Draft Environmental Impact Statement

Volume II of II - 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

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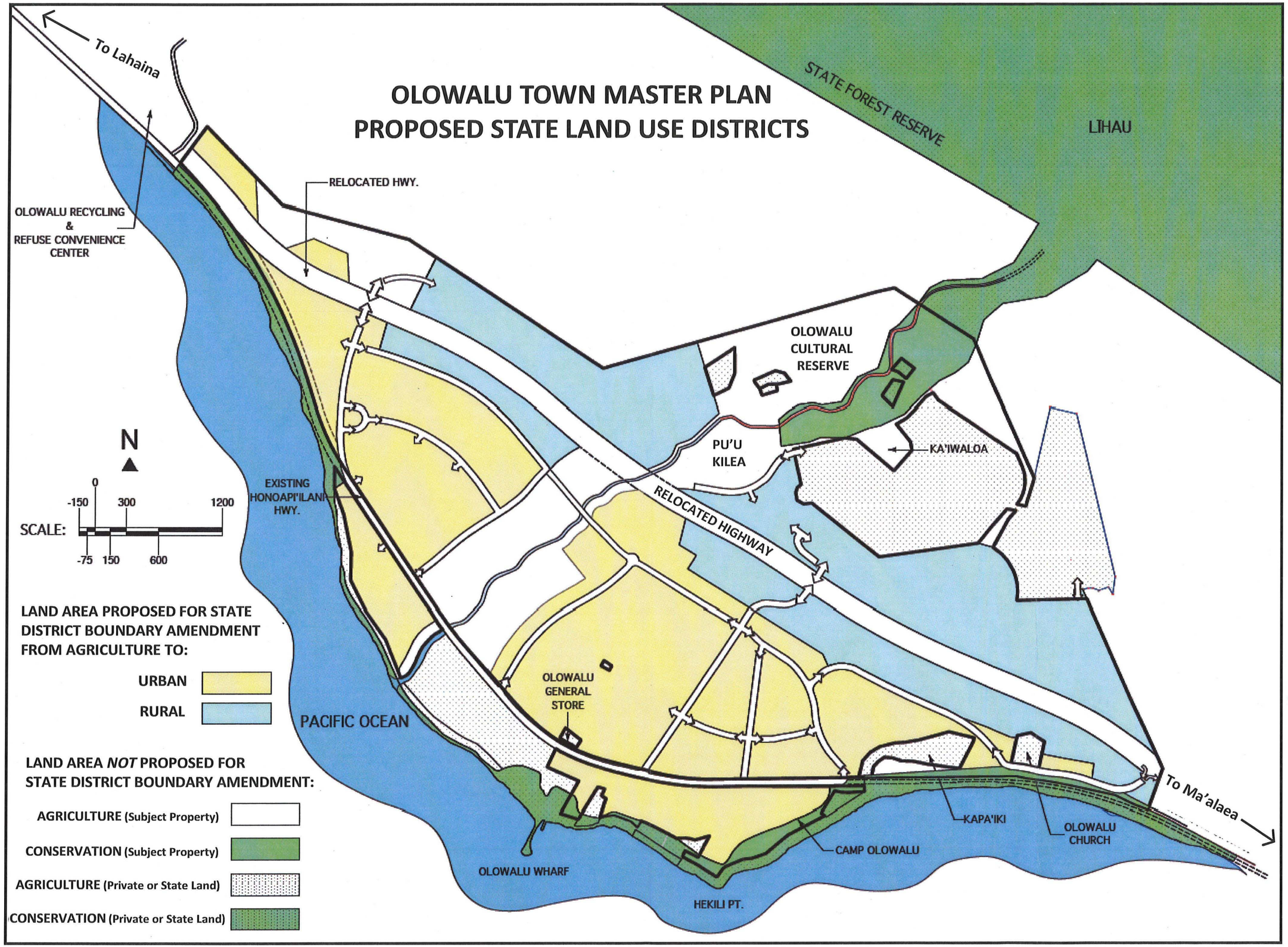
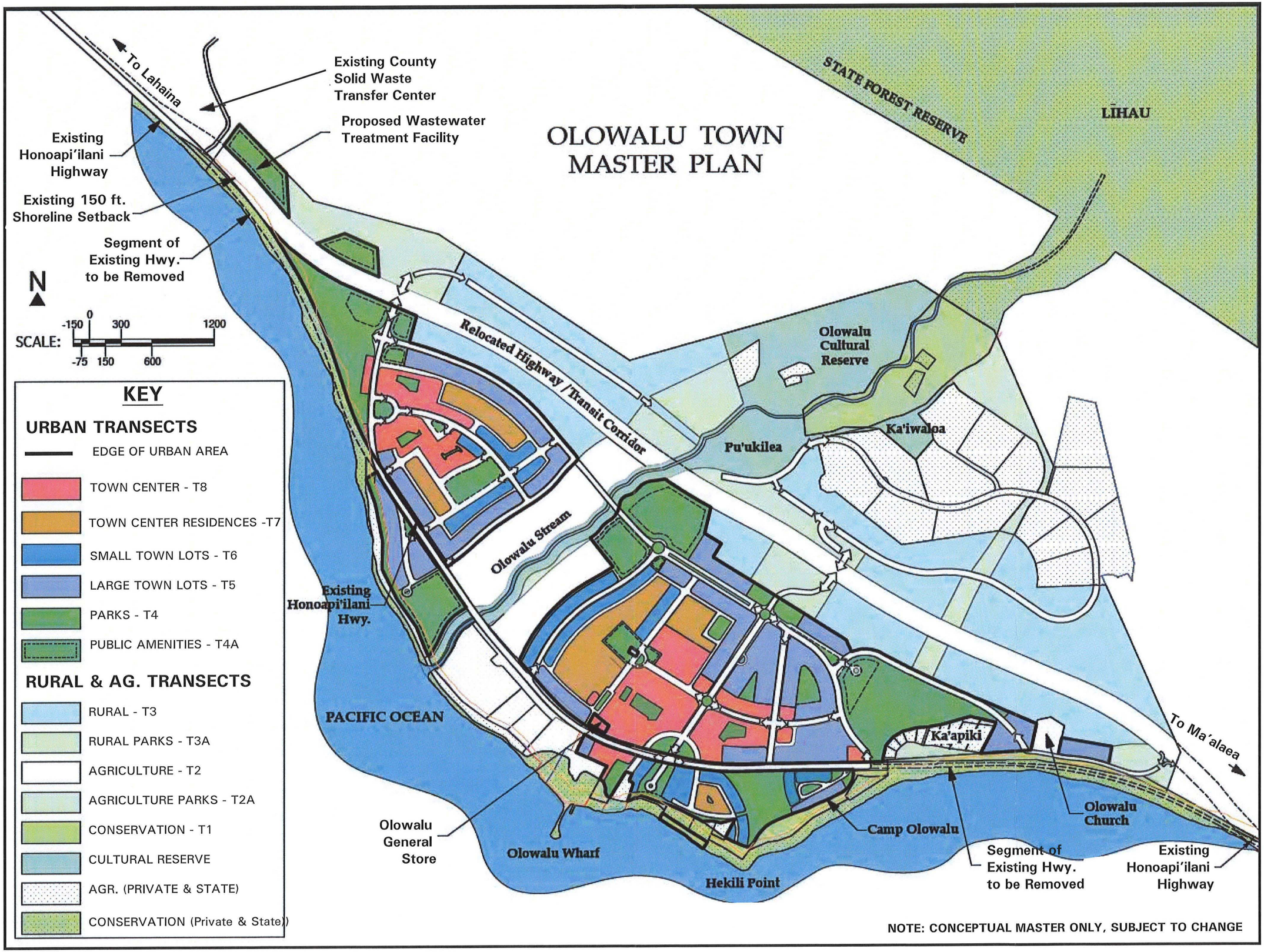
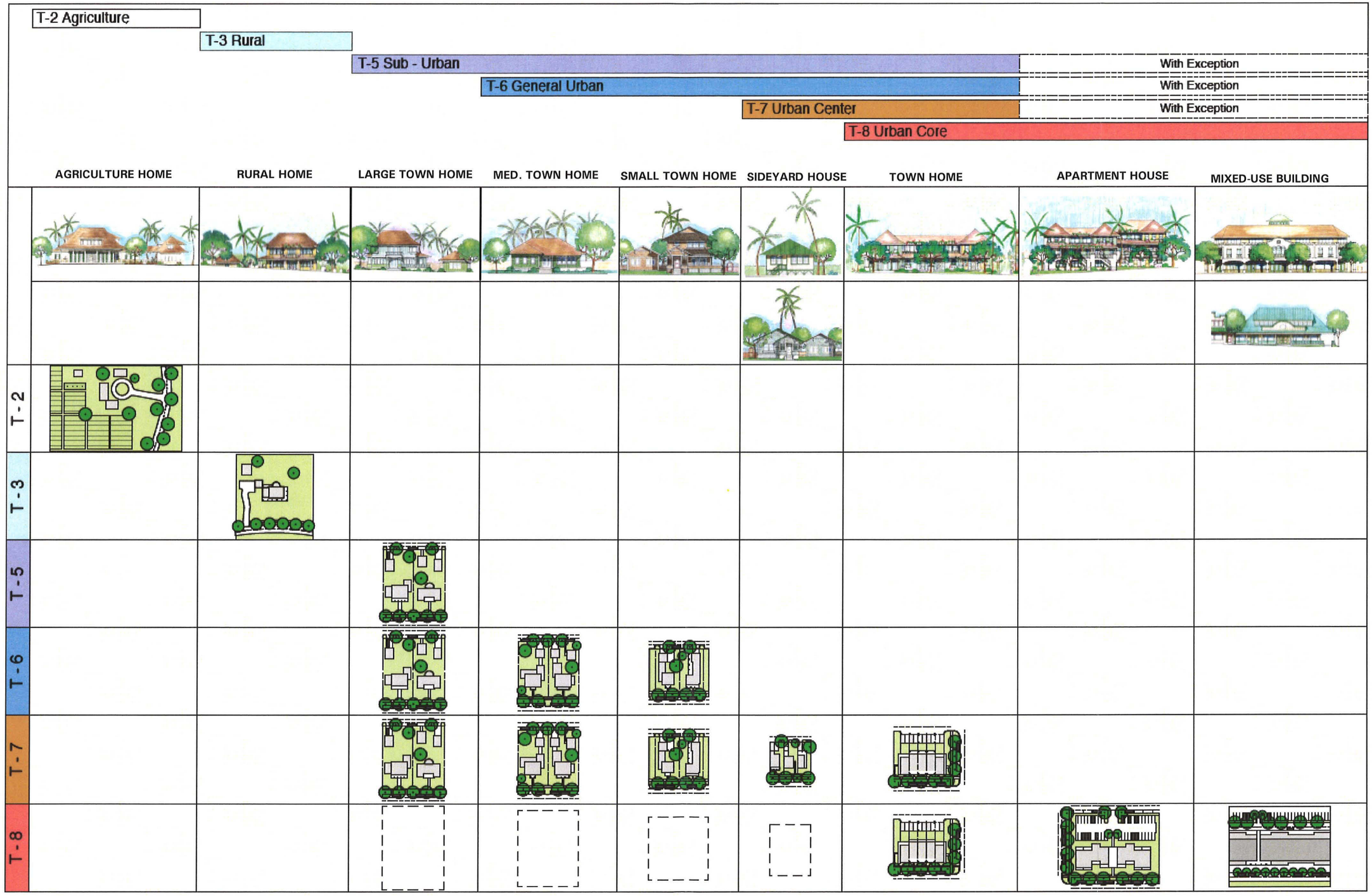
APPENDIX A.

Conceptual Master Plan

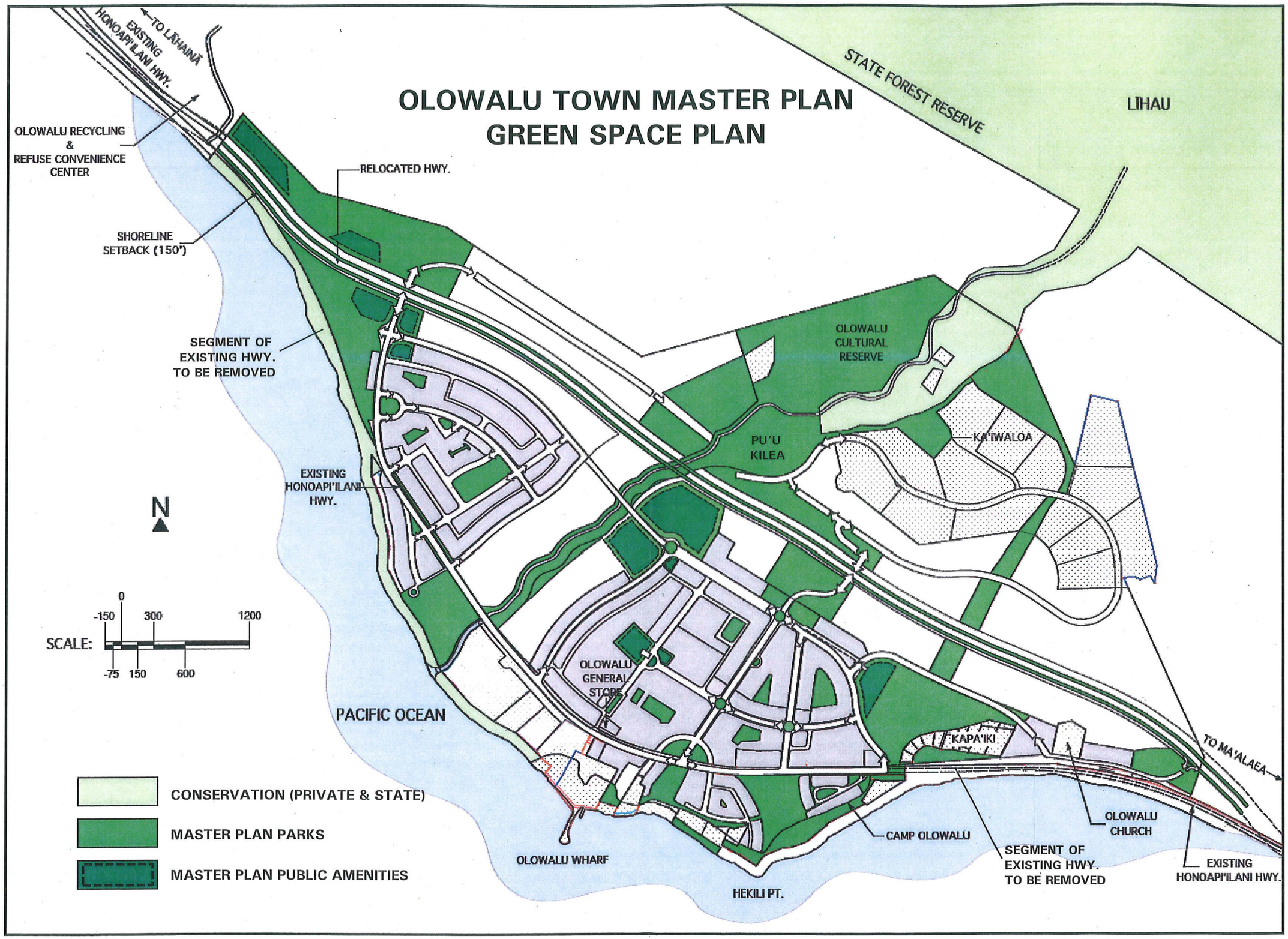

OLOWALU TOWN MASTER PLAN
PROPOSED STATE LAND USE DISTRICTS
To Lahaina
STATE FOREST RESERVE
LIHAU
RELOCATED HWY.
OLOWALU RECYCLING & REFUSE CONVENIENCE CENTER
OLOWALU CULTURAL RESERVE
PU'U KILEA
KA'IWALOA
RELOCATED HIGHWAY
EXISTING HONOAPI'ILANI HWY.
N
SCALE:
0
-150
300
1200
-75
150
600
LAND AREA PROPOSED FOR STATE DISTRICT BOUNDARY AMENDMENT FROM AGRICULTURE TO:
URBAN
RURAL
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)
PACIFIC OCEAN
OLOWALU GENERAL STORE
OLOWALU WHARF
HEKILI PT.
CAMP OLOWALU
KAPA'IKI
OLOWALU CHURCH
To Ma'alaea


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
Ka'iwaloa
Pu'ukilea
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
TO LĀHAINĀ
EXISTING HONOAPI'ILANI HWY.
STATE FOREST RESERVE
LĪHAU
OLOWALU RECYCLING & REFUSE CONVENIENCE CENTER
RELOCATED HWY.
SHORELINE SETBACK (150')
SEGMENT OF EXISTING HWY. TO BE REMOVED
OLOWALU CULTURAL RESERVE
PU'U KILEA
KA'IWALOA
EXISTING HONOAPI'ILANI HWY.
N
0
-150
300
1200
SCALE:
-75
150
600
OLOWALU GENERAL STORE
PACIFIC OCEAN
KAPA'IKI
TO MA'ALAEA
CONSERVATION (PRIVATE & STATE)
MASTER PLAN PARKS
MASTER PLAN PUBLIC AMENITIES
OLOWALU WHARF
CAMP OLOWALU
OLOWALU CHURCH
SEGMENT OF EXISTING HWY. TO BE REMOVED
EXISTING HONOAPI'ILANI HWY.
HEKILI PT.

APPENDIX A-1.

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™

PREFACE FROM USGBC

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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Washington, DC 20037
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(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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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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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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Credit 3	Locations with Reduced Automobile Dependence	27
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Credit 9	Heat Island Reduction	95
Credit 10	Solar Orientation	96
Credit 11	On-Site Renewable Energy Sources	98
Credit 12	District Heating and Cooling	99
Credit 13	Infrastructure Energy Efficiency	100
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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

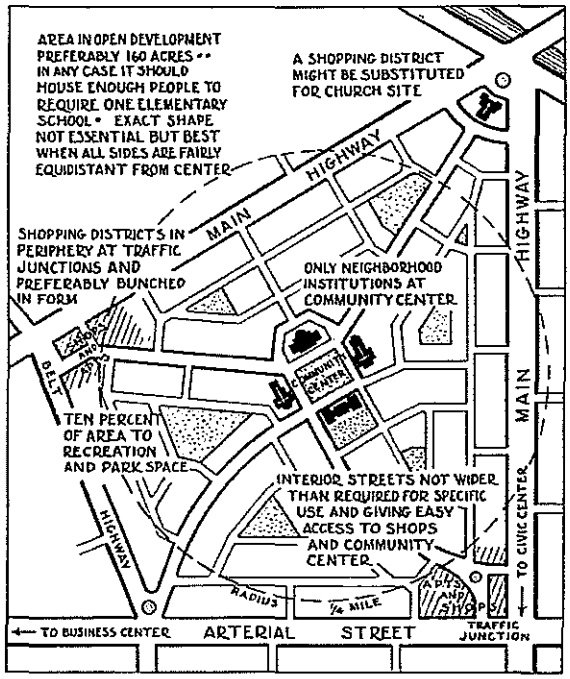
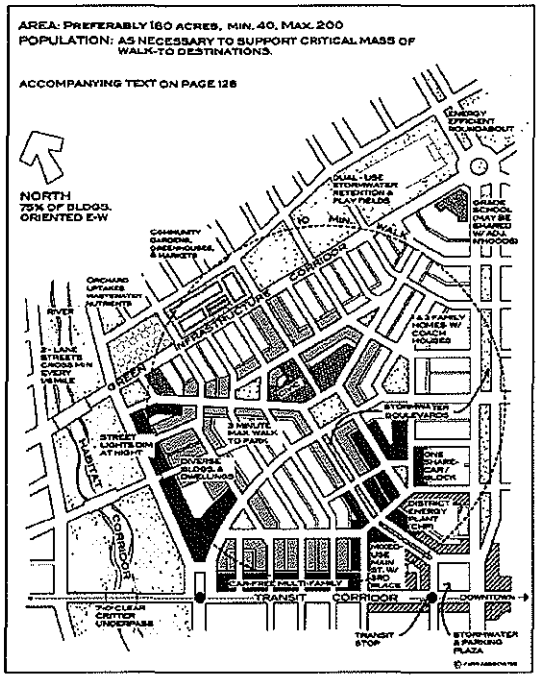


Figure 2. A "sustainable" update of Perry's neighborhood unit. Source: Douglas Farr, *Sustainable Urbanism*

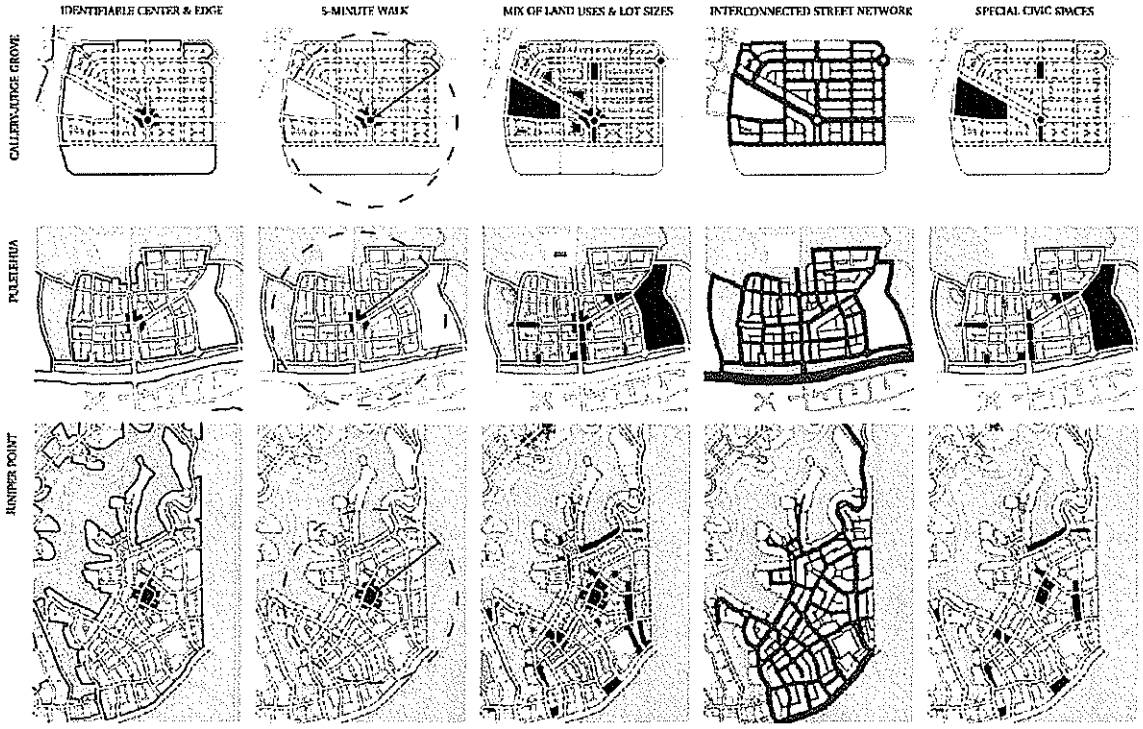


A neighborhood should have places where the public feels welcome and encouraged to congregate, recognizable as the heart of the community. A proper center has at least one outdoor public space for this purpose, designed with pedestrians in mind; this is the most well-defined outdoor "room" in the neighborhood. 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

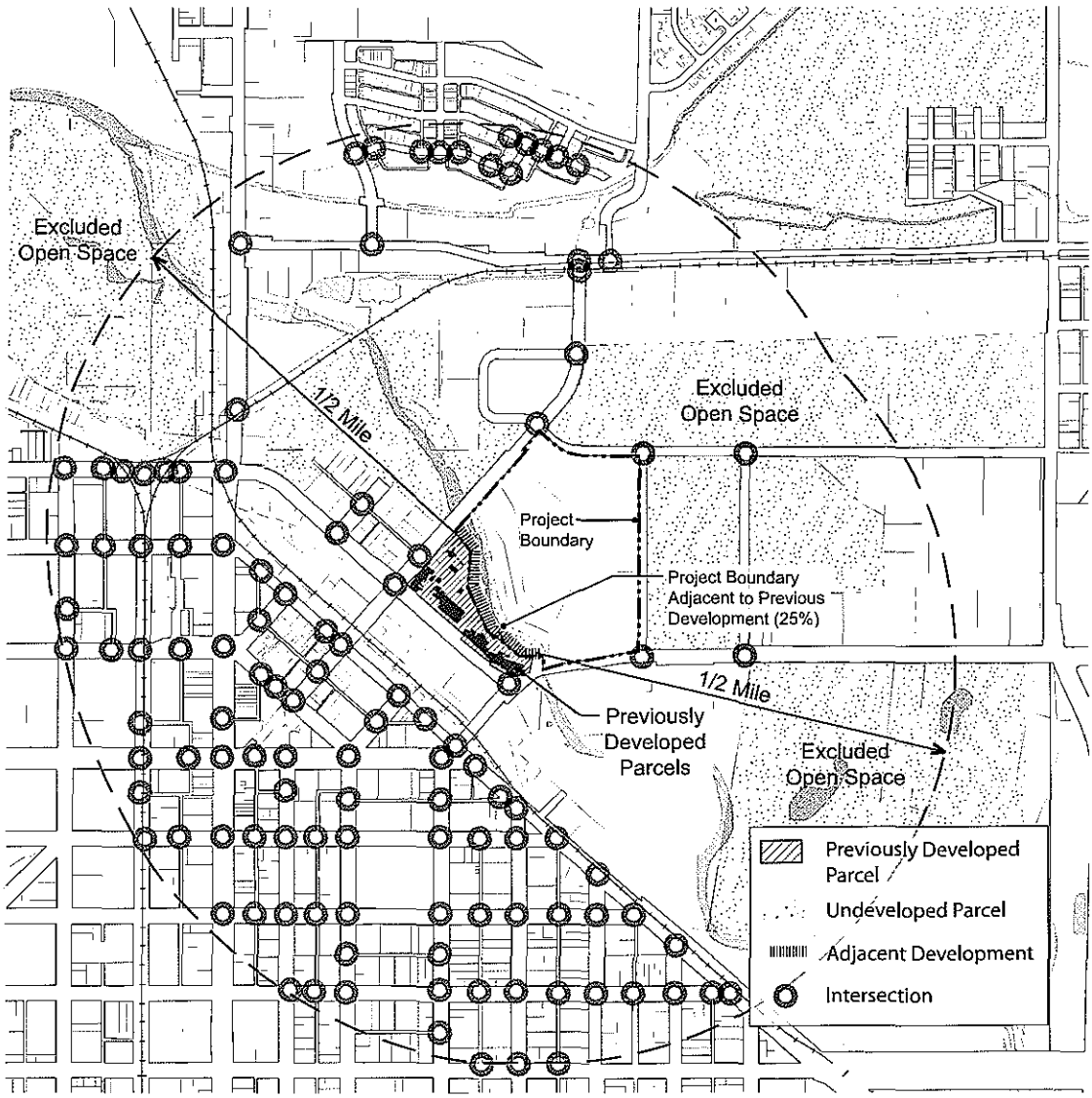
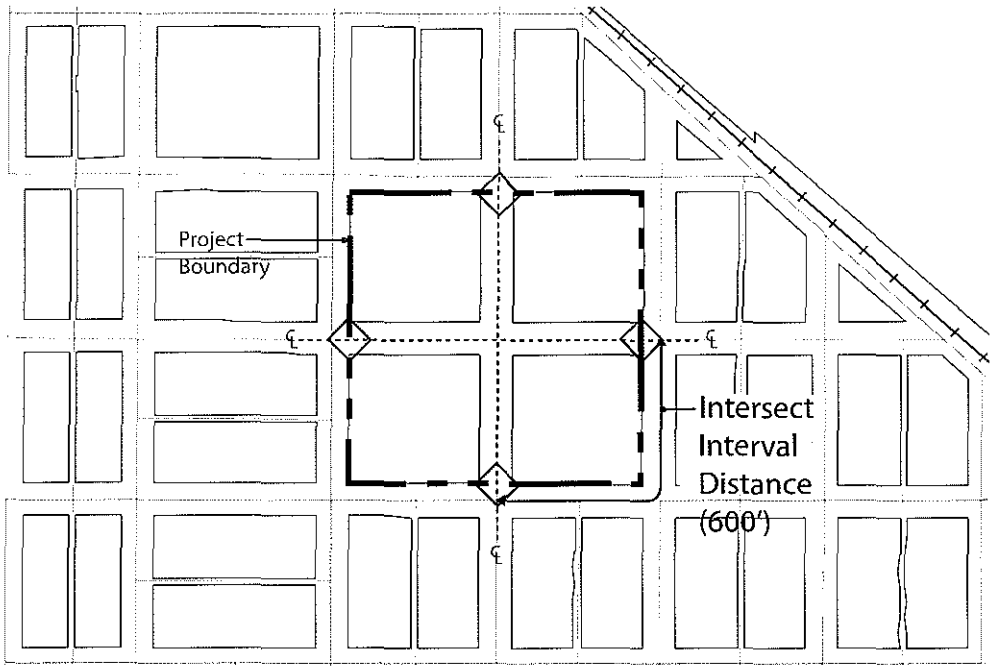


Figure 2. Project site with through-street right-of-way intersecting project boundary at least every 600 feet on average



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.

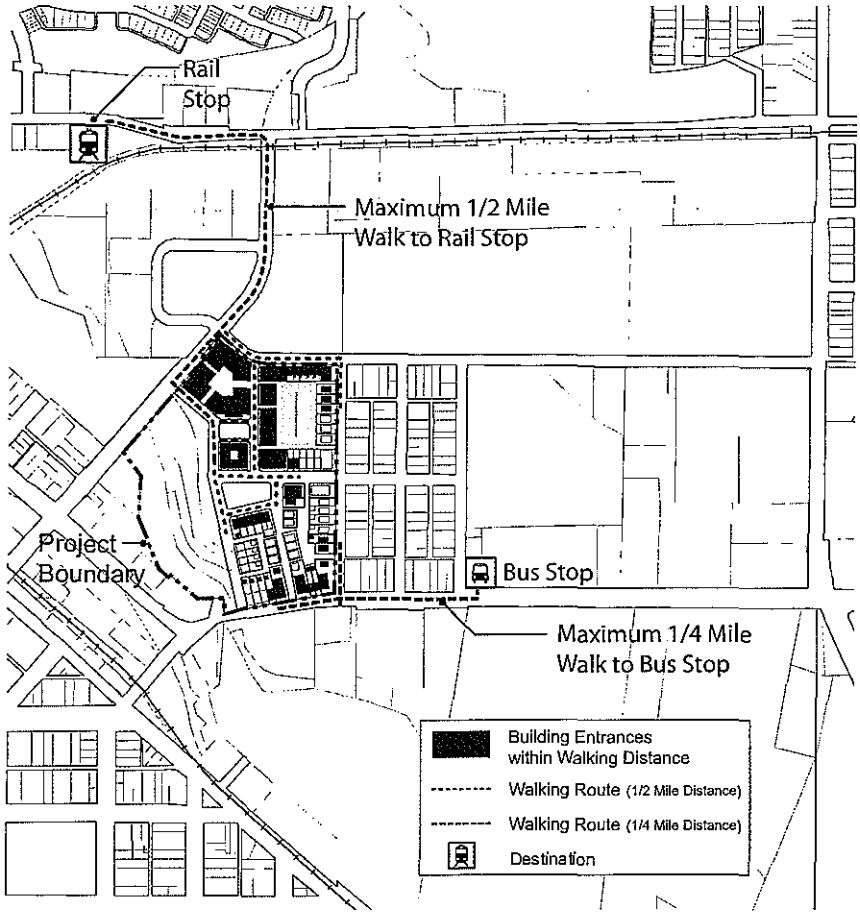
c. For rail service other than streetcars, the transit agency must certify that preliminary engineering for a rail line has commenced. In addition, the service must meet either of these two requirements:

- 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:

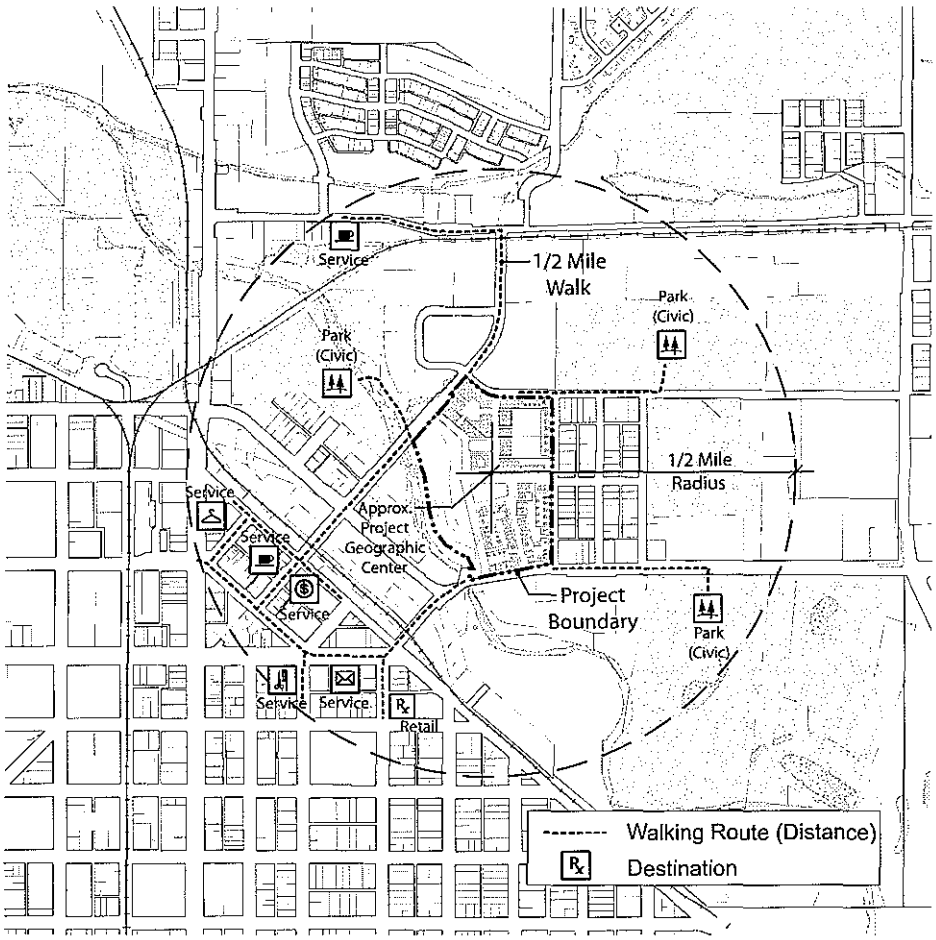
a. A single establishment may not be counted in two categories (e.g., a place of worship may be counted only once even if it also contains a daycare facility, and a retail store may be counted only once even if it sells products in several categories).

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).

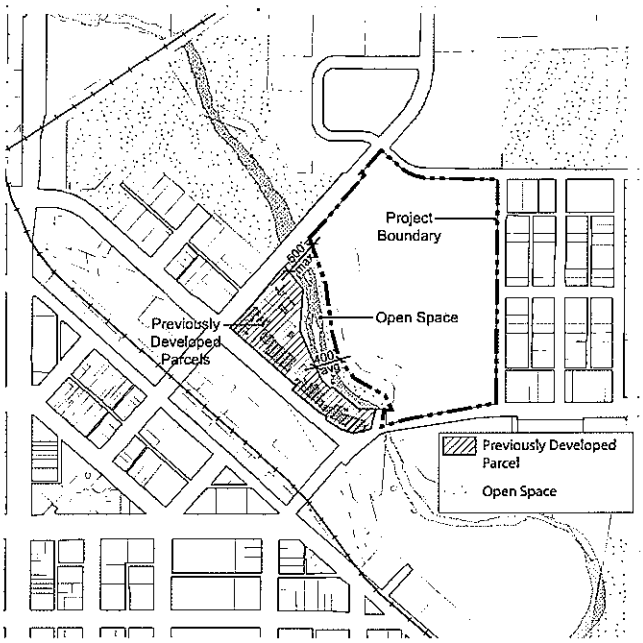
Figure 4. Walking routes on pedestrian network showing distances from dwellings and nonresidential uses to diverse use destinations



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.

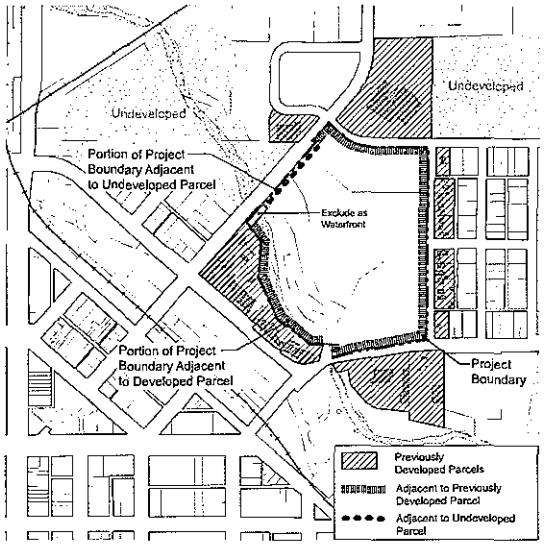
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

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.

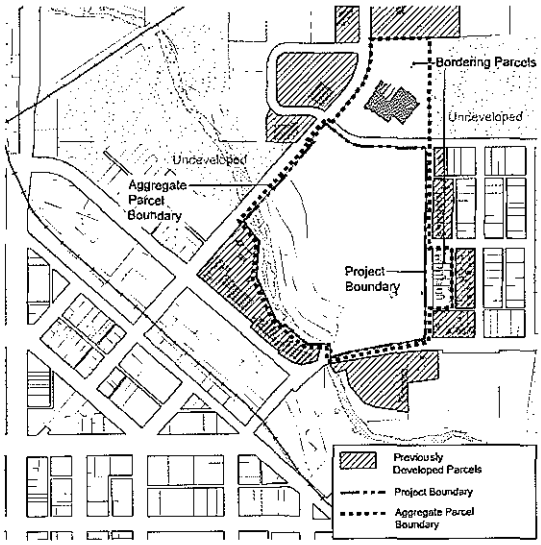
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

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.

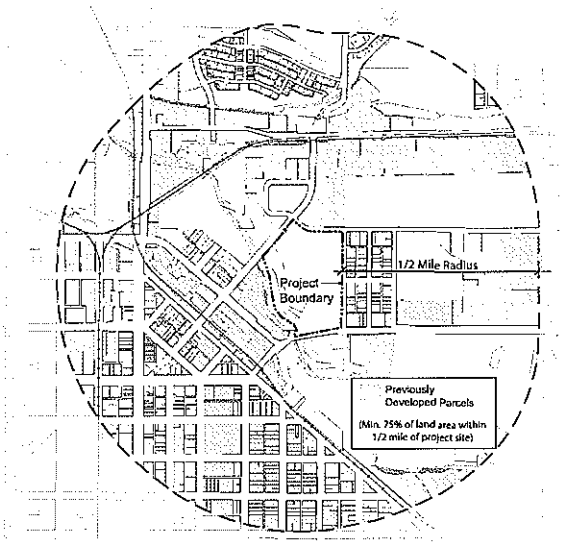
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



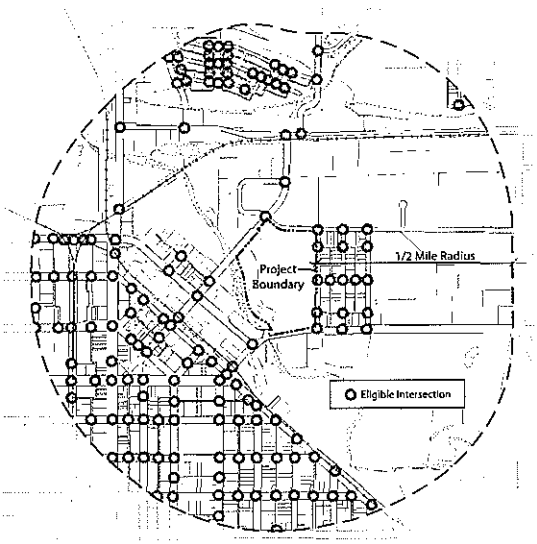
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(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.

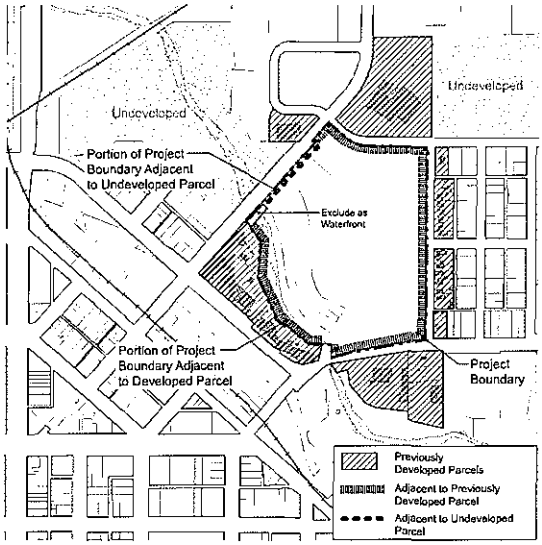
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

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.

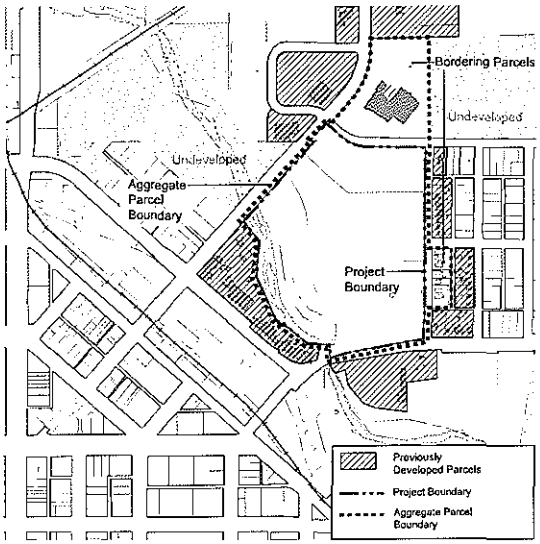
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

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.

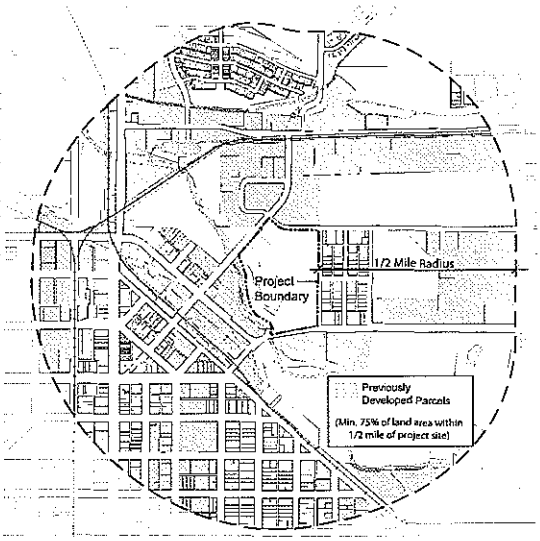
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



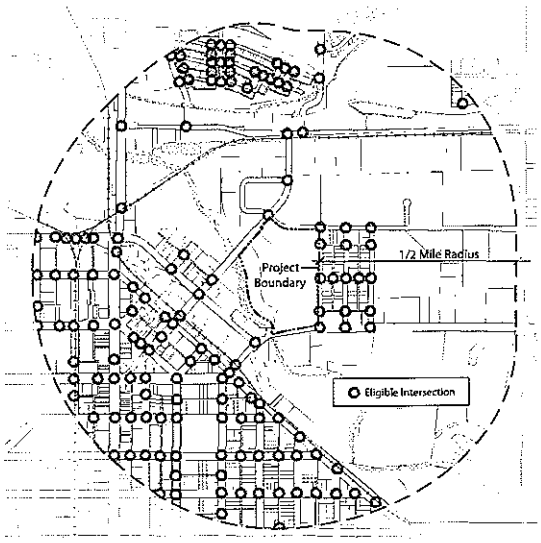
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(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.

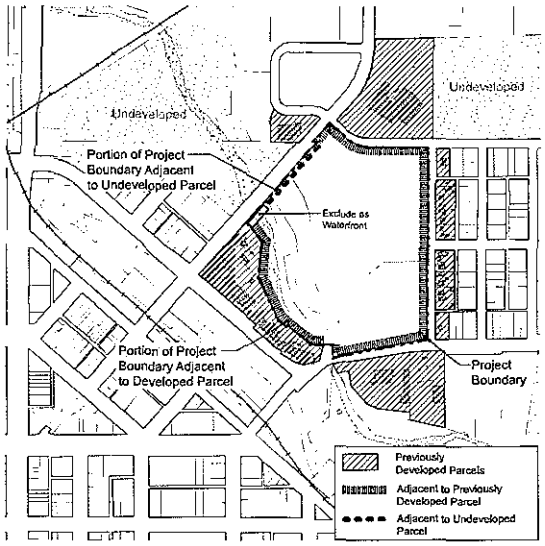
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

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.

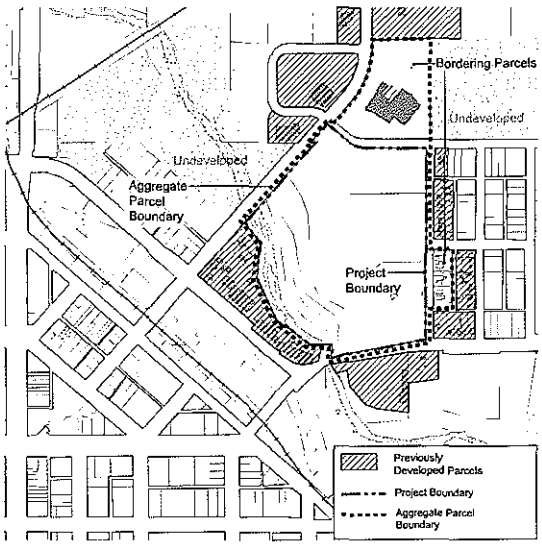
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

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.

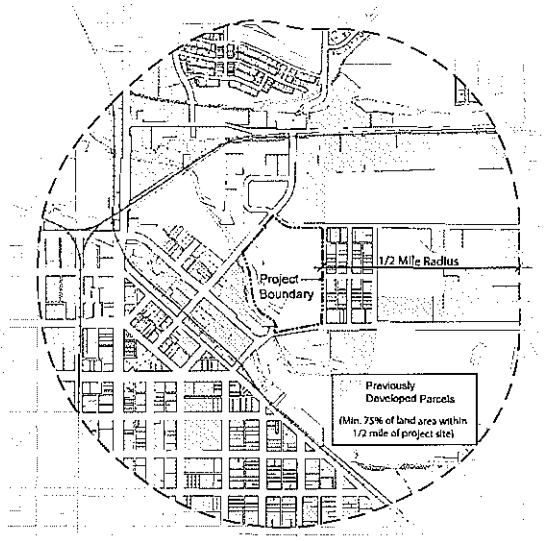
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



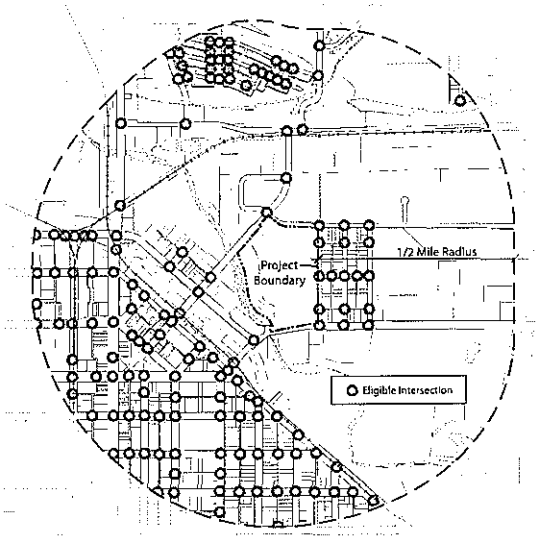
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(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.

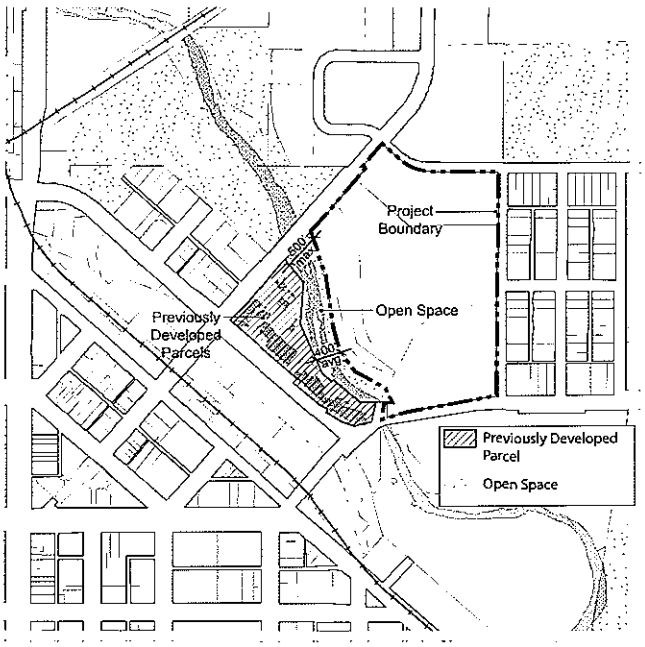
- In addition, locate the project in one of the following high-priority redevelopment areas: EPA National Priorities List, Federal Empowerment Zone, Federal Enterprise Community, Federal Renewal Community, Department of Justice Weed and Seed Strategy Community, Department of the Treasury Community Development 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.

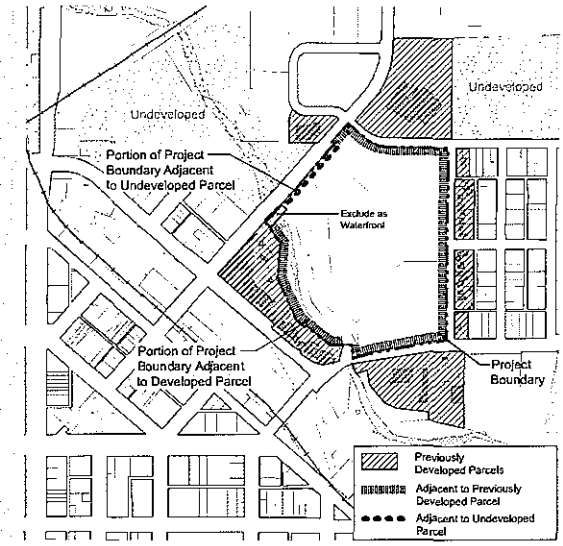
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

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.

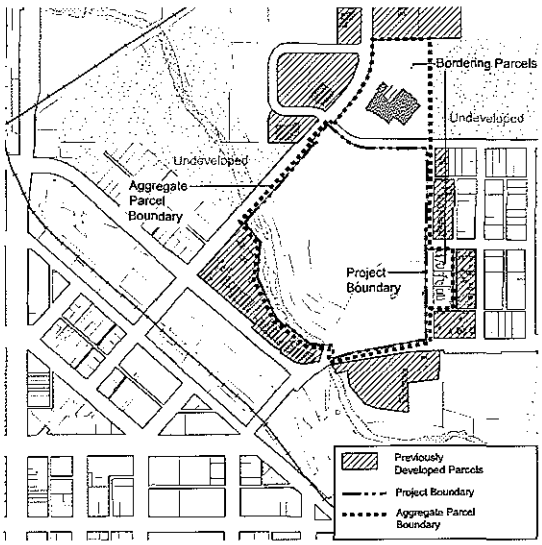
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

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.

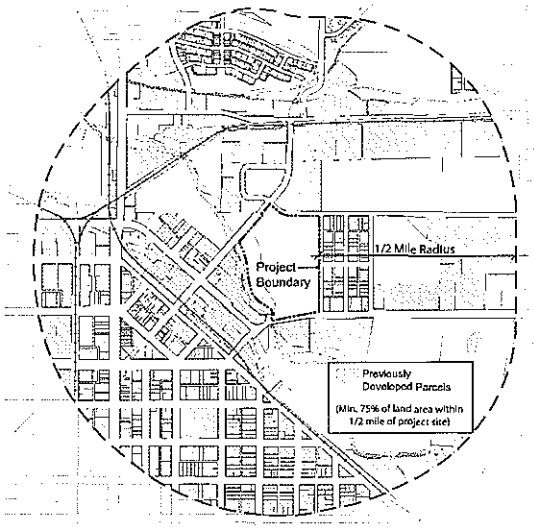
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



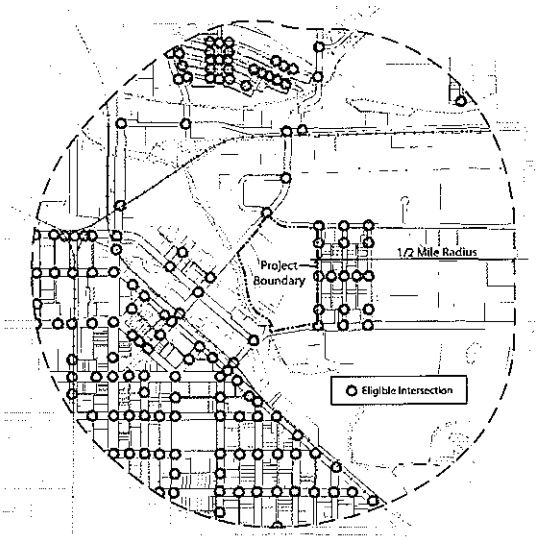
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(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.

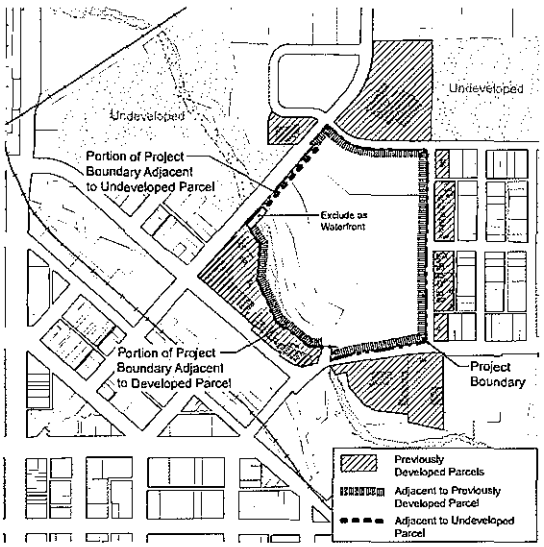
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

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.

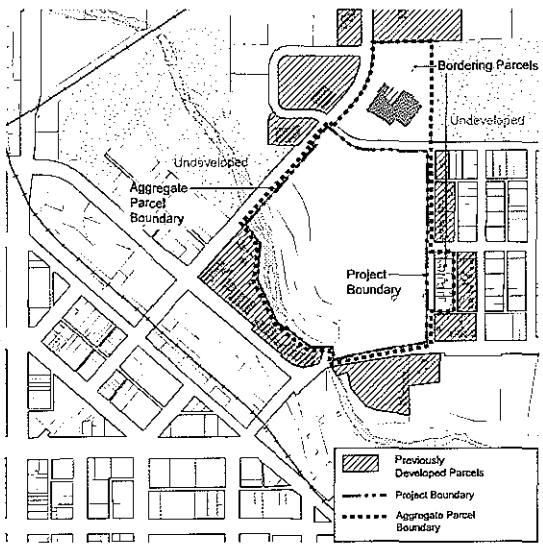
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

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.

