmental Management, Director and Deputy,	Wailuku, Maui
• October 2005	Maui Economic Opportunity (MEO), Executive Director	Wailuku, Maui
• October 2005	West Maui Taxpayer's Association, Executive Director	Wailuku, Maui
• November 2005	Maui Cultural Lands, Ed and Pua Lindsey	Honokowai, Maui
• November 2005	Maui County Department of Parks, Deputy	Wailuku, Maui
• November 2005	Maui County Department of Transportation, Director and Deputy	Wailuku, Maui
• November 2005	Maui County Police Department, West Maui Division	Wailuku, Maui
• November 2005	County Department of Housing & Human Concerns, Director	Wailuku, Maui
• November 2005	Maui County Department of Fire, Deputy	Wailuku, Maui
• November 2005	Olowalu Cultural Reserve, Board of Directors	Olowalu, Maui
• November 2005 February 2006	Former Mayor, Alan Arakawa same as above (2nd meeting)	Kahului, Maui Kahului, Maui
• December 2005	State Association of Professional Engineers, Maui Chapter	Wailuku, Maui
• December 2005	West Maui Mountains Watershed Partnership, Director	Olowalu, Maui
• January 2006	Wailuku Rotary Club	Wailuku, Maui
• January 2006 August 2007	State Senator Roz Baker same as above (2nd meeting)	Kihei, Maui Lahaina, Maui
• January 2006	Maui Contractor's Association	Kahului, Maui
• January 2006	Na Kupuna O Maui	Olowalu, Maui
• January 2006	Maui County Council Member, Michelle Anderson	Wailuku, Maui
• February 2006 July 2007	Maui County Council Member, Joanne Johnson same as above (2nd meeting)	Wailuku, Maui Wailuku, Maui
• February 2006	Kahului Rotary Club	Kahului, Maui
• February 2006 February 2007 January 2008	West Maui Taxpayer's Association, Annual Meeting same as above (2nd meeting) same as above (3rd meeting)	Lahaina, Maui Lahaina, Maui Lahaina, Maui

• March 2006	Maui Young Business Round Table Leaders	Kahului, Maui
• May 2006	Maui County Council Member, Charmaine Tavares	Wailuku, Maui
• July 2006	West Maui Chamber of Commerce	Lahaina, Maui
• August 2006	Kihei-Wailea Rotary Club	Wailea, Maui
• August 2006	American Institute of Architects, Maui Chapter	Wailuku, Maui
• January 2007 July 2007	Maui County Council Member, Gladys Baisa same as above (2nd meeting)	Wailuku, Maui Wailuku, Maui
• January 2007	Maui County Council Member, William Medeiros	Wailuku, Maui
• January 2007 March 2008	Lahaina-Honolua Senior Citizens Club same as above (2nd meeting)	Lahaina, Maui Lahaina, Maui
• July 2007	Maui County Council Member, Riki Hokama	Wailuku, Maui
• July 2007	Maui County Council Member, Danny Mateo	Wailuku, Maui
• July 2007	Maui County Council Member, Mike Molina	Wailuku, Maui
• July 2007	Lahaina Rotary, Sunrise Club	Lahaina, Maui
• August 2007	Maui Chamber of Commerce, West-Side	Lahaina, Maui
• August 2007	State Representative Joe Bertram	Kihei, Maui
• August 2007	Maui County Council Member, Mike Victorino	Wailuku, Maui
• August 2007	State Representative Angus McKelvey	Lahaina, Maui
• August 2007	Council on Aging, Peter Durkson	Wailuku, Maui
• August 2007.	Maui Kiwanis Group	Kahului, Maui
• August 2007	Kihei Community Association	Kihei, Maui
• August 2007	State House Interim Task Force on Smart Growth	Honolulu, Oahu
• September 2007	Wailuku Senior's Club	Wailuku, Maui
• October 2007	County Department of Economic Development, Director	Wailuku, Maui
• October 2007	Kihei-Wailea Rotary Club	Wailea, Maui
• November 2007	Opinions Maui, Akaku TV, Don Couch	Kahului, Maui
• November 2007	AARP Livable Communities Conference	Kahului, Maui
• November 2007 November 2008	Maui Native Hawaiian Chamber of Commerce same as above (2nd meeting)	Wailea, Maui Wailea, Maui

• February 2008	State Department of Education, Planning Division	Honolulu, Oahu
• April 2008	Maui County Mayor, Charmaine Tavares	Wailuku, Maui
• April 2008	State Senator Russell Kokubun	Honolulu, Oahu
• May 2008	State Department of Health, Healthy Communities Initiative, Dir.	Wailuku, Maui
• May 2008	Bank of Hawaii, Wailuku Branch Management	Wailuku, Maui
• August 2008	Maui Realtor's Association, Government Affairs Committee	Kahului, Maui
• August 2008	Olowalu Mauka Homeowner's Association	Olowalu, Maui
• October 2008	Maui Representative for Congresswoman Mazie Hirono	Wailuku, Maui
• October 2008	Maui Representative for Senator Inouye	Wailuku, Maui
• December 2008 January 2009	Maui Nui Marine Resource Council, Representatives same as above (2nd meeting)	Olowalu, Maui Wailuku, Maui
• June 2009	Director of State Land Use Commission	Honolulu, Oahu
• September 2009	Maui YMCA Director	Kahului, Maui
• September 2009	Maui Community College, Chancellor	Kahului, Maui
• September 2009	Sustainable Living Institute of Maui, Director	Kahului, Maui
• March 2011	University of Hawaii Maui College	Kahului, Maui
• April 2011	Kaunoa Senior Center	Spreckelsville, Maui
• June 2011	FACE Maui Chapter	Wailuku, Maui
• August 2011	Lions Club	Kahului, Maui

INDIVIDUALS

• November 2005	Kumu Keli'I Taua & Kimokeo Kapahulehua, Cultural Consultants	Wailuku, Maui
• November 2005	Ed Lindsey, deceased, and wife Pua, Cultural Consultants	Honokowai, Maui
• November 2005	Dana Naone Hall, Cultural Consultant	Wailuku, Maui
• November 2005	Hokulani Holt-Padilla, Cultural Consultant	Wailuku, Maui
• November 2005	Iokepa Naeole, Cultural Consultant	Wailuku, Maui
• November 2005	Katherine King, deceased, long-time Olowalu Resident	Olowalu, Maui
• November 2005	George Rixey, A.I.A	Wailuku, Maui
• November 2005	Dick Mayer, Retired Instructor, MCC	Kula, Maui
• November 2005	Buck Buchanan, Environment	Lahaina, Maui

▪ March 2006	Leslie Kuloloio, Cultural Consultant	Wailuku, Maui
▪ December 2006	Robert Hobdy, Environmental Consultant	Wailuku, Maui
▪ September 2009	Marc Hodges, Natural Resource Consultant	Wailuku, Maui
▪ October 2009	Scott Fisher, Native Flora/Fauna Specialist	Wailuku, Maui