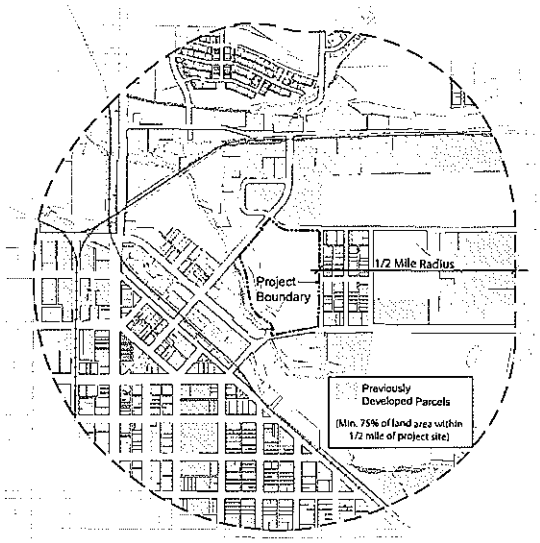
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



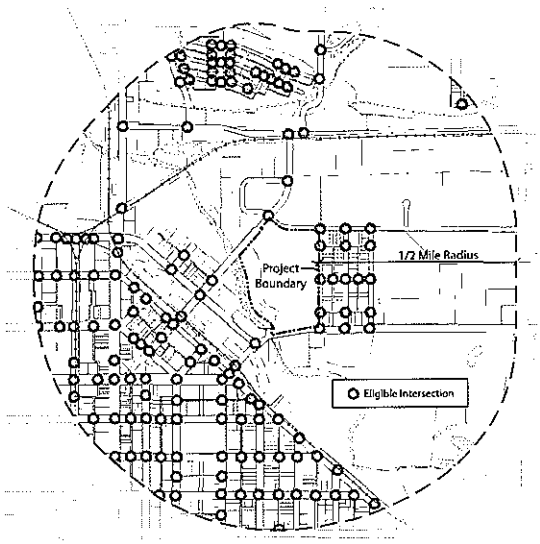
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(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

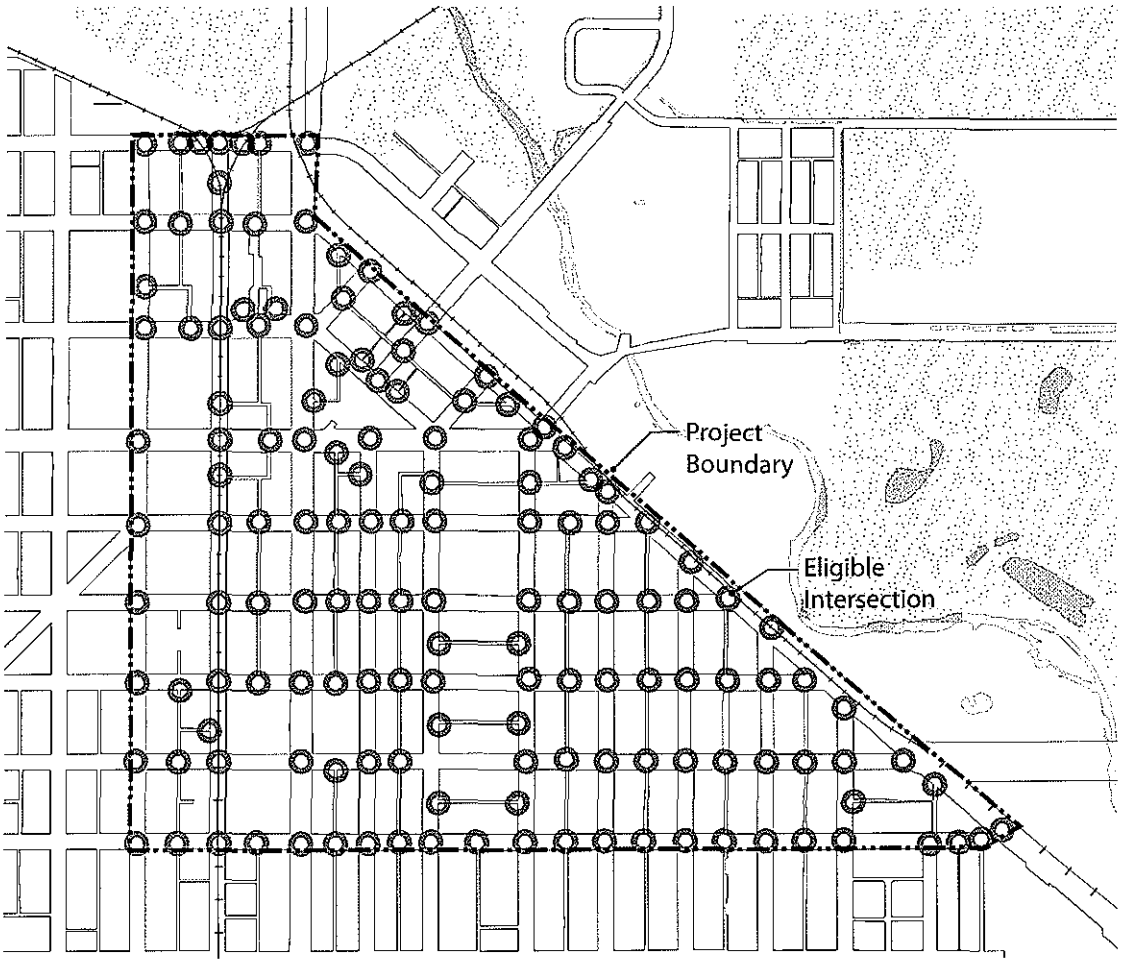
OPTION 1. Projects with Internal Streets

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

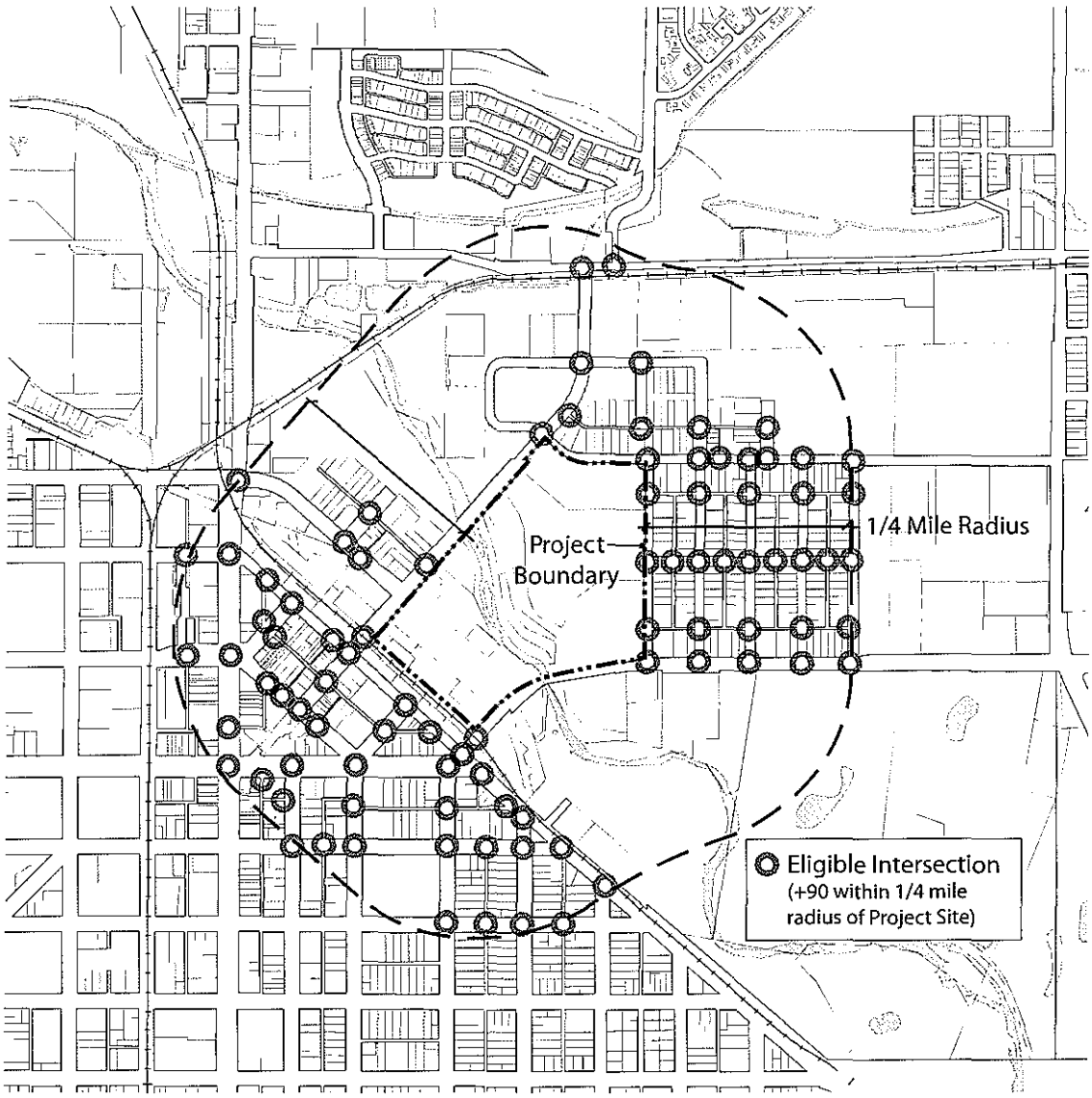


OR

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

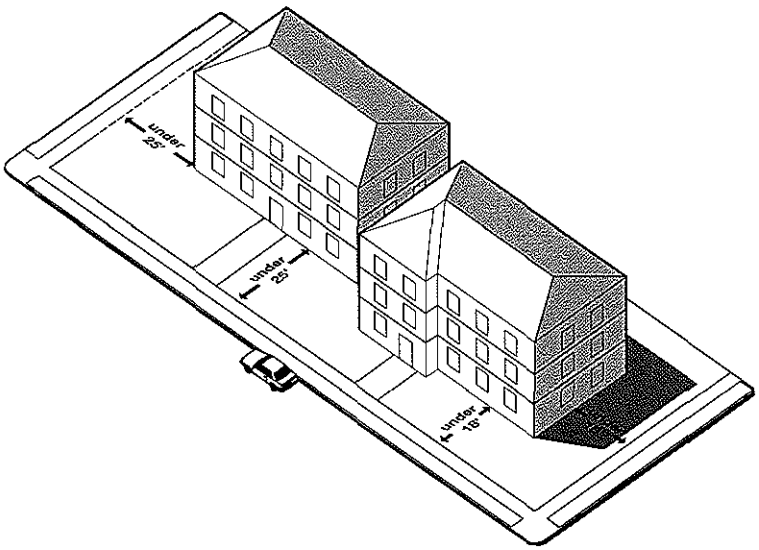
Items achieved	Points
2–3	1
4–5	2
6–7	3
8–9	4
10	7
11	8
12	9
13	10
14	11
15–16	12

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.

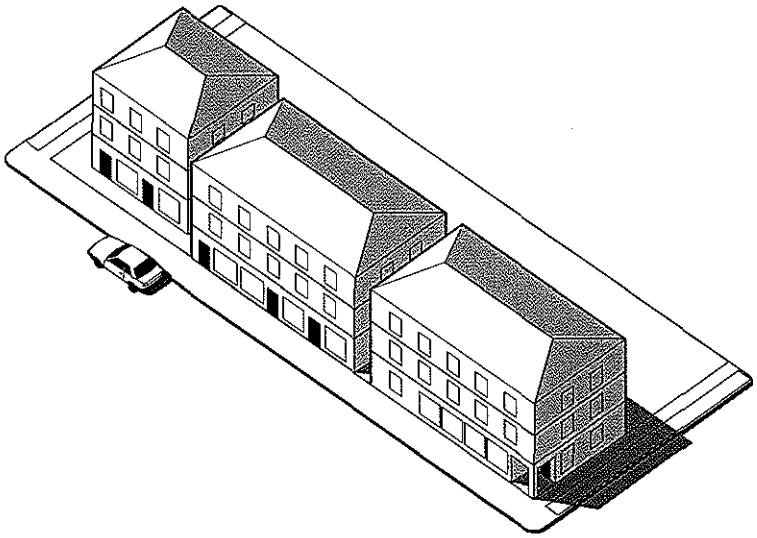
Figure 1. Minimal street-facing building façade setbacks



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).

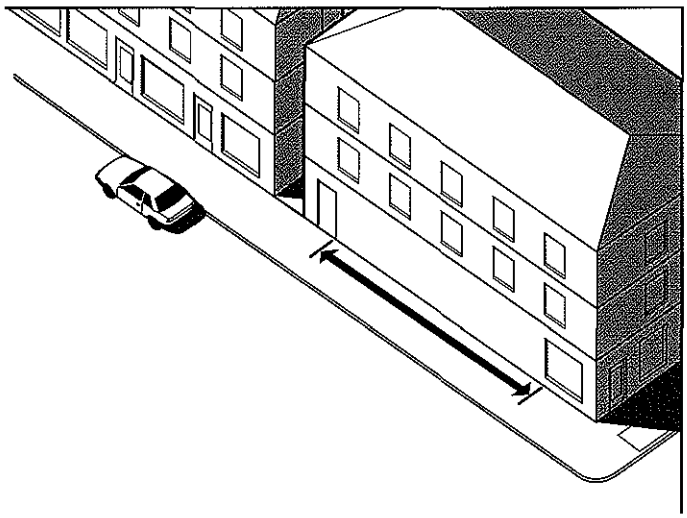
Ground-Level Use and Parking

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

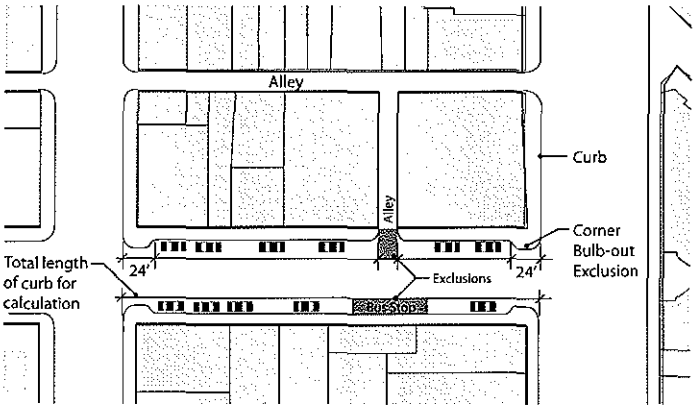


h. Any ground-level retail, service, or trade windows must be kept visible (unshuttered) at night; this must be stipulated in *covenants, conditions, and restrictions* (CC&R) or other binding documents.

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.

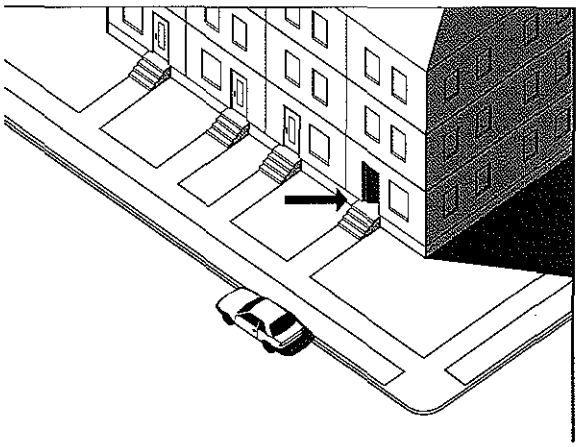
Figure 5. On-street parking requirements



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

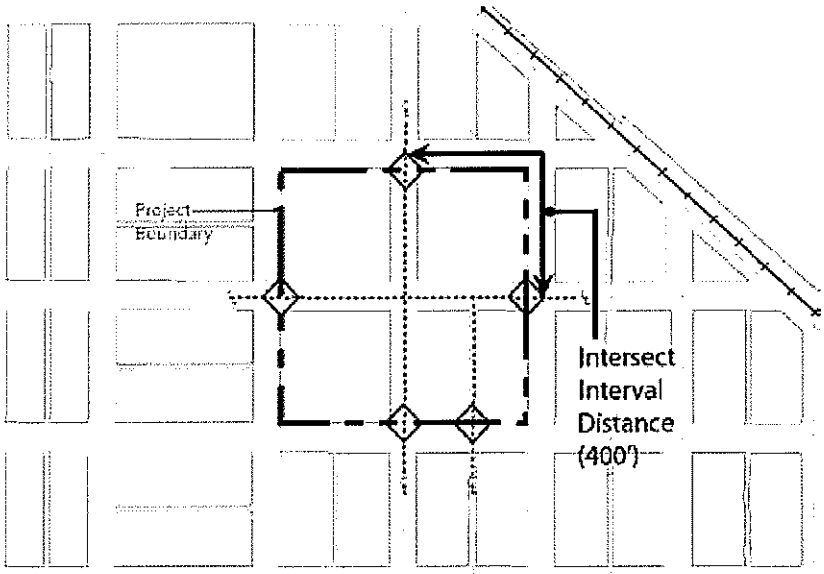
Intent

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 vegetation, 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 SRIcompliant 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.

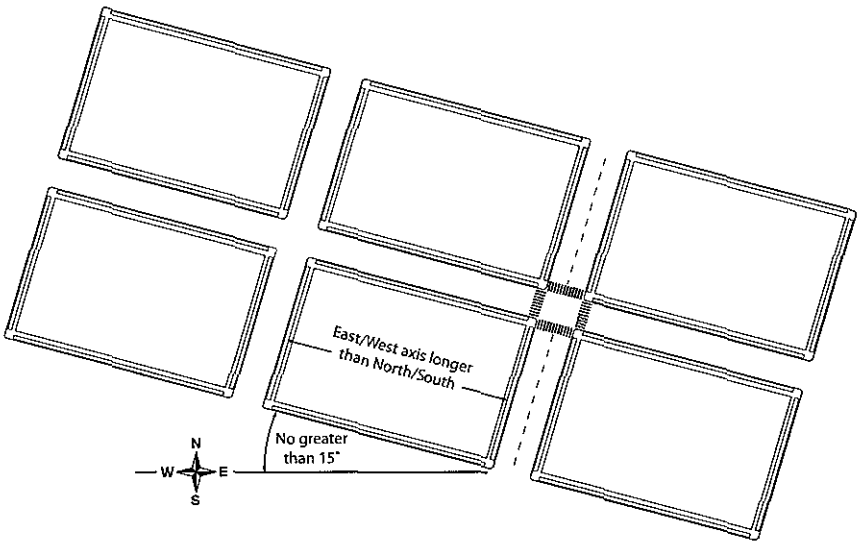
Requirements

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



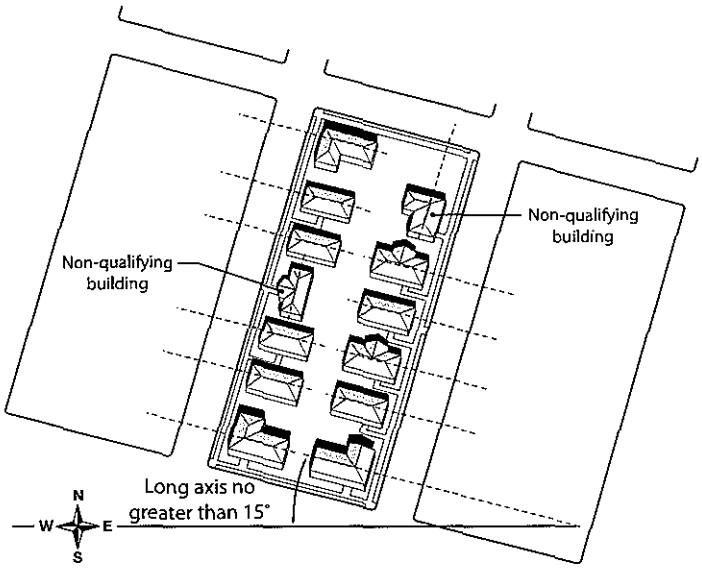
OR

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

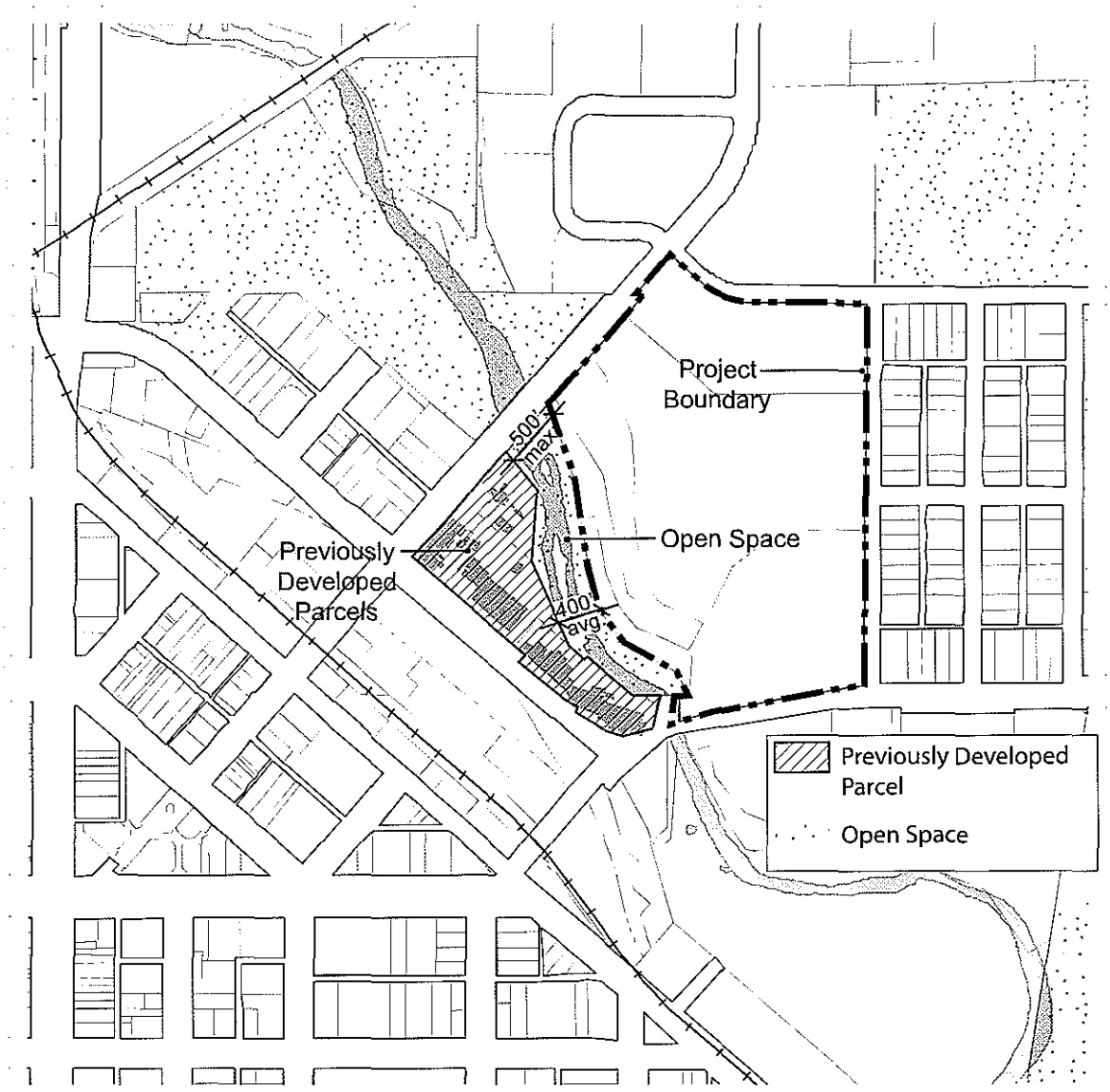
Adapted from Criterion Planners, INDEX neighborhood completeness indicator, 2005.

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.

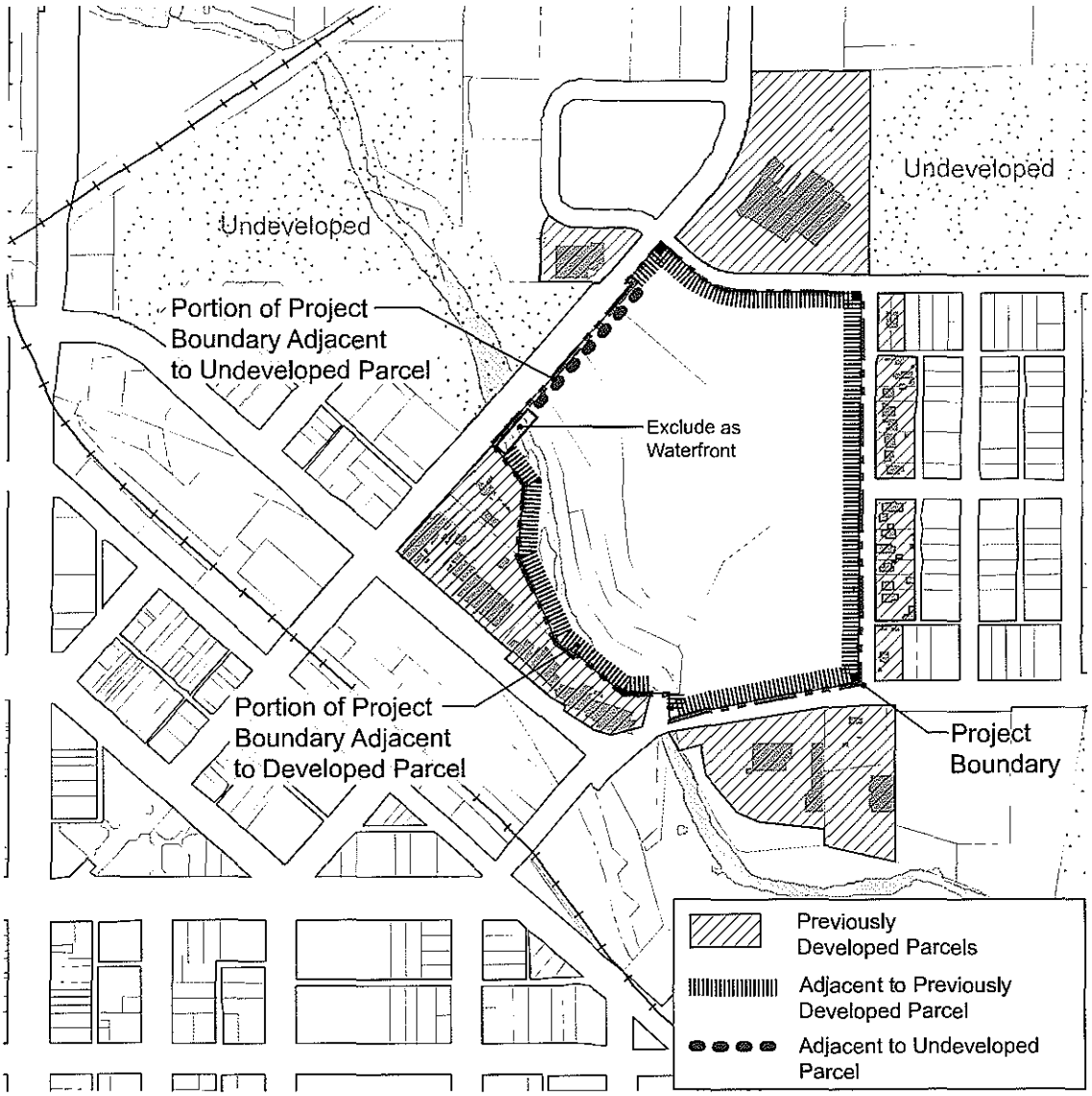
b. The site, in combination with bordering parcels, forms an aggregate parcel whose boundary is 75% bounded by parcels that individually are at least 50% previously developed, and that in aggregate are at least 75% previously developed.

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.

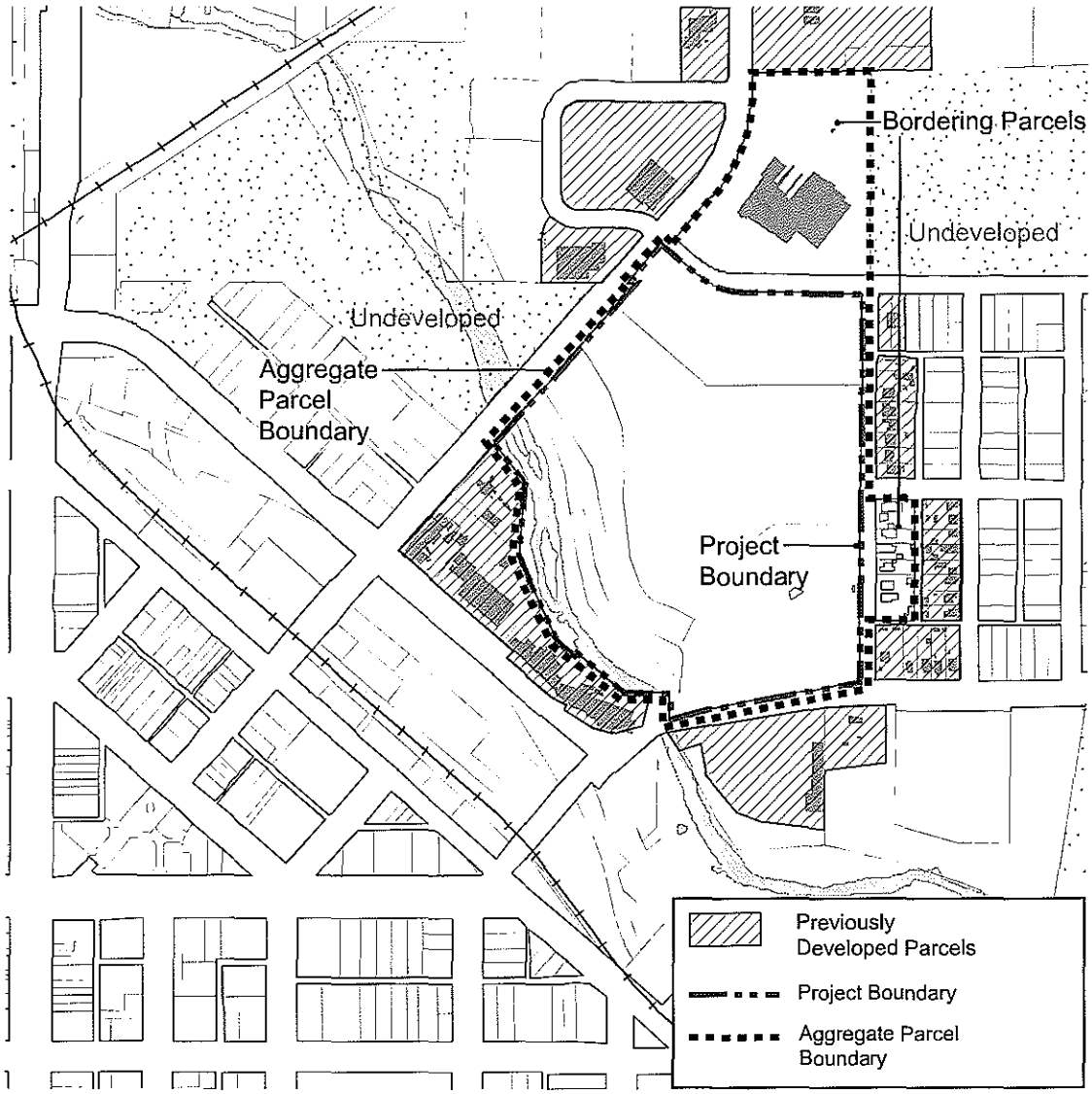
d. The lands within a 1/2 mile distance from the project boundary have a *preproject connectivity* of at least 140 intersections per square mile.

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.

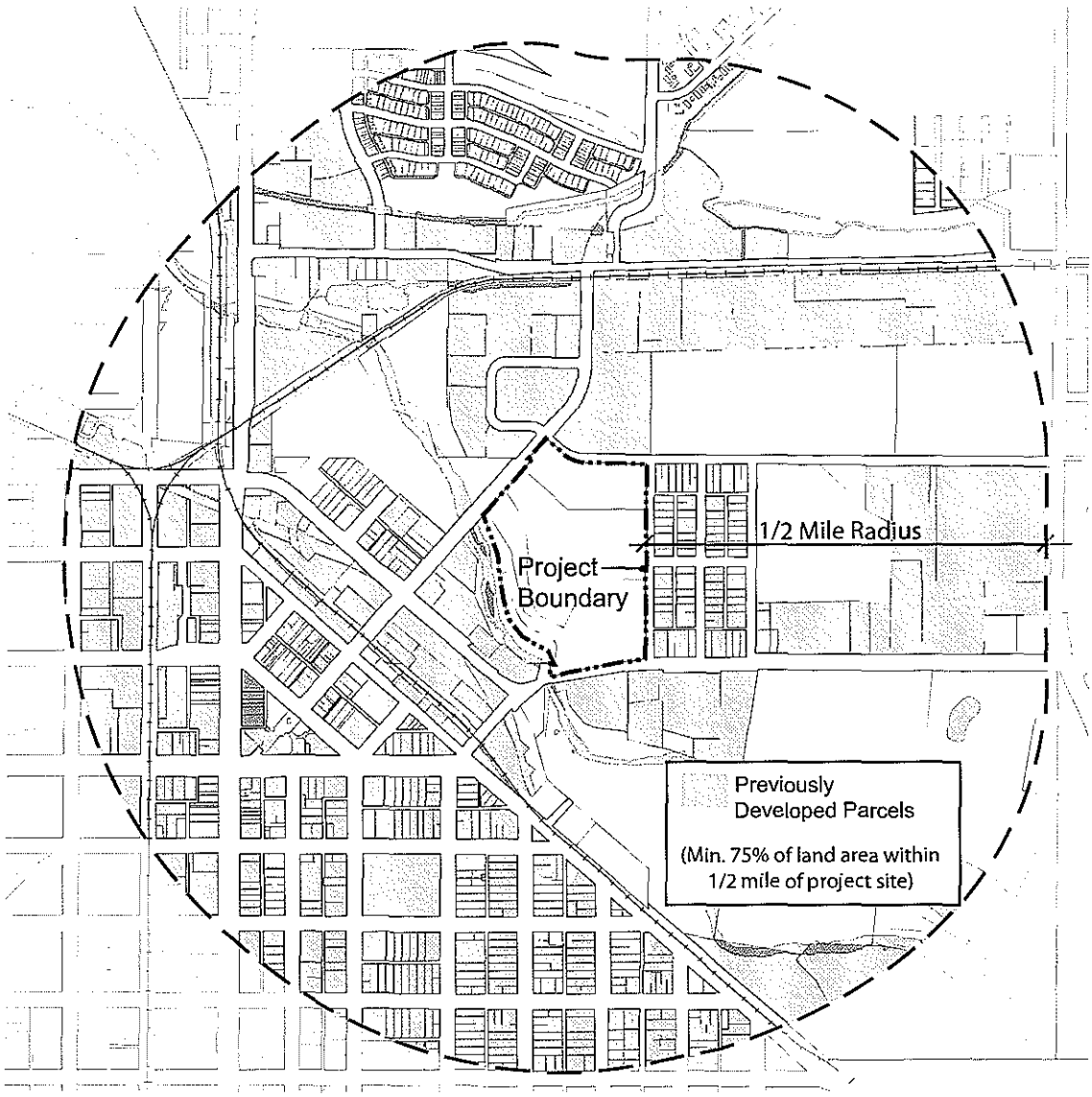
(a). Infill project site based on minimum 75% of perimeter adjacent to previously developed parcels



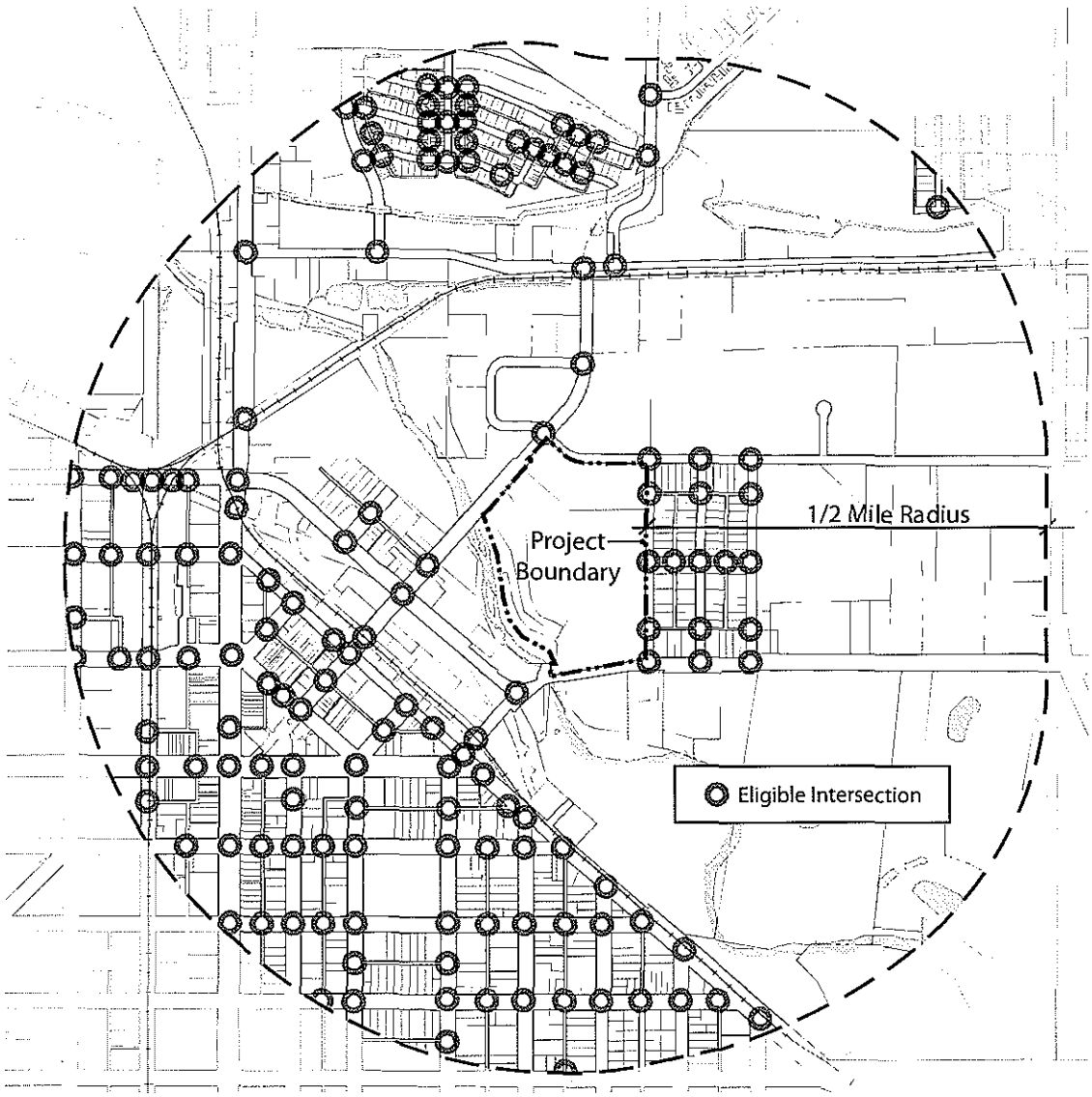
(b). Infill project site based on minimum 75% adjacent to previously developed parcels using project boundary and selected bordering parcels



(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-2.

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.

INTRODUCTION

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

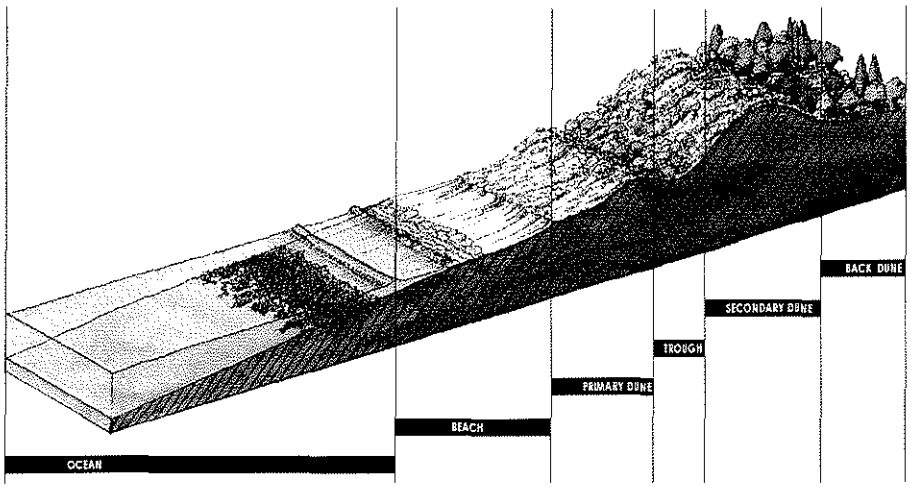
Transect-Based Planning

"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.



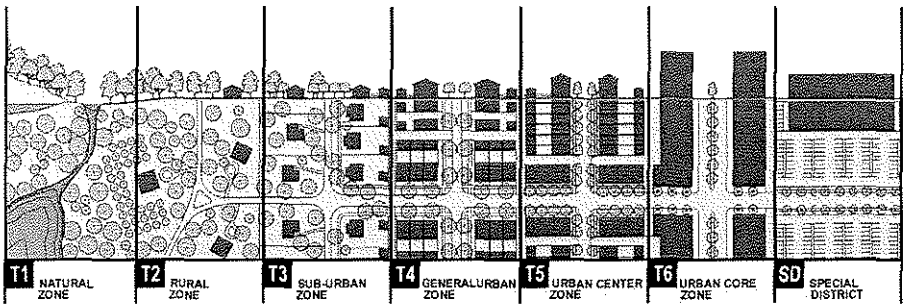
A Typical Natural Transect

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

INTRODUCTION

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.

INTRODUCTION

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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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 Out-building 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.

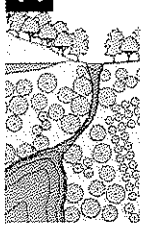
AVAILABLE MODULES FOR ARTICLE 5

- 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

TABLE 1: Transect Zone Descriptions. This table provides descriptions of the character of each T-zone.

T1

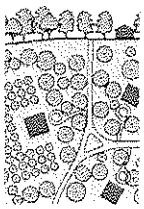


T-1 NATURAL

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

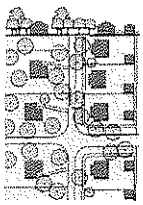


T-2 RURAL

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

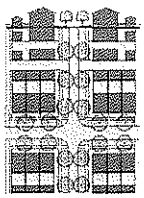


T-3 SUB-URBAN

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

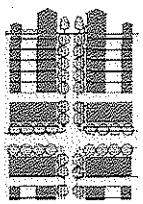


T-4 GENERAL URBAN

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

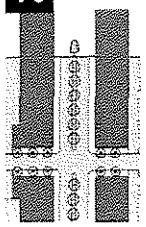


T-5 URBAN CENTER

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

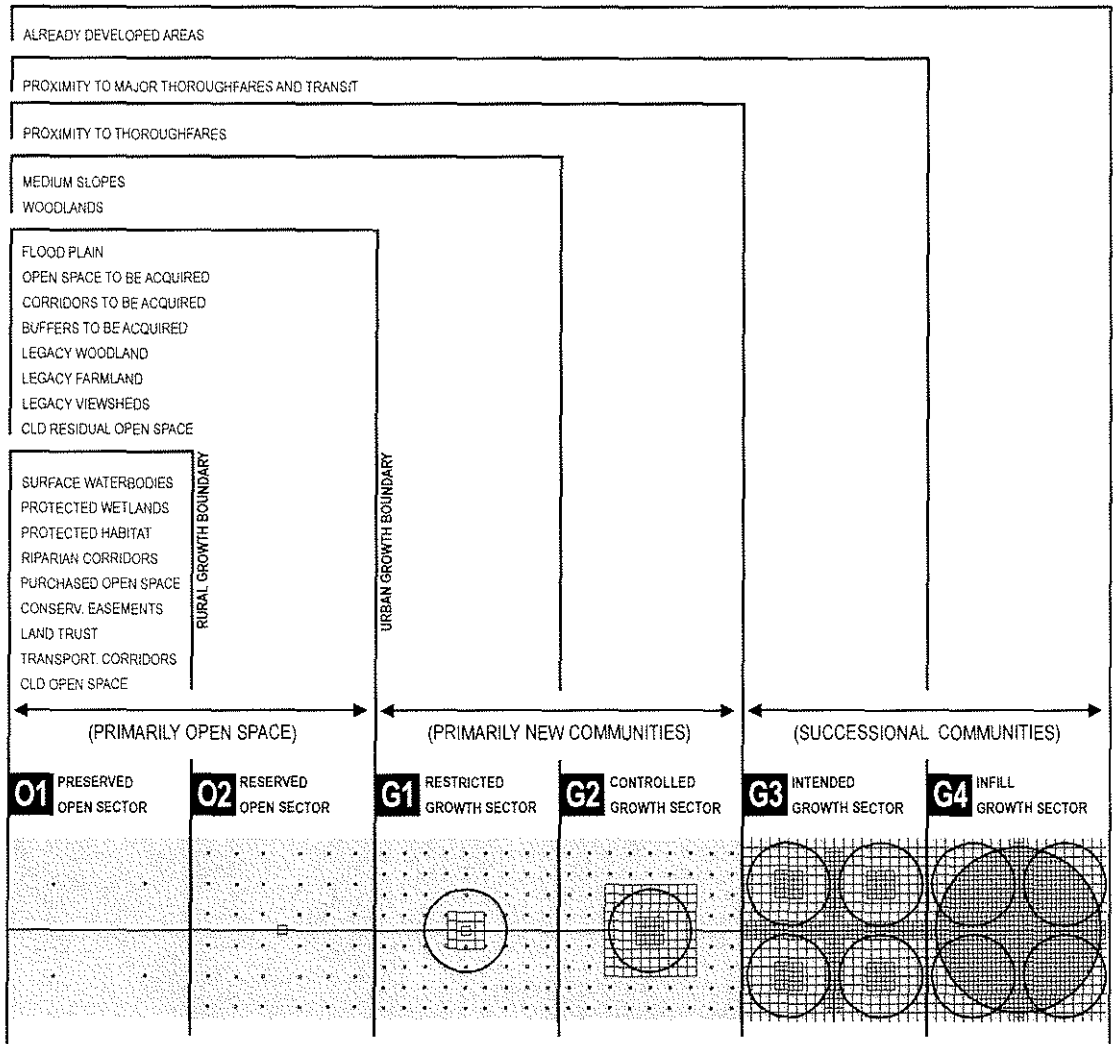


T-6 URBAN CORE

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.

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	▪	▪			▫	▫

▪ BY RIGHT

▫ BY WARRANT

TABLE 3B: Vehicular Lane/Parking Assemblies. The projected design speeds determine the dimensions of the vehicular lanes and Turning Radii assembled for Thoroughfares.

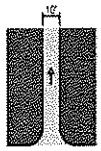
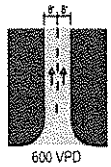
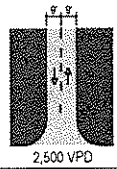
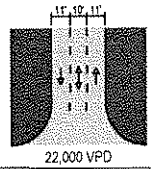
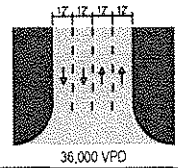
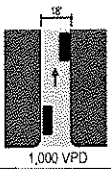
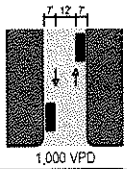
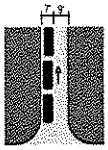
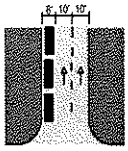
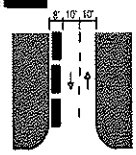
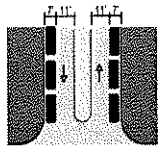
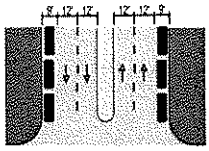
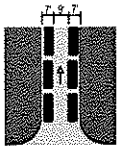
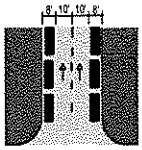
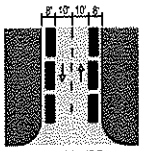
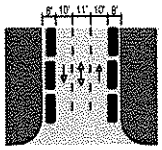
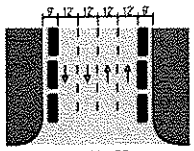
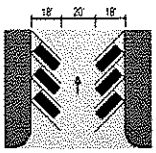
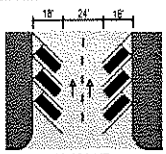
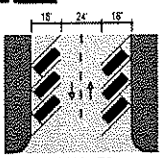
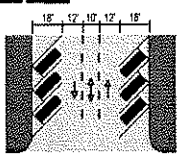
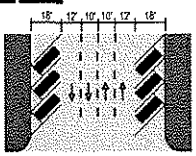
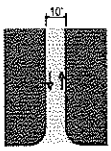
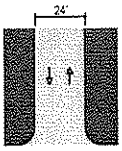
	ONE WAY MOVEMENT →			TWO WAY MOVEMENT →		
a. NO PARKING	T1 T2 T3	T1 T2 T3		T1 T2 T3	T1 T2	T1 T2
						
Design ADT	300 VPD	600 VPD		2,500 VPD	22,000 VPD	36,000 VPD
Pedestrian Crossing	3 Seconds	5 Seconds		5 Seconds	9 Seconds	13 Seconds
Design Speed	20 - 30 MPH	Below 20 MPH		20-25 MPH		35 MPH and above
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	18,000 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	6 Seconds	
Design Speed						

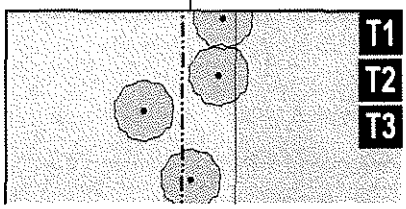
TABLE 4A. PUBLIC FRONTAGES - GENERAL

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.

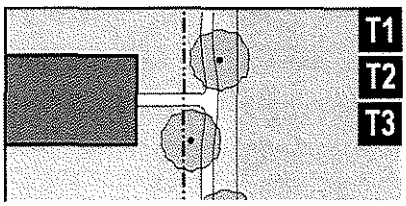
PLAN

LOT ► ◄ R.O.W.
PRIVATE FRONTAGE ► ◄ PUBLIC FRONTAGE

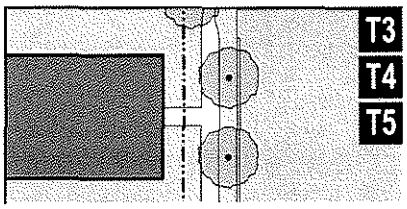
a. (HW) For Highway: This Frontage has open Swales drained by percolation, Bicycle Trails and no parking. The landscaping consists of the natural condition or multiple species arrayed in naturalistic clusters. Buildings are buffered by distance or berms.



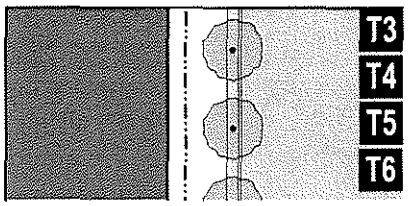
b. (RD) For Road: This Frontage has open Swales drained by percolation and a walking Path or Bicycle Trail along one or both sides and Yield parking. The landscaping consists of multiple species arrayed in naturalistic clusters.



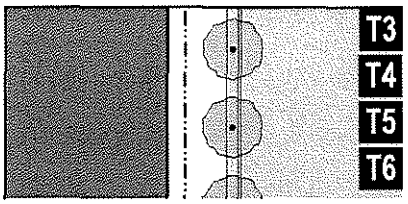
c. (ST) For Street: This Frontage has raised Curbs drained by inlets and Sidewalks separated from the vehicular lanes by individual or continuous Planters, with parking on one or both sides. The landscaping consists of street trees of a single or alternating species aligned in a regularly spaced Allee, with the exception that Streets with a right-of-way (R.O.W.) width of 40 feet or less are exempt from tree requirements.



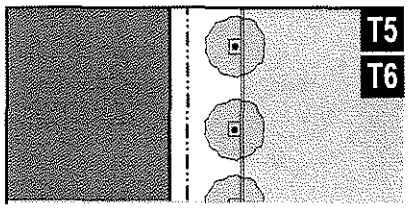
d. (DR) For Drive: This Frontage has raised Curbs drained by inlets and a wide Sidewalk or paved Path along one side, related to a Greenway or waterfront. It is separated from the vehicular lanes by individual or continuous Planters. The landscaping consists of street trees of a single or alternating 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.

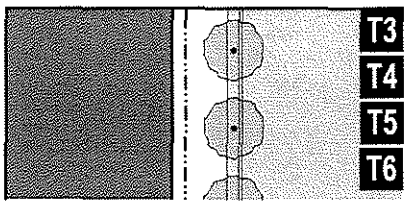


Table 4B: Public Frontages - Specific. This table assembles prescriptions and dimensions for the Public Frontage elements - Curbs, walkways and Planters – relative to specific Thoroughfare types within Transect Zones. Table 4B-a assembles all of the elements for the various street types. Locally appropriate planting species should be filled in to the calibrated Code.

RURAL ||||||||||||||||||||TRANSECT||||||||||||||||||||URBAN

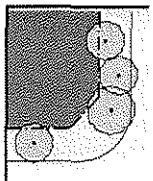
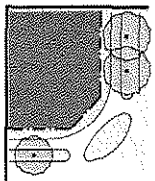
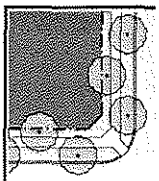
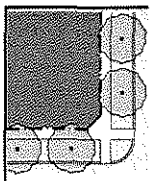
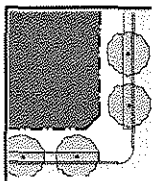
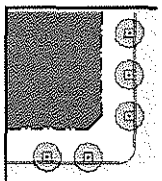
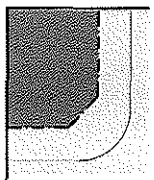
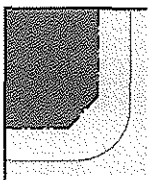
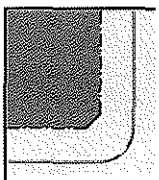
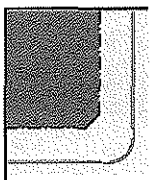
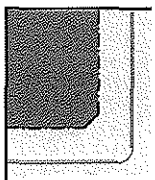
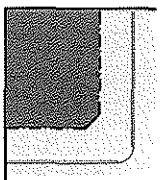
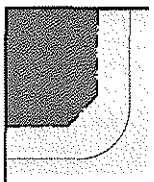
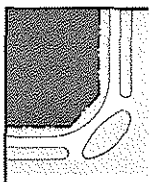
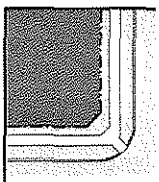
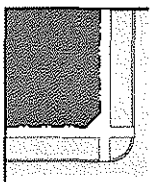
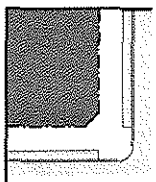
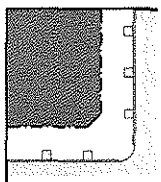
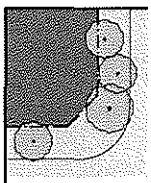
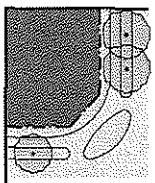
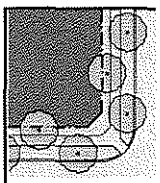
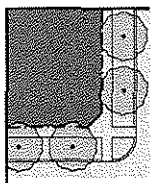
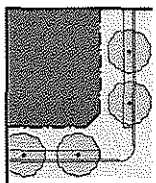
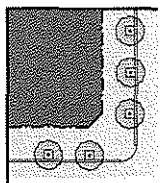
TRANSECT ZONE	T1 T2 T3	T1 T2 T3	T3 T4	T4 T5	T5 T6	T5 T6
Public Frontage Type	HW & RD	RD & ST	ST-DR-AV	ST-DR-AV-BV	CS-DR-AV-BV	CS-DR-AV-BV
a. Assembly: The principal variables are the type and dimension of Curbs, walkways, Planters and landscape.						
Total Width	16-24 feet	12-24 feet	12-18 feet	12-18 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)						

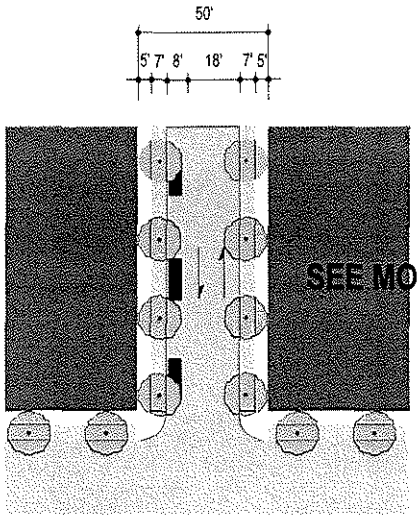
TABLE 4C: Thoroughfare Assemblies. These Thoroughfares are assembled from the elements that appear in Tables 3A and 3B and incorporate the Public Frontages of Table 4A. The key gives the Thoroughfare type followed by the right-of-way width, followed by the pavement width, and in some instances followed by specialized transportation capability.

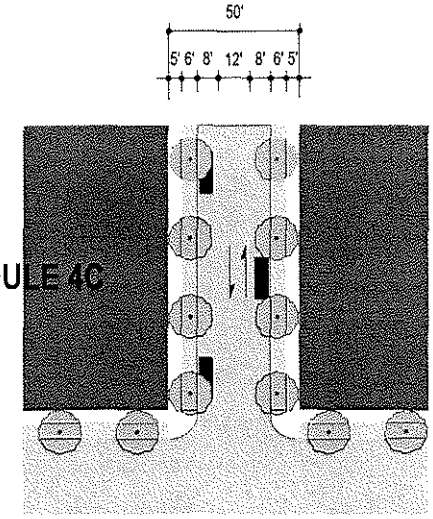
KEY ST-57-20-BL

- 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





SEE MODULE 4C

	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.

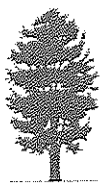
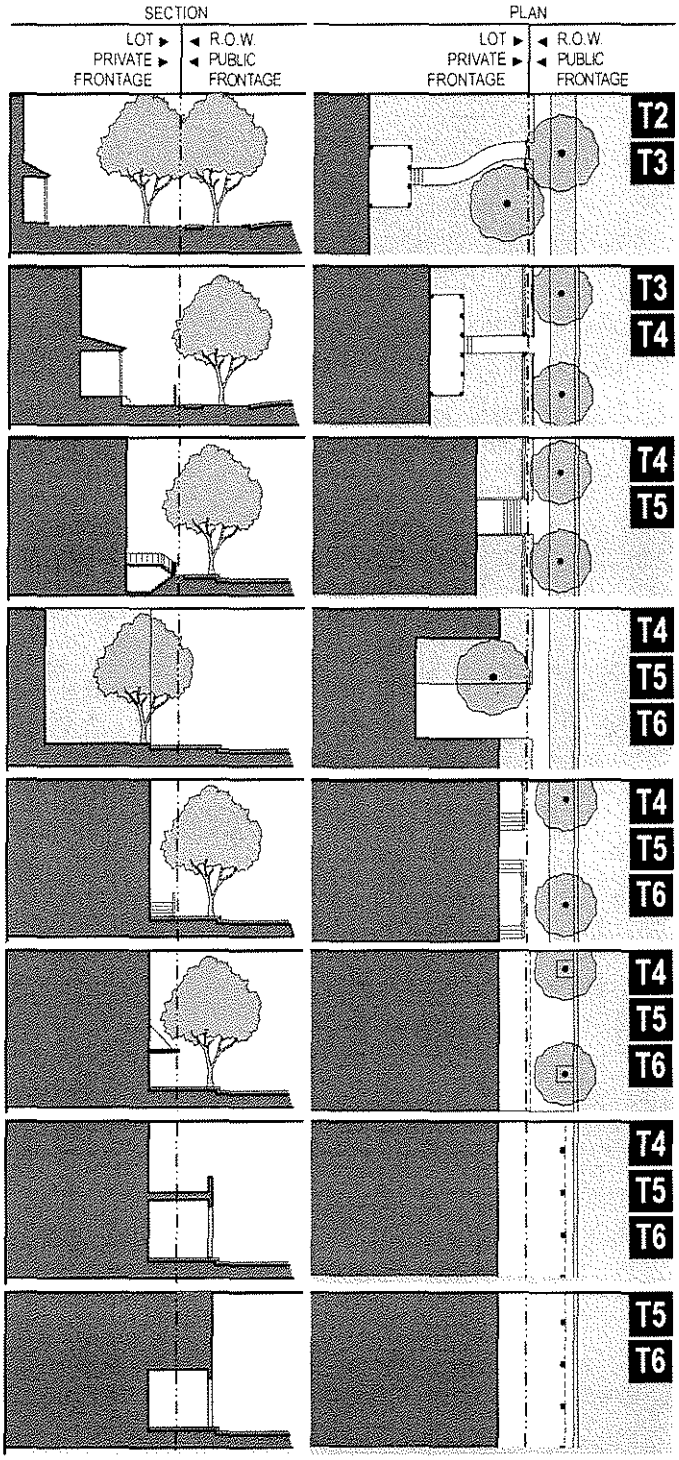
	T1	T2	T3	T4	T5	T6	SD	Specific Lighting
Pole	▪	▪	▪	▪	▪	▪		
Oval 	▪	▪	▪	▪	▪	▪		
Ball	▪	▪	▪	▪	▪	▪		
Pyramid	▪	▪	▪	▪				
Umbrella	▪	▪	▪	▪				
Vase	▪	▪	▪	▪				

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.

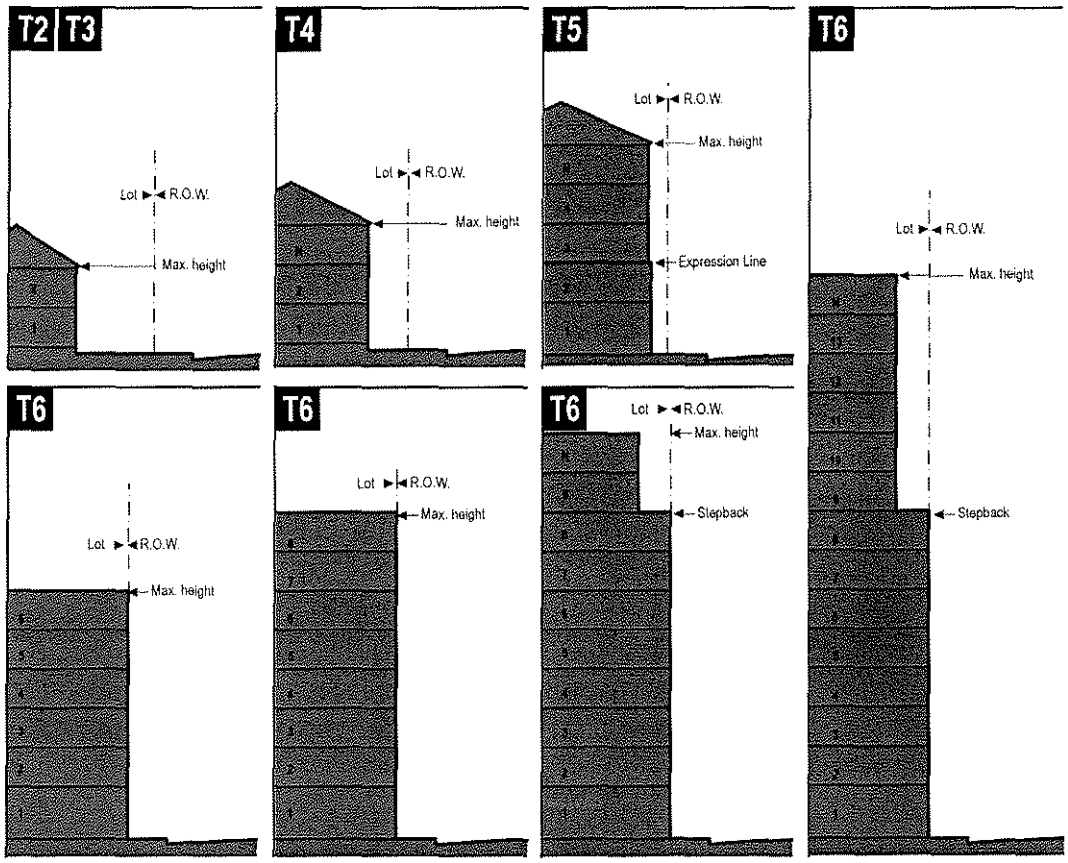
e. Stoop: a Frontage wherein the Facade is aligned close to the Frontage Line with the first Story elevated from the Sidewalk sufficiently to secure privacy for the windows. The entrance is usually an exterior stair and landing. This type is recommended for ground-floor Residential use.

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.

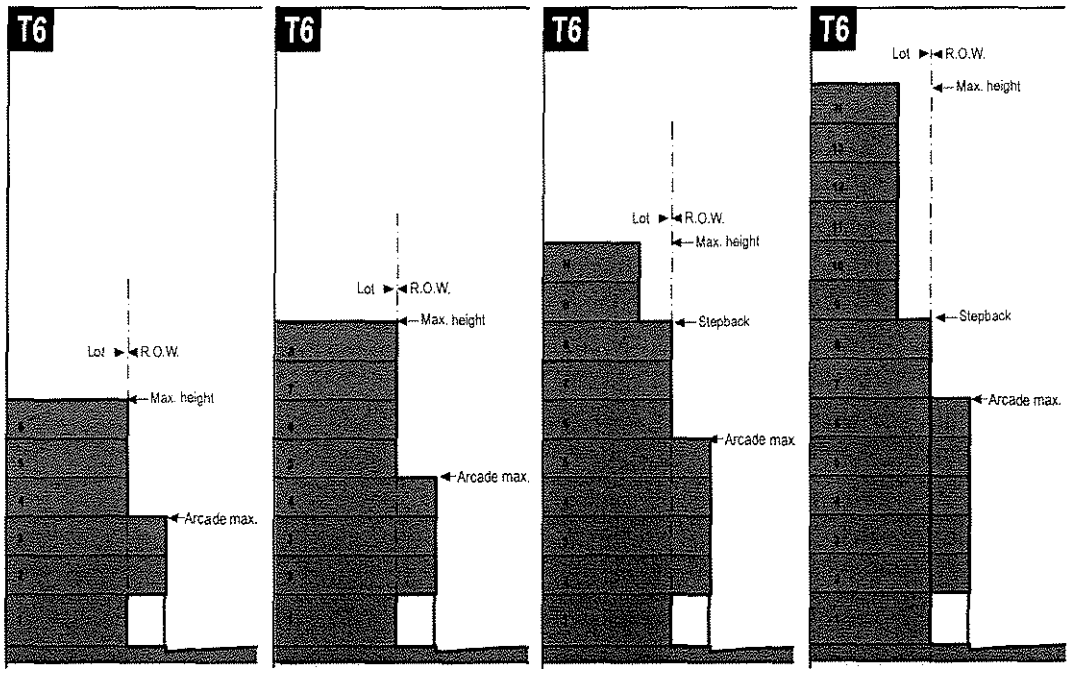
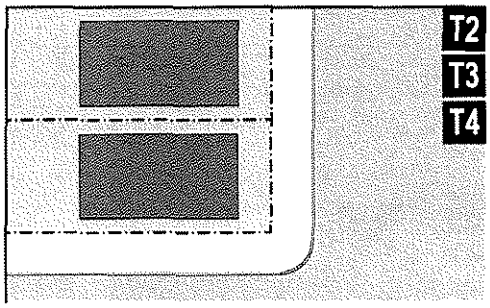
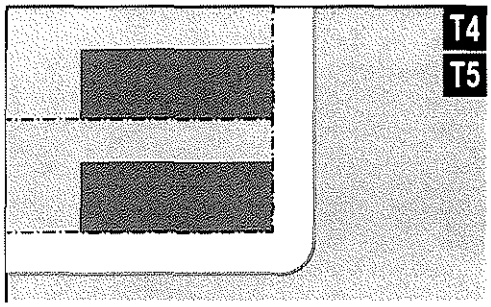


TABLE 9: Building Disposition. This table approximates the location of the structure relative to the boundaries of each individual Lot, establishing suitable basic building types for each Transect Zone.

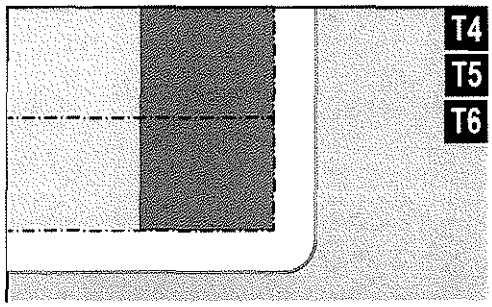
a. Edgeyard: Specific Types - single family House, cottage, villa, estate house, urban villa. A building that occupies the center of its Lot with Setbacks on all sides. This is the least urban of types as the front yard sets it back from the Frontage, while the side yards weaken the spatial definition 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.



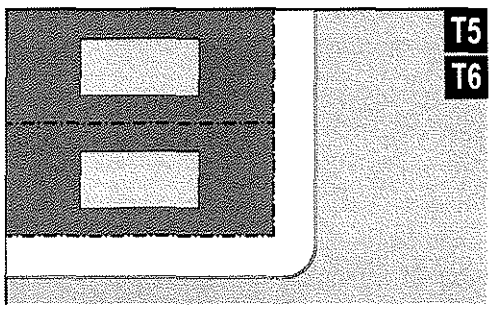
b. Sideyard: Specific Types - Charleston single house, double house, zero lot line house, twin. A building that occupies one side of the Lot with the Setback to the other side. A shallow Frontage Setback defines a more urban condition. If the adjacent building is similar with a blank side wall, the yard 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.

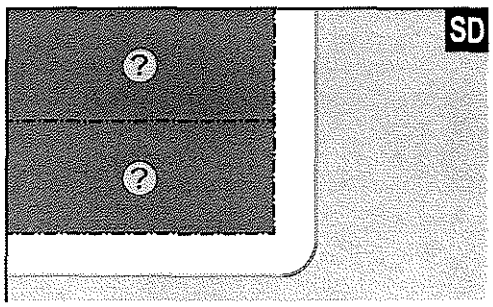


TABLE 10: Building Function. This table categorizes Building Functions within Transect Zones. Parking requirements are correlated to functional intensity. For Specific Function and Use permitted By Right or by Warrant, see Table 12.

	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

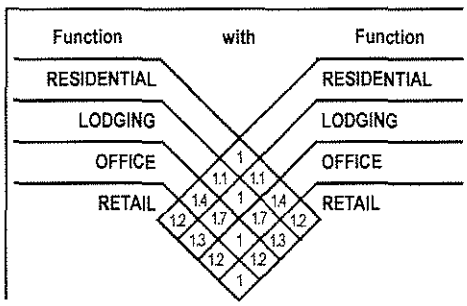


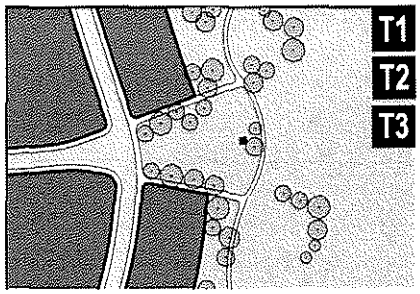
TABLE 12: Specific Function & Use. This table expands the categories of Table 10 to delegate specific Functions and uses within Transect Zones. Table 12 should be customized for local character and requirements.

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		■	■	■	■	■	■

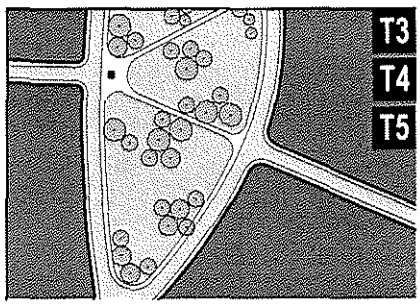
f. OTHER: AGRICULTURE	T1	T2	T3	T4	T5	T6	SD
Grain Storage	■	■					□
Livestock Pen	□	□					□
Greenhouse	■	■	□				□
Stable	■	■	□				□
Kennel	■	■	□	□	□	□	□
f. OTHER: AUTOMOTIVE							
Gasoline		□			□	□	■
Automobile Service							■
Truck Maintenance							■
Drive -Through Facility					□	□	■
Rest Stop	■	■					□
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

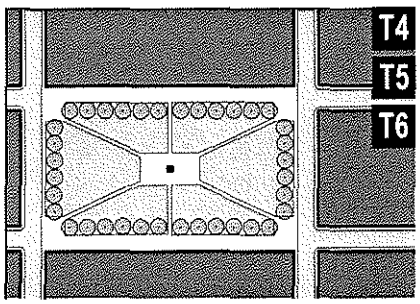
a. Park: A natural preserve available for unstructured recreation. A park may be independent of surrounding building Frontages. Its landscape shall consist of Paths and trails, meadows, waterbodies, woodland and open shelters, all naturalistically disposed. Parks may be lineal, following the trajectories of natural corridors. The minimum size shall be 8 acres. Larger parks may be approved by Warrant as Special Districts in all zones.



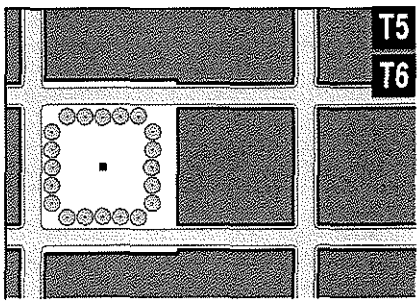
b. Green: An Open Space, available for unstructured recreation. A Green may be spatially defined by landscaping rather than building Frontages. Its landscape shall consist of lawn and trees, naturalistically disposed. The minimum size shall be 1/2 acre and the maximum shall be 8 acres.



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.

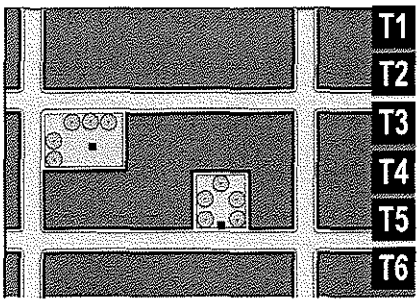
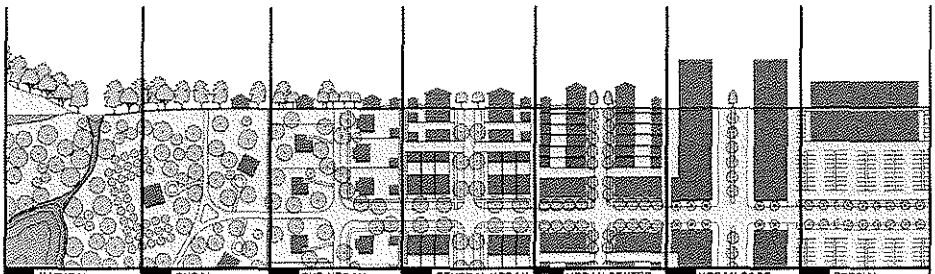


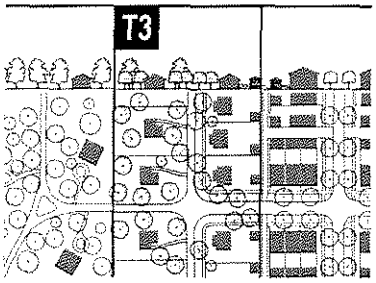
TABLE 14. SMARTCODE SUMMARY

Note: All requirements in this Table are subject to calibration for local context.



	T1 NATURAL ZONE	T2 RURAL ZONE	T3 SUB-URBAN ZONE	T4 GENERAL URBAN ZONE	T5 URBAN CENTER ZONE	T6 URBAN CORE ZONE	SD SPECIAL DISTRICT	
a. ALLOCATION OF ZONES per Pedestrian Shed (applicable to Article 3 only)							(see Table 16)	
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 *		
d. THOROUGHFARES (see Table 3 and Table 4)						* 3000 ft. max with parking structures		
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		
e. CIVIC SPACES (see Table 13)						* permitted within Open Spaces		
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	60% 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 8)								
Principal Building	not applicable	2 Stories max	2 Stories max	3 Stories max, 2 min	5 Stories max, 2 min	6 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)

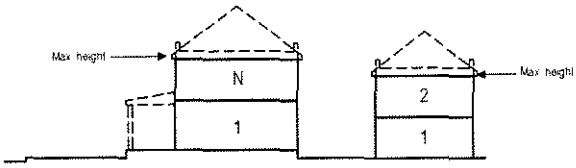
I. BUILDING FUNCTION (see Table 10 & Table 12)	
Residential	restricted use
Lodging	restricted use
Office	restricted use
Retail	restricted use
k. BUILDING CONFIGURATION (see Table 8)	
Principal Building	2 stories max.
Outbuilding	2 stories max.
f. LOT OCCUPATION (see Table 14f)	
Lot Width	72 ft. min 120 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

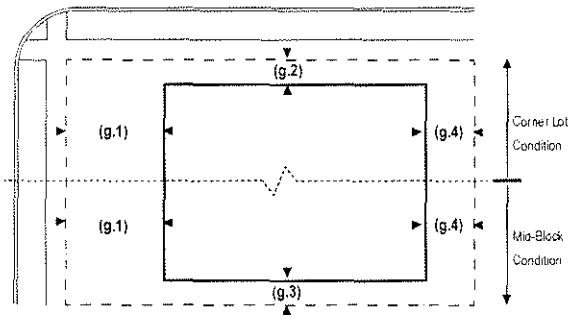
BUILDING CONFIGURATION

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.



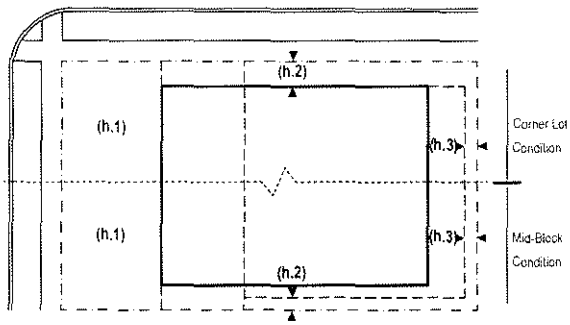
SETBACKS - PRINCIPAL BLDG

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.



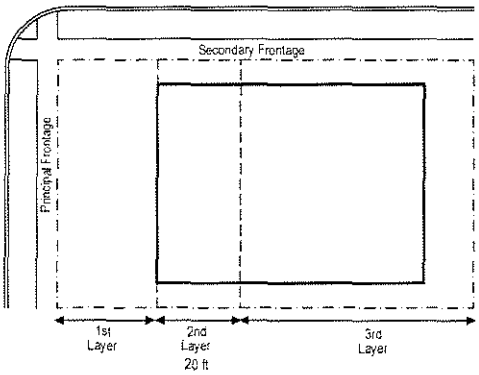
SETBACKS - OUTBUILDING

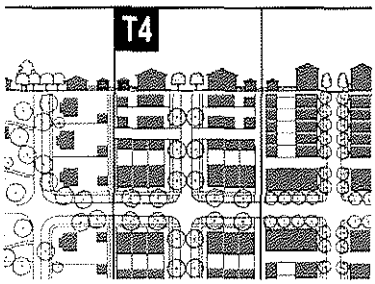
1. The Elevation of the Outbuilding shall be distanced from the Lot lines as shown.



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.





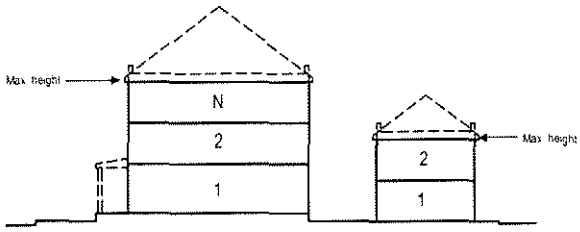
(see Table 1)

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	

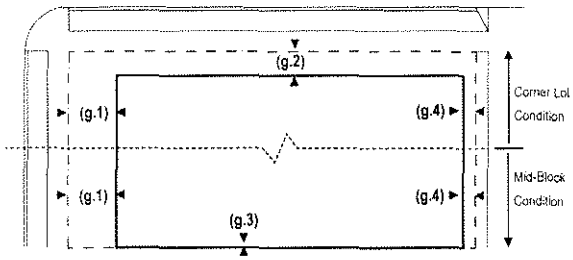
*or 15 ft. from center line of alley

"N" stands for any Stories above those shown, up to the maximum. Refer to metrics for exact minimums and maximums

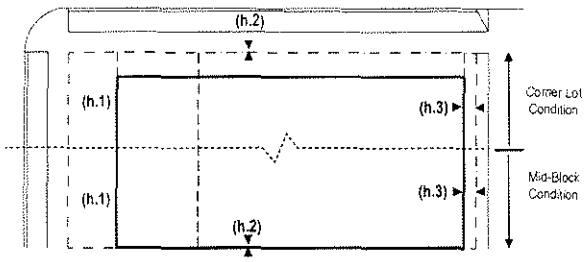
BUILDING CONFIGURATION
1. Building height shall be measured in number of Stories, excluding Attics and raised basements.
2. Stories may not exceed 14 feet in height from finished floor to finished ceiling, except for a first floor Commercial function which must be a minumum of 11 ft with a maximum of 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.

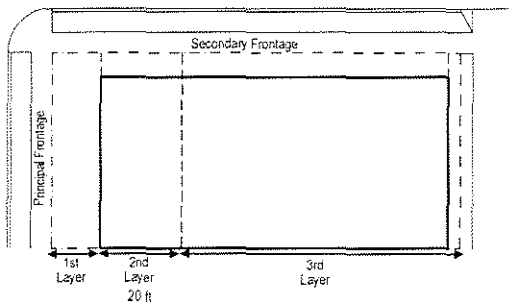
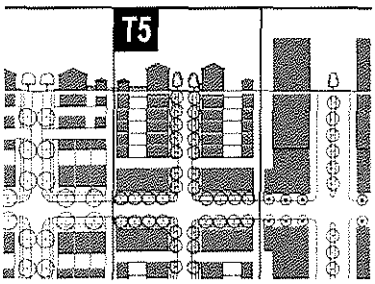


TABLE 15C. FORM-BASED CODE GRAPHICS - T5



(see Table 1)

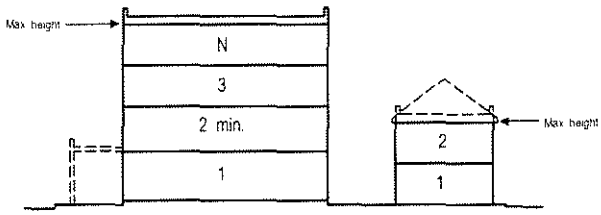
I. BUILDING FUNCTION (see Table 10 & Table 12)	
Residential	open use
Lodging	open use
Office	open use
Retail	open use
k. BUILDING CONFIGURATION (see Table 8)	
Principal Building	5 stories max. 2 min.
Outbuilding	2 stories max.
f. LOT OCCUPATION (see Table 14f)	
Lot Width	18 ft min 180 ft max
Lot Coverage	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

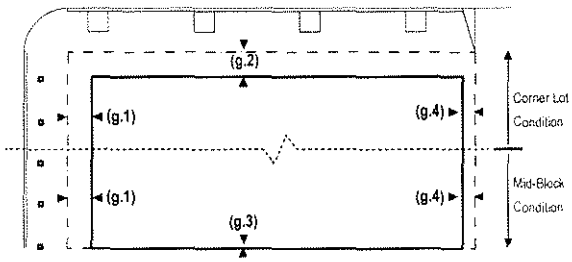
BUILDING CONFIGURATION

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.



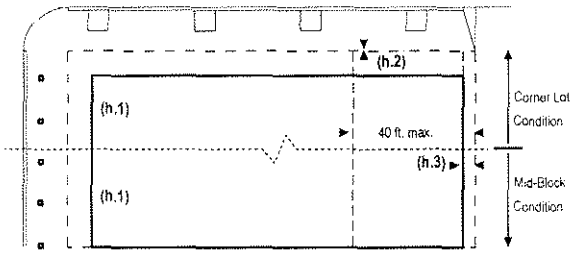
SETBACKS - PRINCIPAL BLDG

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.



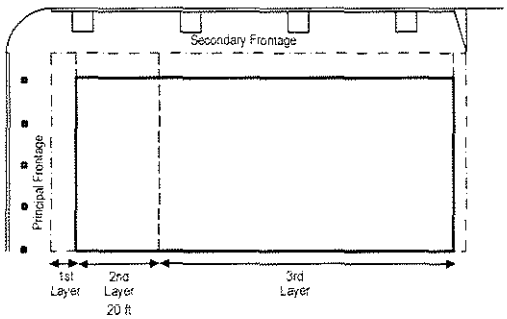
SETBACKS - OUTBUILDING

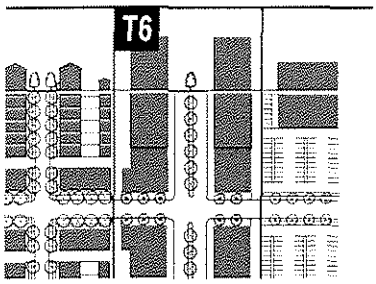
1. The Elevations of the Outbuilding shall be distanced from the Lot lines as shown.



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)

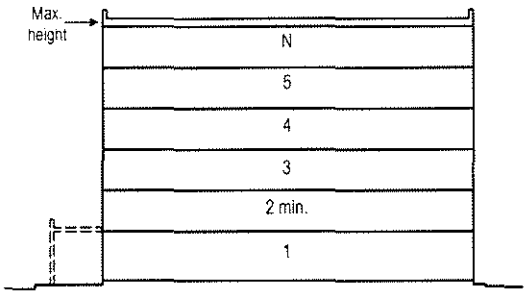
I. BUILDING FUNCTION (see Table 10 & Table 12)	
Residential	open use
Lodging	open use
Office	open use
Retail	open use
k. BUILDING CONFIGURATION (see Table 8)	
Principal Building	8 stories max. 2 min.
Outbuilding	N/A
f. LOT OCCUPATION (see Table 14f)	
Lot Width	18 ft. min 700 ft. max
Lot Coverage	90% 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

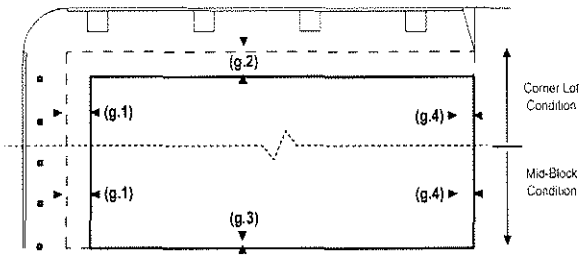
BUILDING CONFIGURATION

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 specified 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.

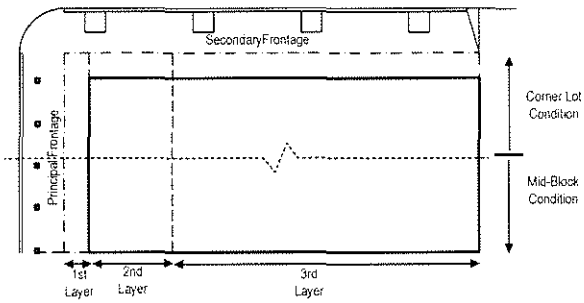
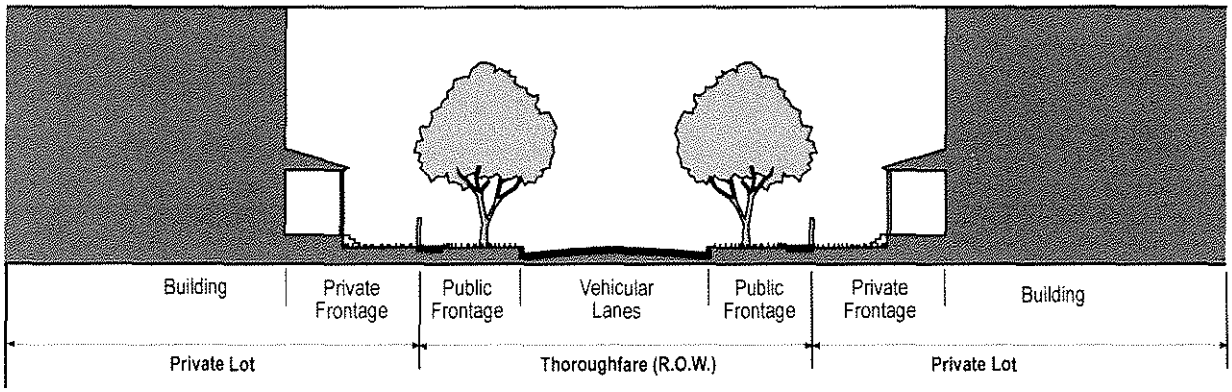


TABLE 16. SPECIAL DISTRICT STANDARDS

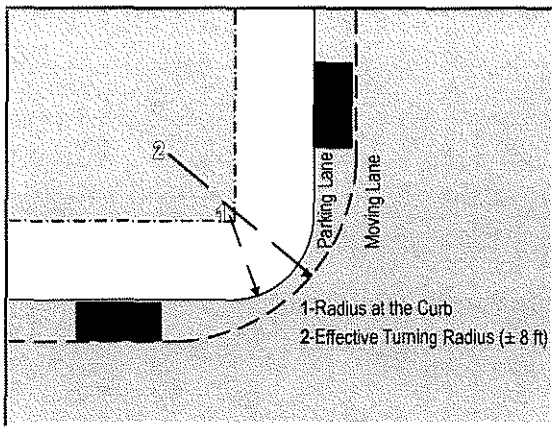
The metrics for each column of this table (SD1, SD2, etc.) are to be filled in for each Special District as they currently exist, or as they are permitted.More pages can be added. Special Districts that do not have provisions within this Code shall be governed by the standards of the pre-existing zoning.

	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							
Galiery	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							

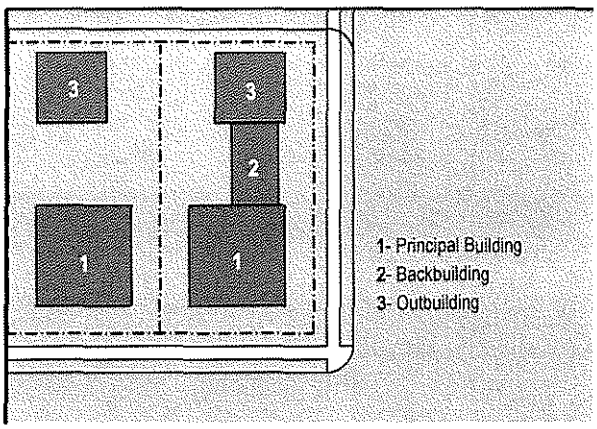
a. THOROUGHFARE & FRONTAGES



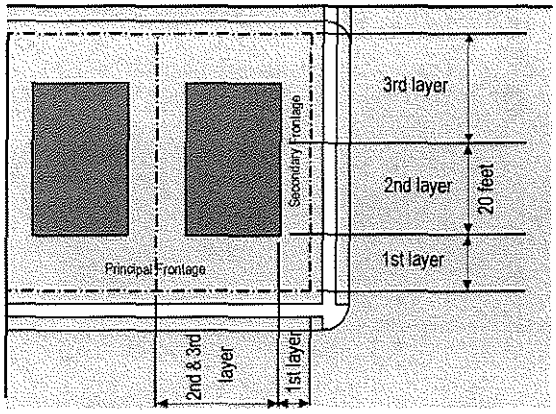
b. TURNING RADIUS



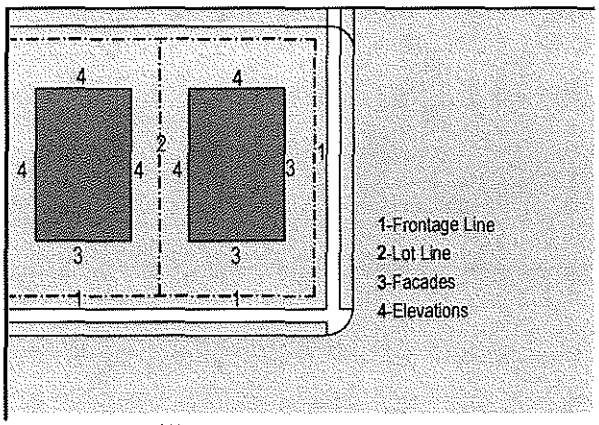
c. BUILDING DISPOSITION



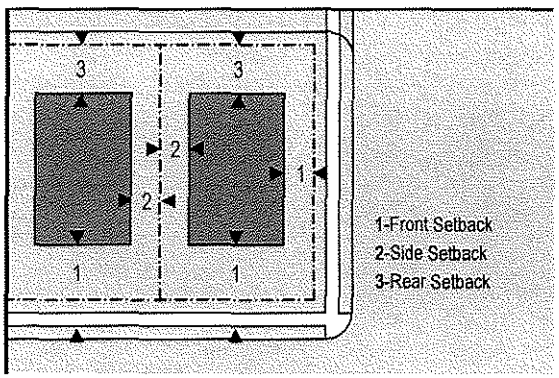
d. LOT LAYERS



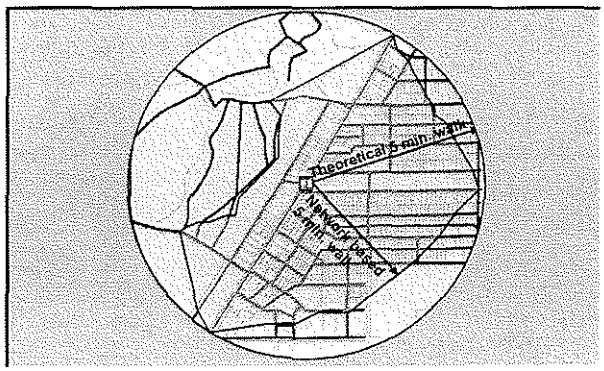
e. FRONTAGE & LOT LINES



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.

Preliminary Engineering Report

PRELIMINARY ENGINEERING REPORT

FOR

OLOWALU TOWN

Olowalu, Maui, Hawaii

T.M.K.: (2) 4-8-003: 84, 98 - 118, 124

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FOR
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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

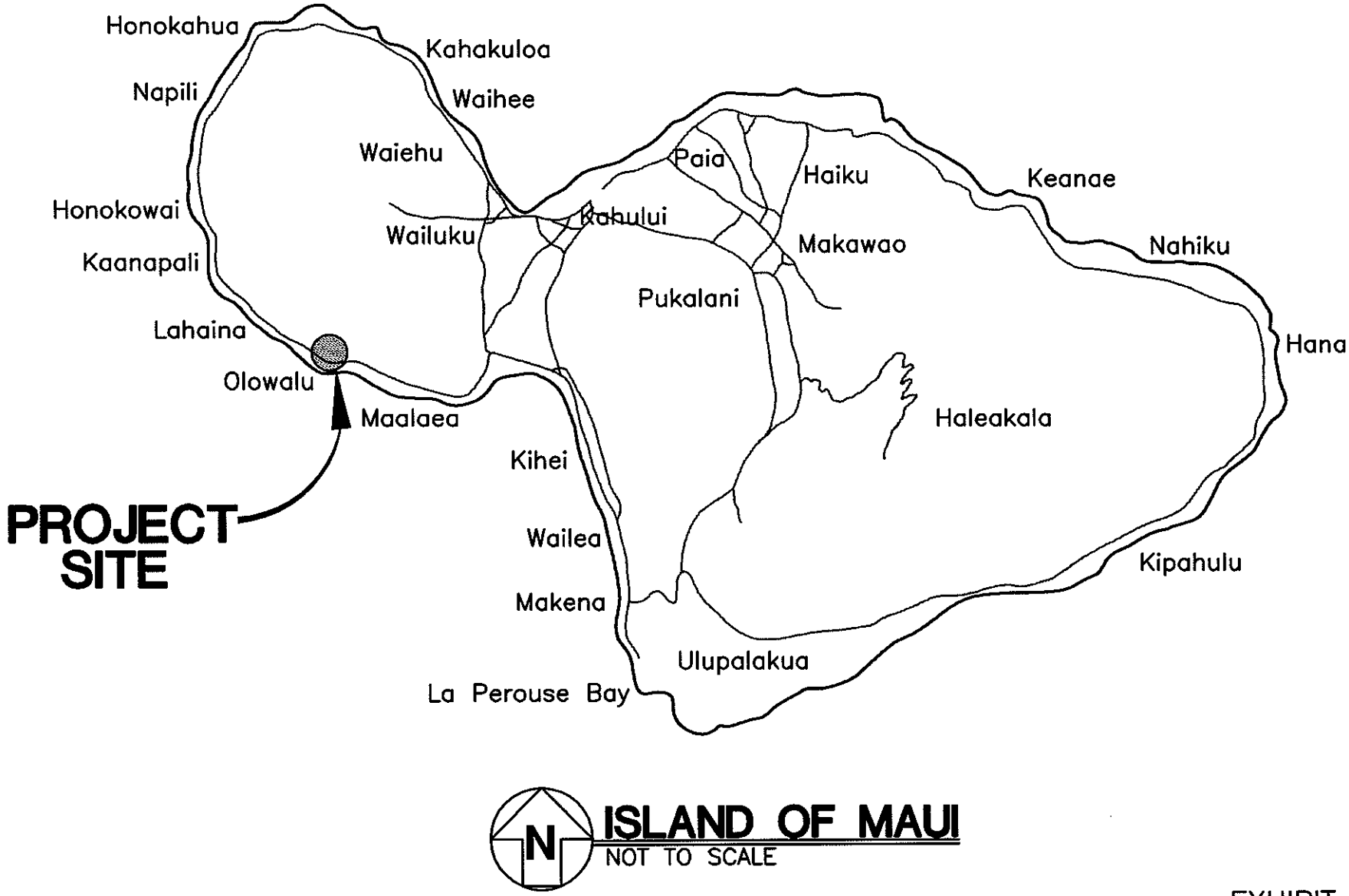

Honokahua
Kahakuloa
Napili
Waihee
Waiehu
Paia
Haiku
Keanae
Honokowai
Kahului
Wailuku
Makawao
Nahiku
Kaanapali
Pukalani
Lahaina
Hana
Olowalu
Maalaea
Haleakala
Kihei
PROJECT SITE
Wailea
Kipahulu
Makena
Ulupalakua
La Perouse Bay
N
ISLAND OF MAUI
NOT TO SCALE

EXHIBIT 1

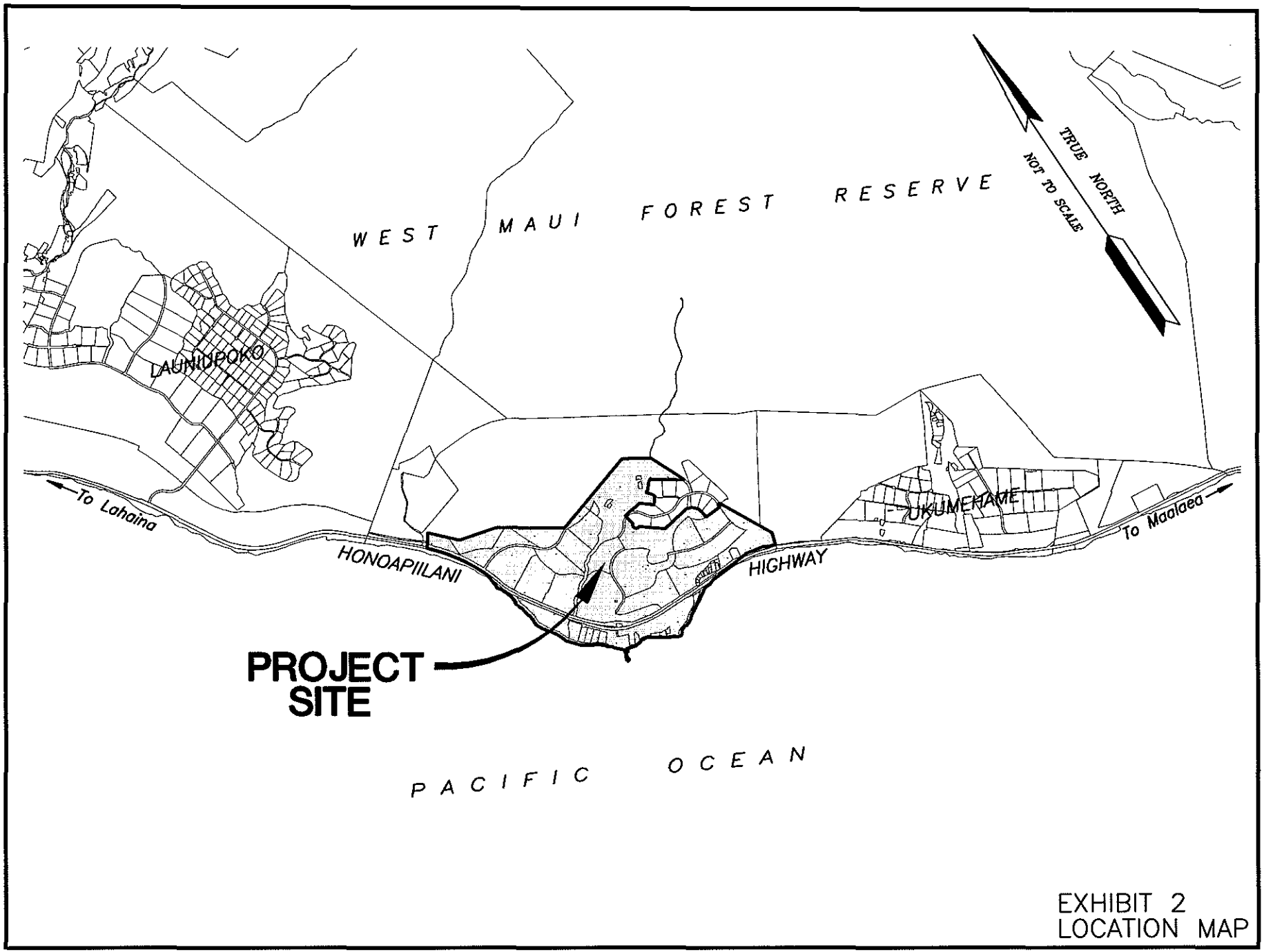


EXHIBIT 2
LOCATION MAP

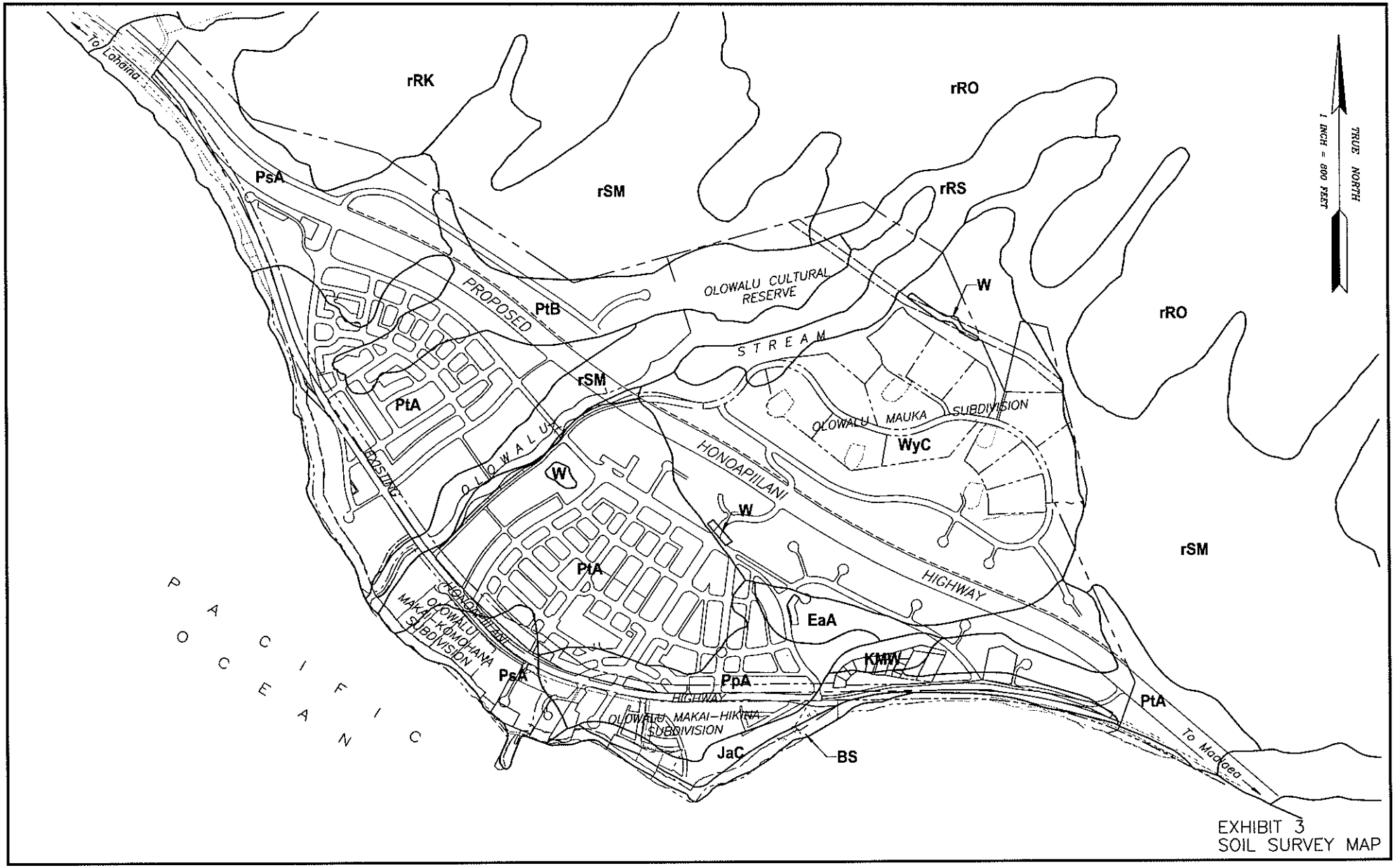


EXHIBIT 3
SOIL SURVEY MAP

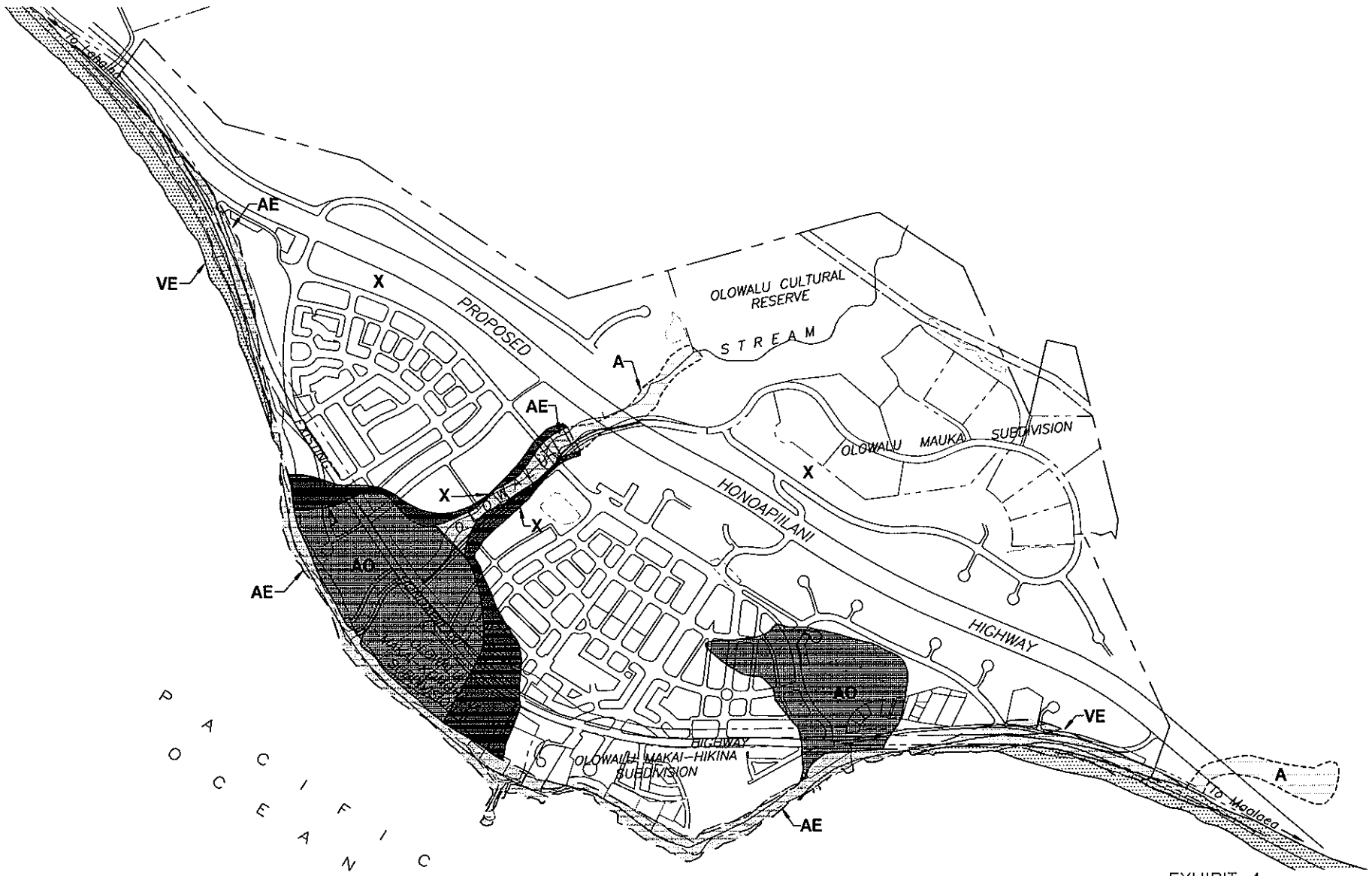


EXHIBIT 4
FLOOD INSURANCE RATE MAP

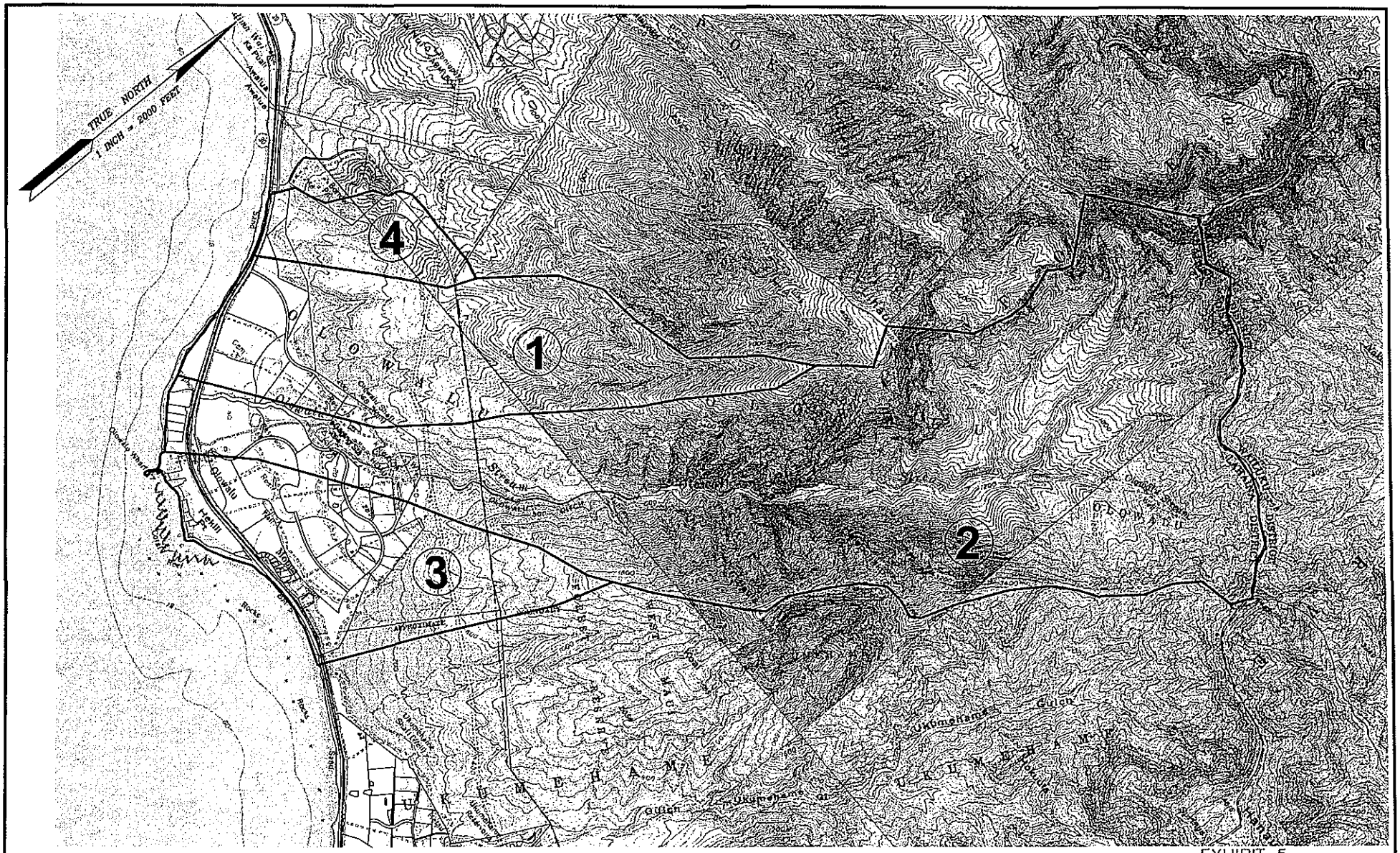


EXHIBIT 5
DRAINAGE AREA MAP

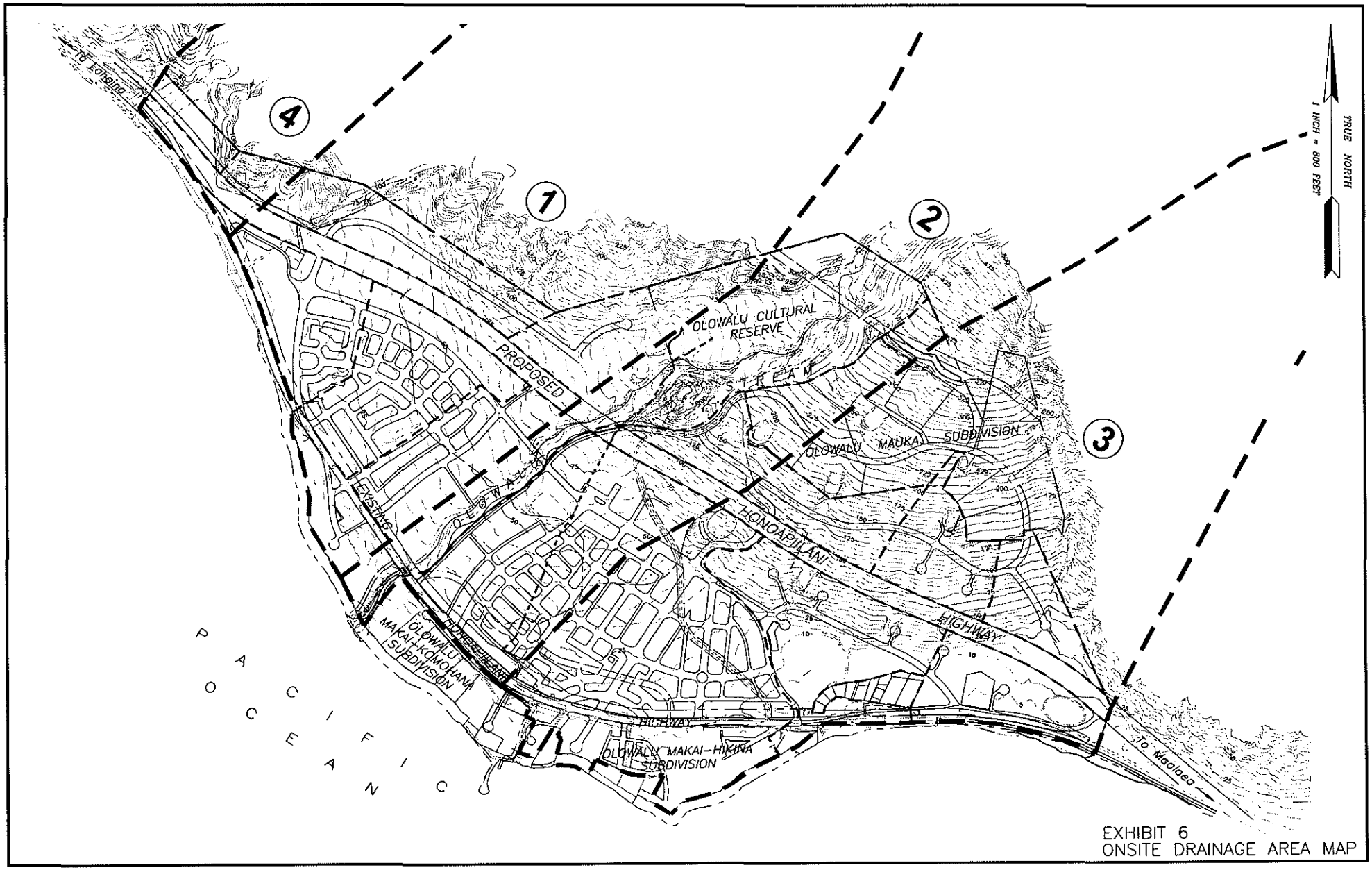


EXHIBIT 6
ONSITE DRAINAGE AREA MAP

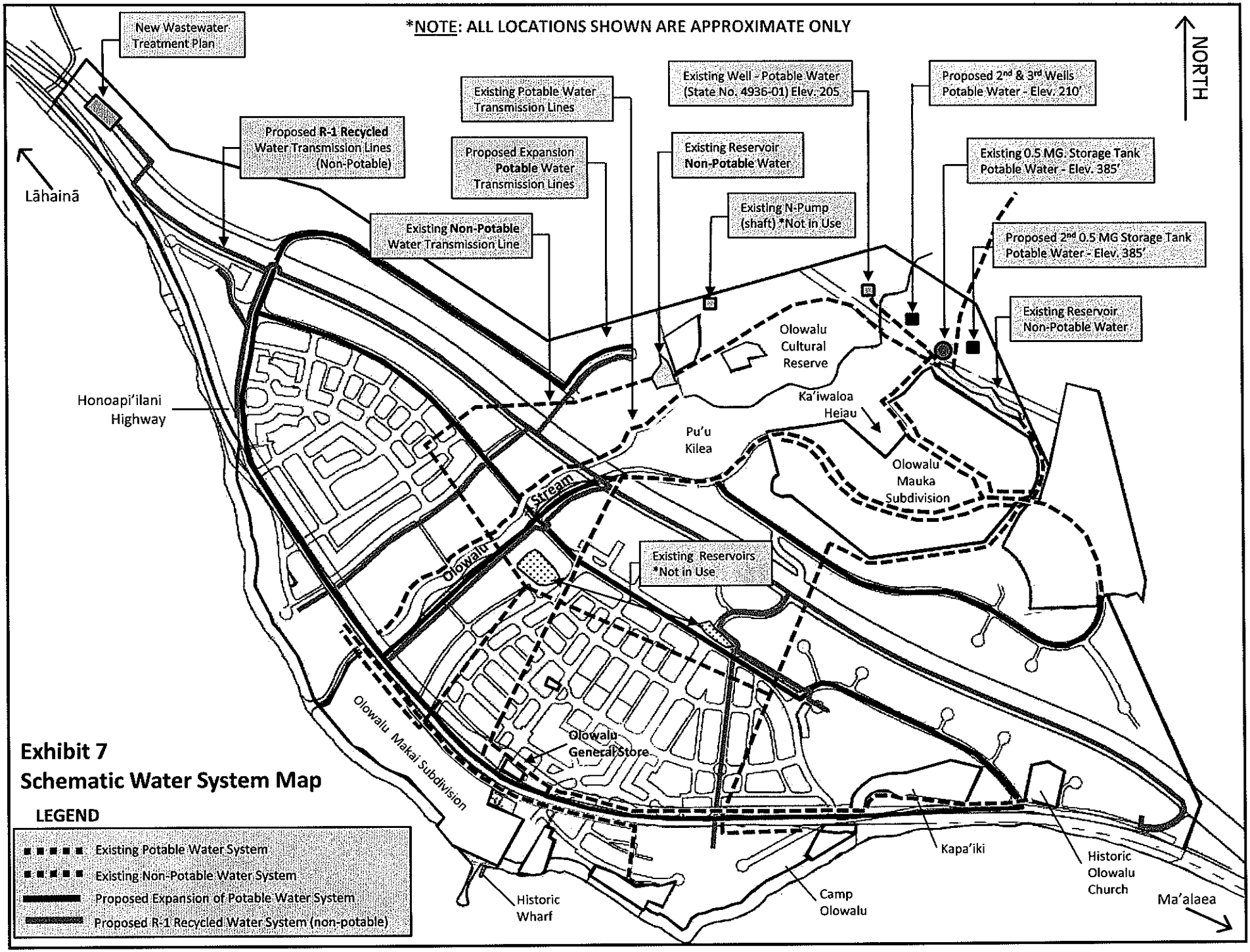


Exhibit 7
Schematic Water System Map

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

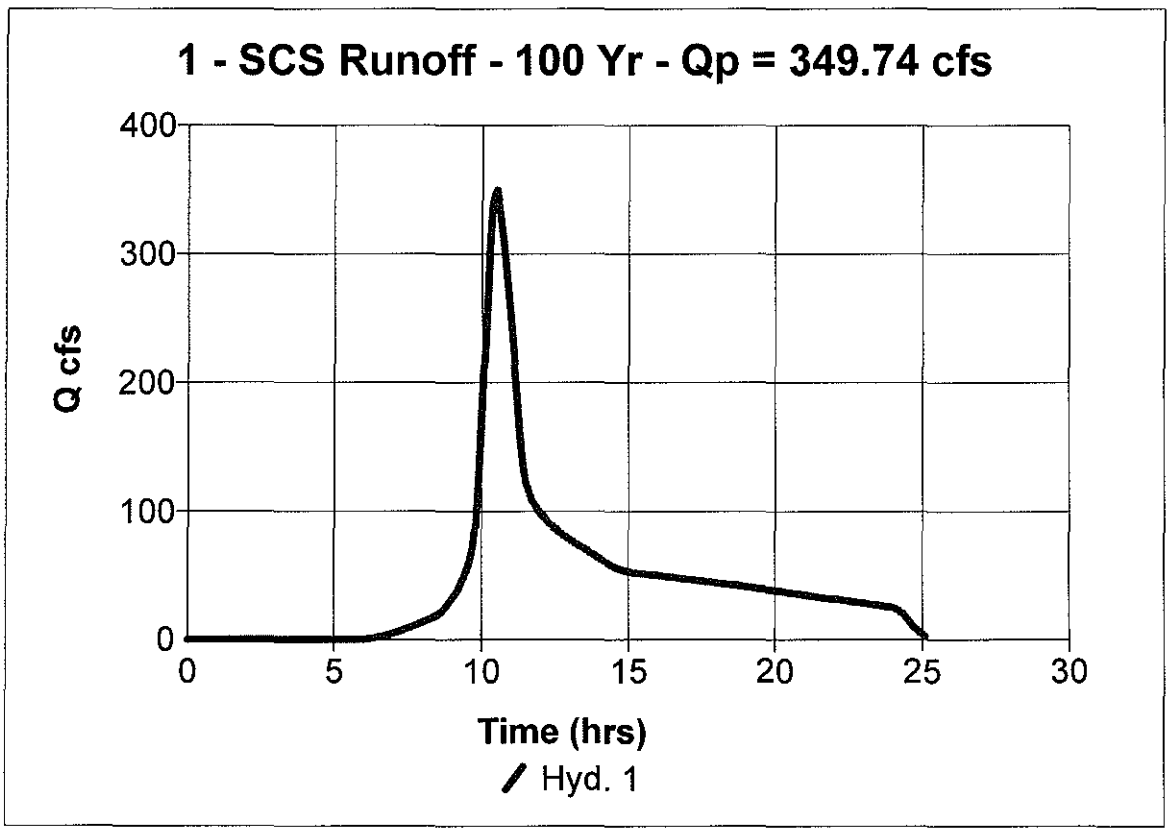
English

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

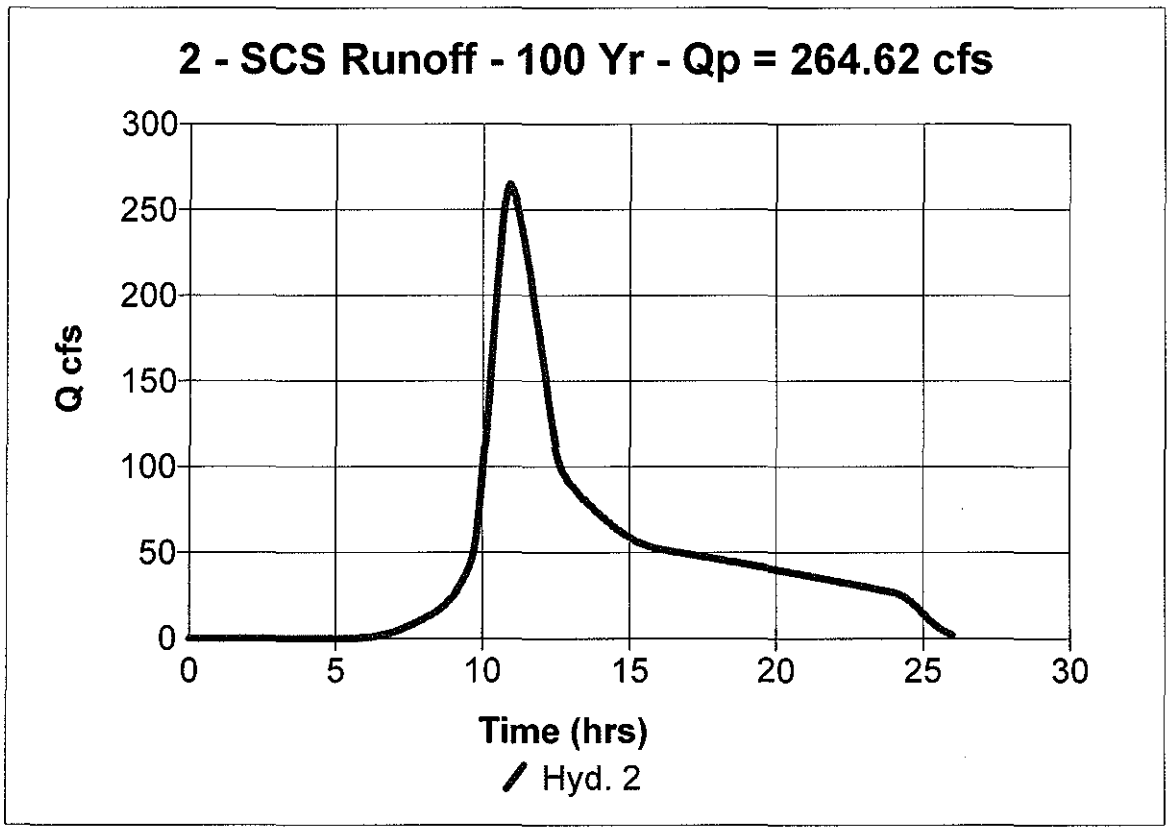
English

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

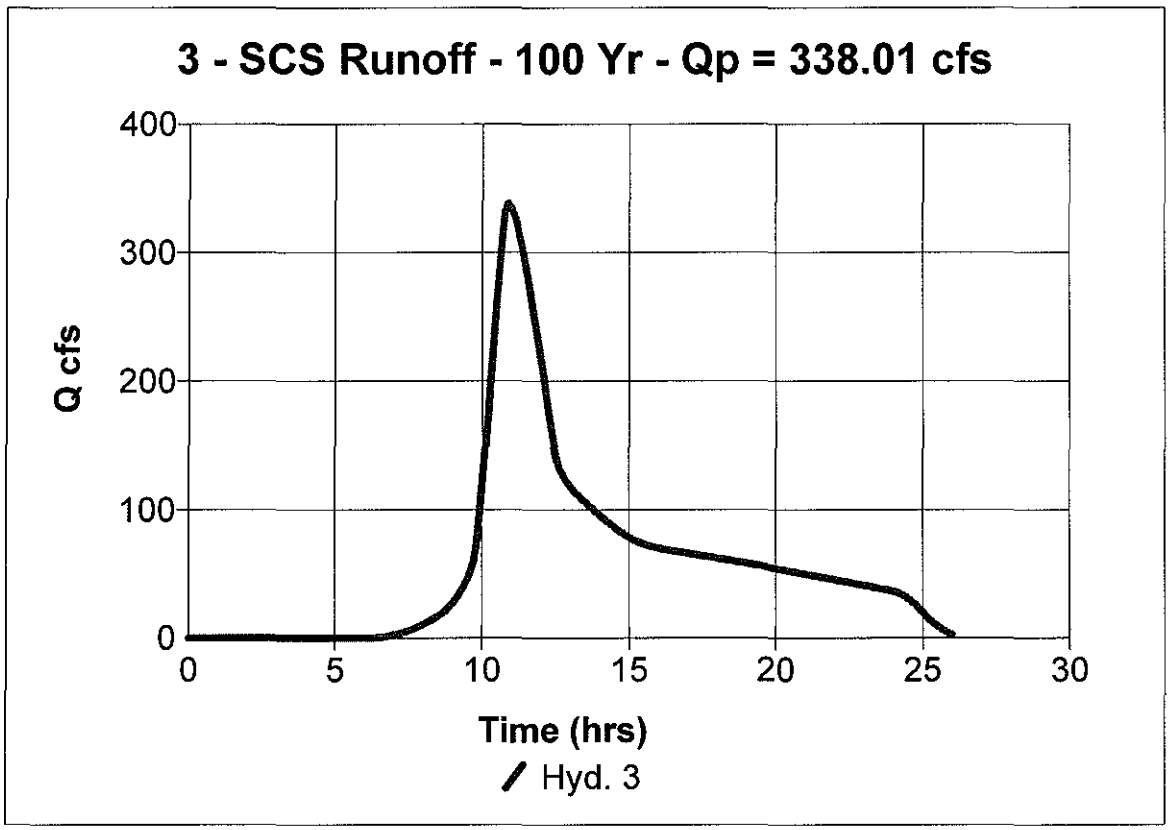
English

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

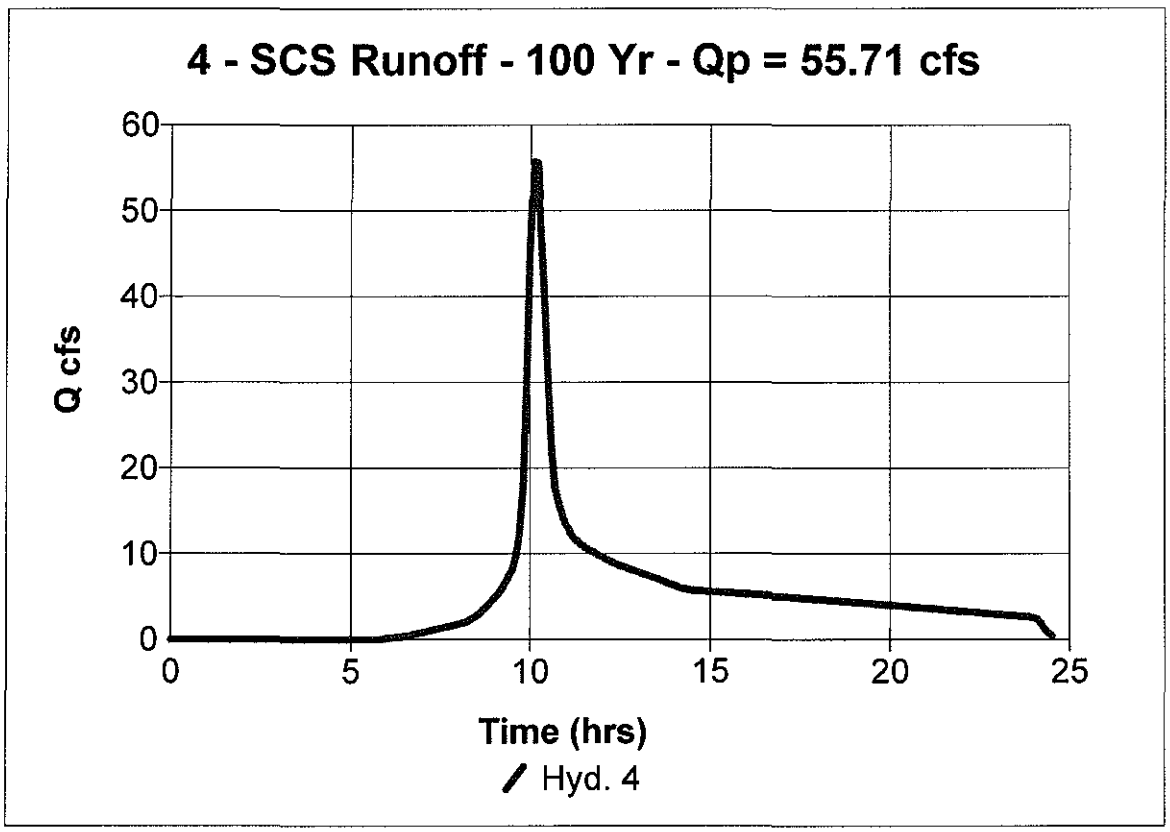
English

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

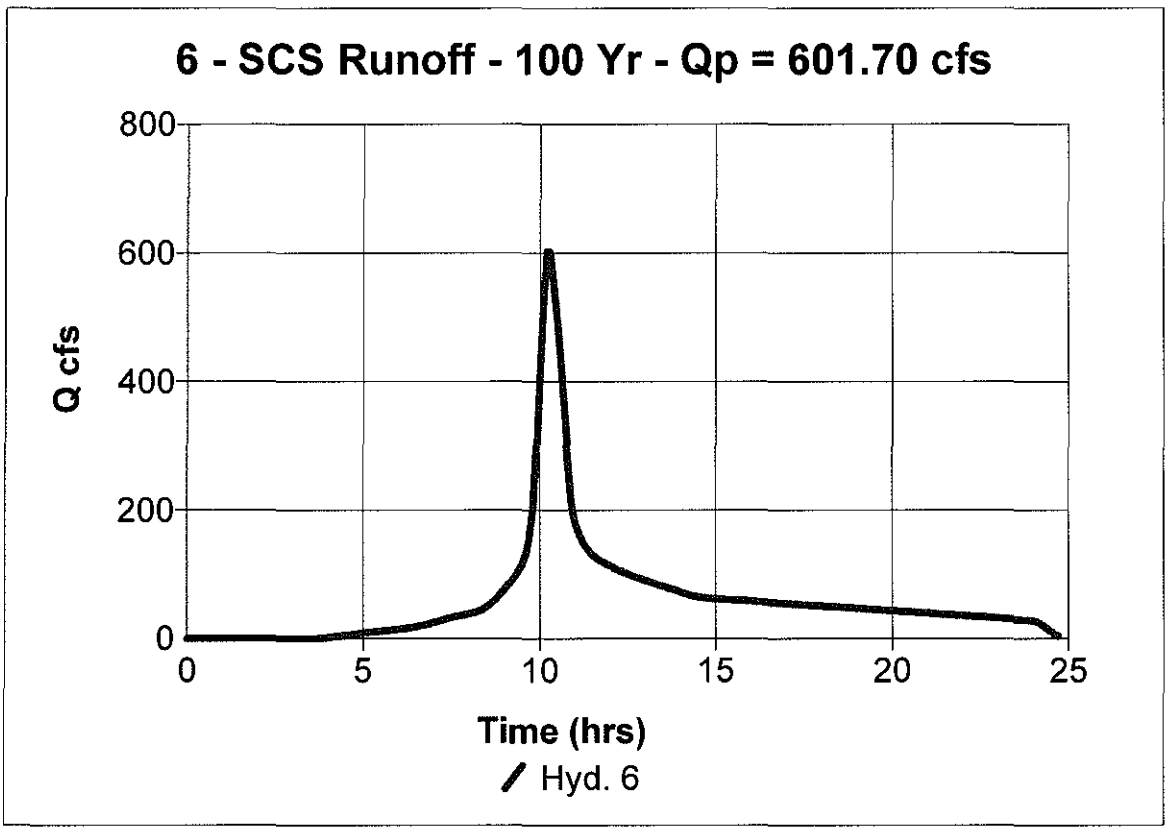
English

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

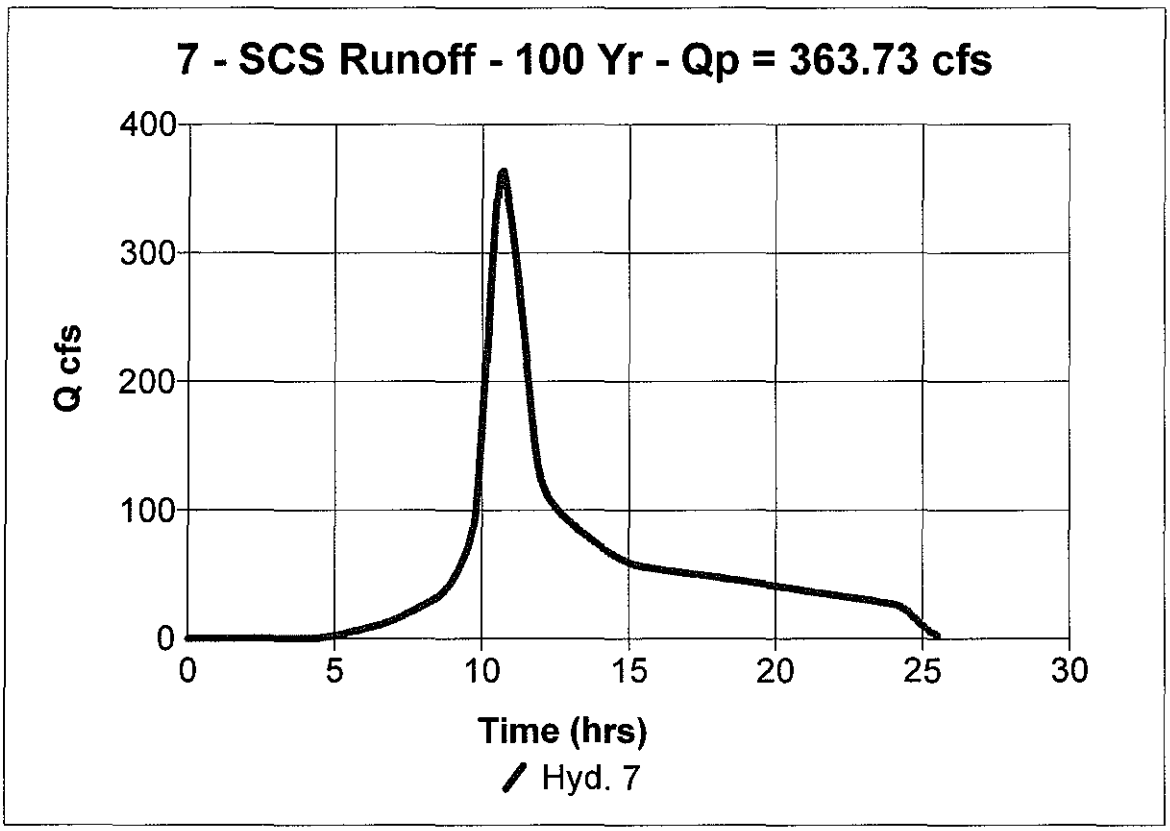
English

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

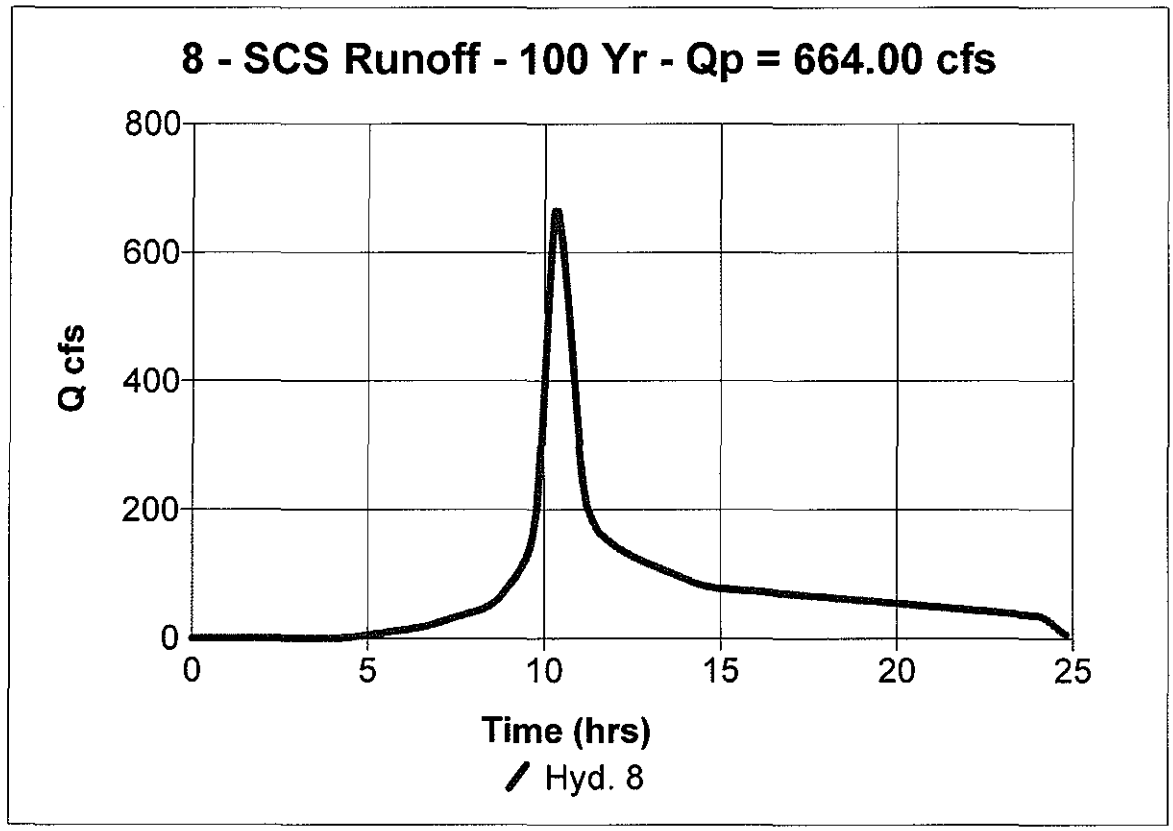
English

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

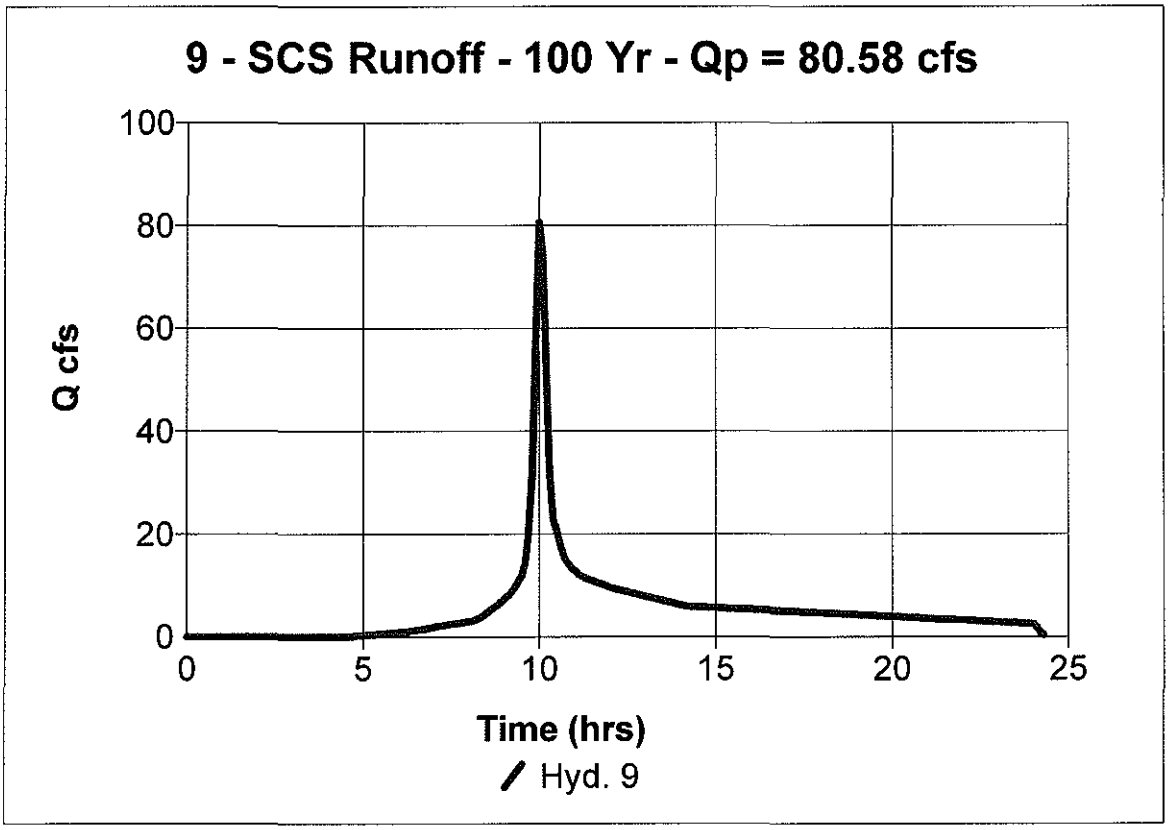
English

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)

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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 B-1.

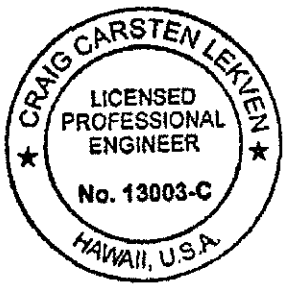
Stormwater Quality Enhancements

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



THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

Signature

April 30, 2012
Expiration Date of License

Brown AND Caldwell
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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

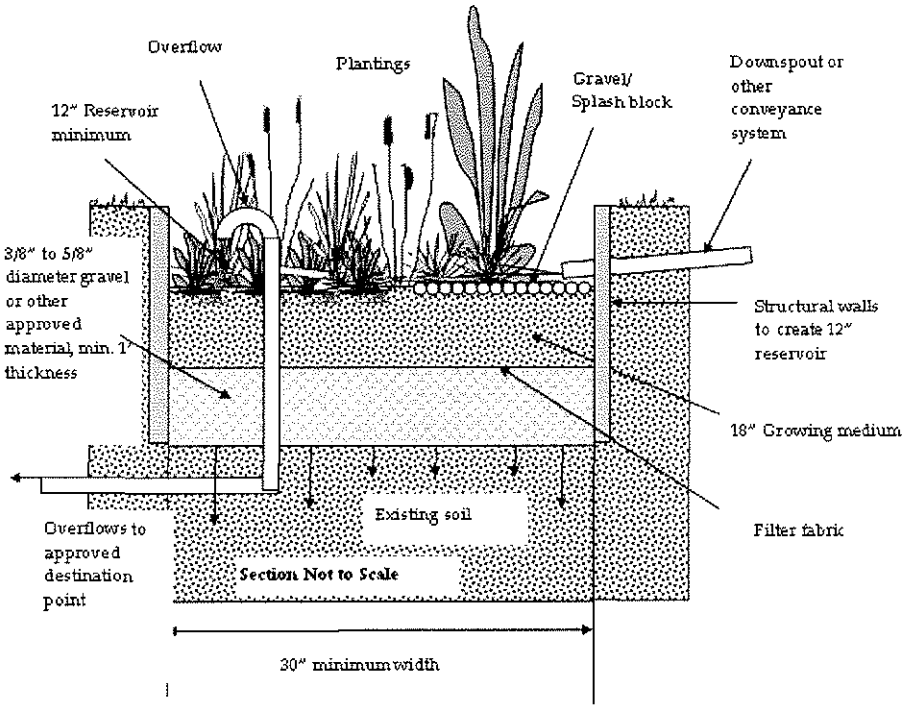

Figure 2-2. Schematic of a bio-retention rain garden

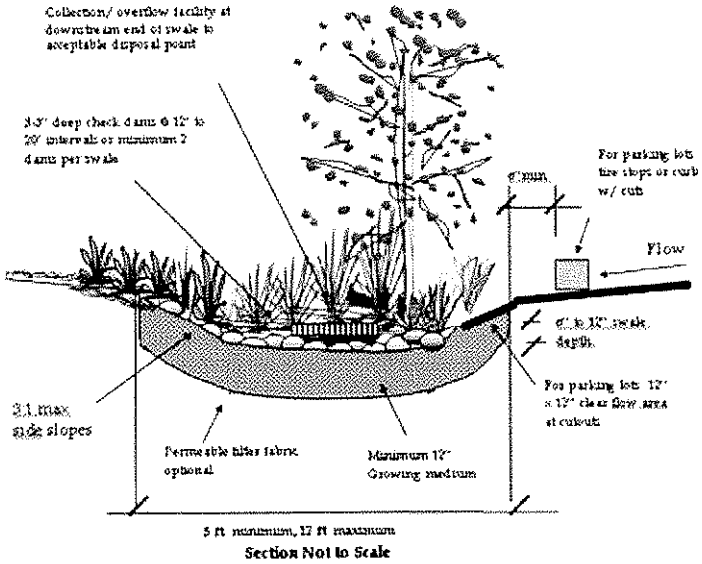

Figure 2-3. Vegetated swale

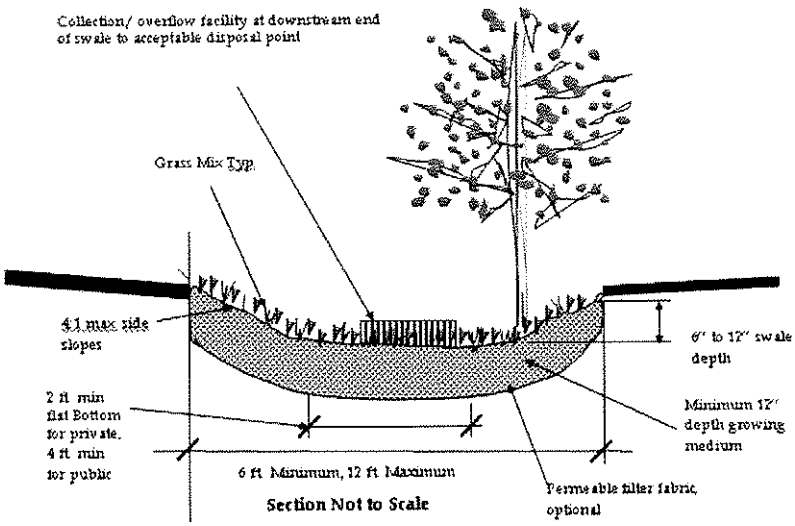

Figure 2-4. Grassy swale

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.

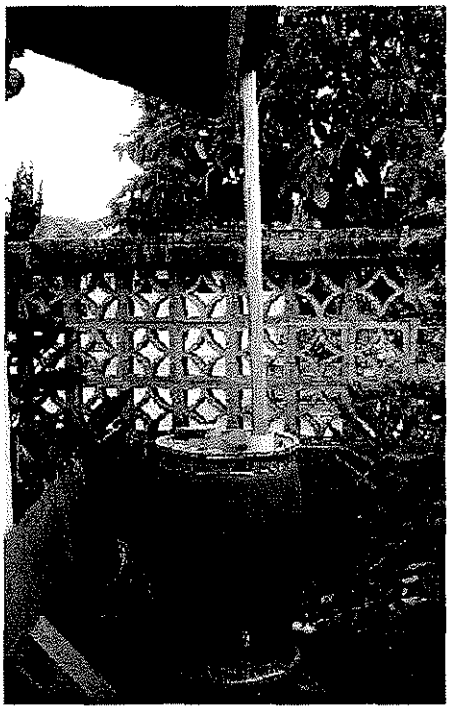

Figure 2-5. Rain barrel receiving water from a roof gutter system

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.

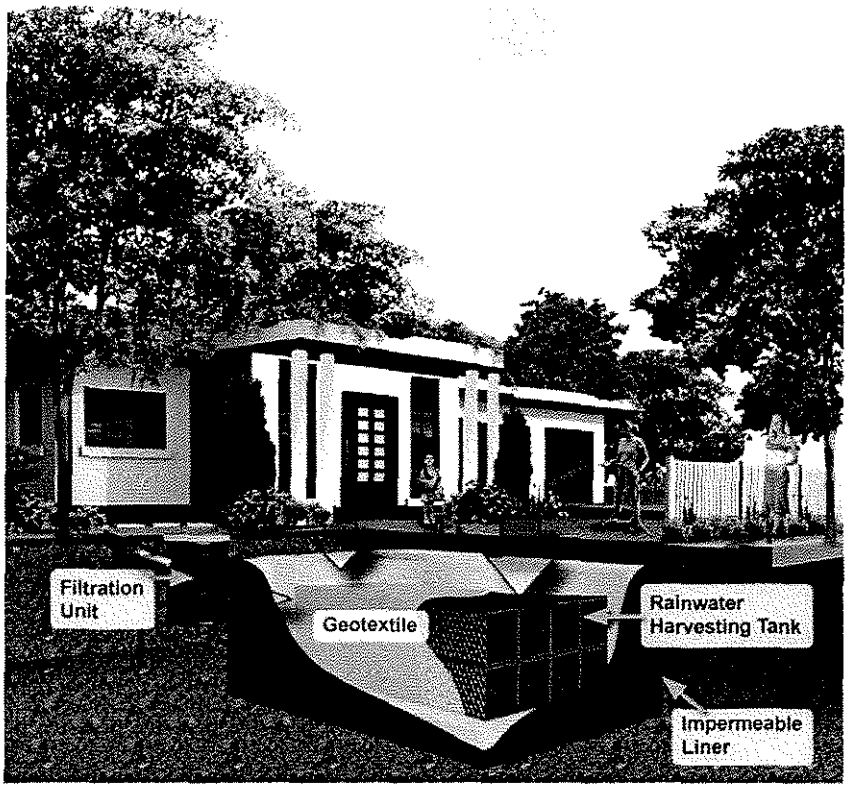

Figure 2-6. Schematic of a subsurface tank

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.

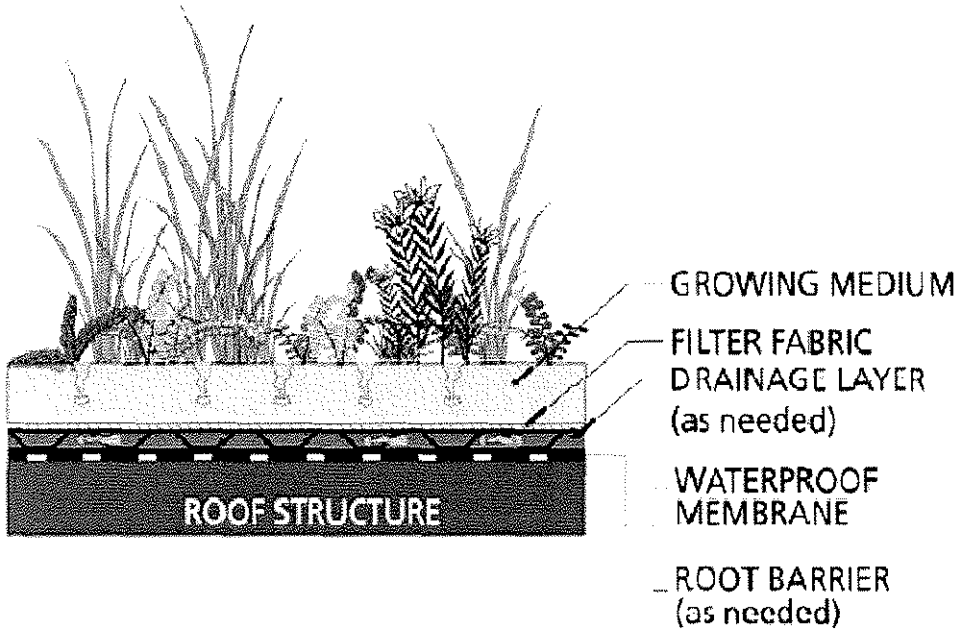

Figure 3-1. Vegetated roof schematic diagram

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.

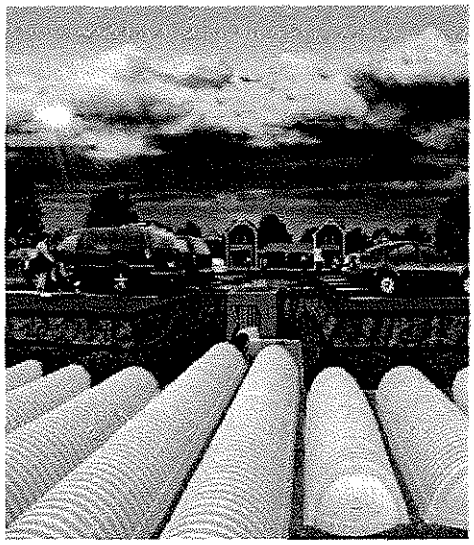

Figure 3-3. Subsurface chambers under a parking lot

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.

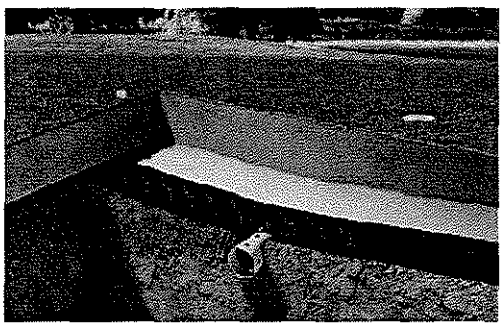

Figure 4-1. Illustration of a reinforced turf surface

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.

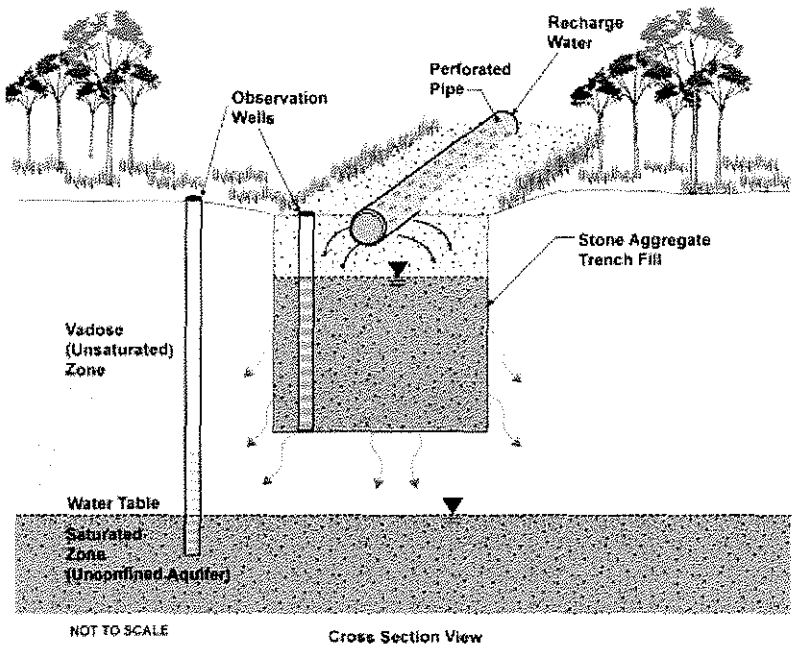

Figure 4-2. Cross section of an infiltration trench

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

BMP	Applicable Olowalu Town Parcels				
	Residential		Commercial	Public Facilities	Green Space/ Recreational
	Single Family	Multi-Family			
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.

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APPENDIX C.

Impact on Water Resources Study

Impact on Water Resources of the Olowalu Town Project

Prepared for:

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Prepared by:

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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

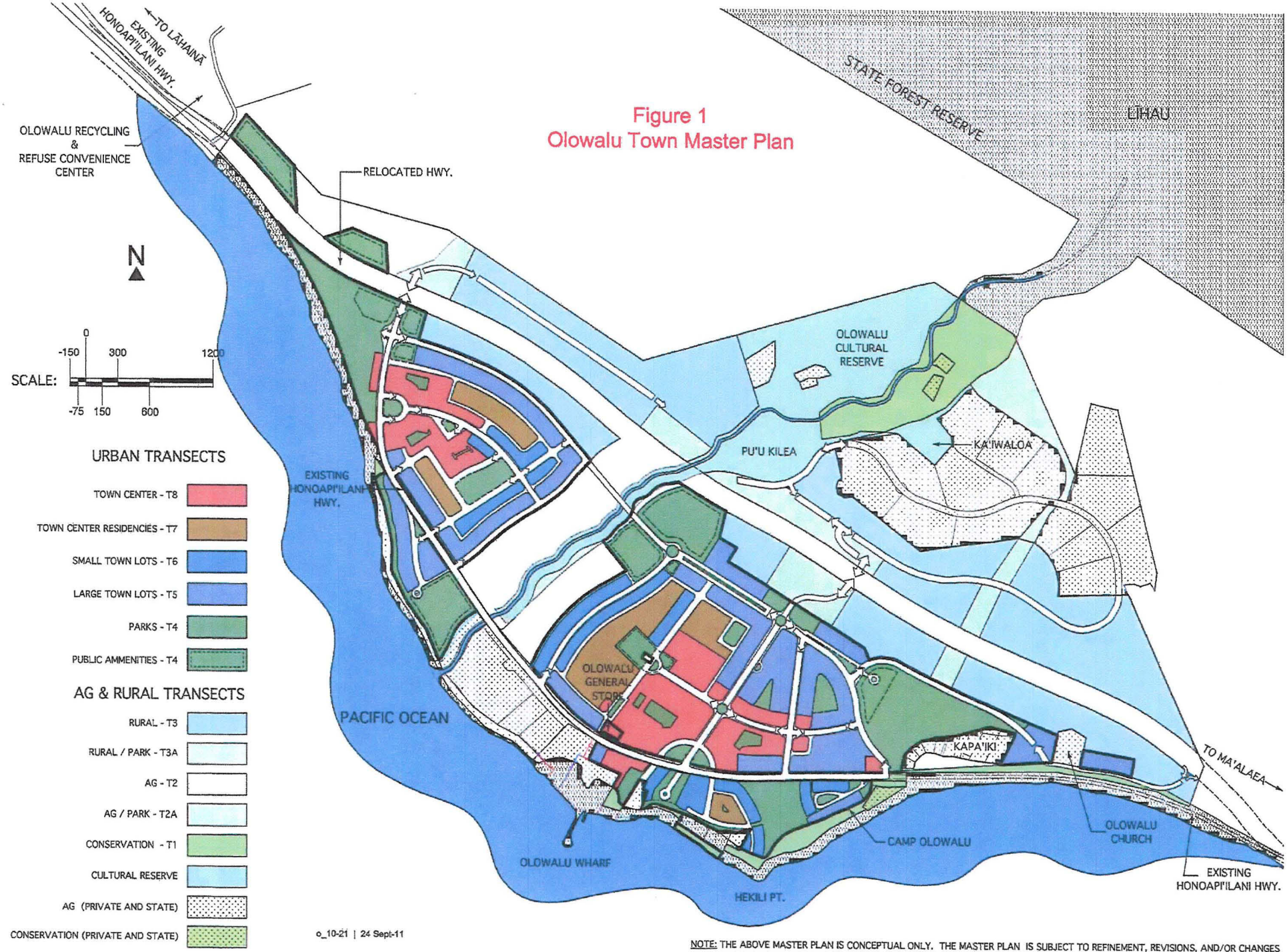
Potable Water System. The potable water system run by Olowalu Water Company, Inc. (OWC) has been designated by the State Department of Health as Public Water System No. 209. The water system presently supplies the 14-lot Olowalu Agricultural Subdivision, the five-lot Olowalu Makai Subdivision, Kapaiki 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



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NOTE: THE ABOVE MASTER PLAN IS CONCEPTUAL ONLY. THE MASTER PLAN IS SUBJECT TO REFINEMENT, REVISIONS, AND/OR CHANGES BASED UPON COMMENTS, FEEDBACK, AND INPUT RECEIVED THROUGHOUT THE LAND USE ENTITLEMENT REVIEW PROCESS.

Figure 2
Proposed State Land Use Designation for the Olowalu Town Master Plan

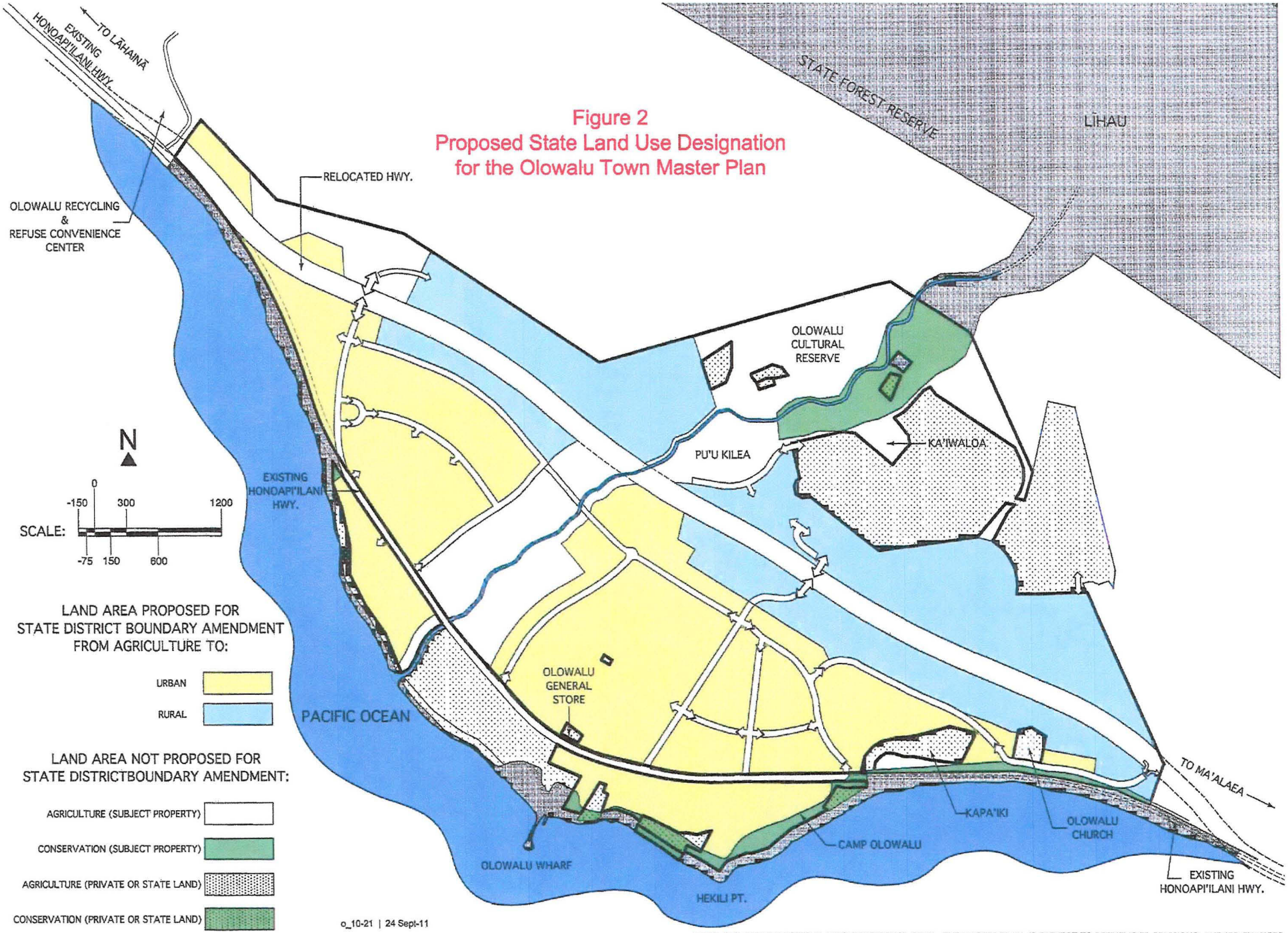

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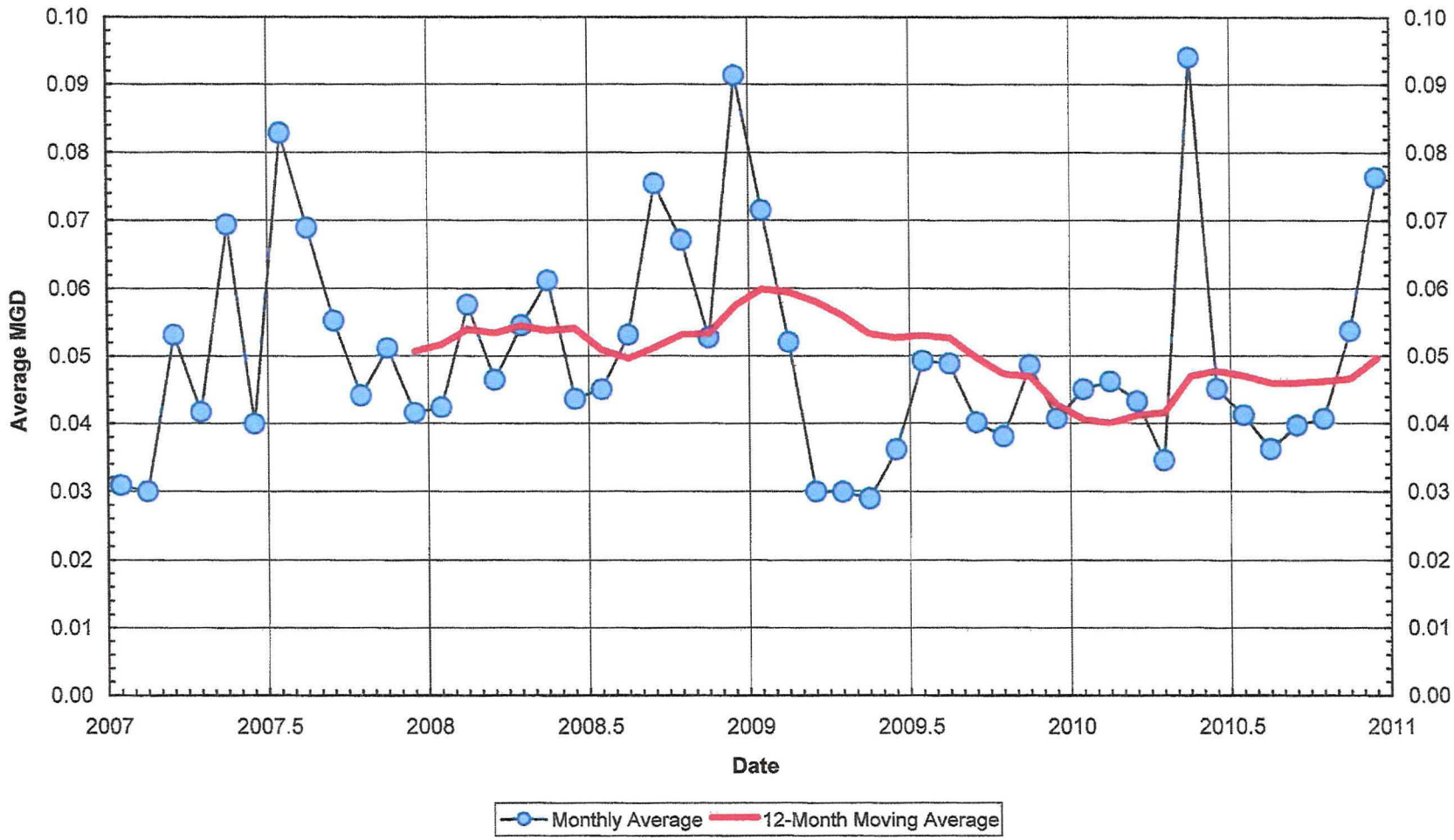
Figure 3. Monthly Pumpage of the Olowalu-Elua Well, State No. 4936-01, January 2007 through December 2010 (Data from Olowalu Water Company)



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)

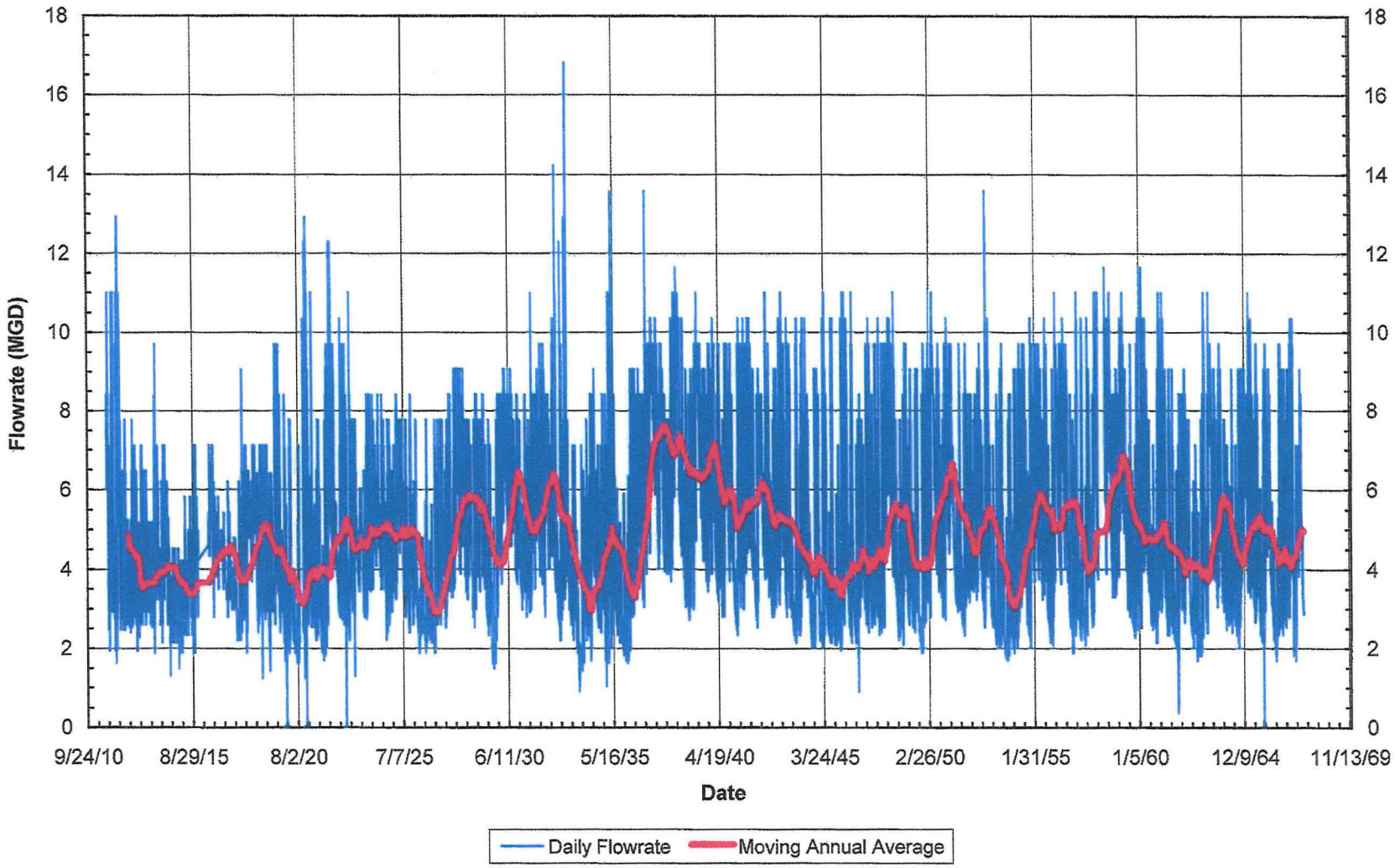


Figure 5. Duration-Discharge Characteristics of Olowalu Ditch at USGS Gage 6450 Based on 1911 to 1967 Daily Flowrates

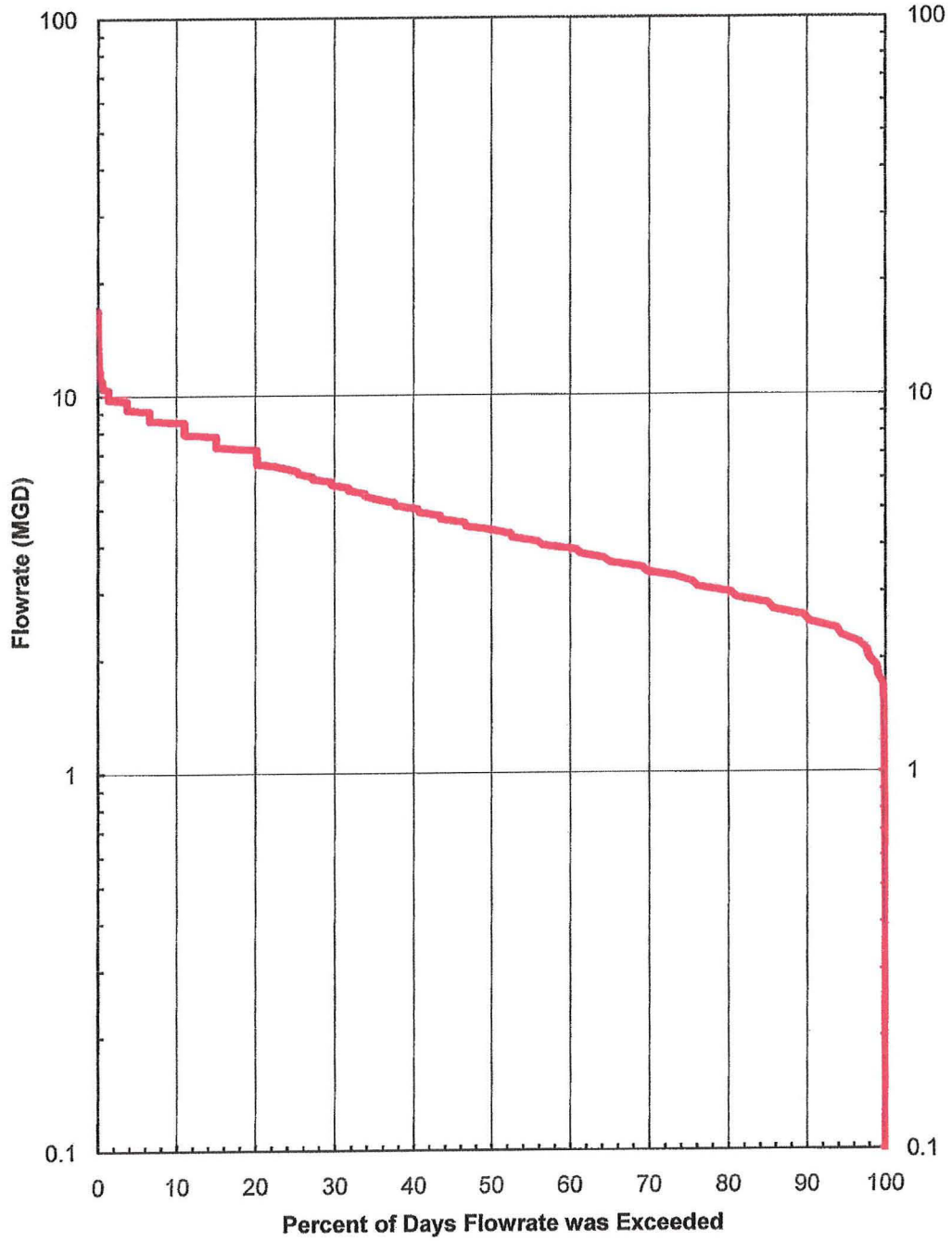


Table 1

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

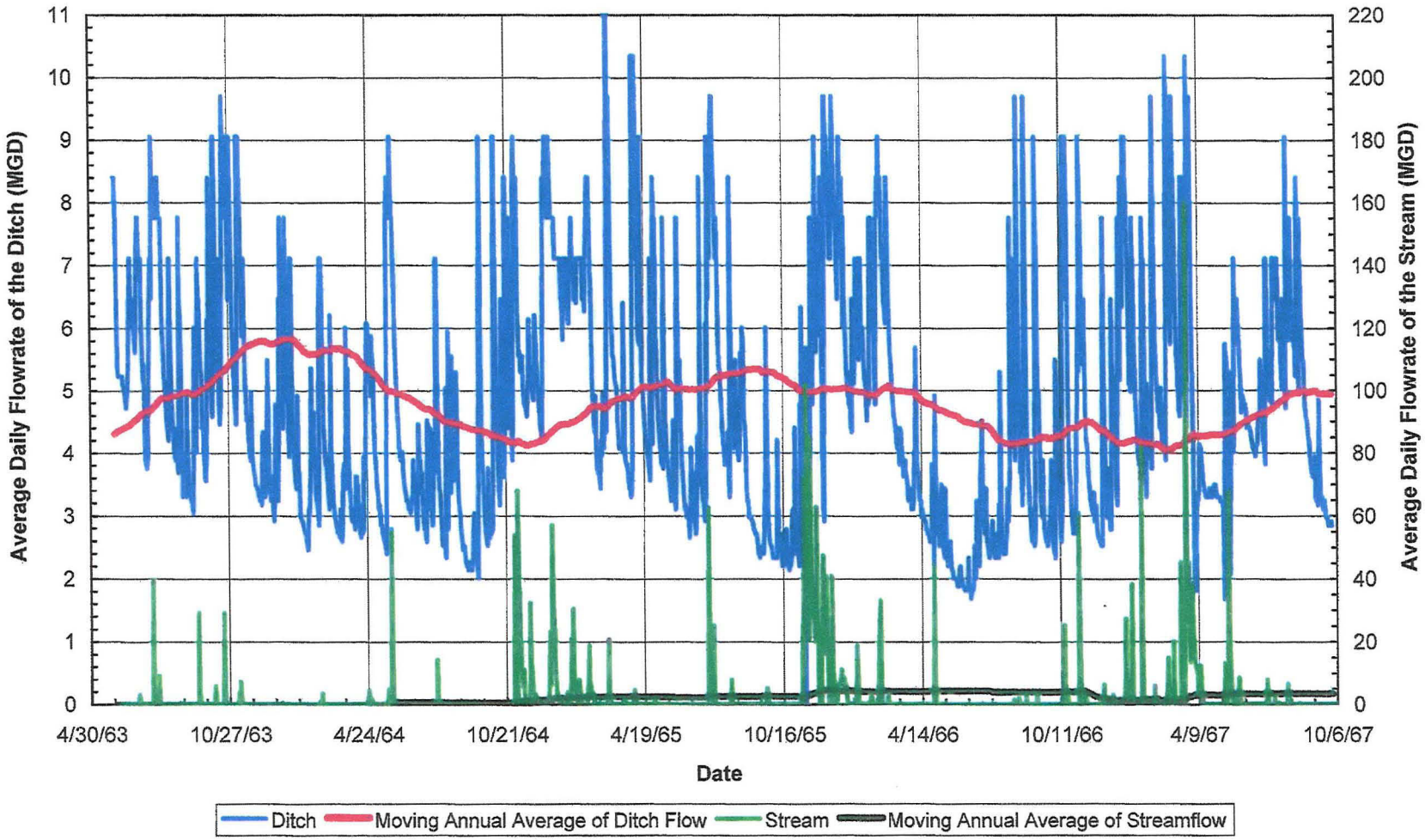
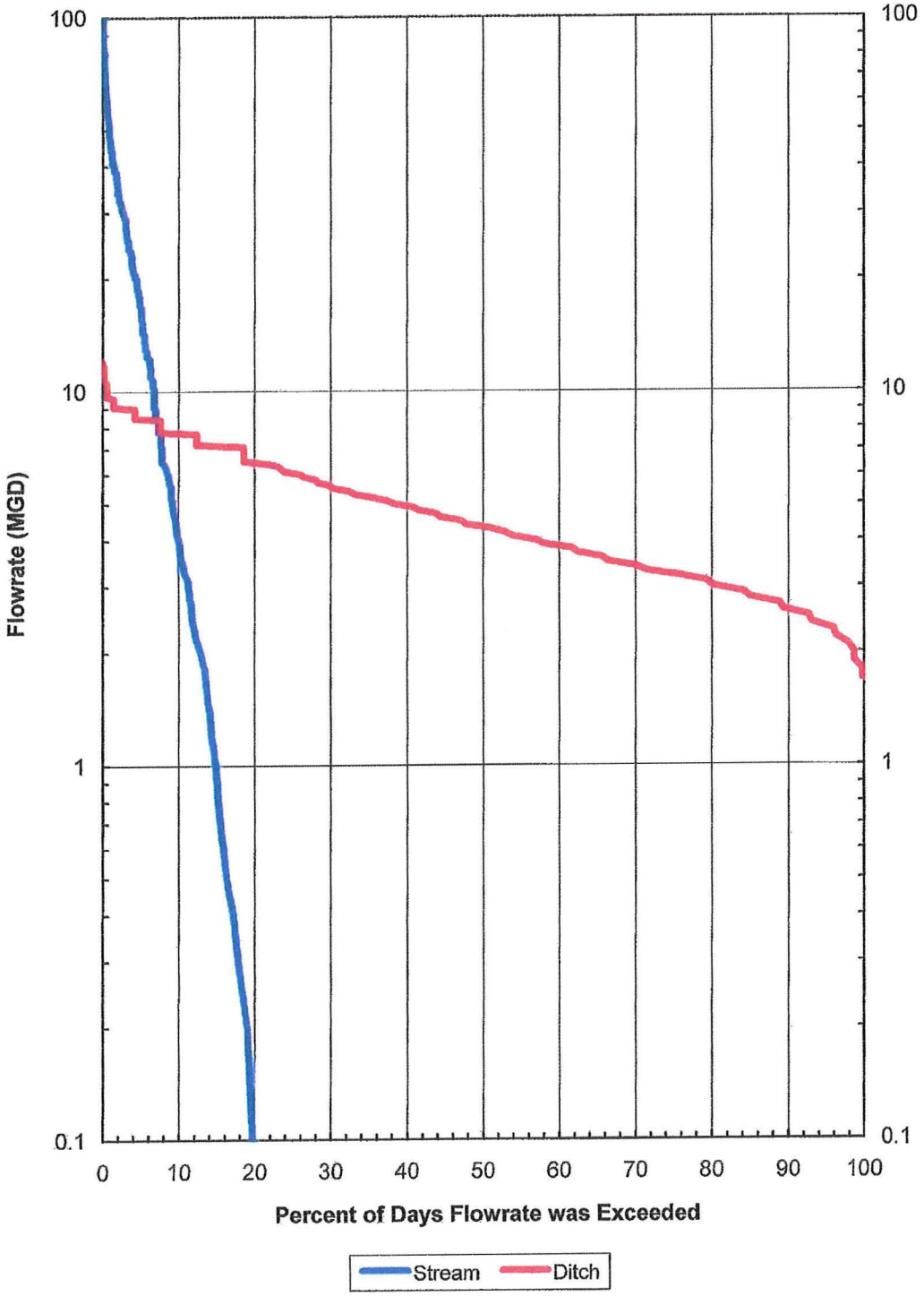


Figure 7. Comparison of Duration-Discharge Characteristics of Olowalu Ditch and Olowalu Stream, June 1963 to September 1967



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

Table 3

Projected Changes in the
Groundwater Discharged Along the Project's Shoreline

I t e m	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% Decrease	9.8% Increase	0.9% Decrease

- 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.

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

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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 was 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 control 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 a 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 gradient 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 distribution 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 conservative 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 $476 \times 10^3\,m^2$, while the lowest abundance is seen in the class where coral covers greater than 90% of the bottom ($51 \times 10^3\,m^2$). 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 $16 \times 10^3\,m^2$). 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 on 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 *Porolithon* 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 of 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 Tom 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 about 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 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 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 (*Heterocentrotus 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 nearshore 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 Town Master Plan is a series of retention basins within the project site for the purpose of retaining storm 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 to the ocean compared to 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 analyses 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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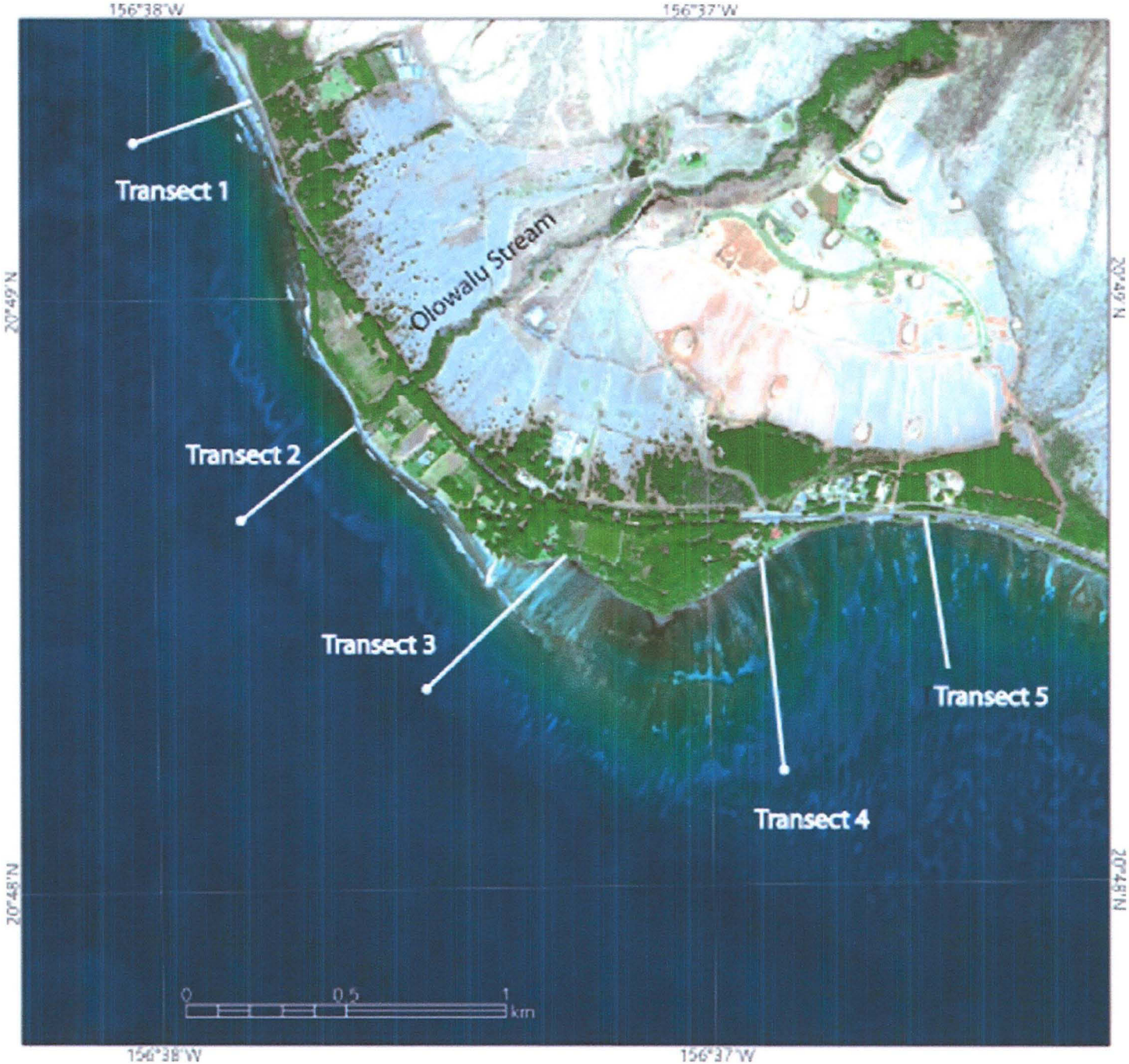


FIGURE 1. Satellite image of Olowalu, Maui, Hawaii showing locations of five water sampling transects that extend from the shoreline to 400-600 meters offshore. Nine sampling stations were located on each transect.

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 (std.units)	CHL a (µg/L)	TEMP (deg.C)	O2 % Sat
Olowalu 1	0S	0.56	50.12	8.48	310.16	1.08	14.72	1.64	73.32	0.79	18.942	7.88	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	2.36	0.88	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	0.62	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	3.72	322.60	0.60	22.48	2.88	26.60	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	3.79	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	0.18	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	0.17	2.16	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	0.63	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 form 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 (std.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	1026	0.79	18.942	7.88	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	33.04	12.33	2383	33.48	132.7	38.44	178.1	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	70.68	394.8	3.79	28.616	7.74	0.35	25.58	109.9
	5S	17.05	8.96	33.33	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	20.73	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	8.82	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 form 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.

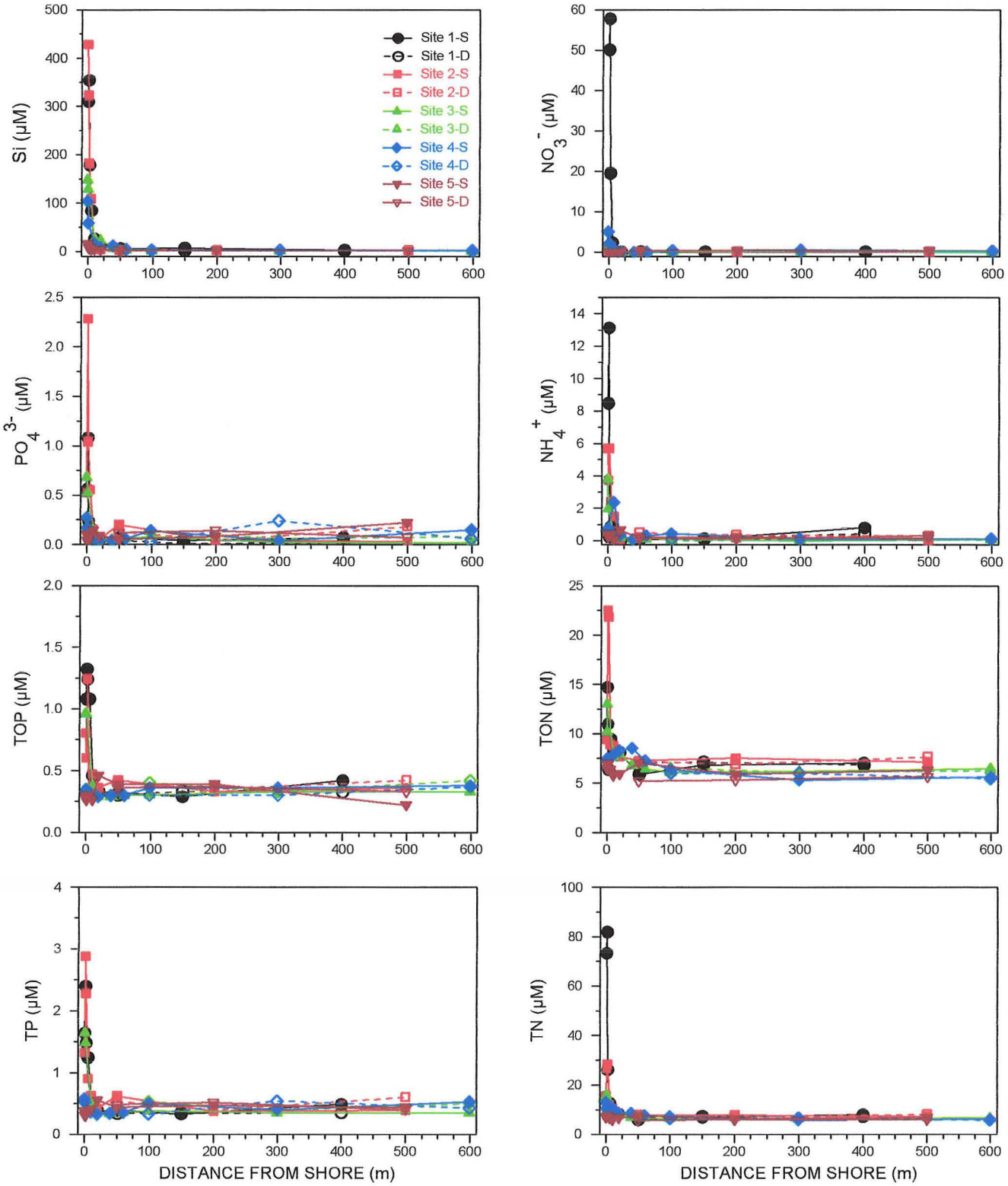


FIGURE 2. Plots of dissolved nutrients in surface (S) and deep (D) samples collected on June 11, 2010 as a function of distance from the shoreline in the vicinity of Olowalu Town project. For site locations, see Figure 1.

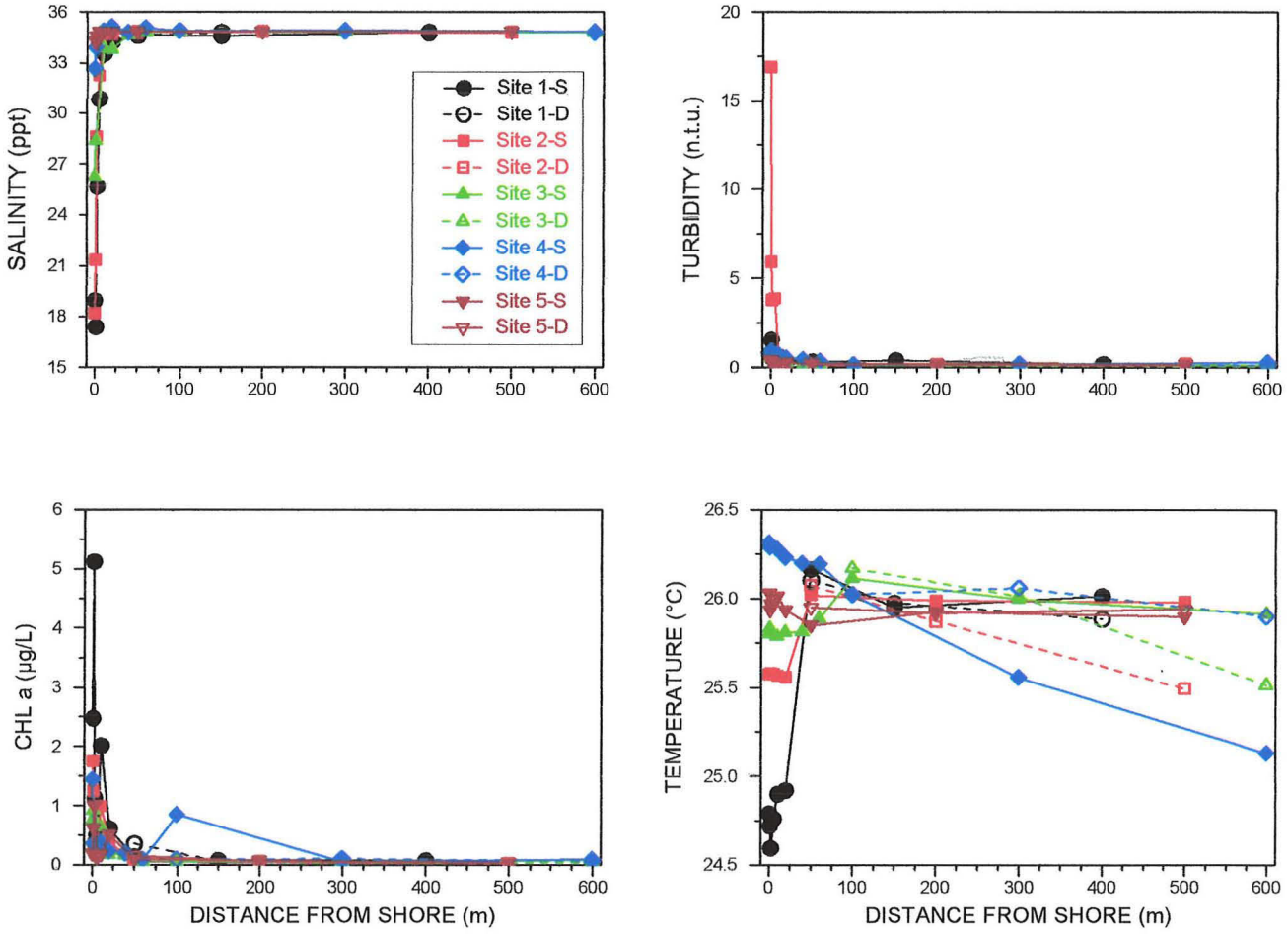


FIGURE 3. Plots of water chemistry constituents in surface (S) and deep (D) samples collected on June 11, 2010 as a function of distance from the shoreline in the vicinity of Olowalu Town project. For site locations, see Figure 1.

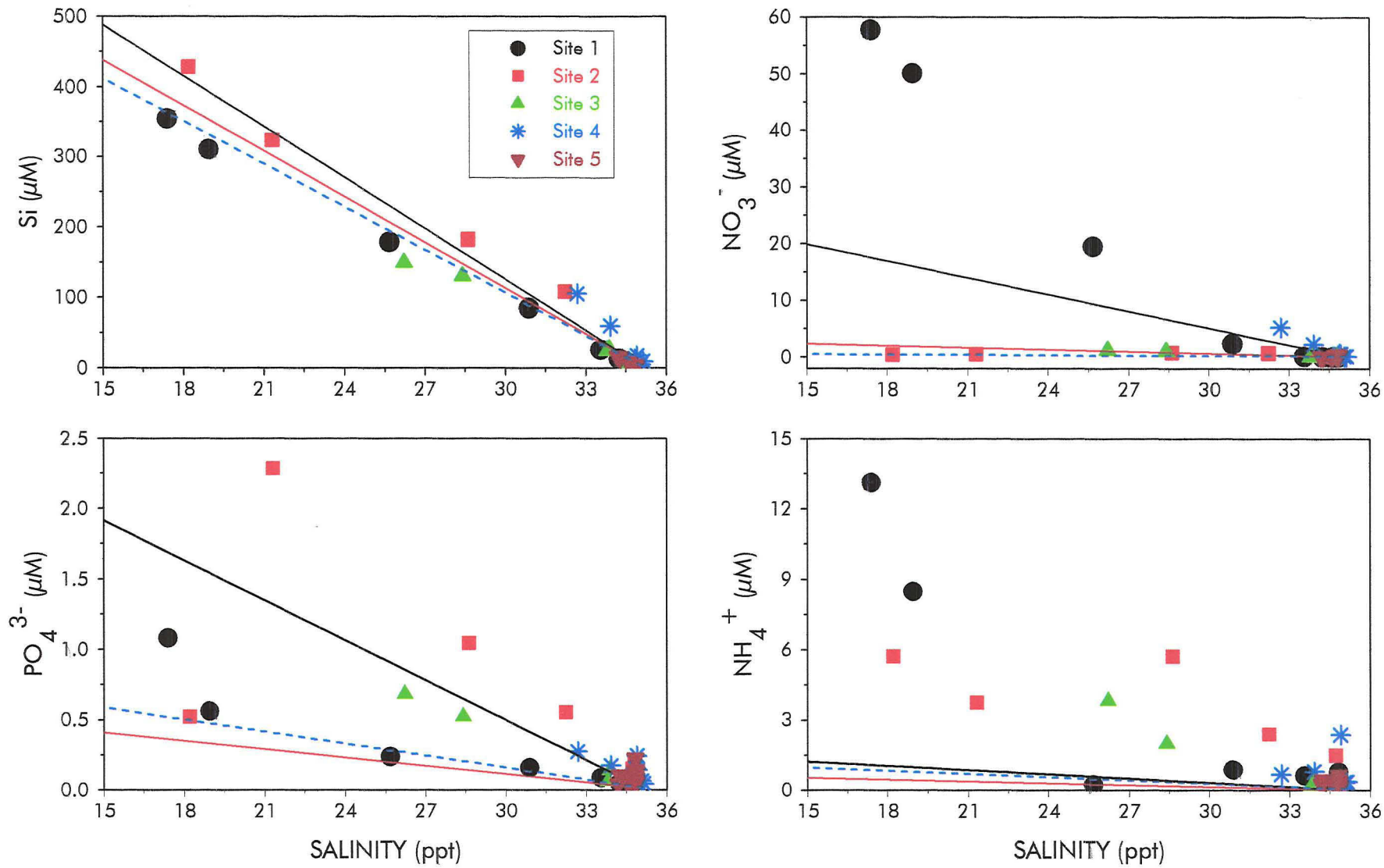


FIGURE 4. Mixing diagram showing concentration of dissolved nutrients from samples collected offshore of the Olowalu Town project on June 11, 2010 as functions of salinity. Conservative mixing lines, constructed by connecting the concentrations in open coastal water with water from two groundwater wells 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.

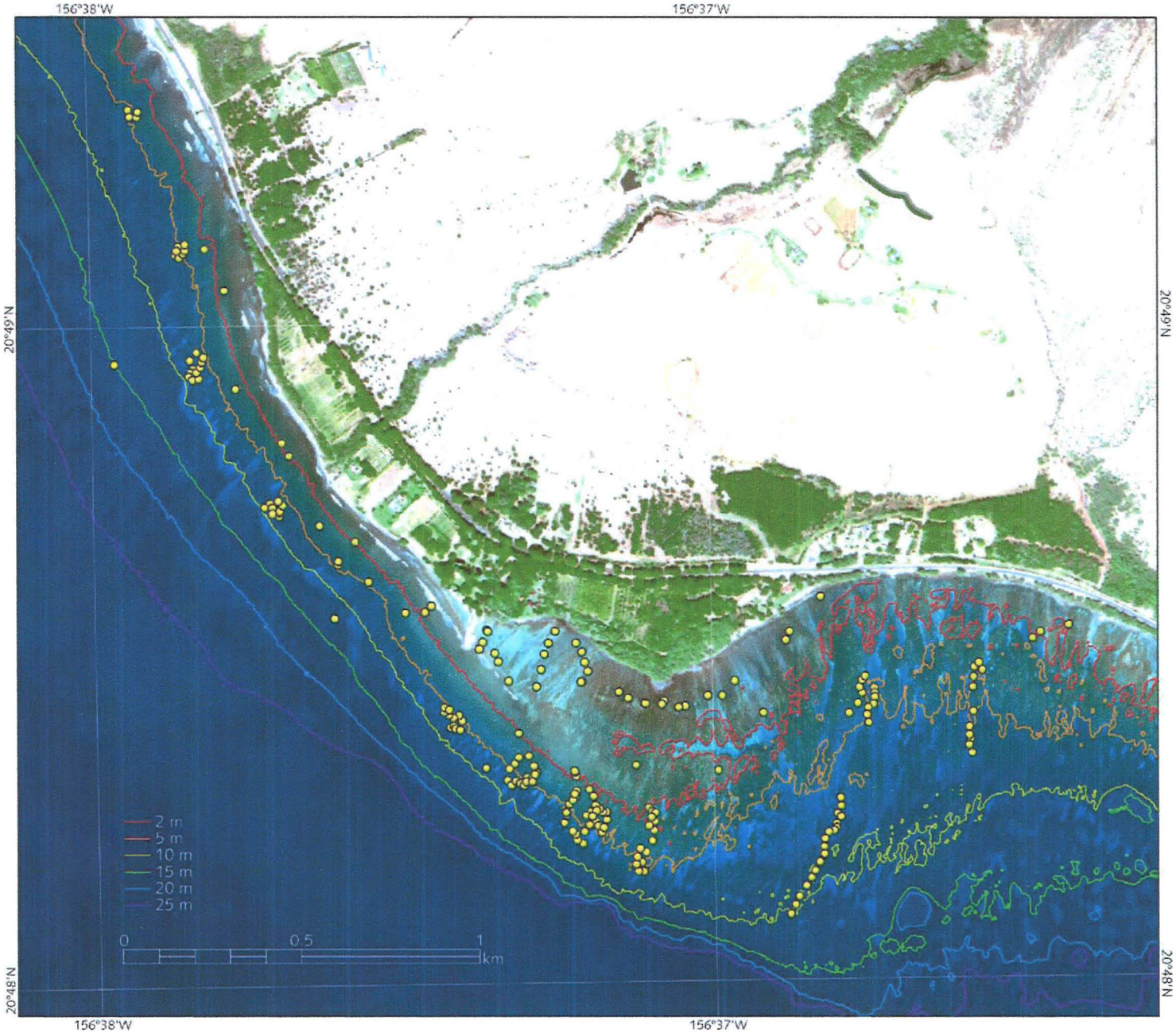


FIGURE 5. Satellite image of study area off Olowalu, Maui, Hawaii showing depth contours and locations of 200 reef survey calibration/validation sites (yellow circles).

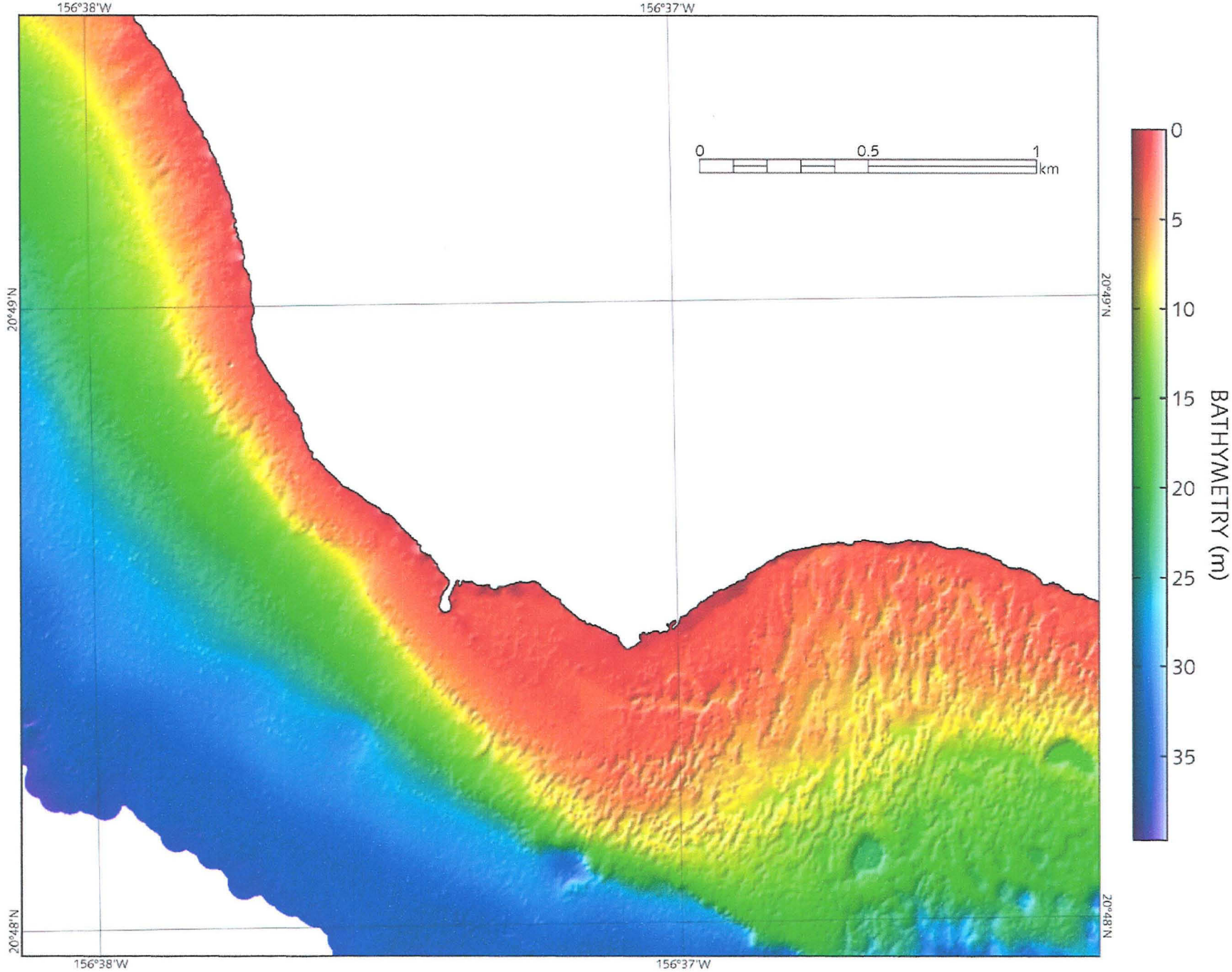


FIGURE 6. Three-dimensional color-coded bathymetry of nearshore marine environment off of Olowalu, Maui (land is white). Note significantly greater rugosity of reef structure on east side of Olowalu Point relative to west side. Data provided by SHOALS (Scanning Hydrographic Operational Airbourne Lidar Survey).

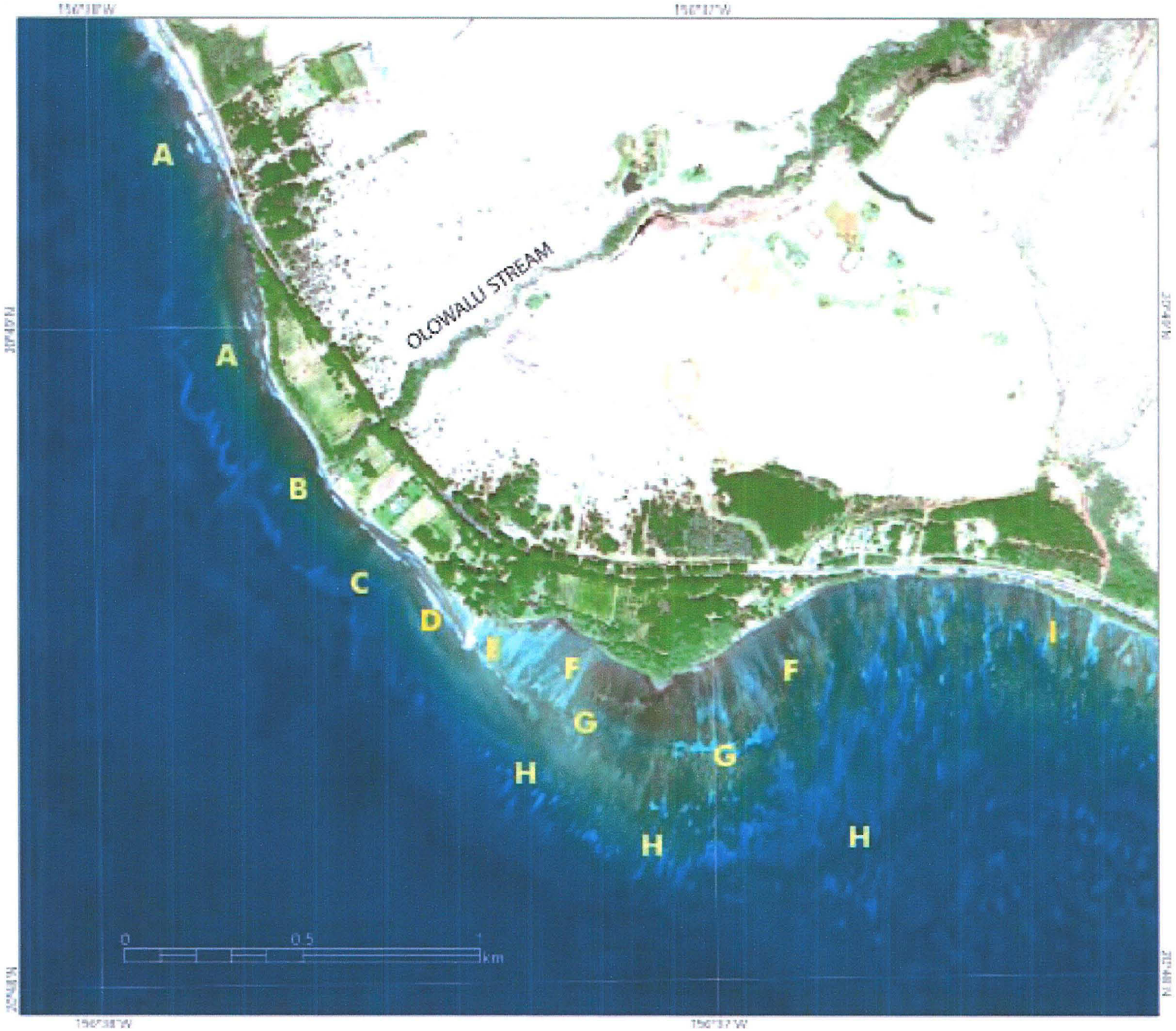
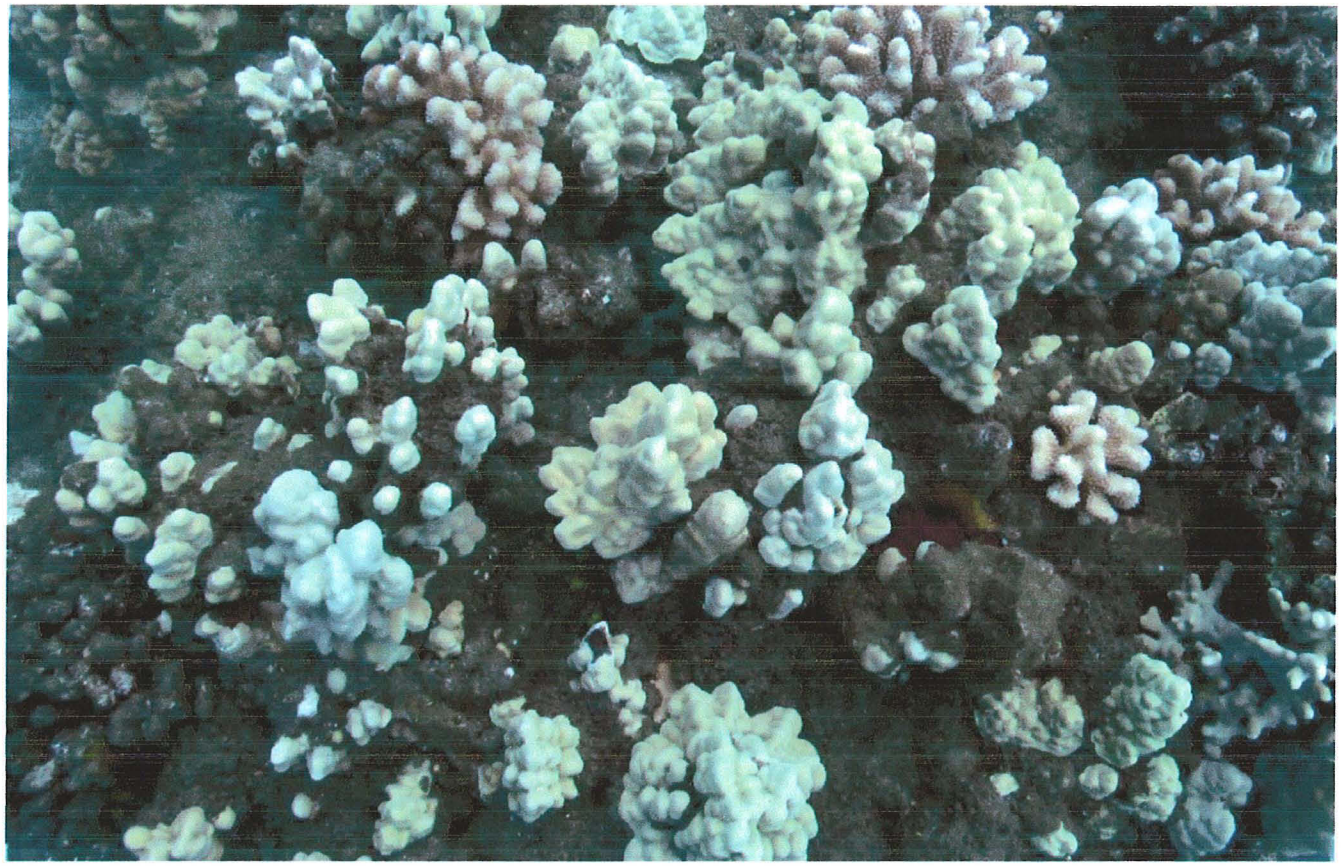


FIGURE 7. Satellite image of coastal and reef area of Olowalu, Maui, Hawaii . Letters designate regions of various reef zones described in text.

FIGURE 8. Views of shoreline at northern end (top) central (middle) and southern end (bottom) of Olowalu Town project site.



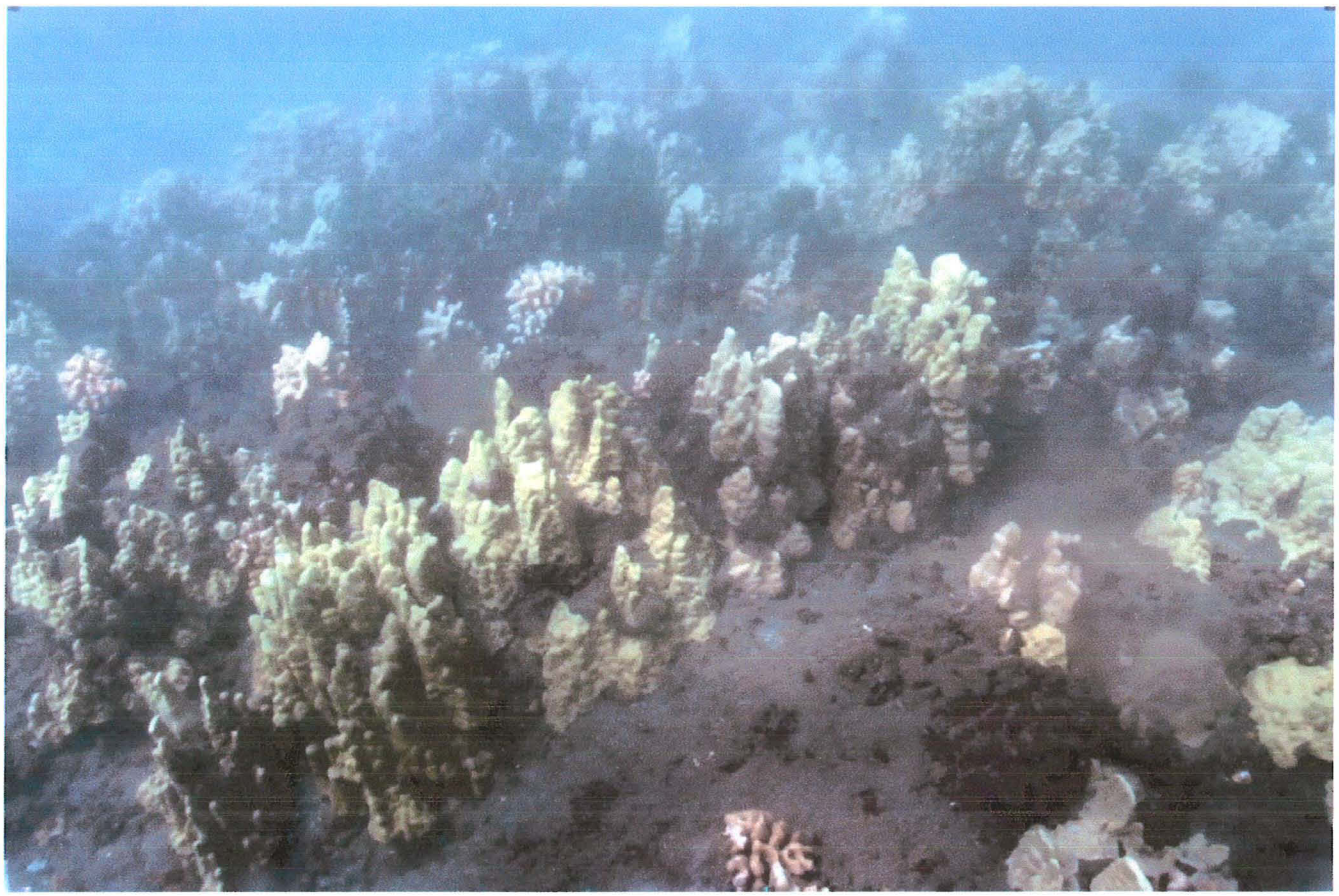
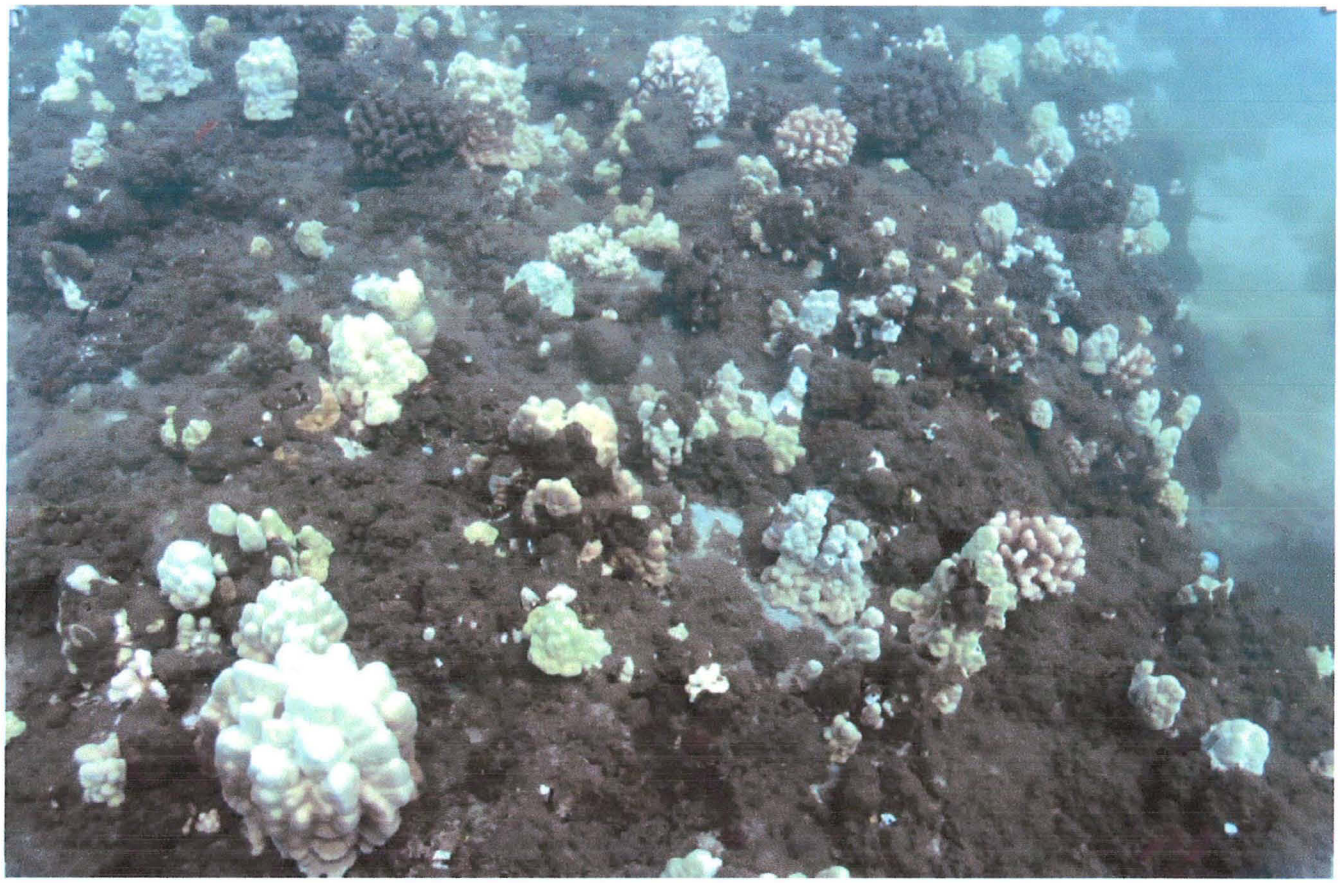


FIGURE 9. Reef platform typifying Zone A (see Figure 7) near northern boundary of Olowalu Town project site, and north of the discharge area of Olowalu Stream. Predominant species of coral in both photos is *Porites lobata*. Note layer of mud on reef surface between coral colonies.



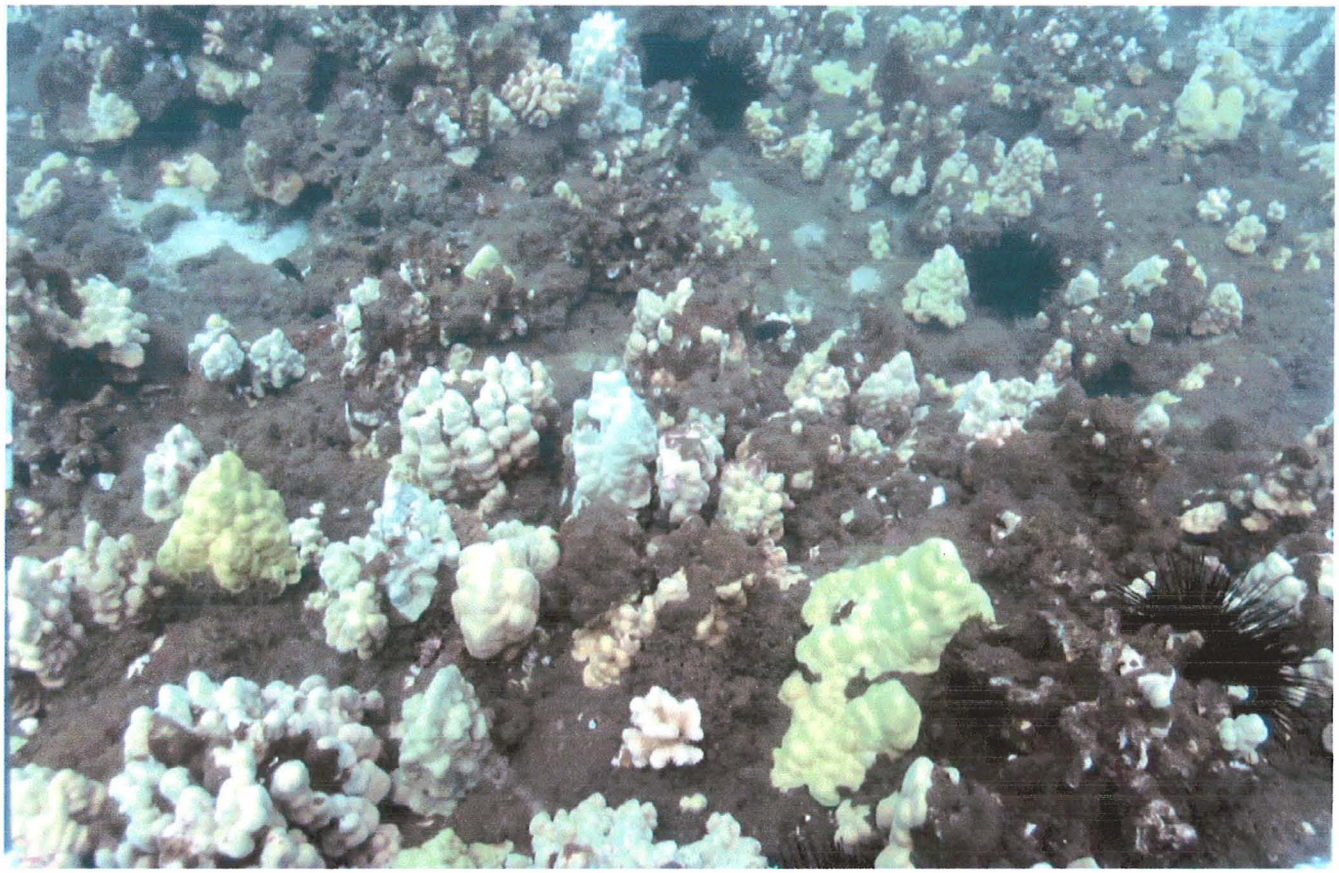


FIGURE 10. Two examples of the reef platform in Zone A north of Olowalu Point. Predominant corals in both photos are *Porites lobata* (tan and green knobby colonies) and *Pocillopora meandrina* (round branching colonies). Not bottom cover of dark colored sediment between corals.

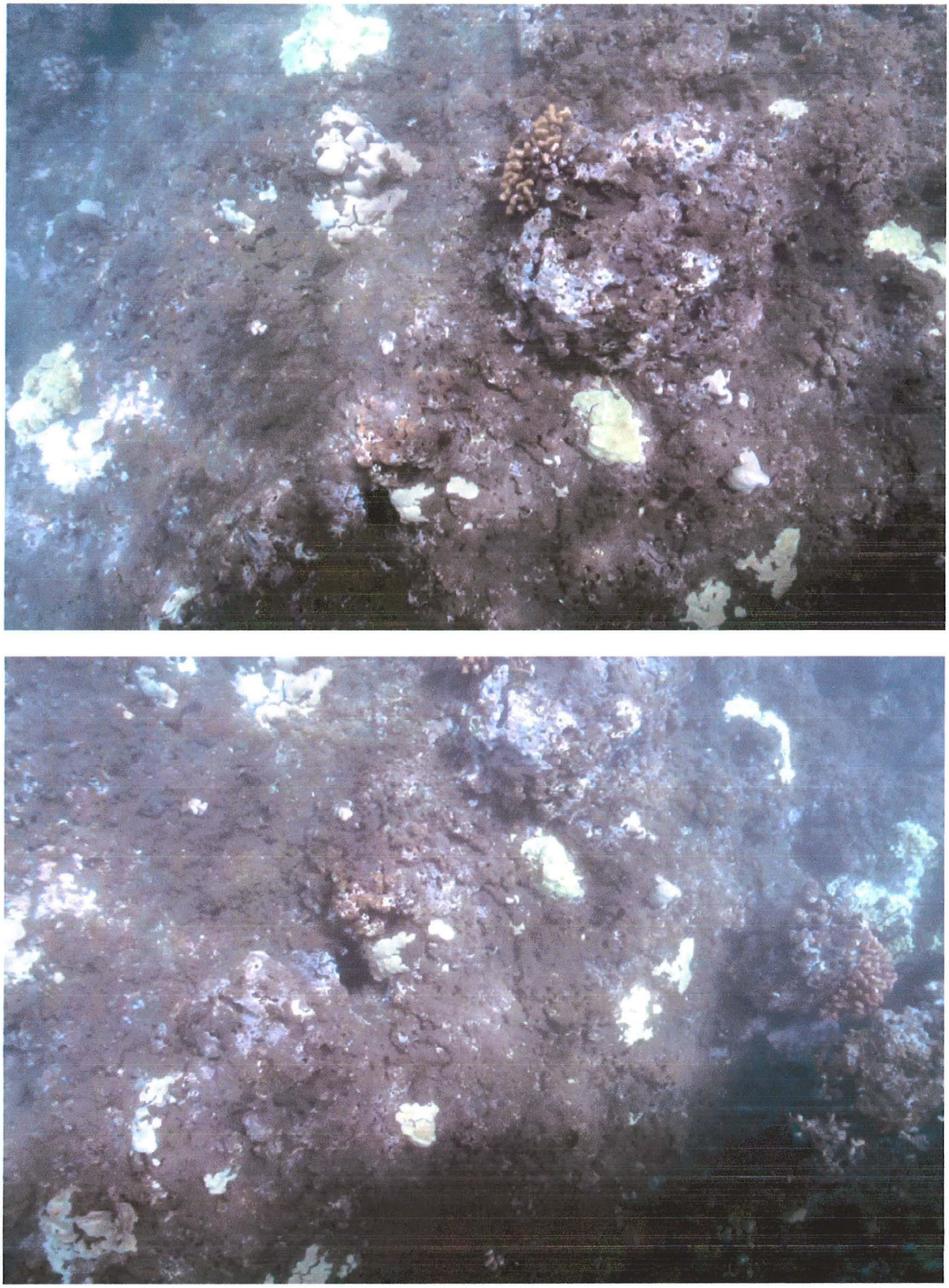
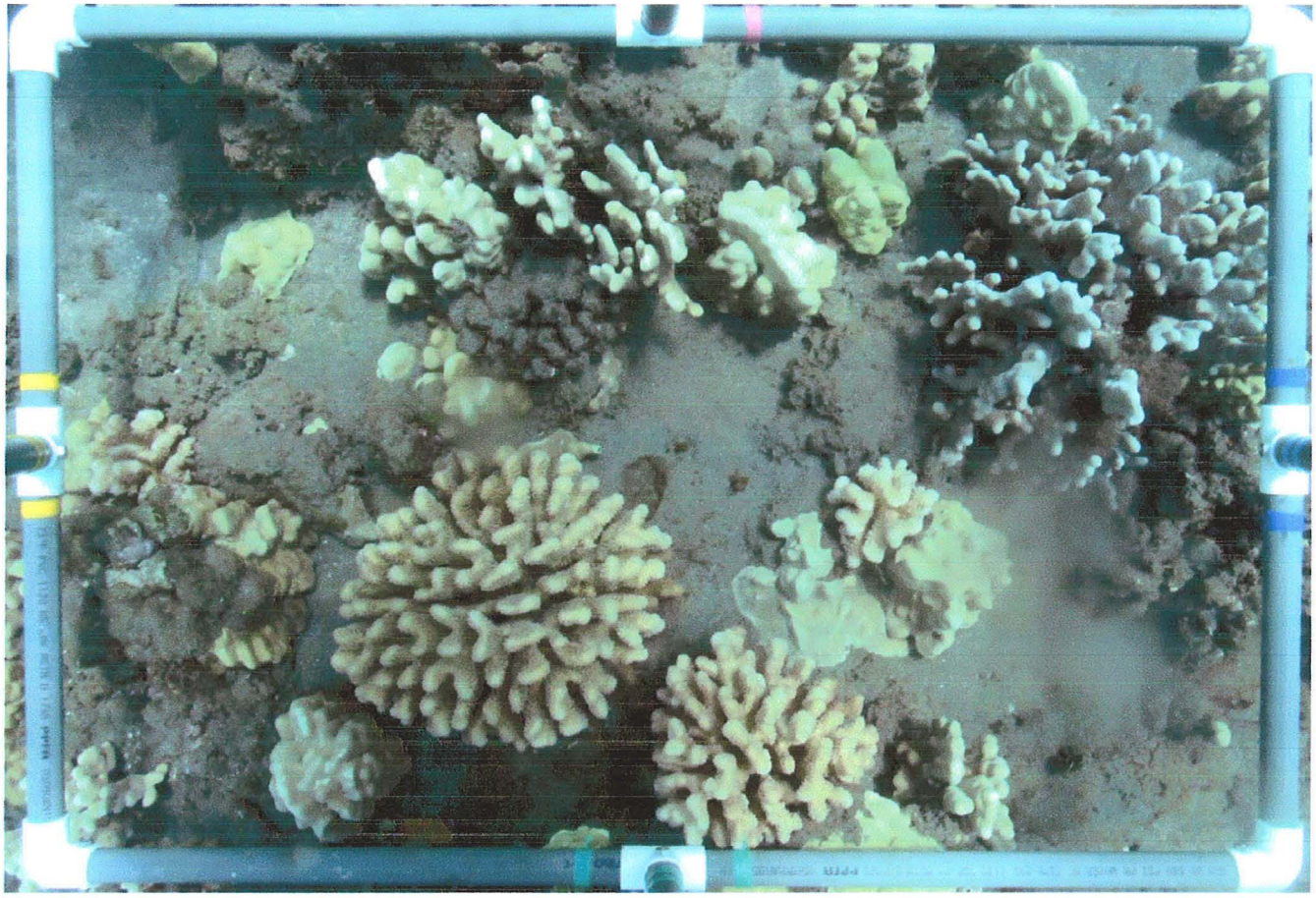


FIGURE 11. Two views of reef surface near point of discharge of Olowalu Stream (see Zone B in Figure 7).



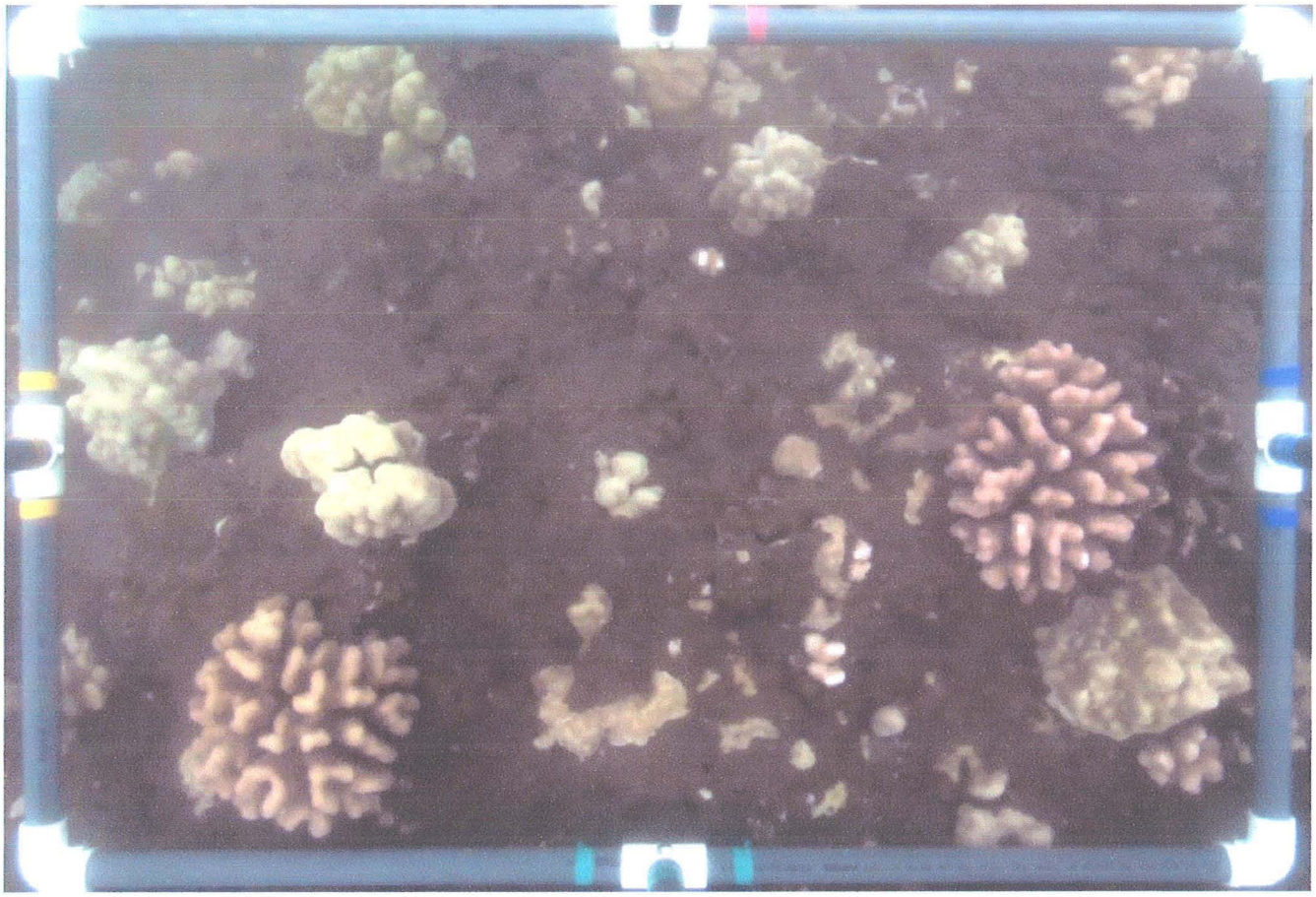
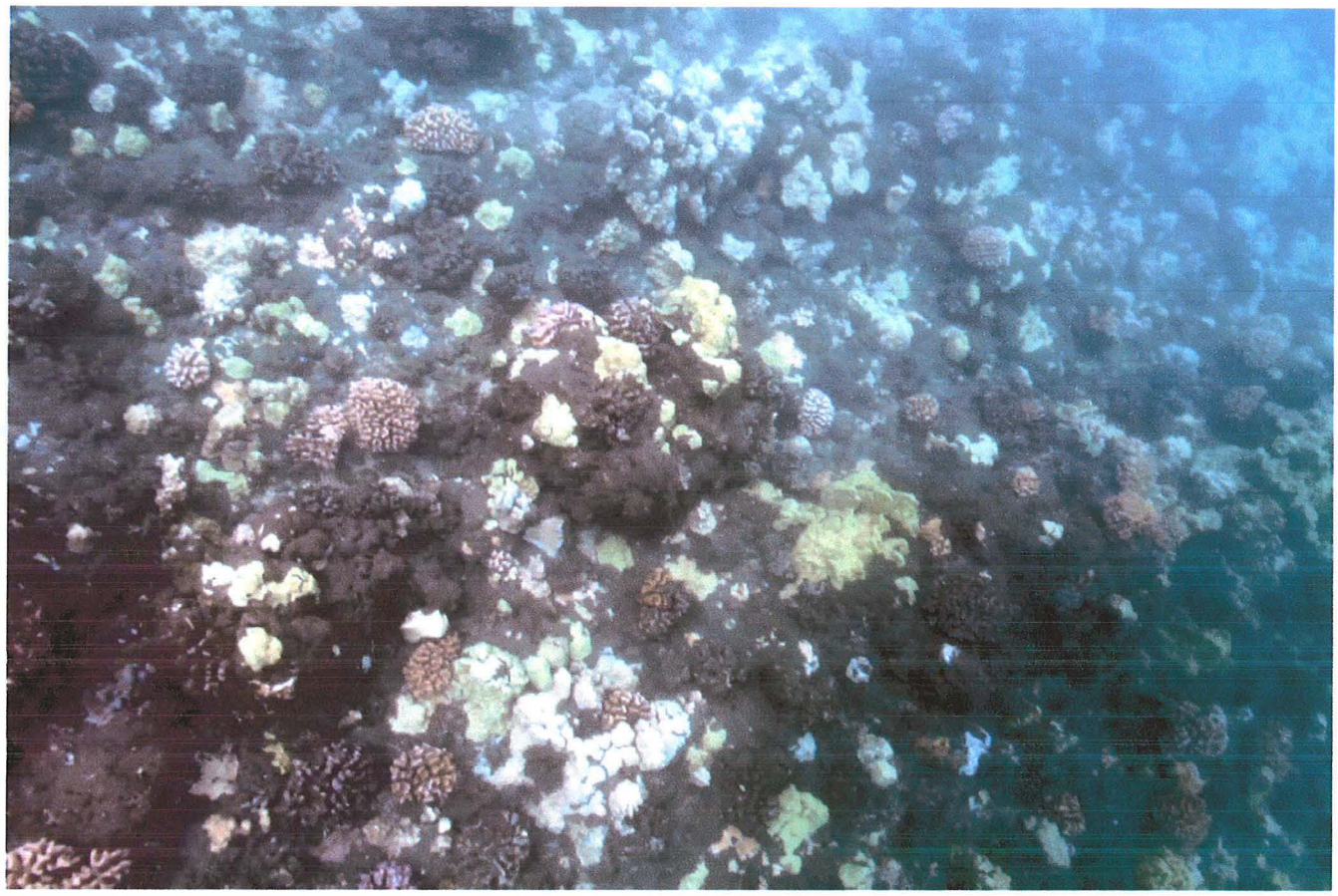


FIGURE 12. Two examples of photoquadrats taken in Zone B (see Figure 7) near the point where Olowalu Stream discharges to the ocean. Note significant deposition of muddy sediment between corals.



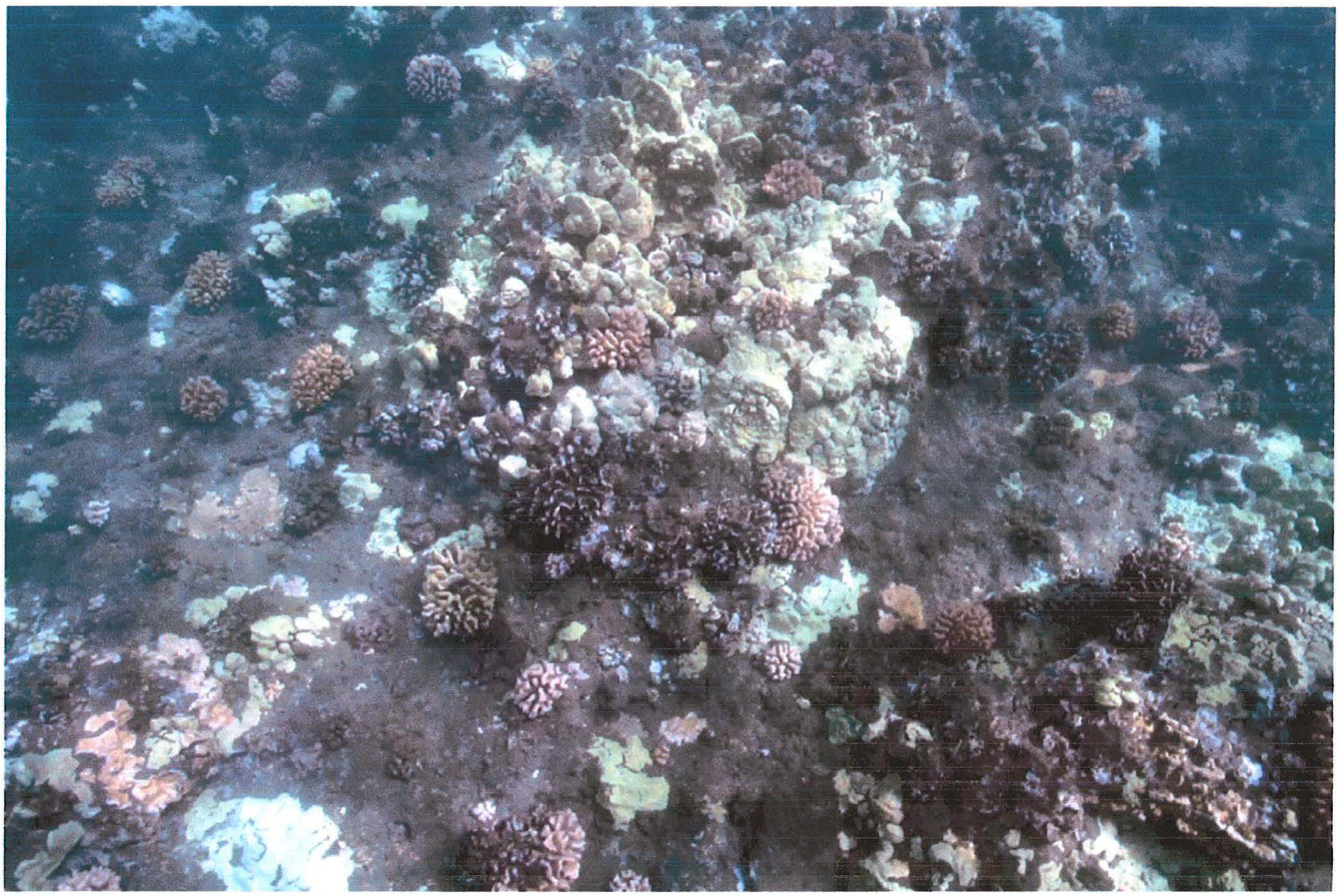


FIGURE 13. Two examples of coral communities on southwest reef platform (Zone C in Figure 7) located between Olowalu Stream Discharge and Olowalu Point. Note higher density of corals and lower levels of deposited mud on bottom compared to Zones A and B.

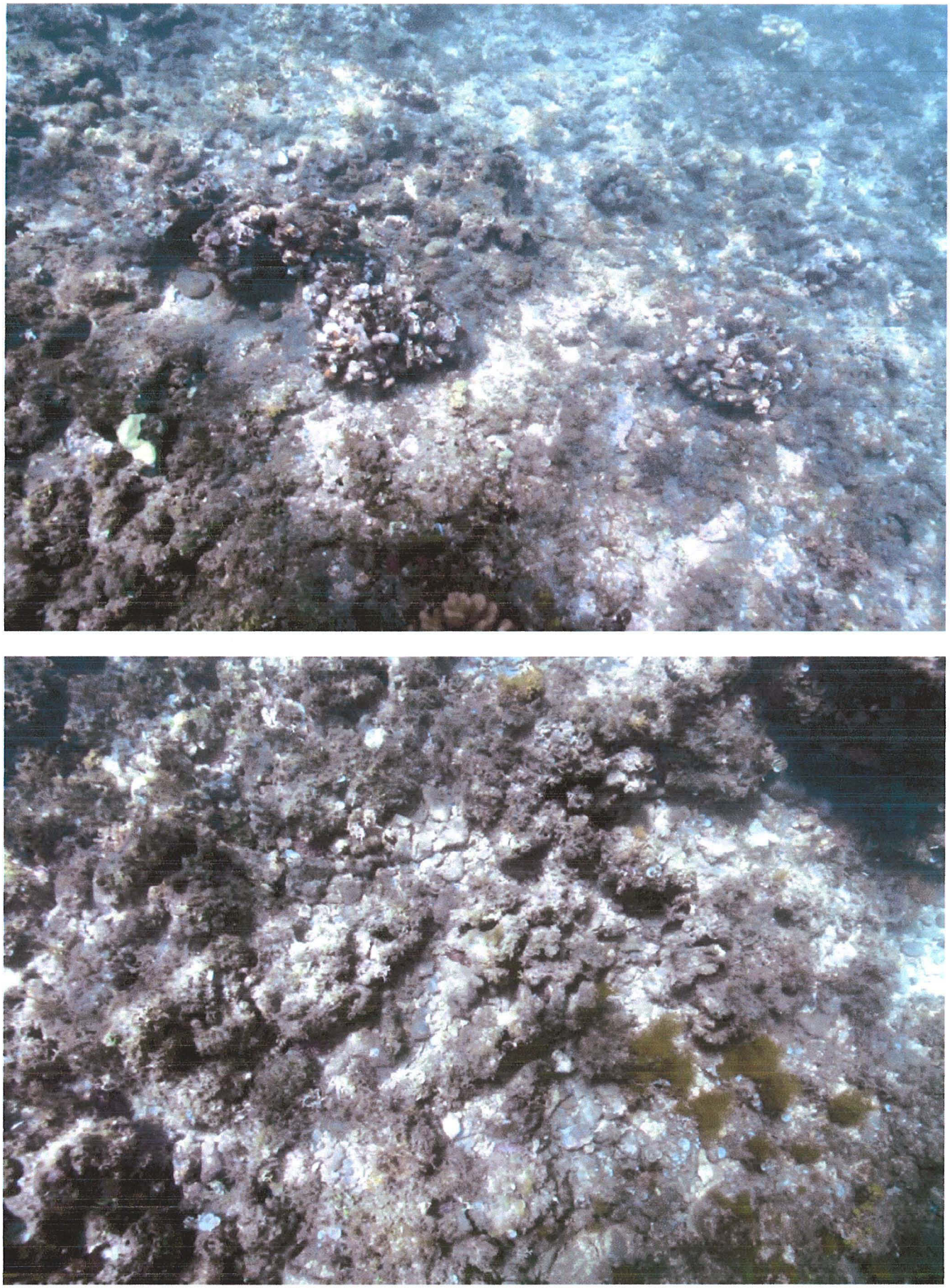
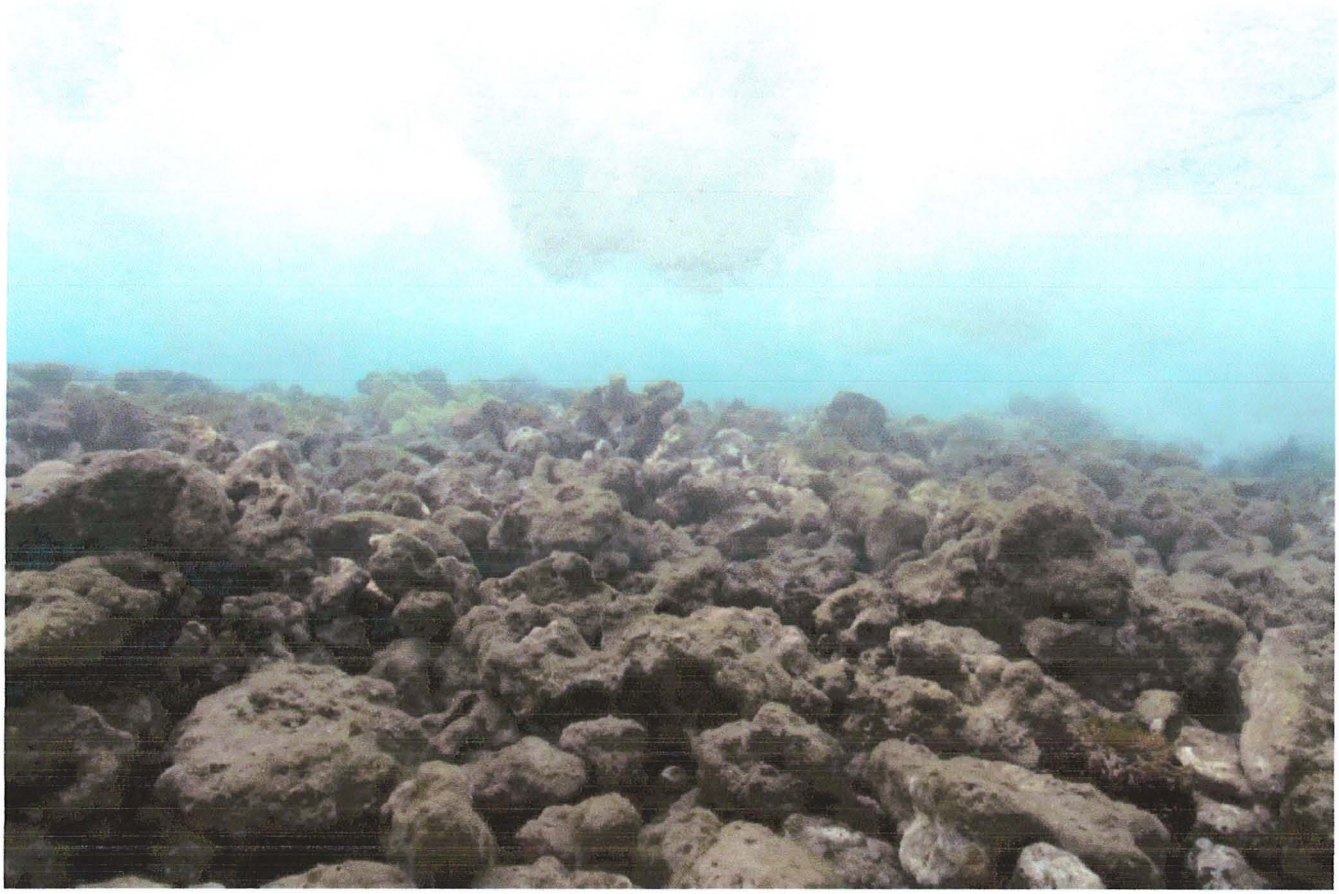


FIGURE 14. Two views of shallow inner reef platform on the north side of Olowalu Point (see Zone D in Figure 7).



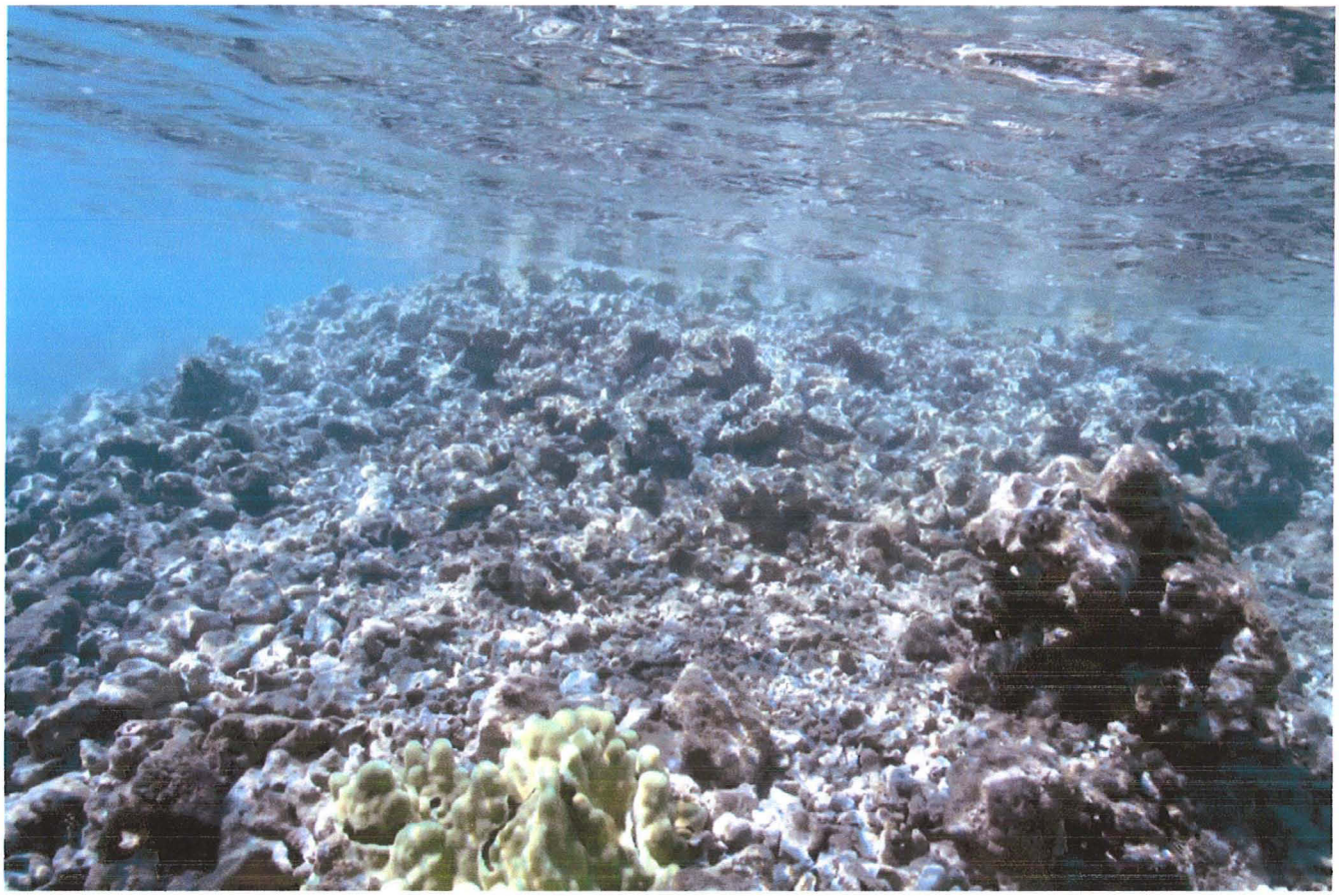
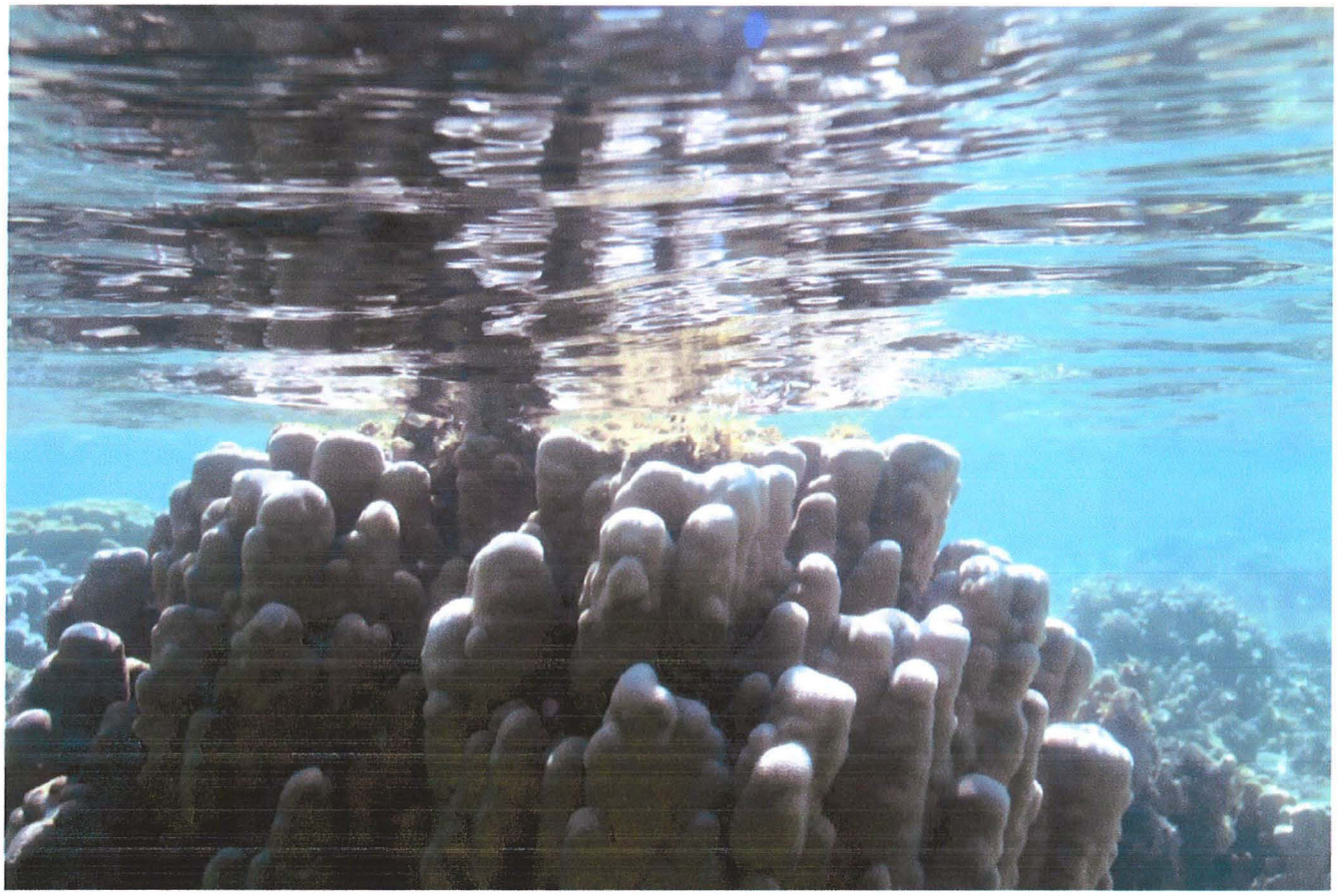


FIGURE 15. Reef crest (Zone E in Figure 7) off the south side of old pier off Olowalu Point. Reef crest is emergent at low tide and absorbs the force of breaking waves (top photo). Not the lack of living coral on the upper surface of the crest in both photos.



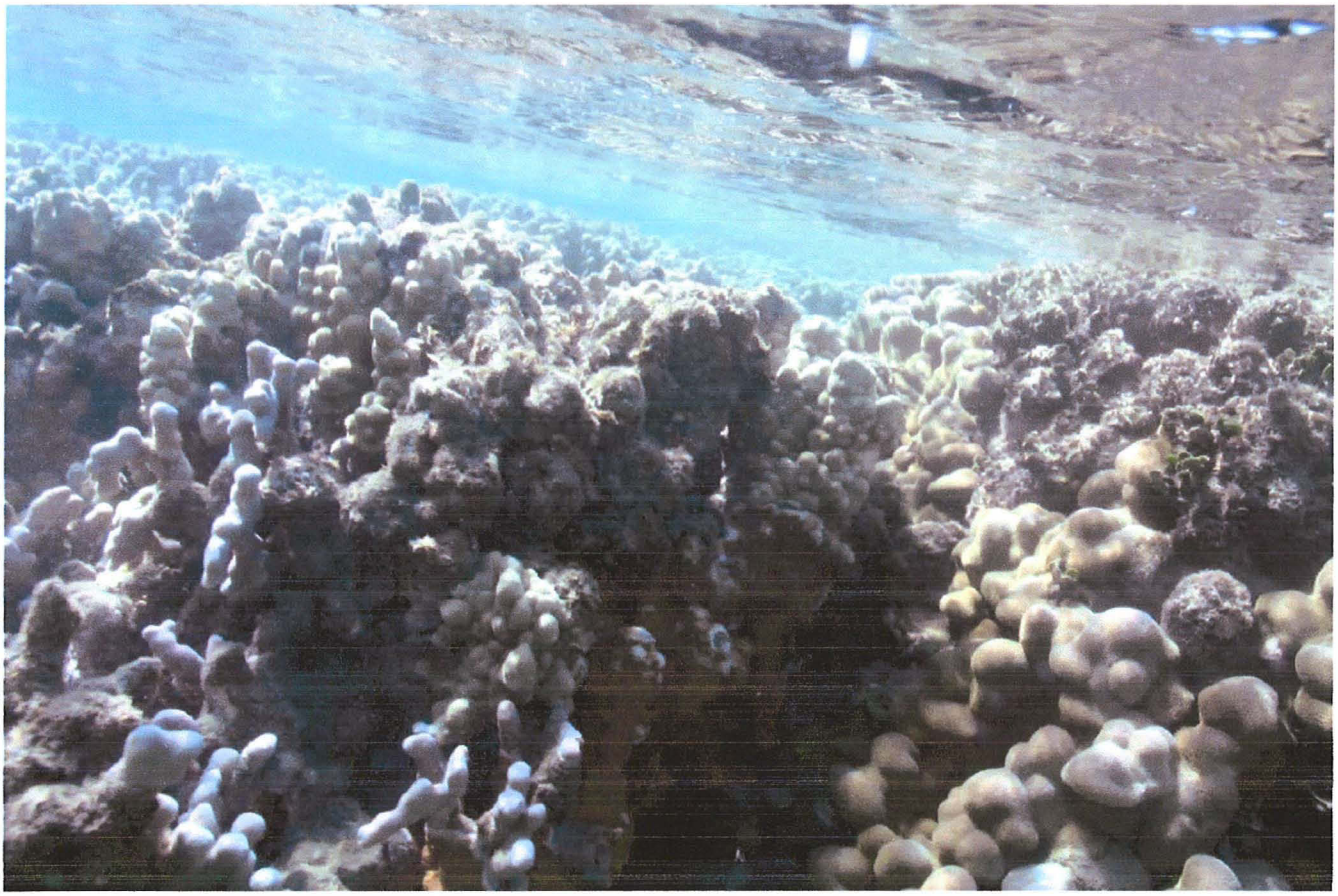
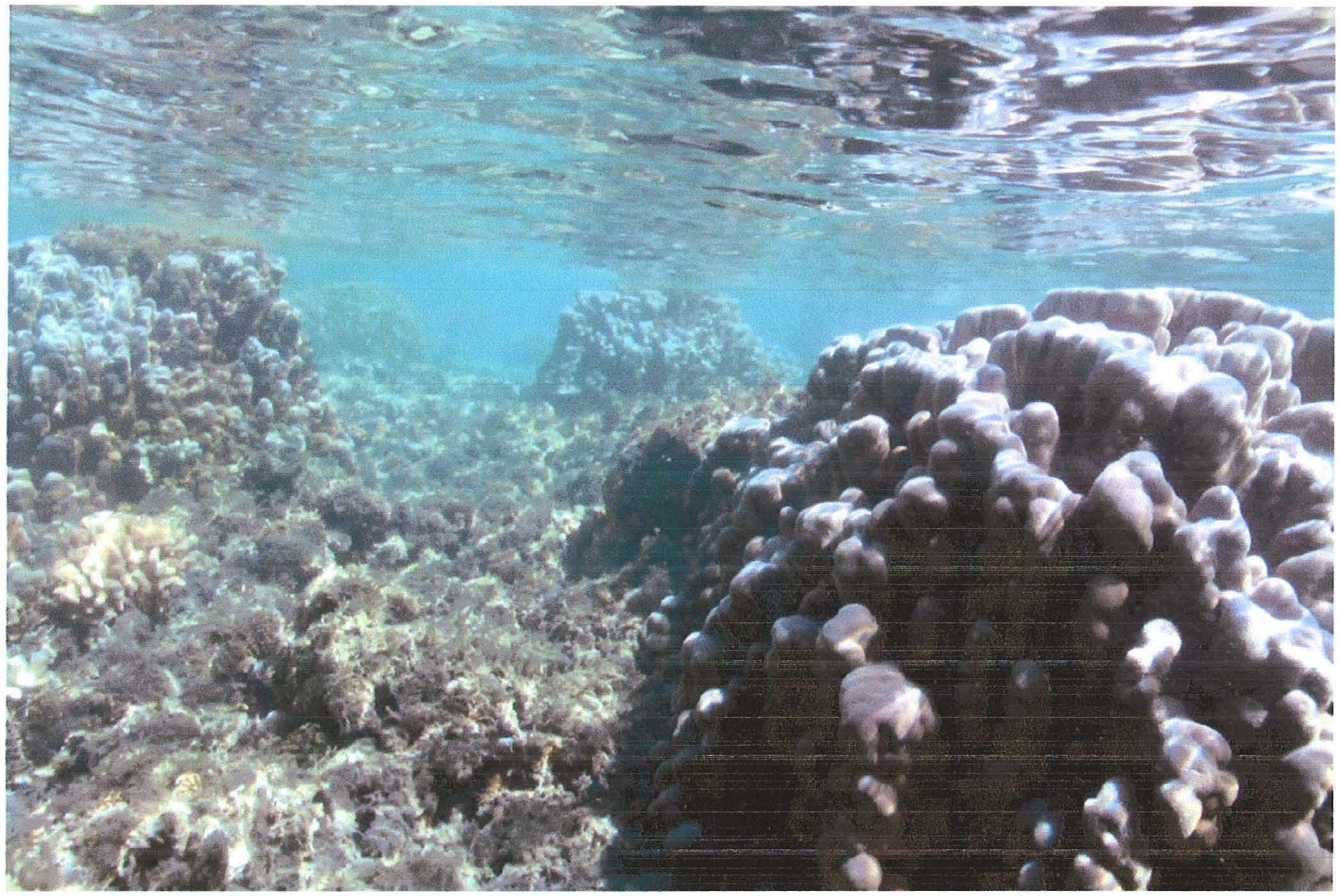


FIGURE 16. Two examples of coral growth to the surface of the water column on inner reef flat off Olowalu Point (Zone F in Figure 7). Predominant coral in both photos is *Porites compressa*.



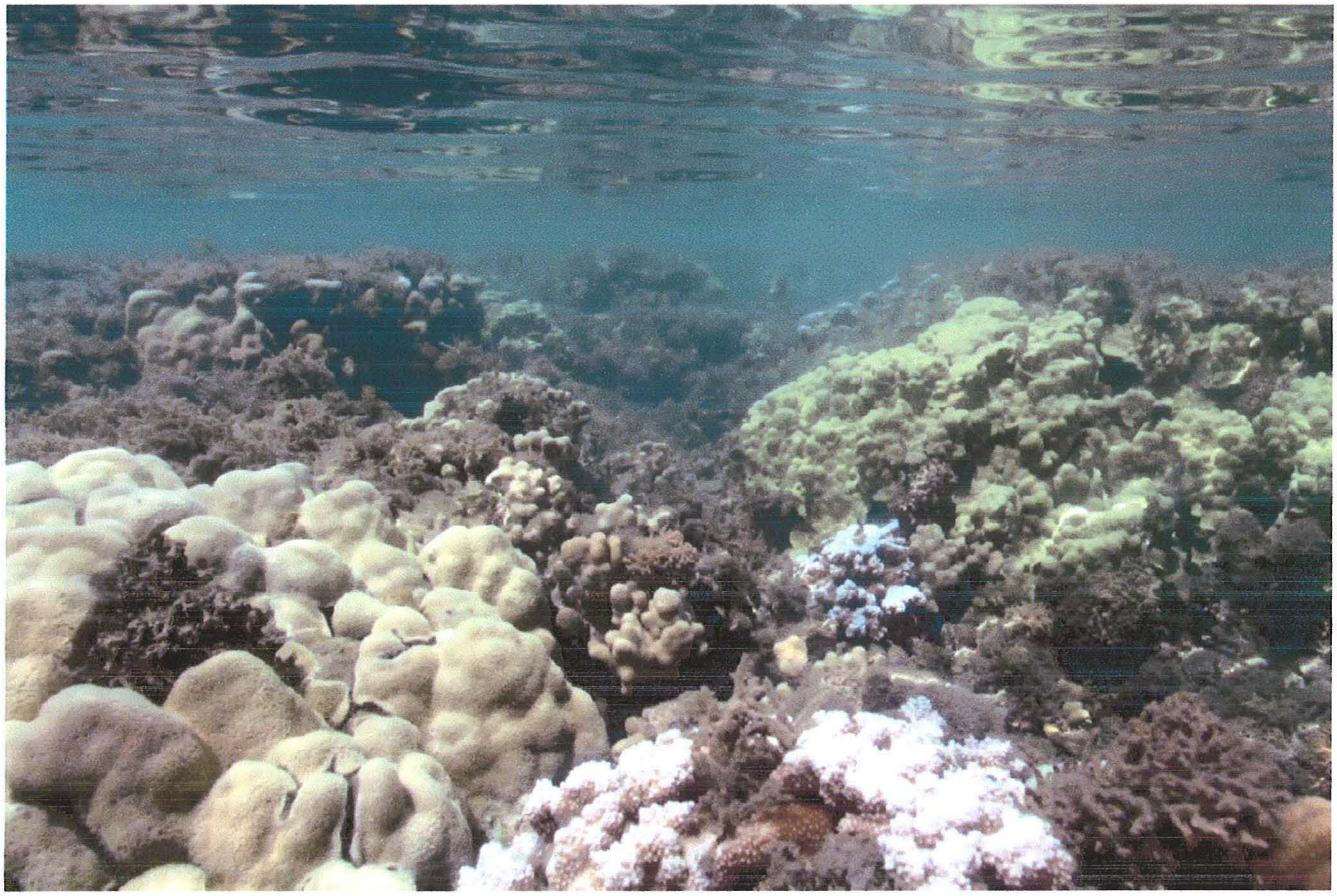


FIGURE 17. Two views of inner reef flat landward of reef crest off Olowalu Point. Predominant corals in both photos are *Porites lobata*.

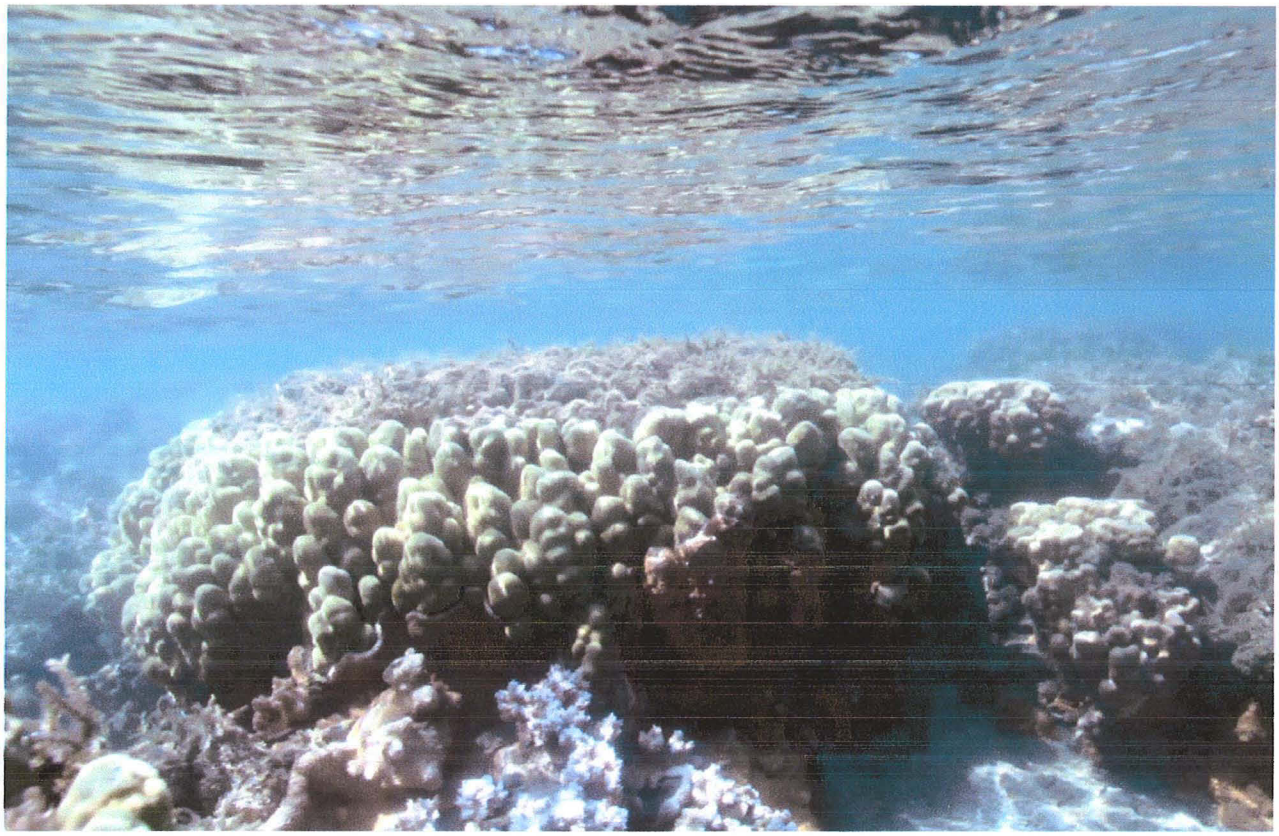
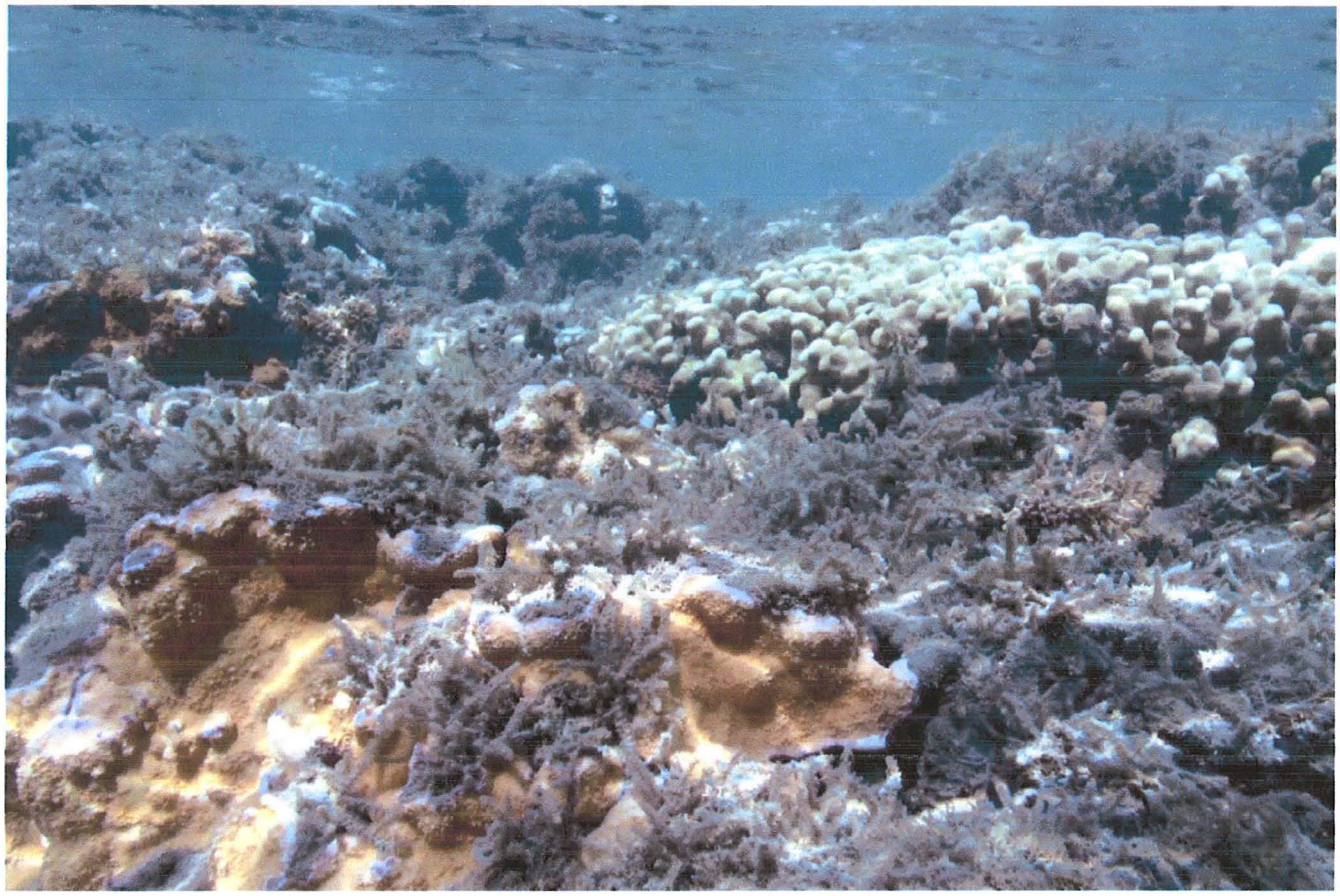


FIGURE 18. Two examples of "microatolls" on inner reef flat (Zone F in Figure 7) off southern side of Olowalu Point. Upward growth of colonies is limited by surface of water, resulting in lateral growth, thus increasing the diameter of the coral. Live coral cover on the upper surface is limited, and in most cases is replaced by the alien algae *Acanthophora specifera*.



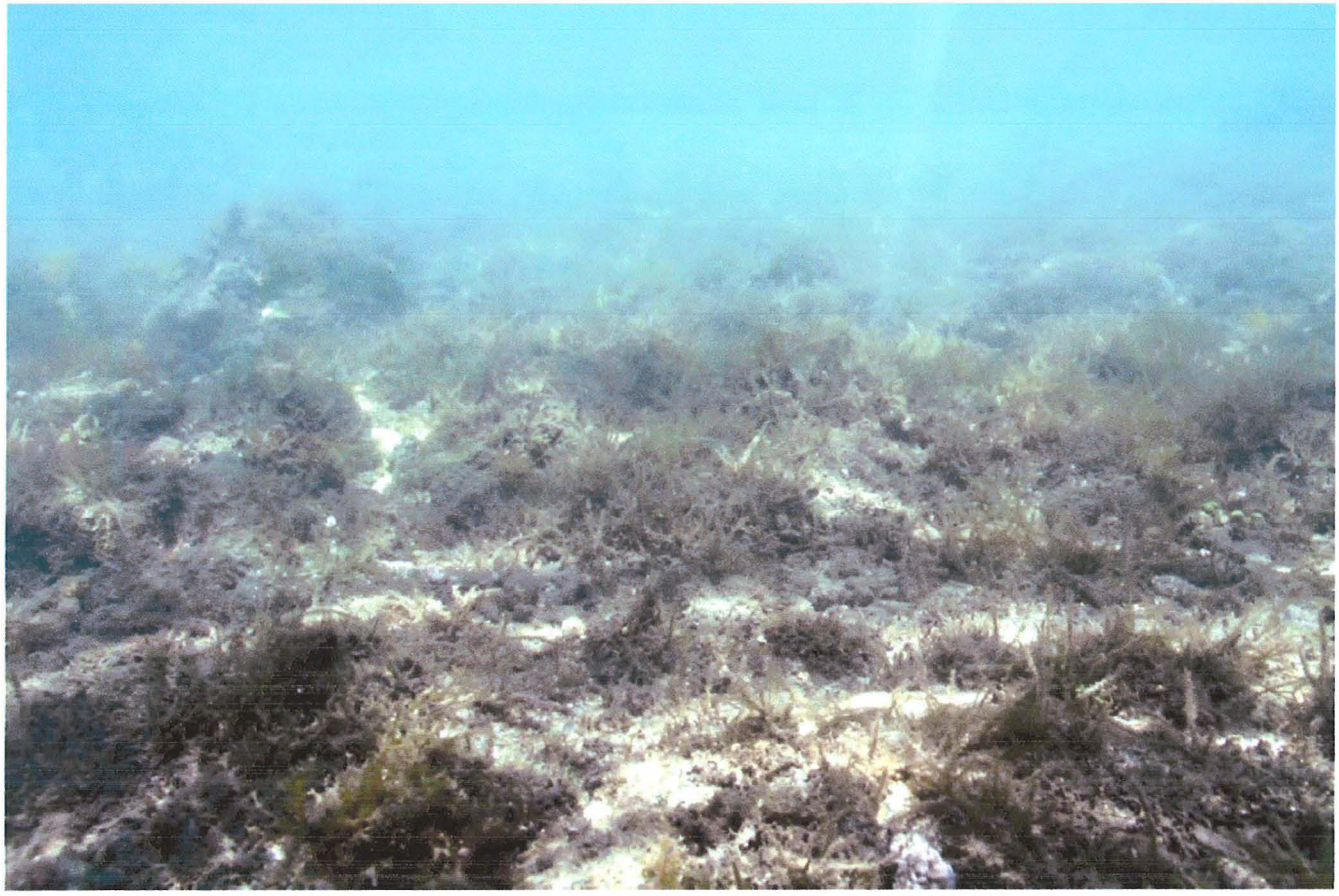
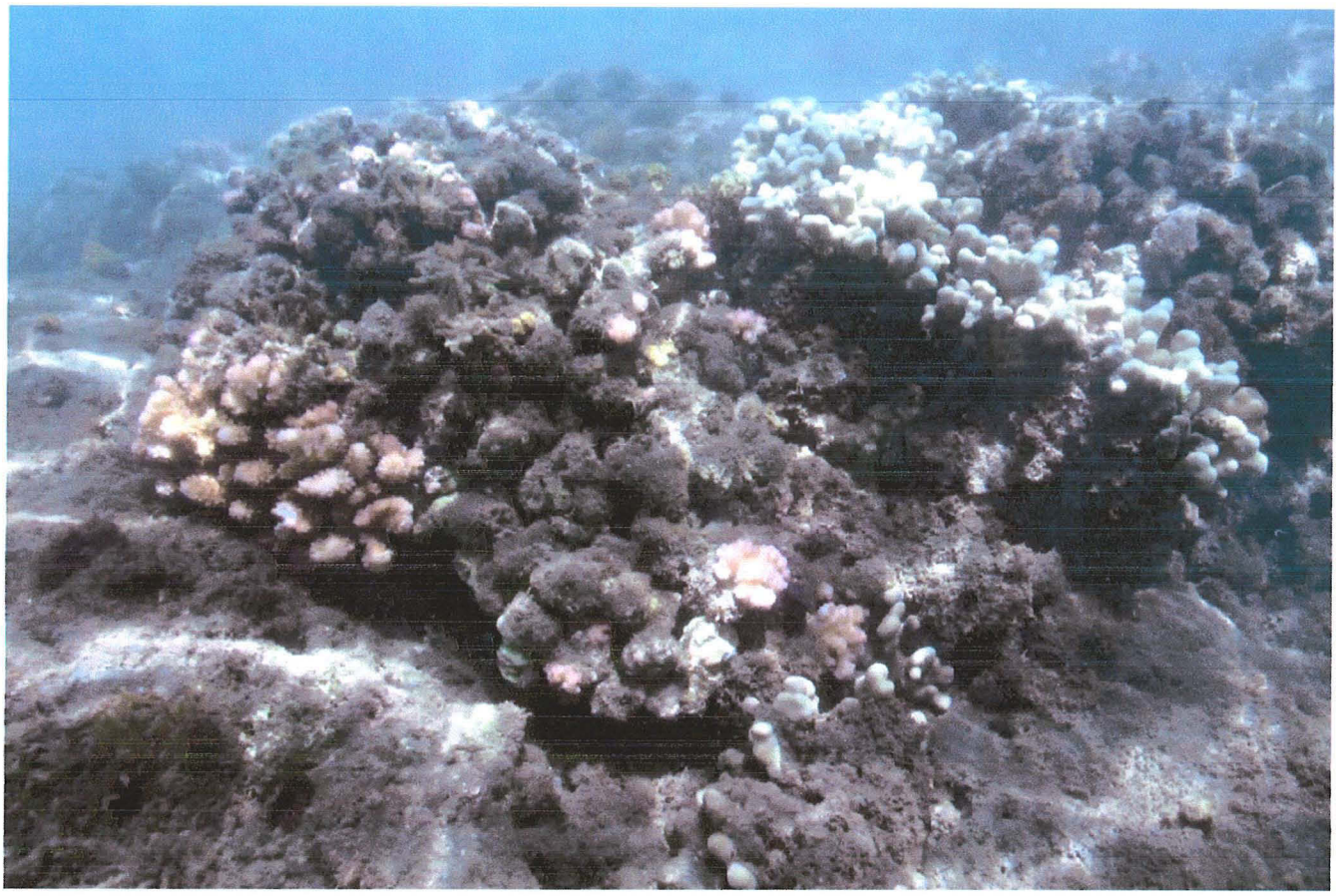


FIGURE 19. Patches of the invasive algae *Acanthophora specifera* covers much of the reef surface (top), as well sandy bottom (bottom) on the nearshore inner reef flat at Olowalu (Zone F in Figure 7).



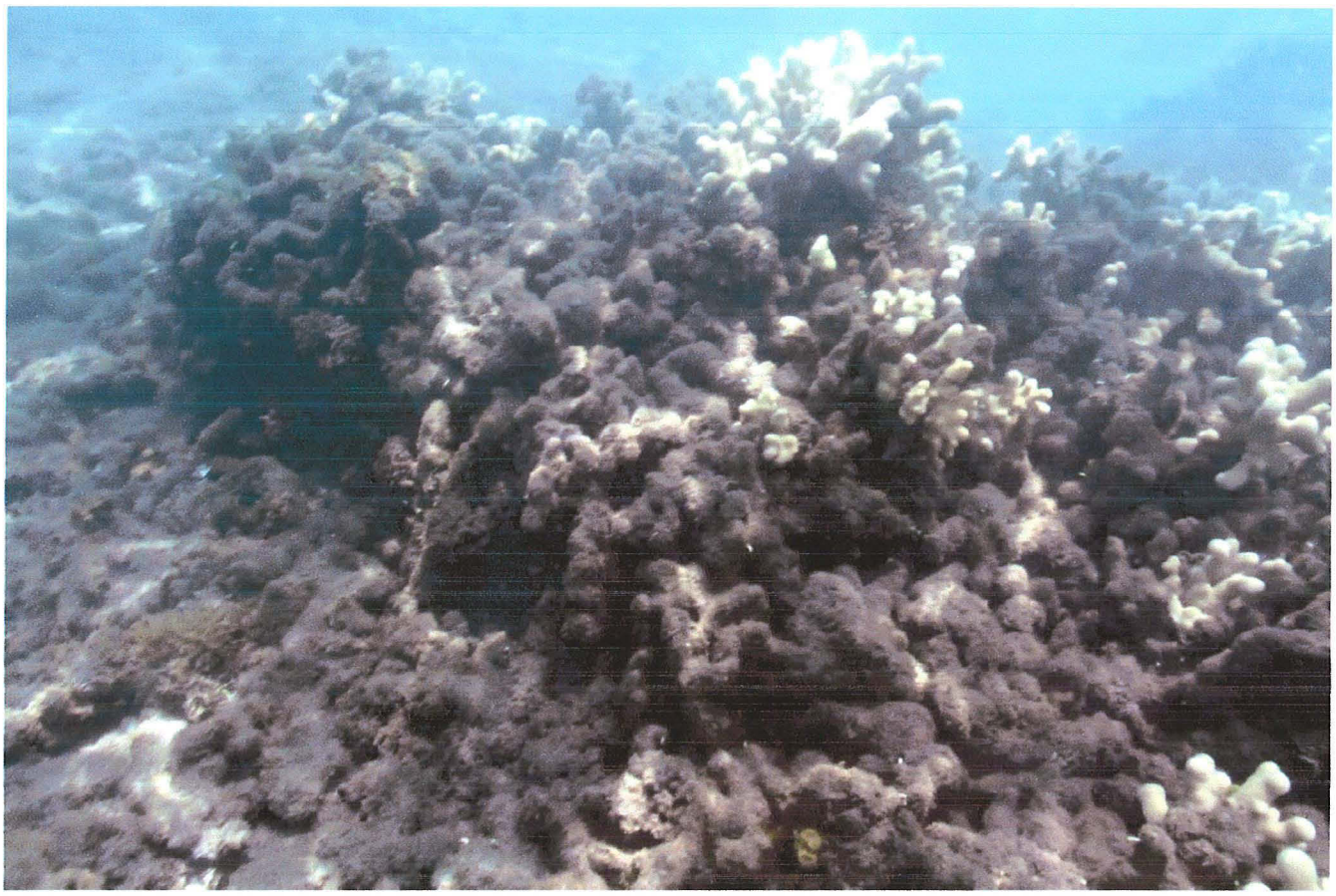
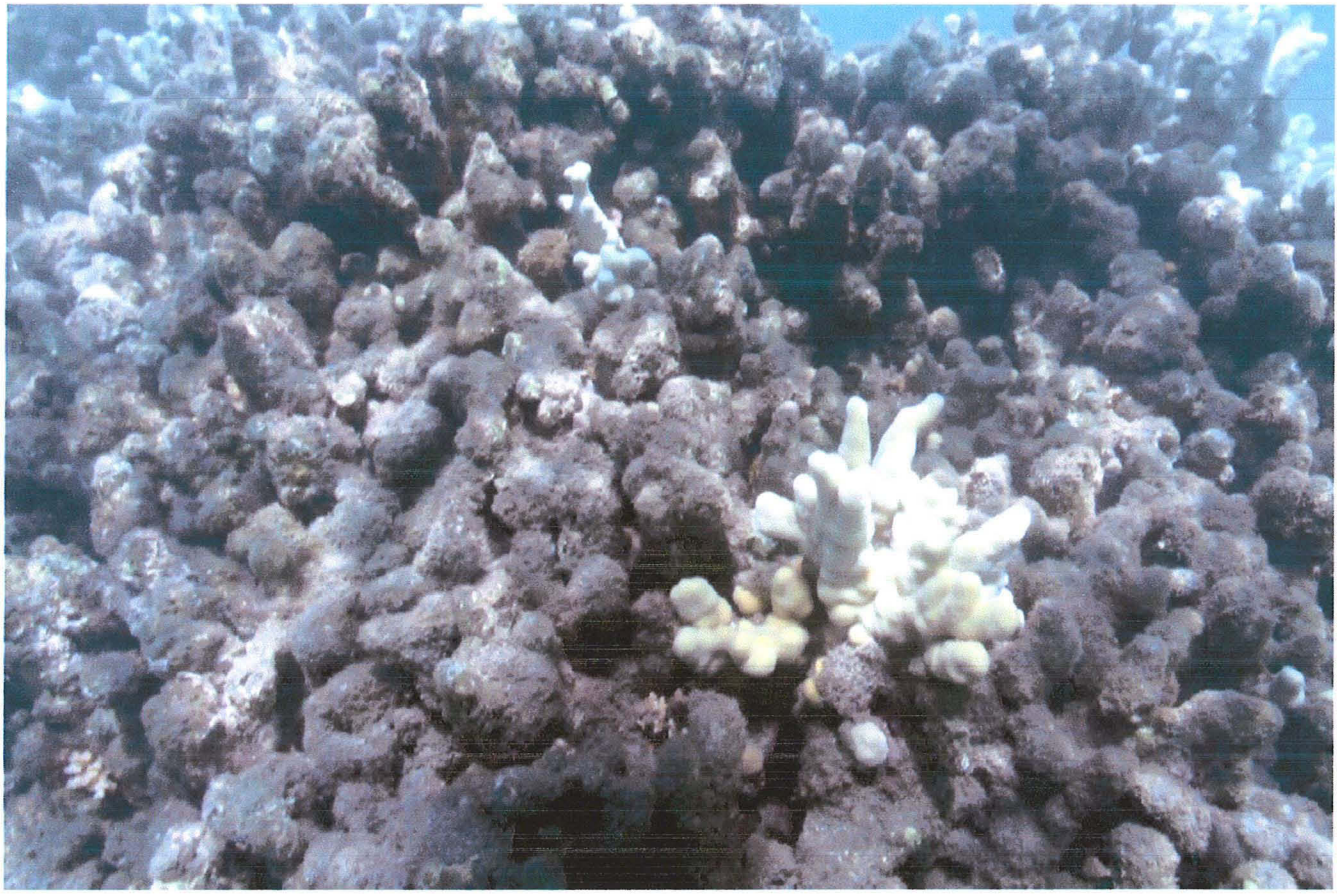


FIGURE 20. Partially dead coral colonies covered with algal turf in southern region of the reef flat off Olowalu (Zone F in Figure 7).



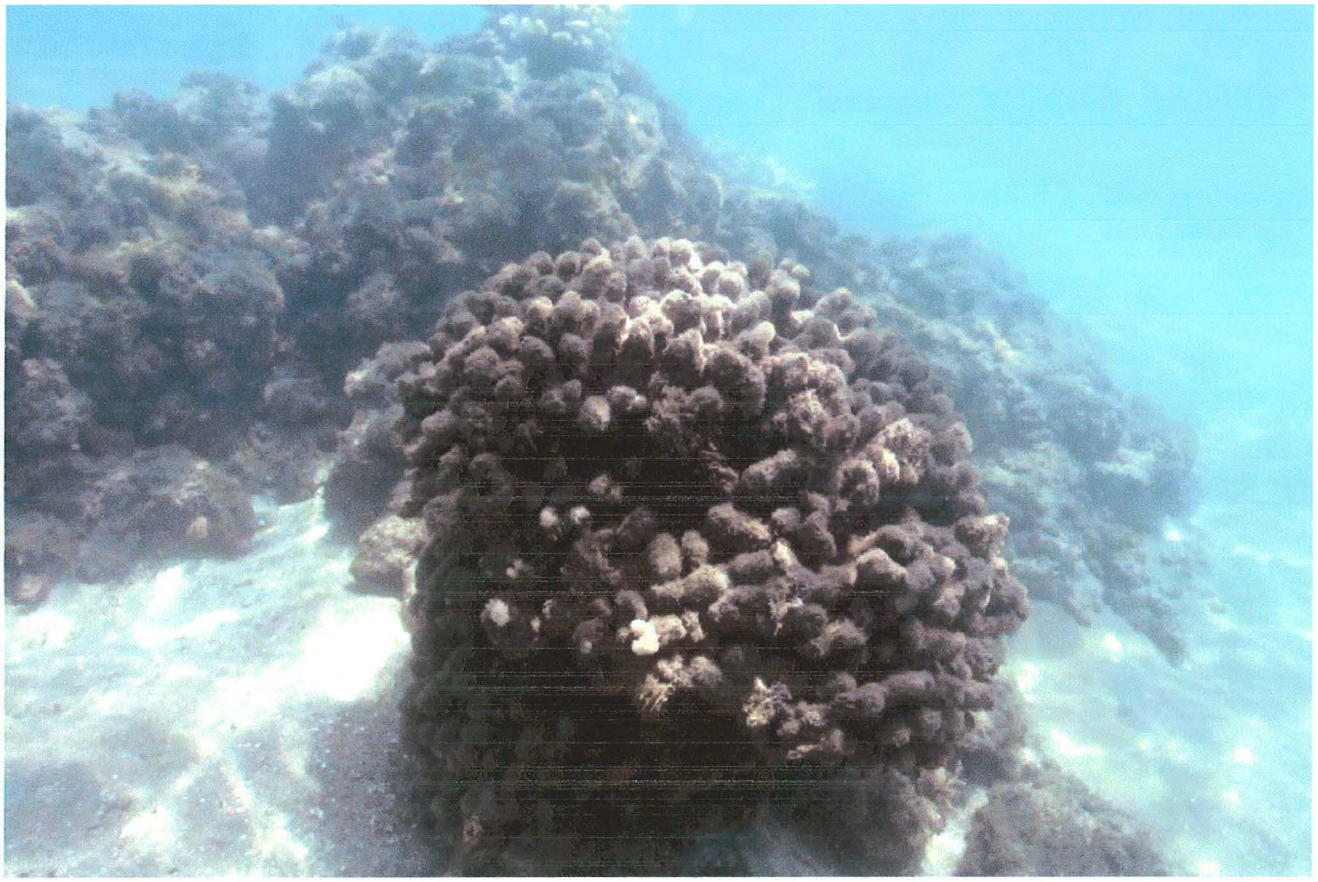
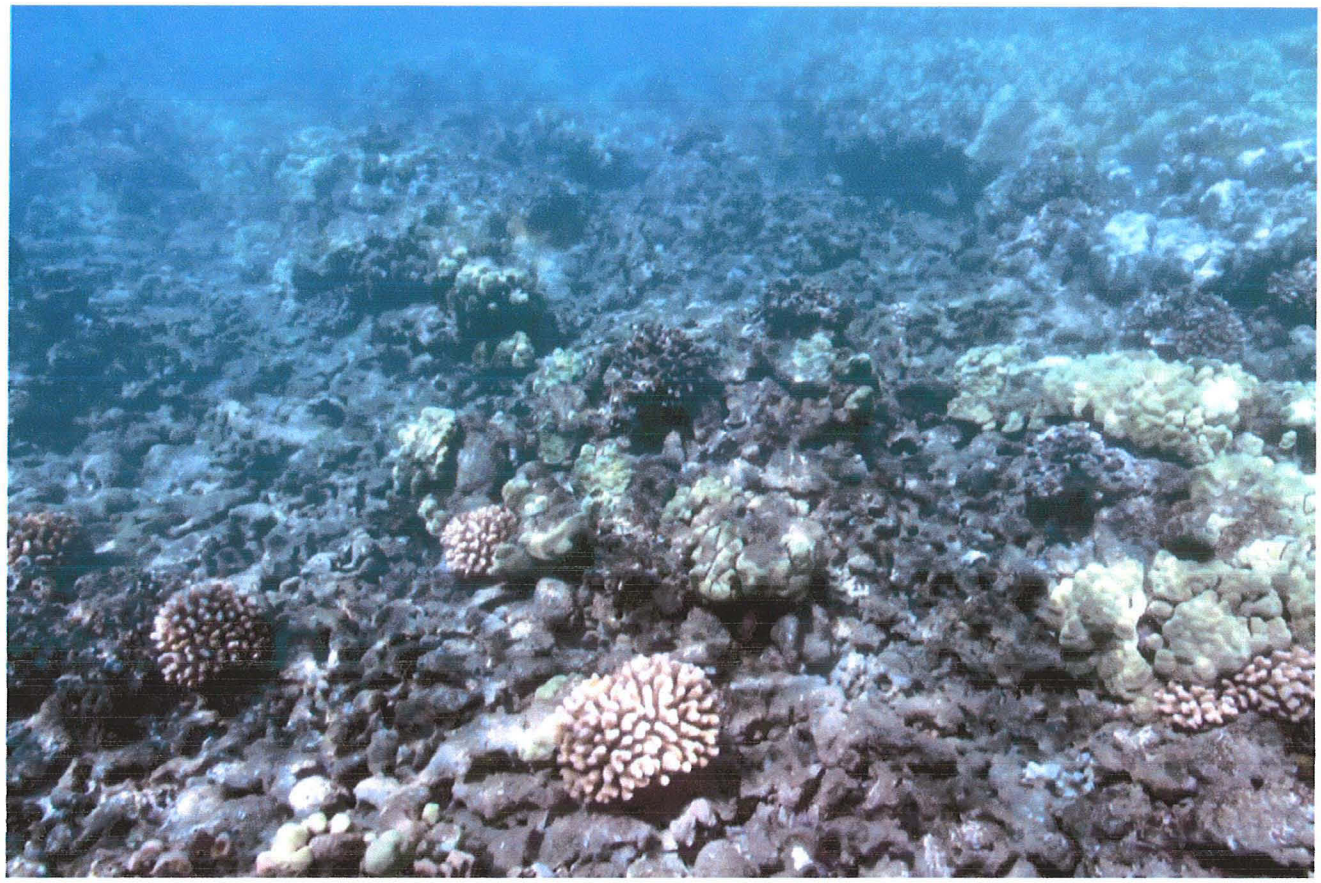


FIGURE 21. Partially dead coral colonies covered with algal turf in southern region of the reef flat off Olowalu (Zone F in Figure 7).



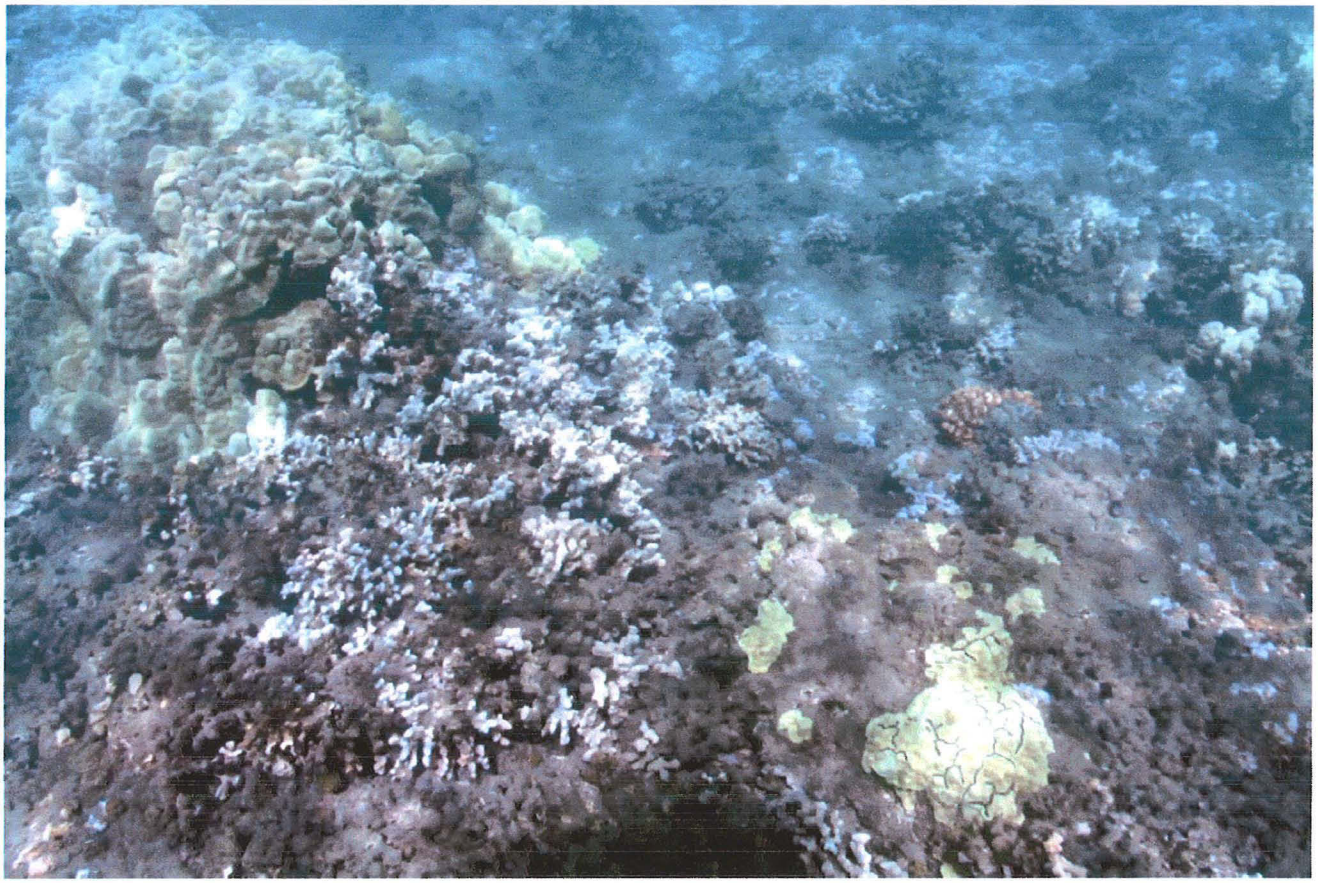


FIGURE 22. Two views of outer reef flat (Zone G in Figure 7). Coral cover is higher than on inner reef flat, although evidence of sediment effects are still visible.

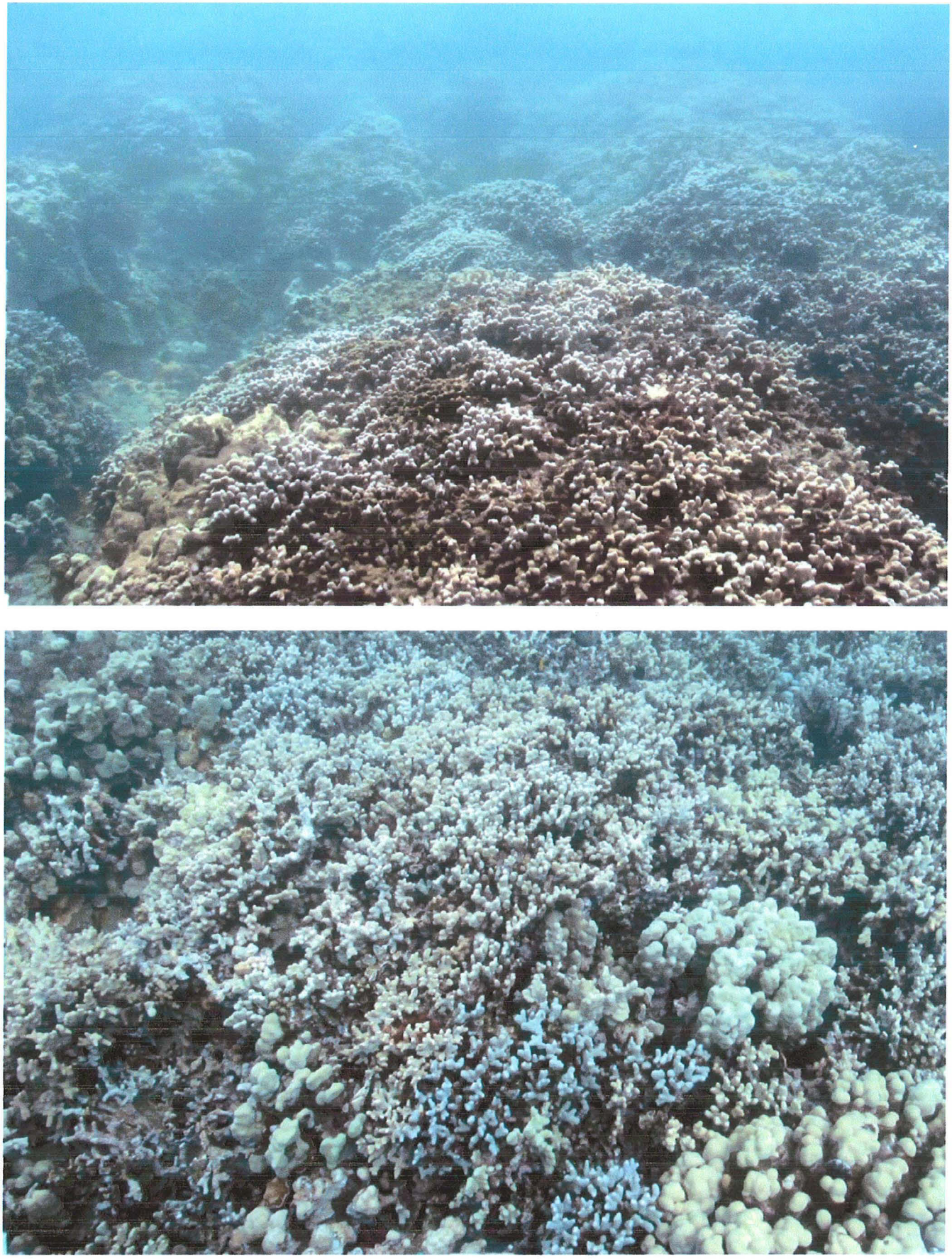
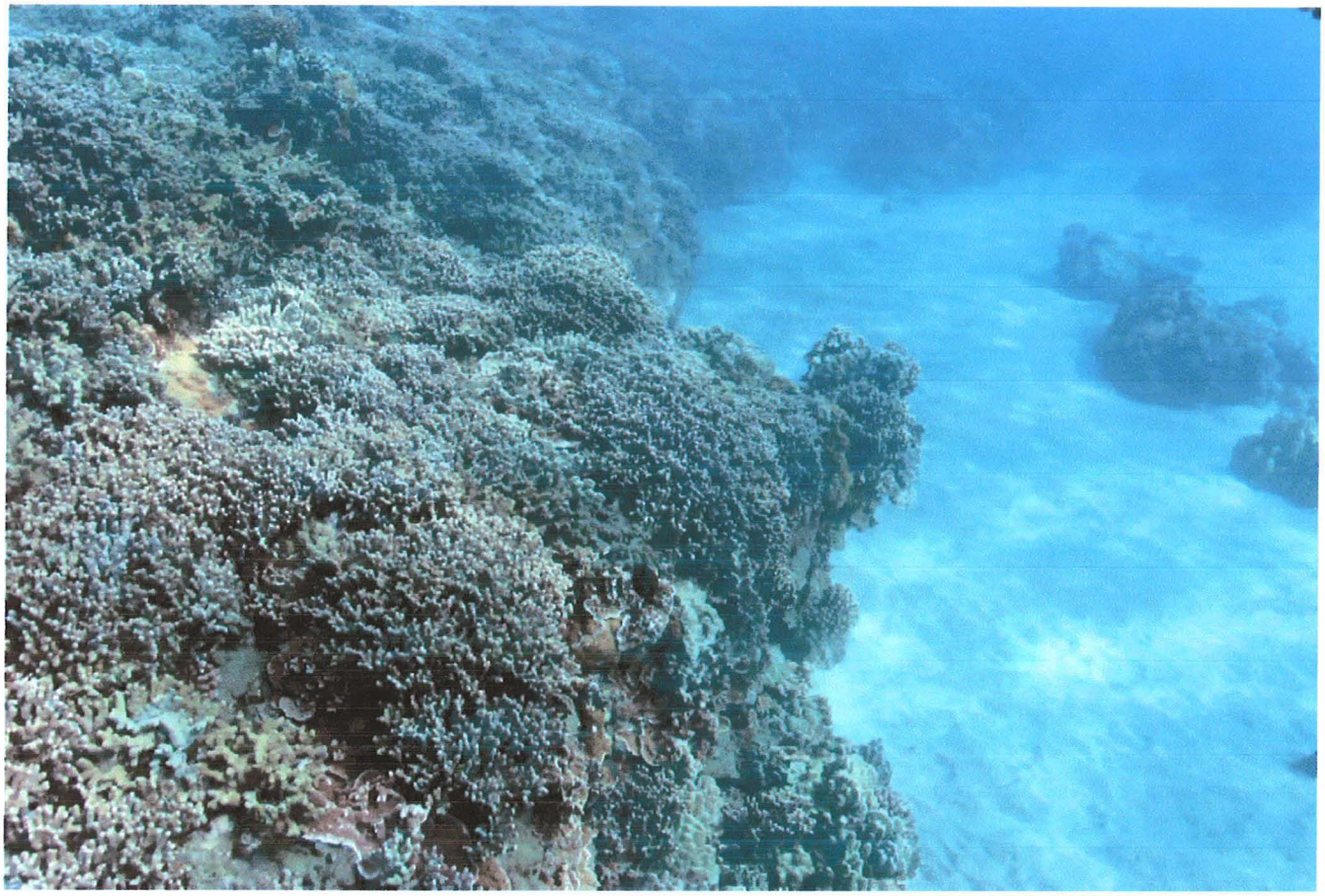


FIGURE 23. Expanses of interconnected mats of finger coral (*Porites compressa*) on the outer reef face at Olowalu (Zone H in Figure 7). Without disturbance from episodic wave stress, these colonies have amalgated over time to form true reefs in the sense that they are accreting limestone. Such accretion is relatively rare in exposed coastal areas of Hawaii.



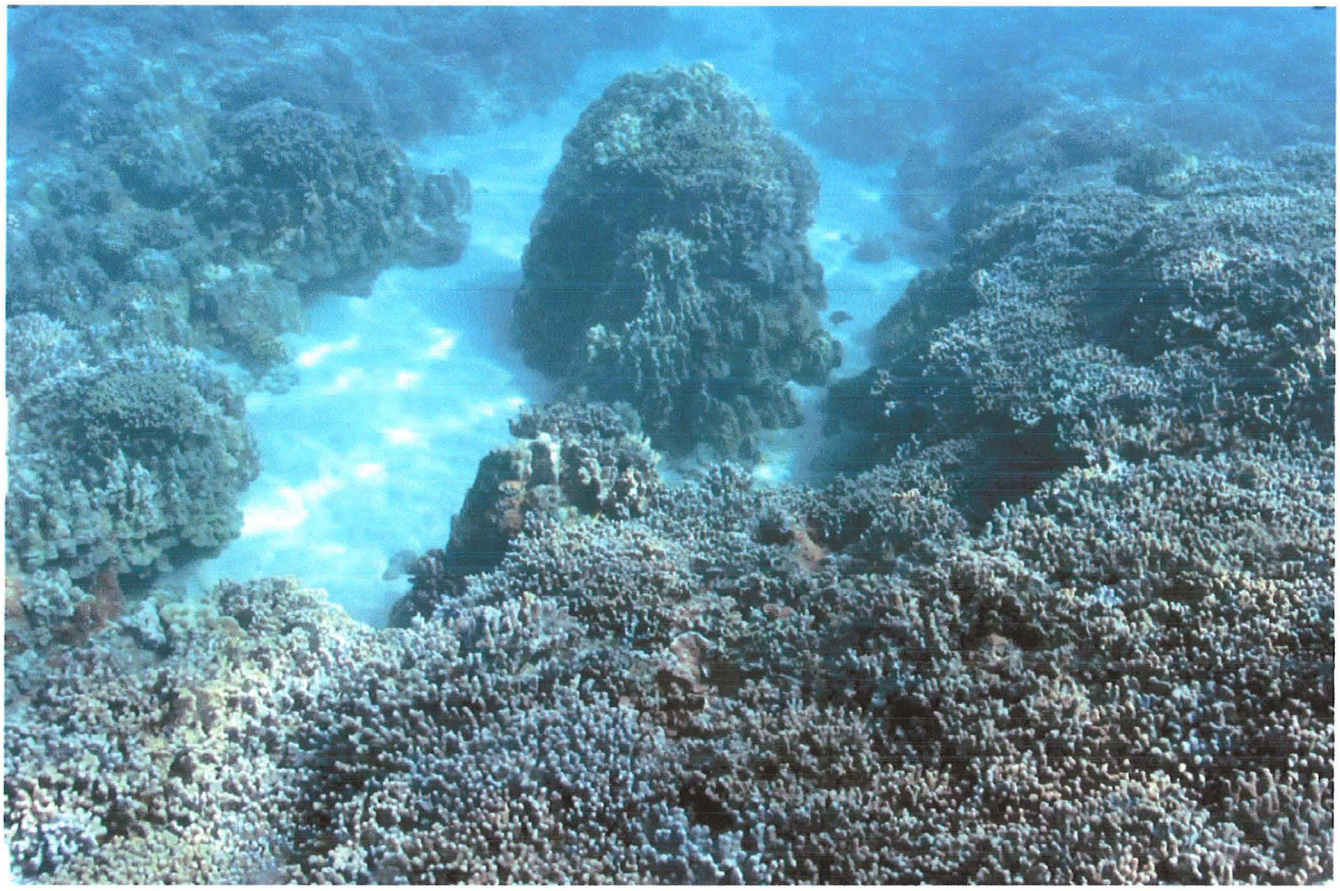


FIGURE 24. Two areas of expansive growth of interconnected mats of finger coral (*Porites compressa*) at the outer edge of the reef face off Olowalu Point (Zone H in Figure 7). The seaward edge of the reef in the top photo drops to a bed of sand that extends seaward.

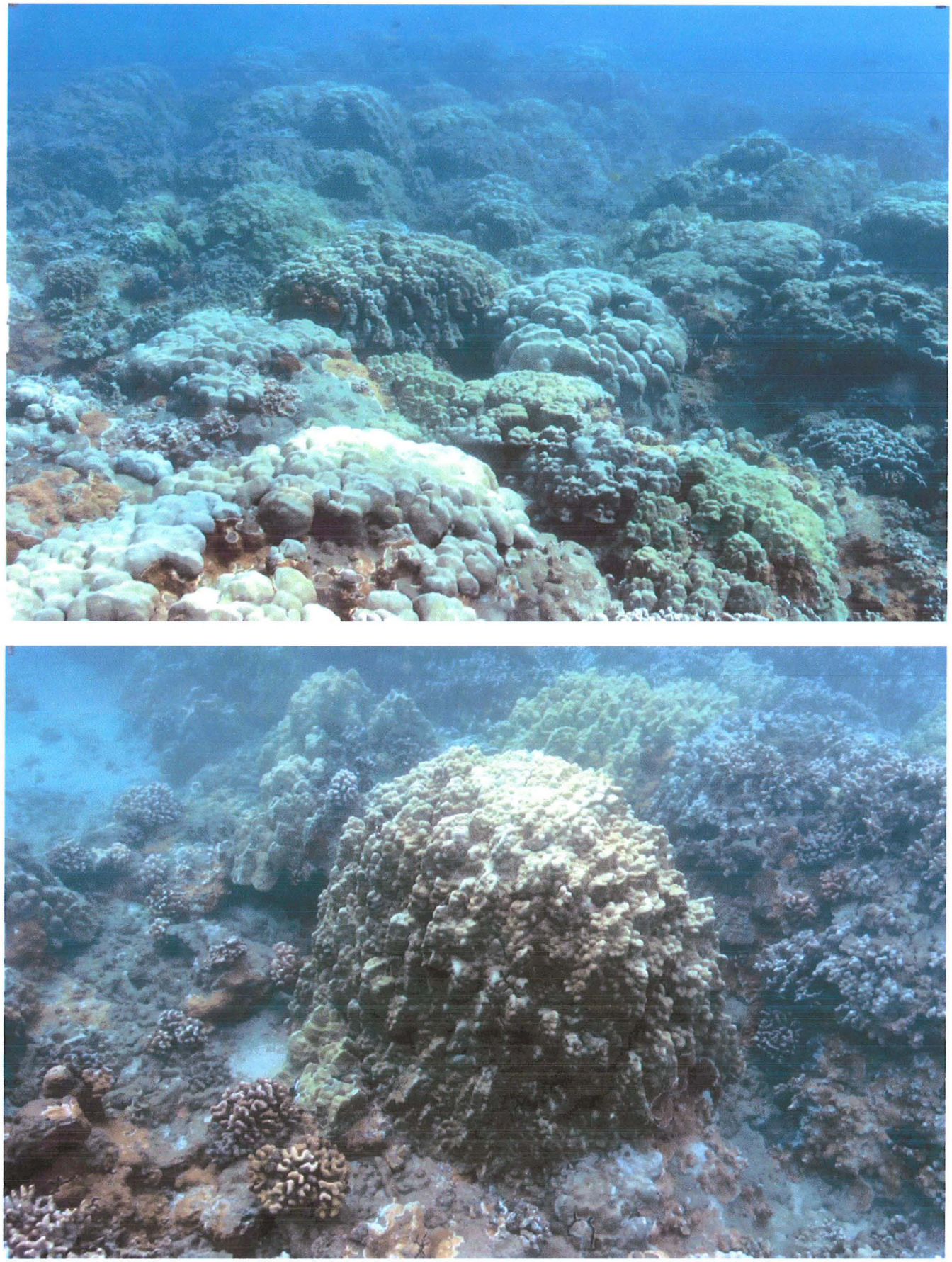


FIGURE 25. Two views of *Porites lobata* community structure in outer reef face zone at Olowalu (Zone H in Figure 7). Upper photo shows area where numerous colonies have essentially fused into a massive "super-colony." Lower photo shows a solitary colony approximately 2 meters in height.

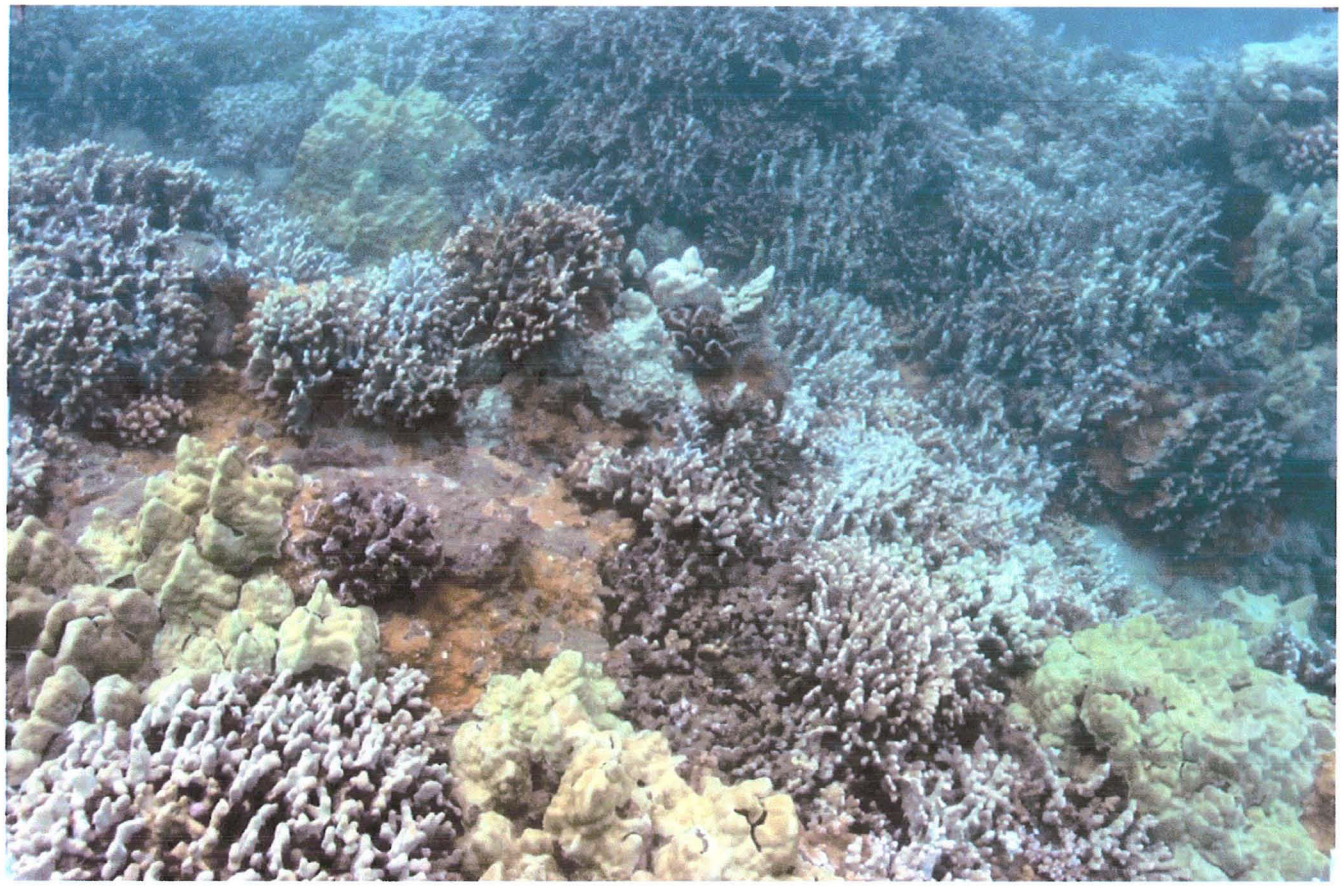


FIGURE 26. Outer reef face coral communities off Olowalu Point. Elevated accreting formations above the level of sand channels. Extensive coral growth covers essentially all of the hard substratum in the area.

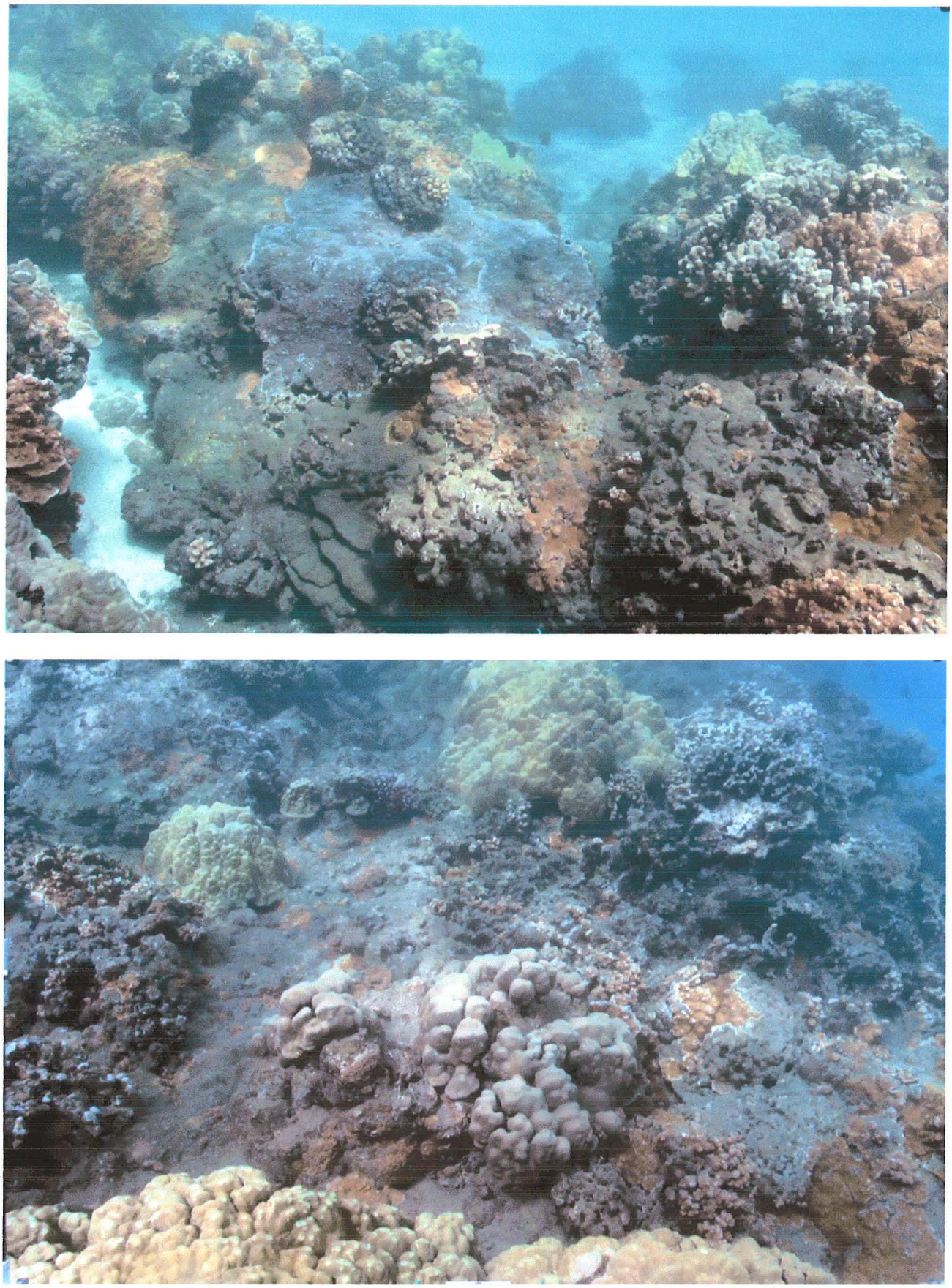
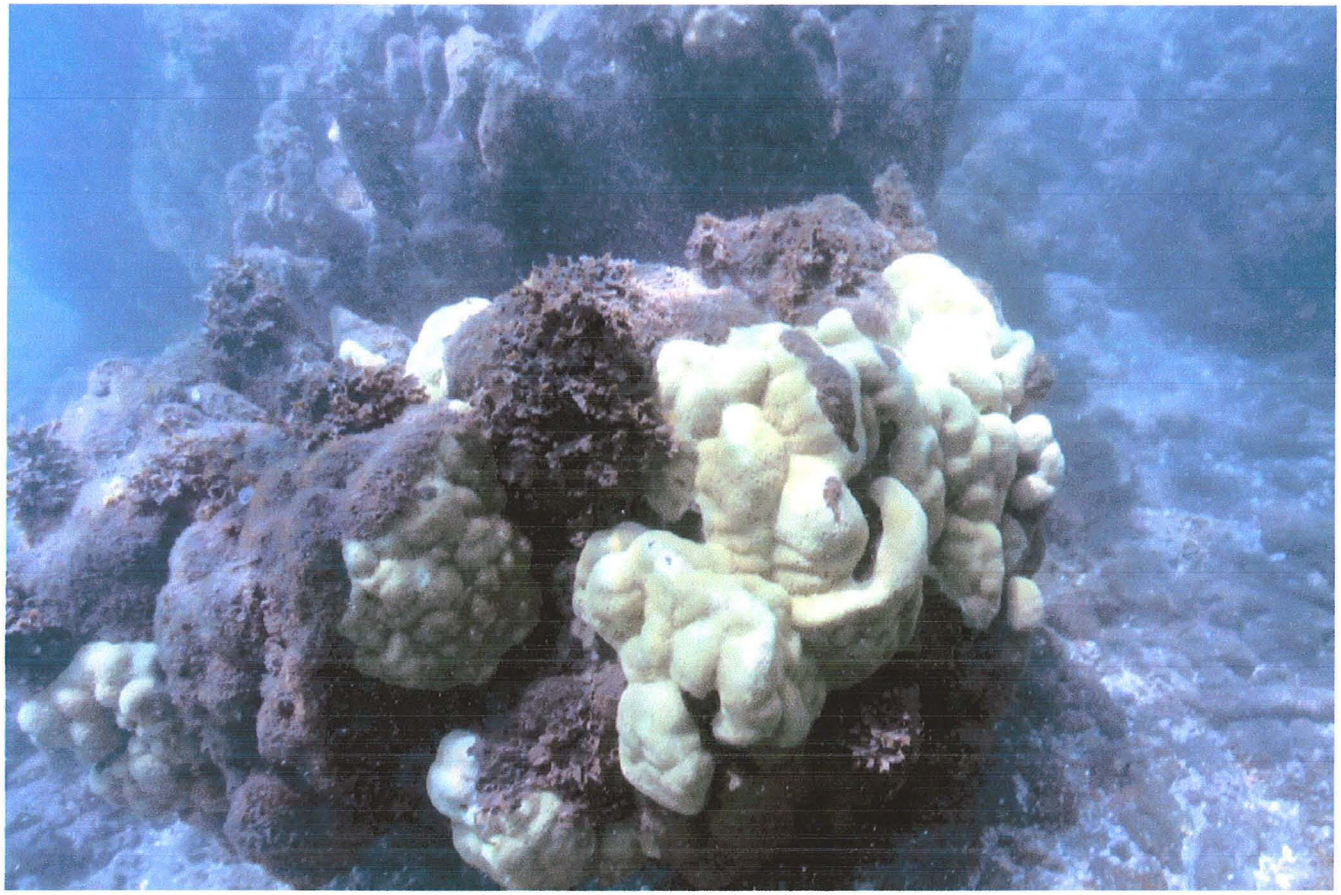


FIGURE 27. Reef surface off southern end of Olowalu Town project site, at dive site known as 14-Mile Marker (Zone I in Figure 7). Note substantial areas of the reef surface where coral is dead and covered with a layer of sediment.



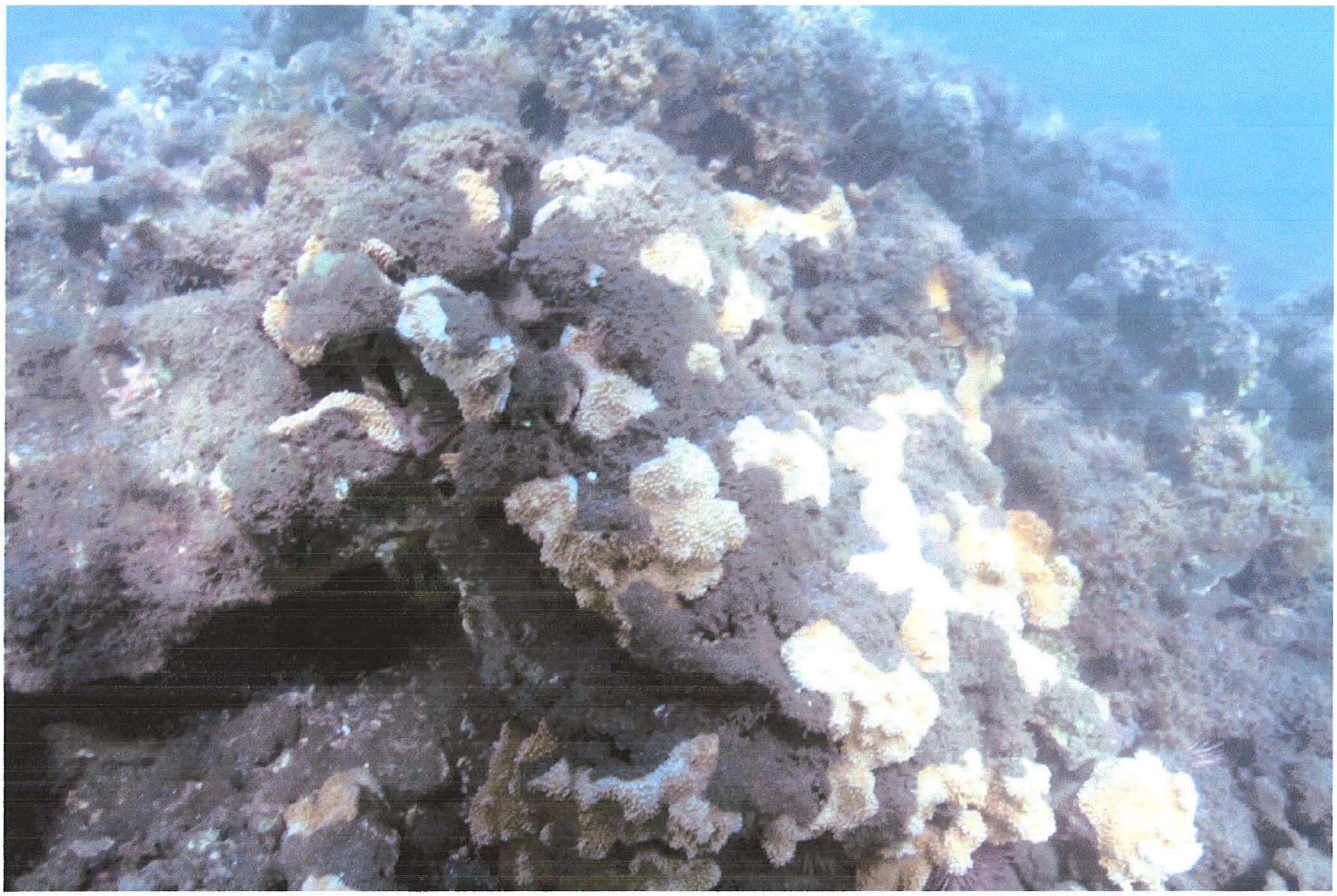


FIGURE 28. Partially dead and sediment covered corals at 14-Mile dive site at southern end of Olowalu (Zone I in Figure 7).

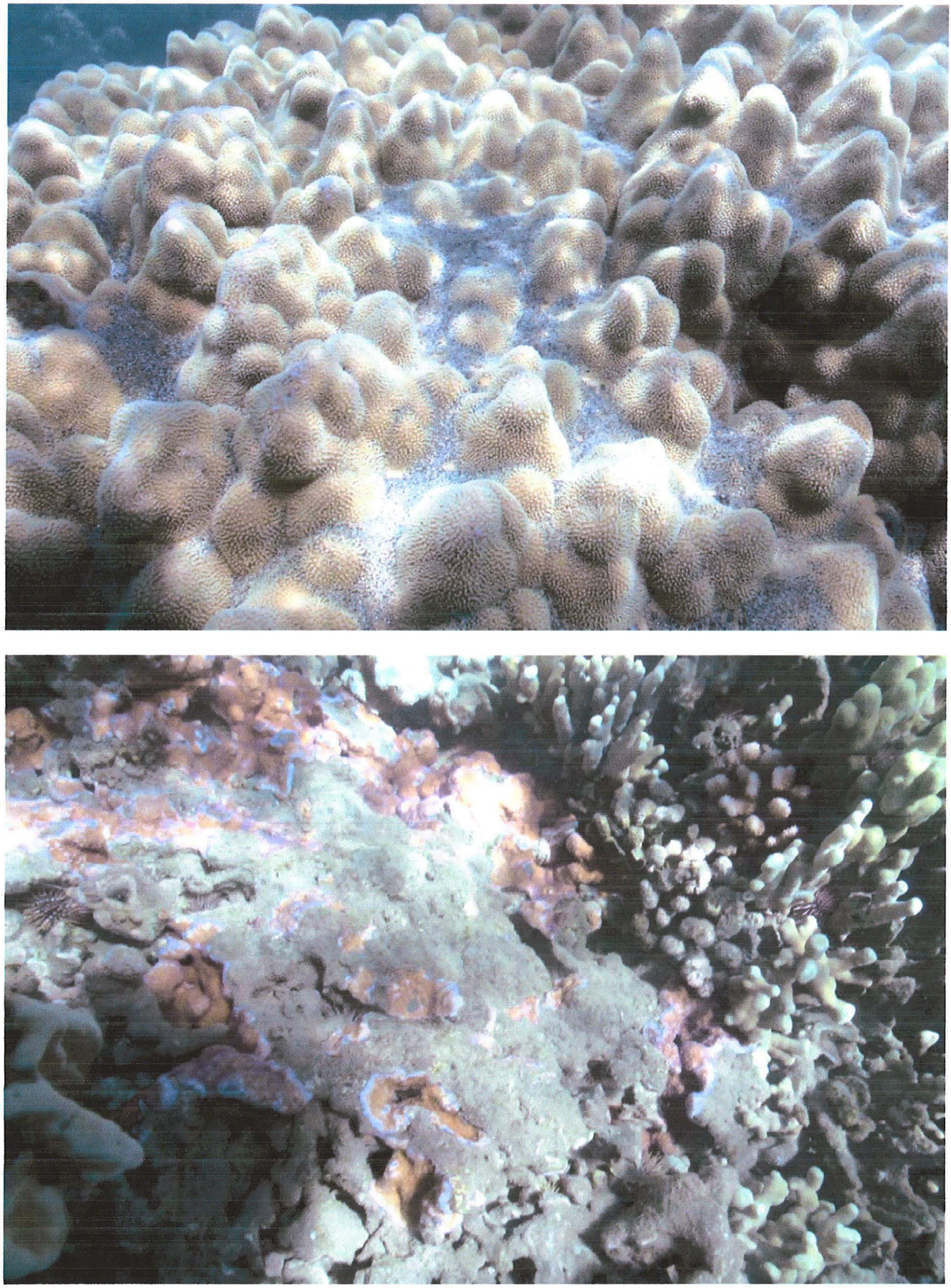


FIGURE 29. Upper photos shows deposition of marine sand on living surface of colony of *Porites* sp. at 14-Mile Marker area. Inspection of the areas under the sand revealed areas of stressed tissue. Lower photo shows colony of *Montipora* sp. with significant portions of the colony dead, likely from 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

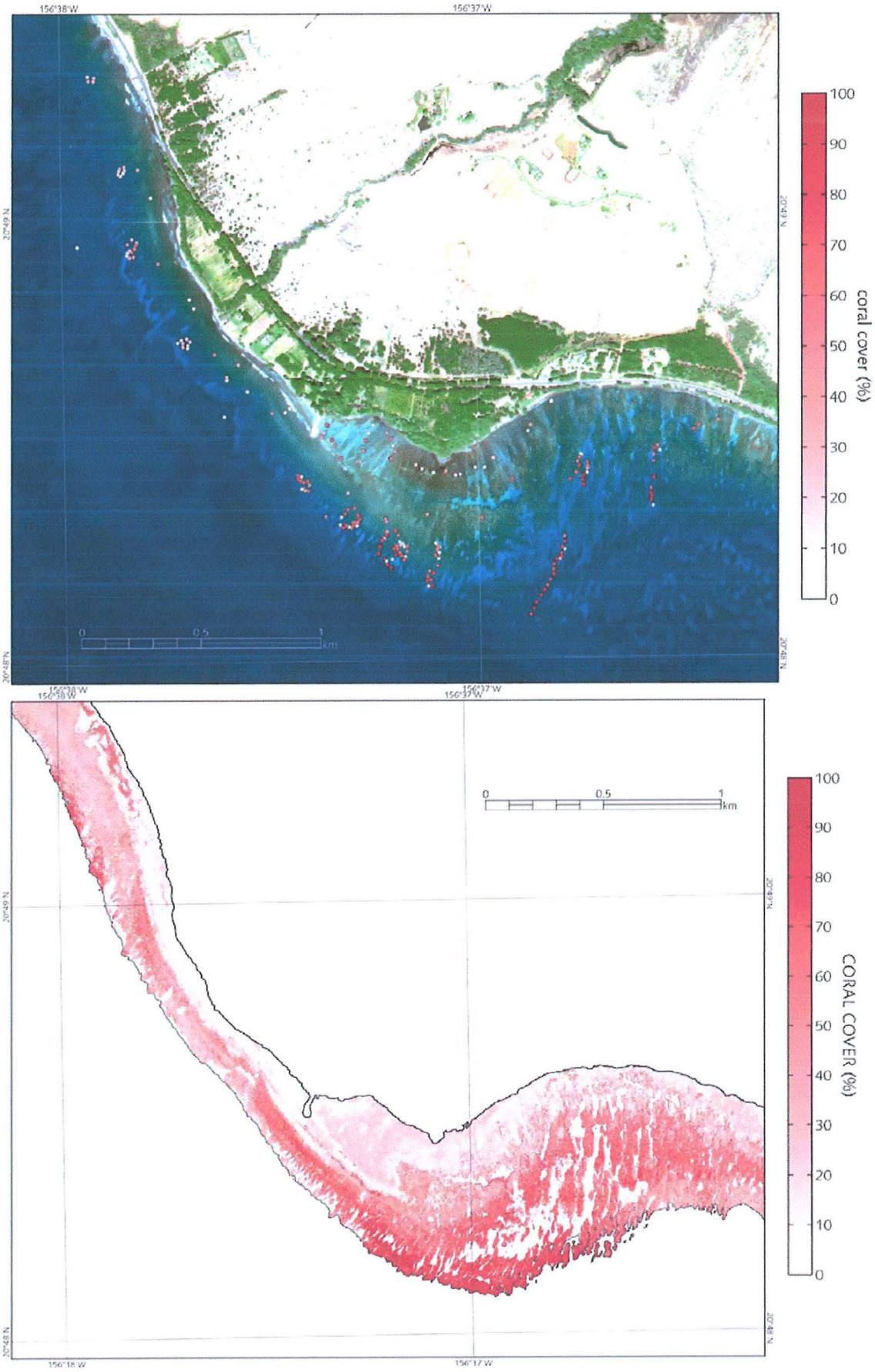


FIGURE 30. Satellite image showing coral cover at Olowalu with cal/val sites color-coded to indicate intensity of cover (top). Map of coral cover created from cal/val data (bottom).

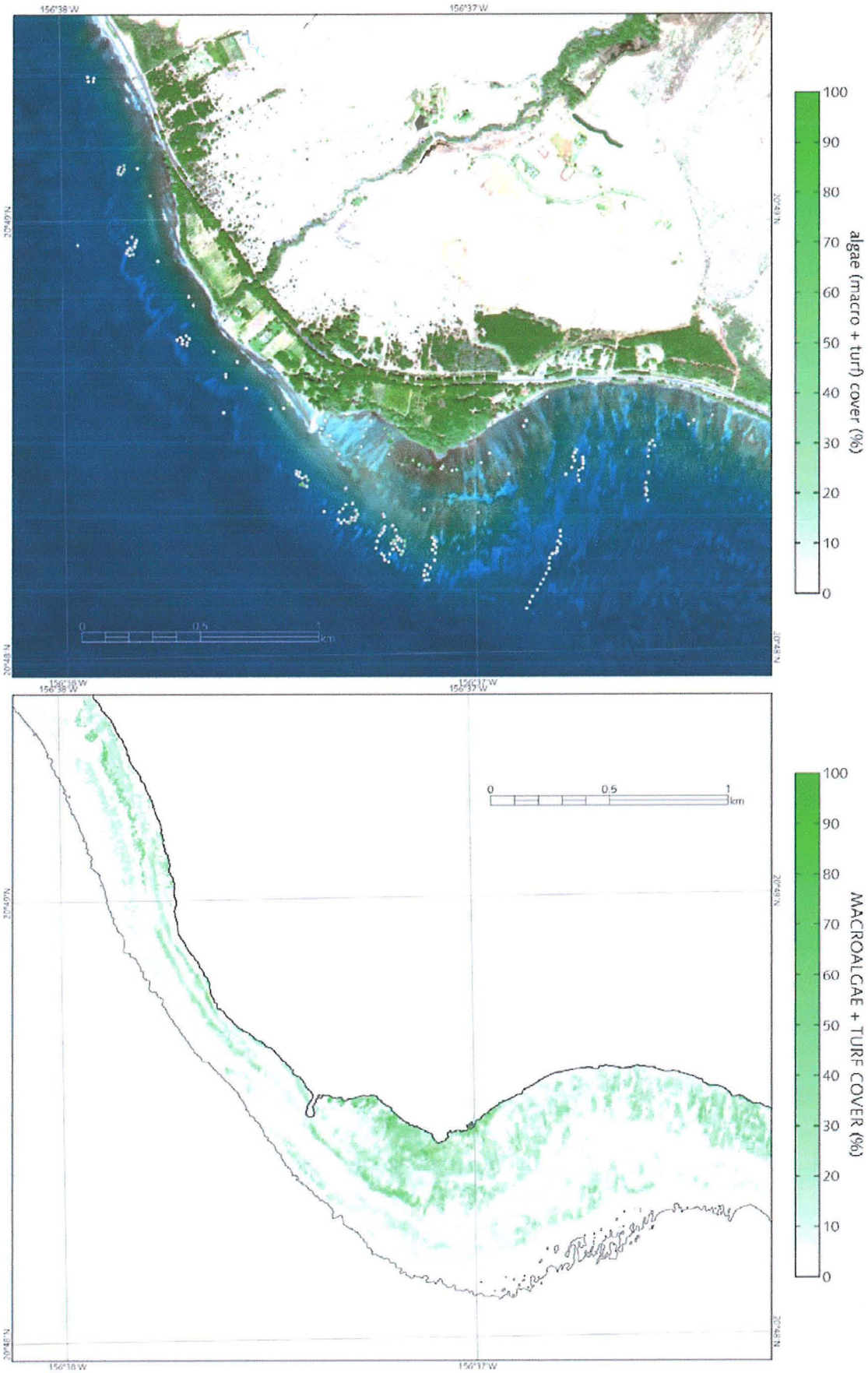


FIGURE 31. Satellite image showing algal cover at Olowalu with cal/val sites color-coded to indicate intensity of cover (top). Map of algal cover created from cal/val data (bottom).

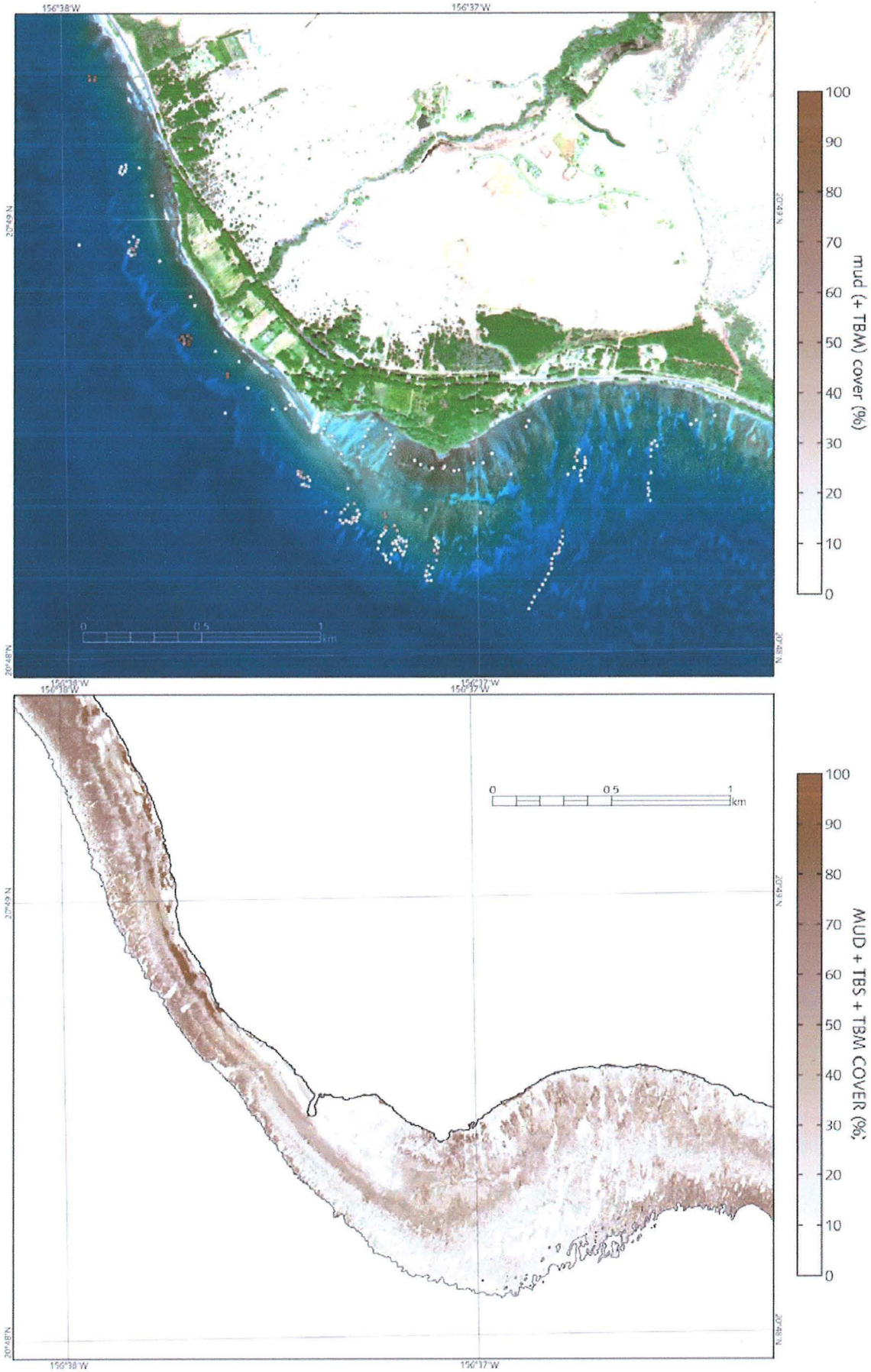


FIGURE 32. Satellite image showing mud and sediment cover at Olowalu with cal/val sites color-coded to indicate intensity of cover (top). Map of mud and sediment cover created from cal/val data (bottom).

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
$0 < x \leq 10$	235	390	400	250
$10 < x \leq 30$	476	153	136	449
$30 < x \leq 50$	234	53	159	385
$50 < x \leq 70$	257	78	36	160
$70 < x \leq 90$	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

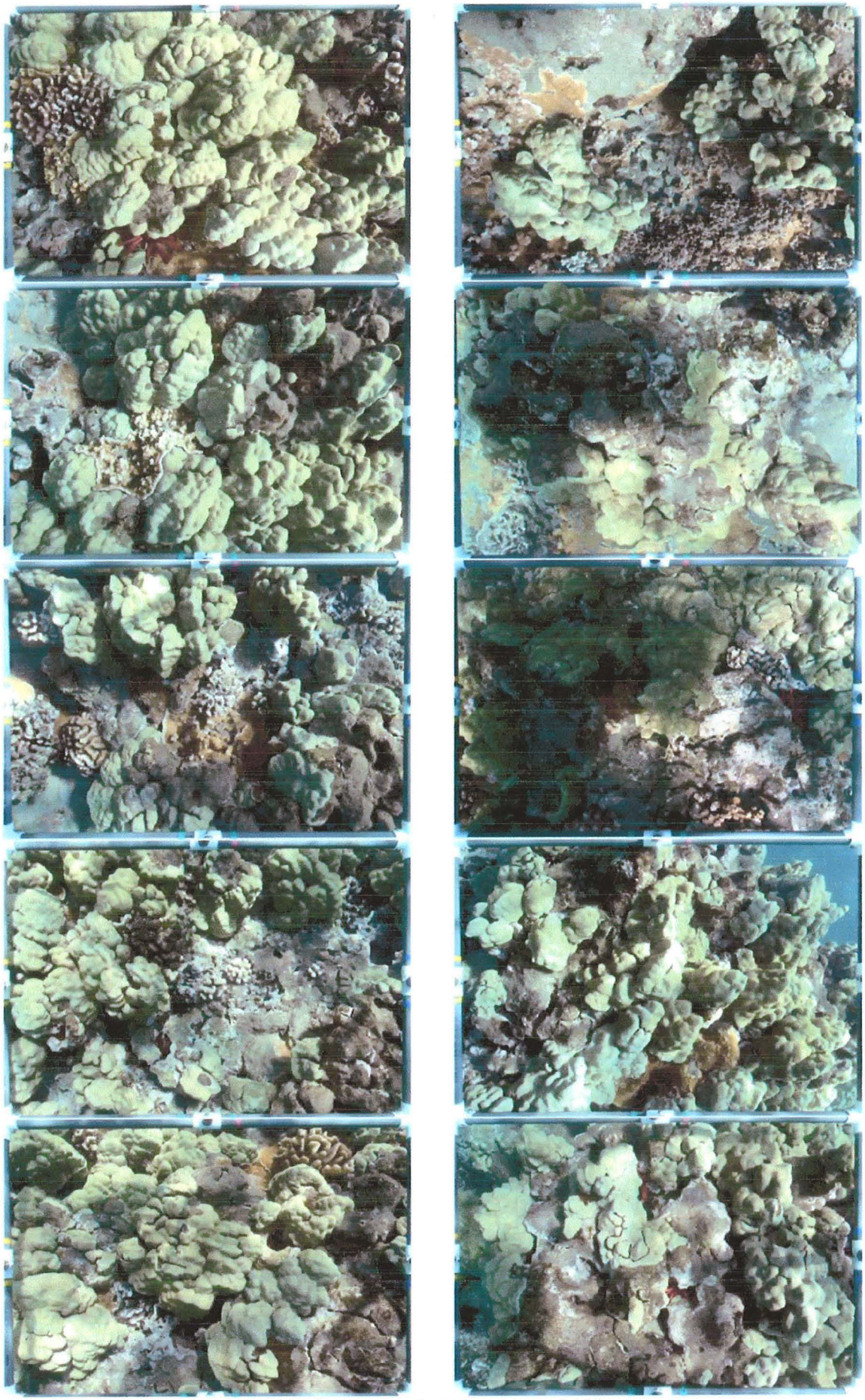
Transect Site ID	590	610	615	964	980	991	84	95
Depth (feet)	30	25	27	24	29	27	25	30
Sample Date:	11/15/10	11/15/10	11/15/10	2/27/11	2/27/11	2/27/11	2/27/11	2/27/11
FAMILY								
Species								
CIRRHITIDAE								
Paracirrhites arcatus	8	3	2	1		2		1
P. forsteri				2				
MULLIDAE								
Parupeneus multifasciatus	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 fasciolatus	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.

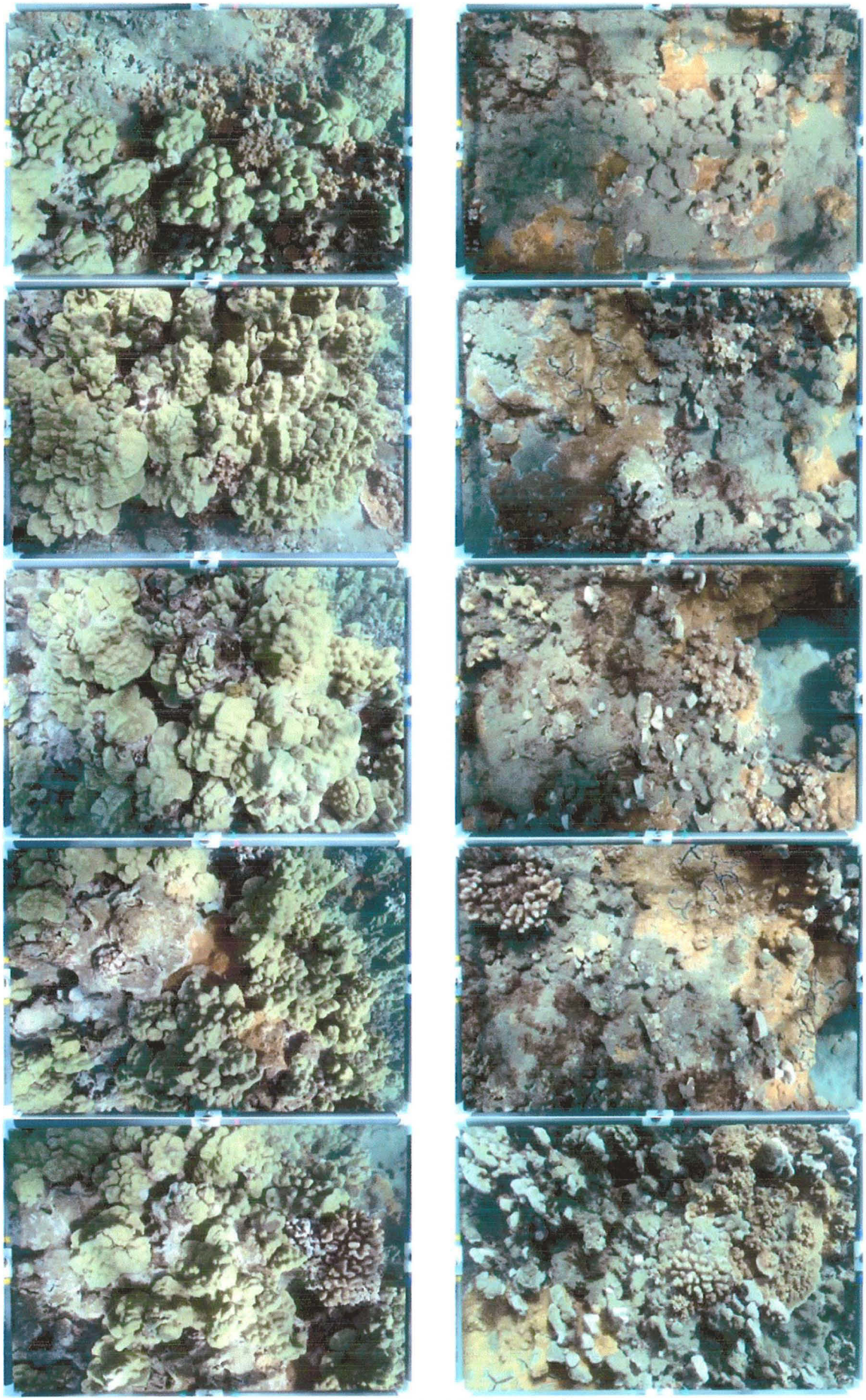
Photoquadrats

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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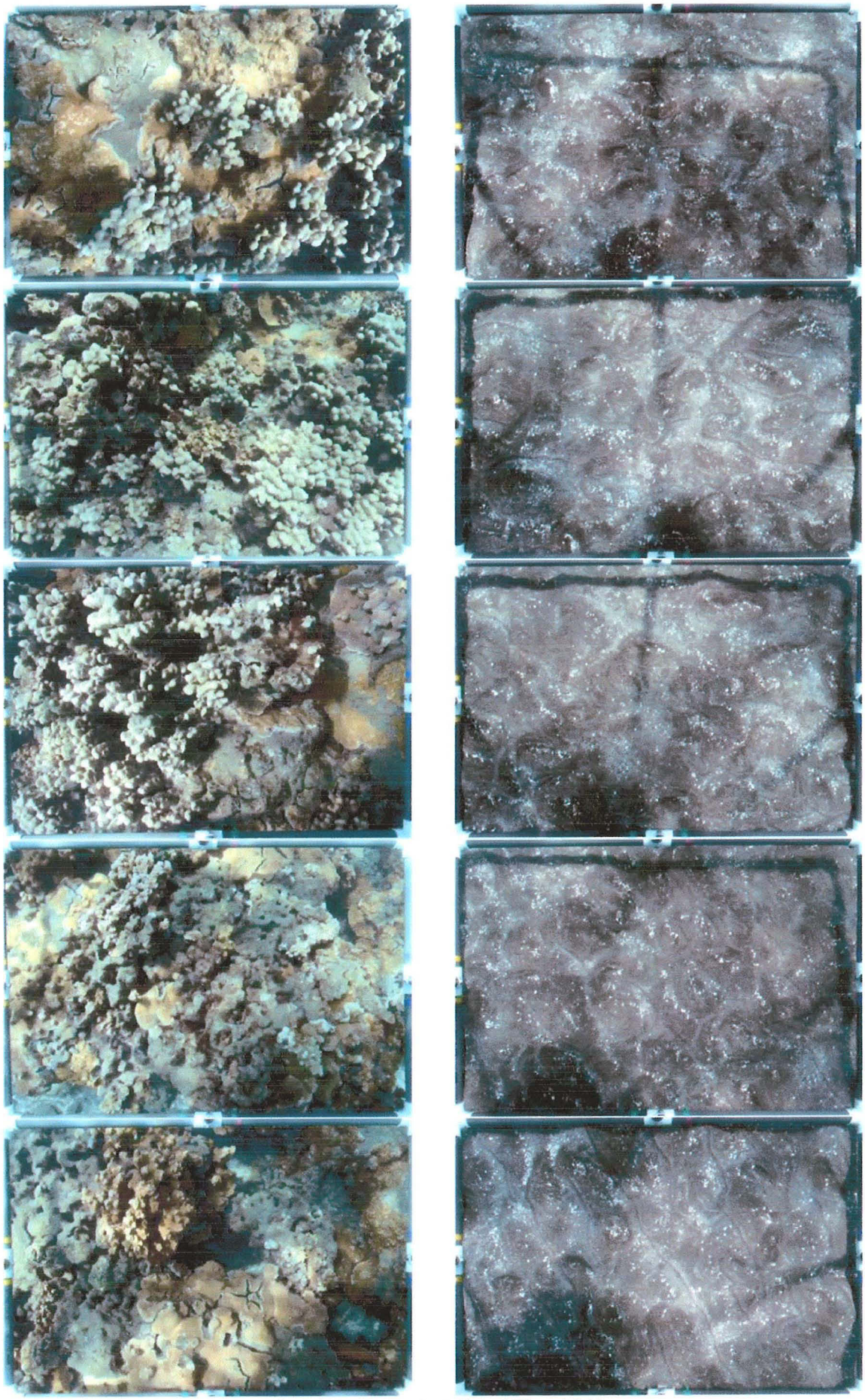

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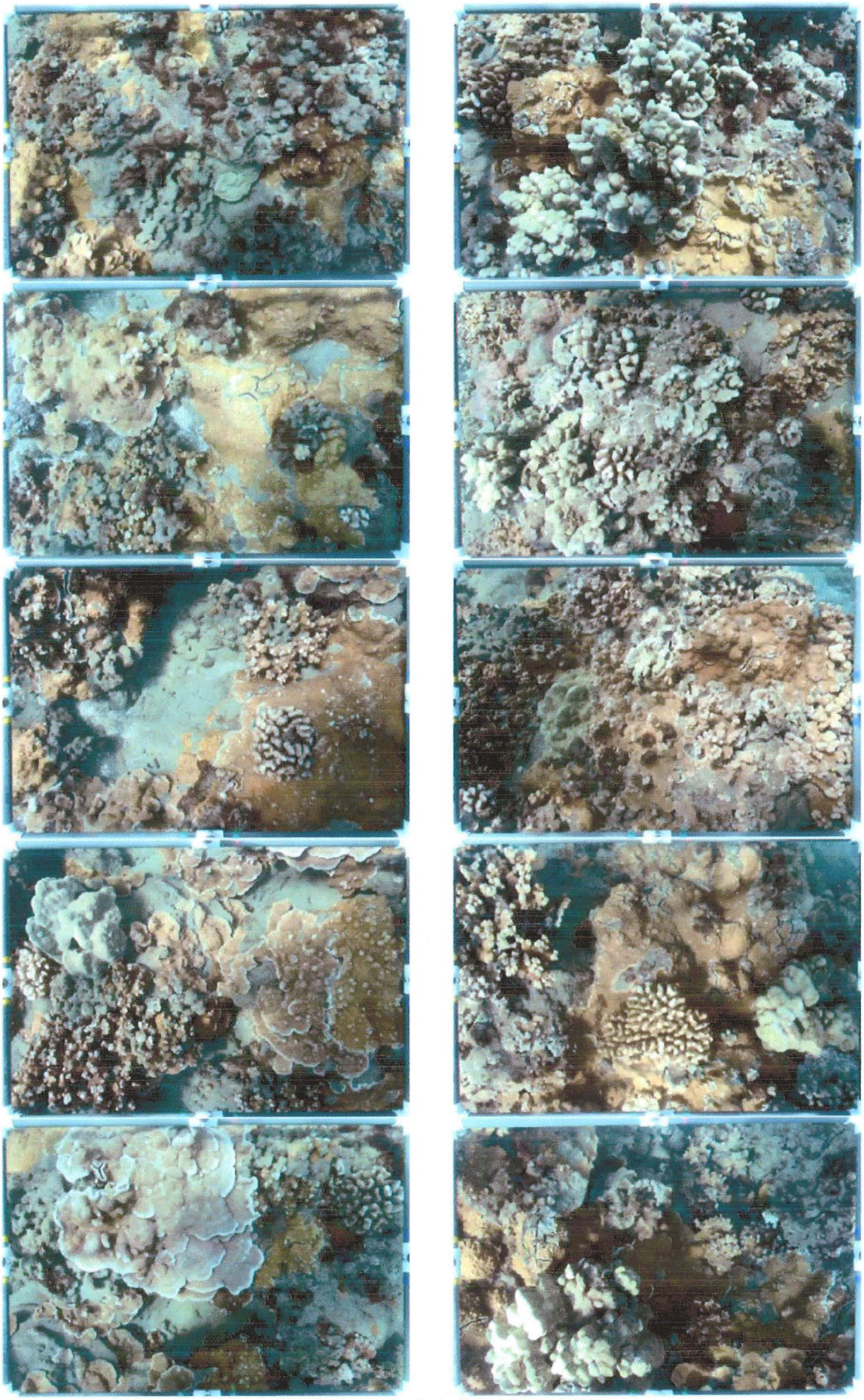

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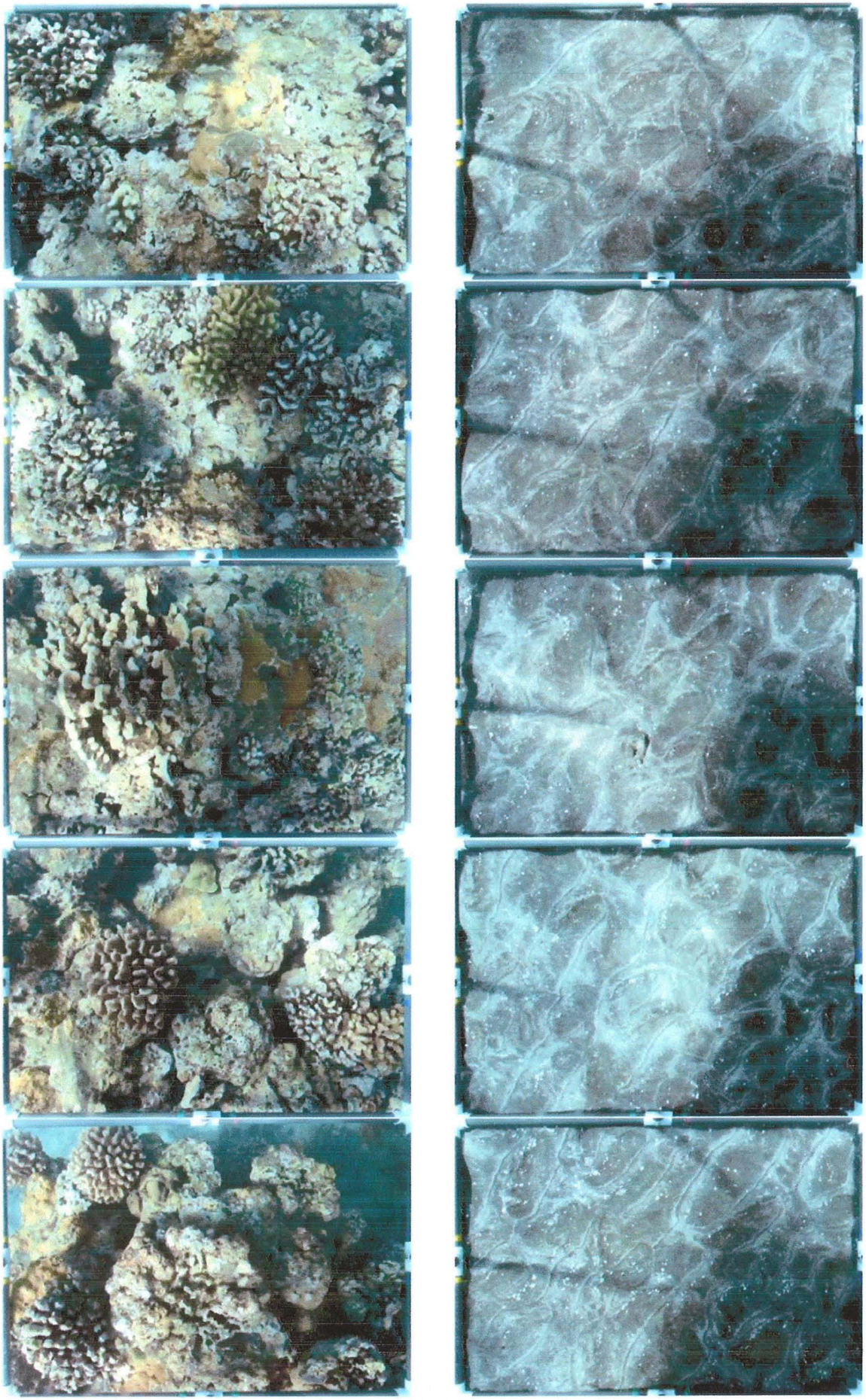

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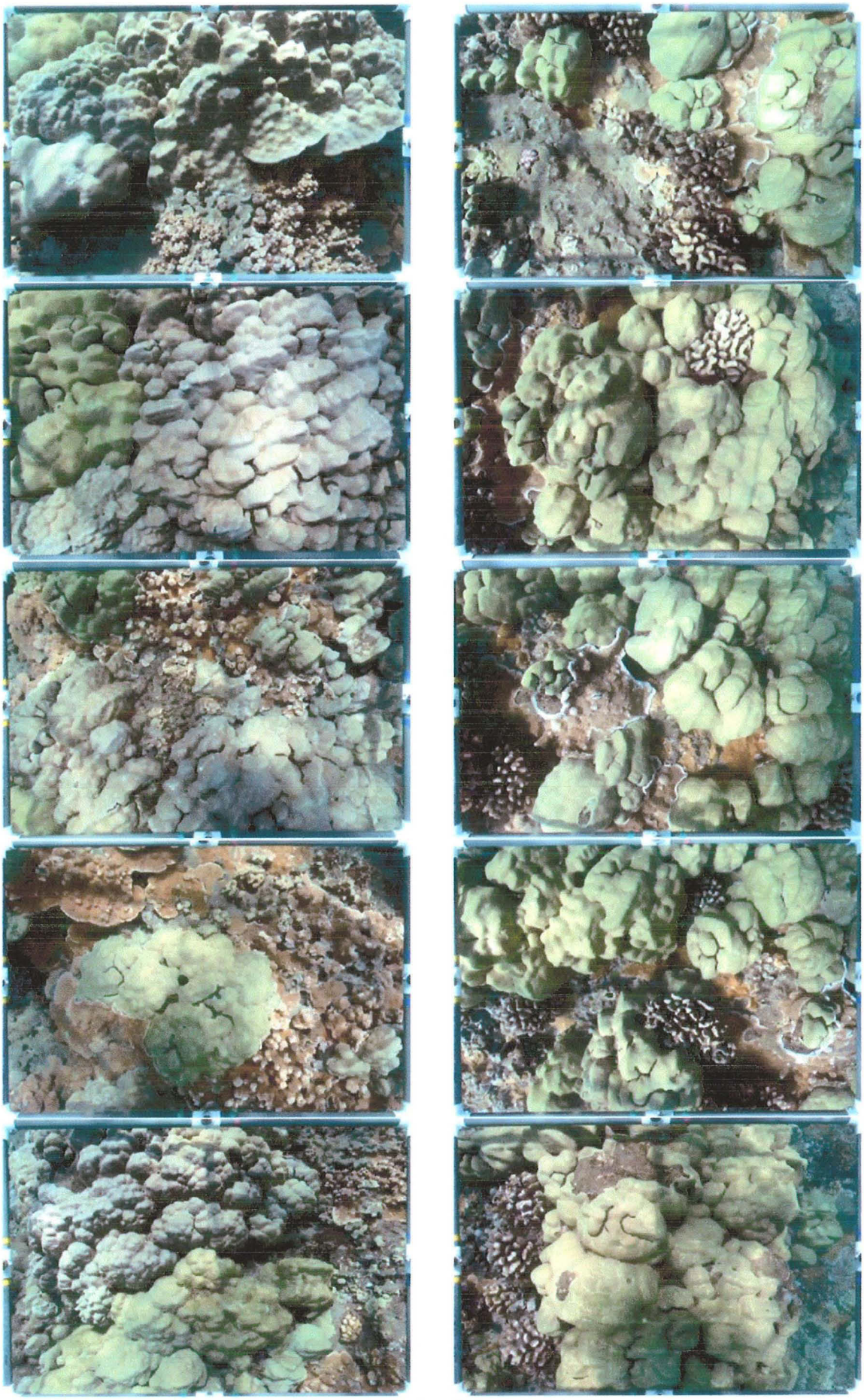

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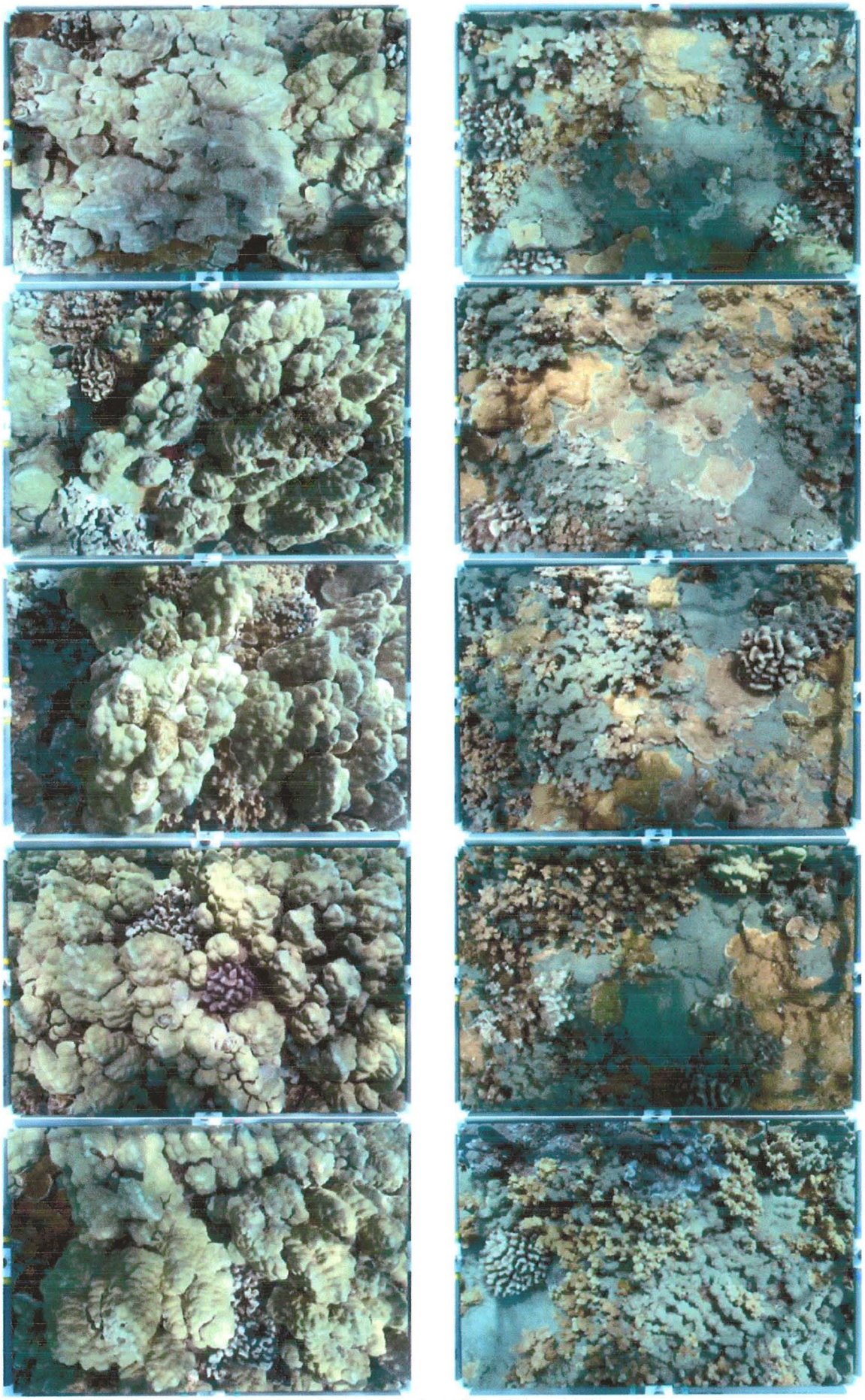

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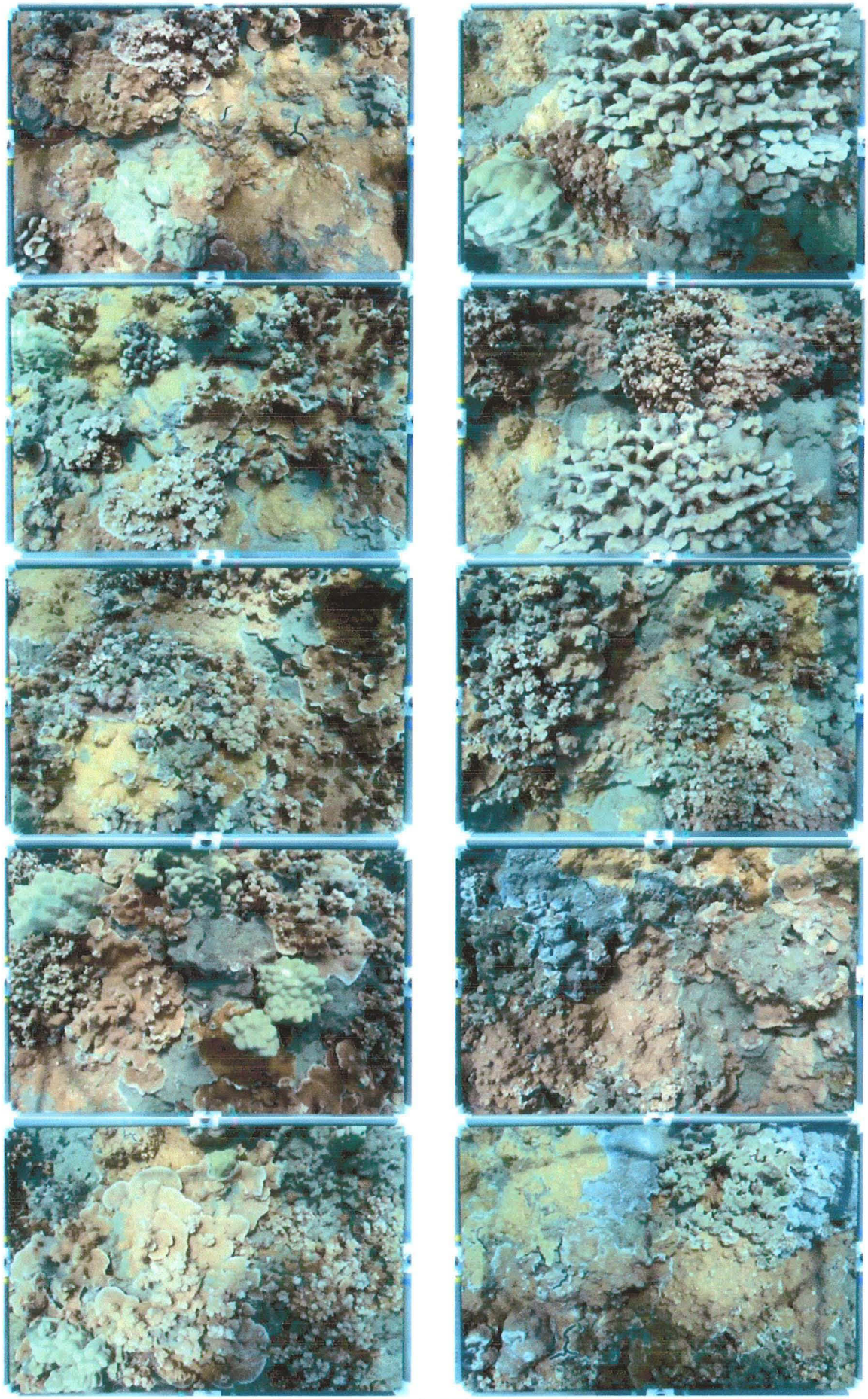

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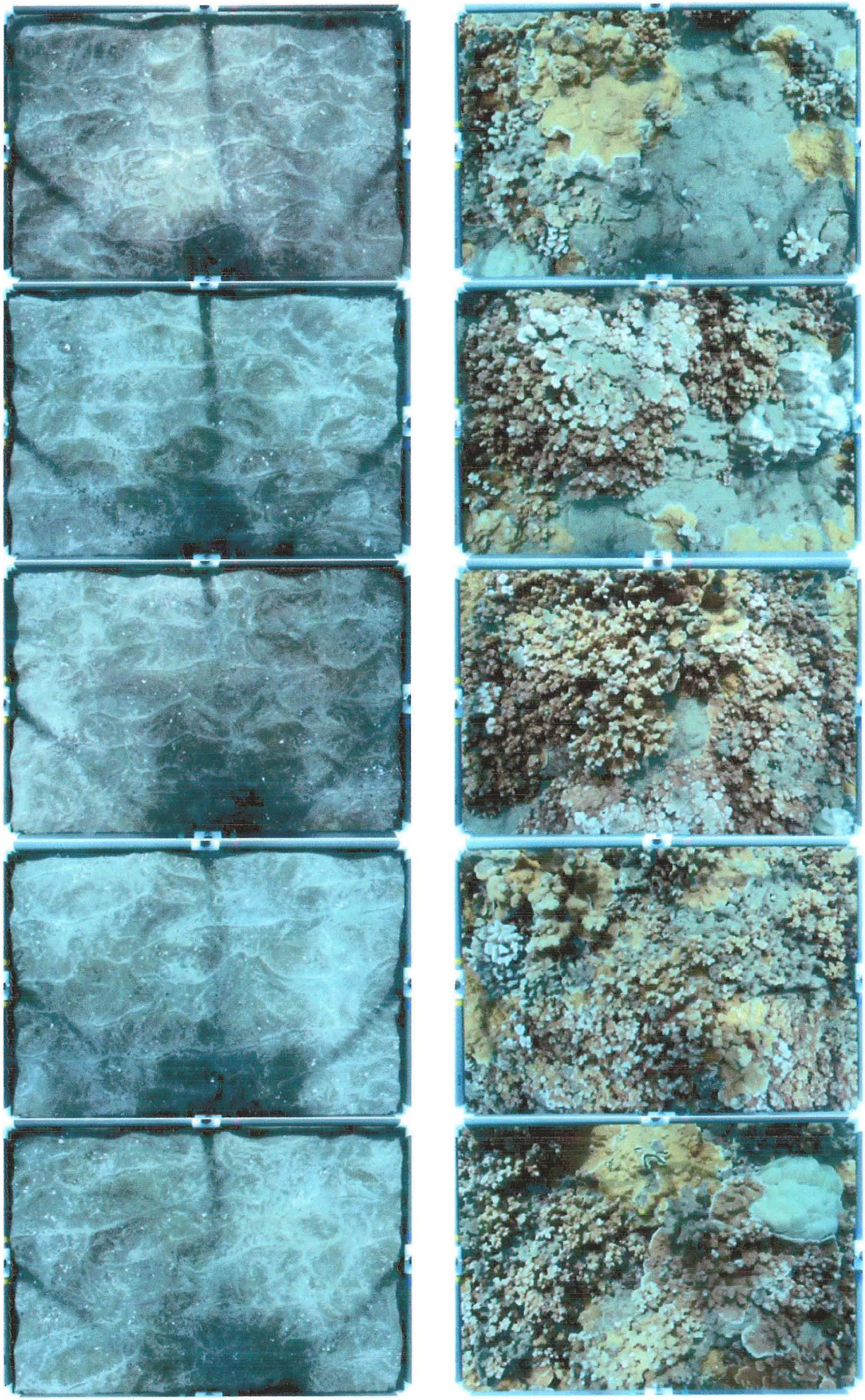

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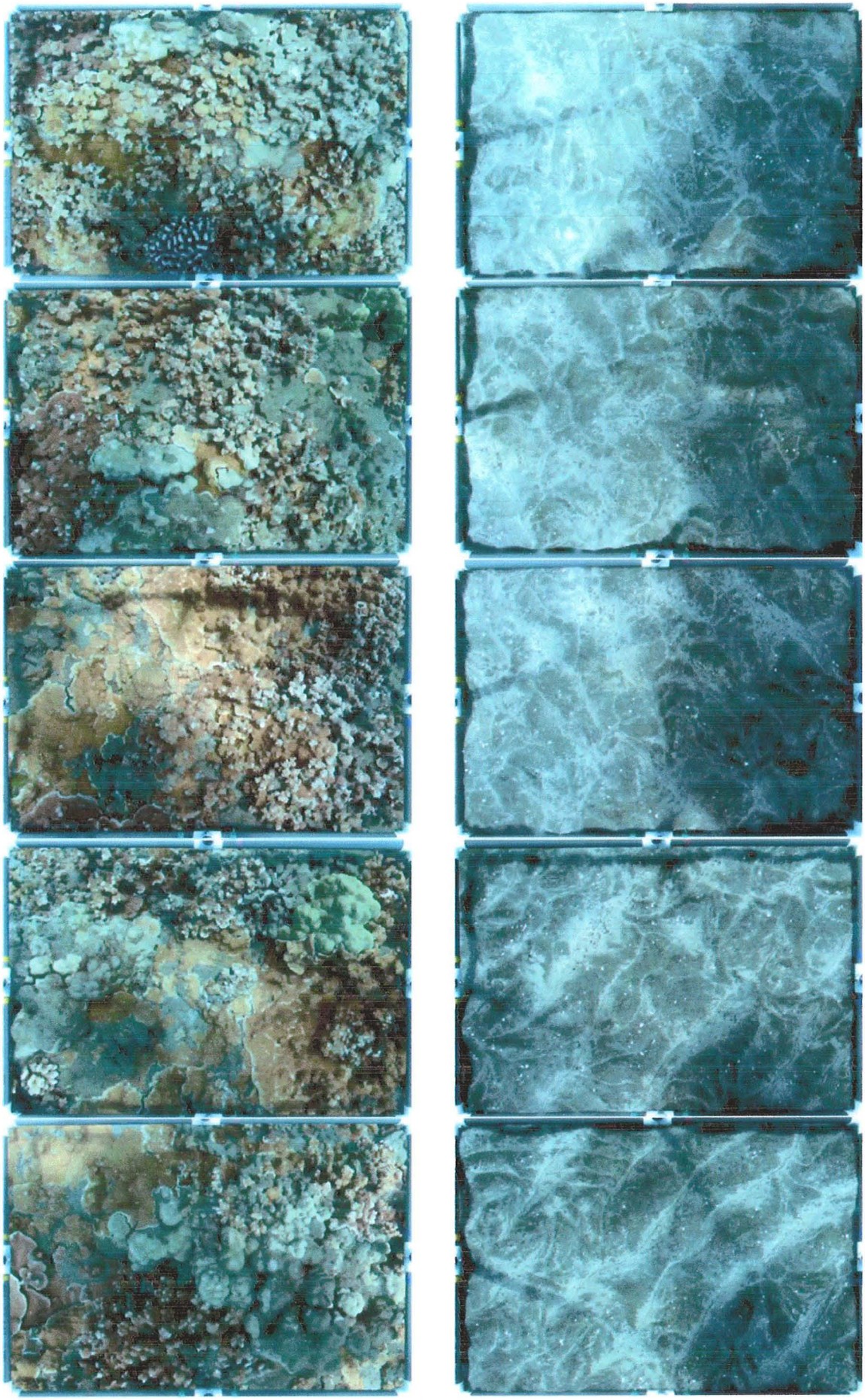

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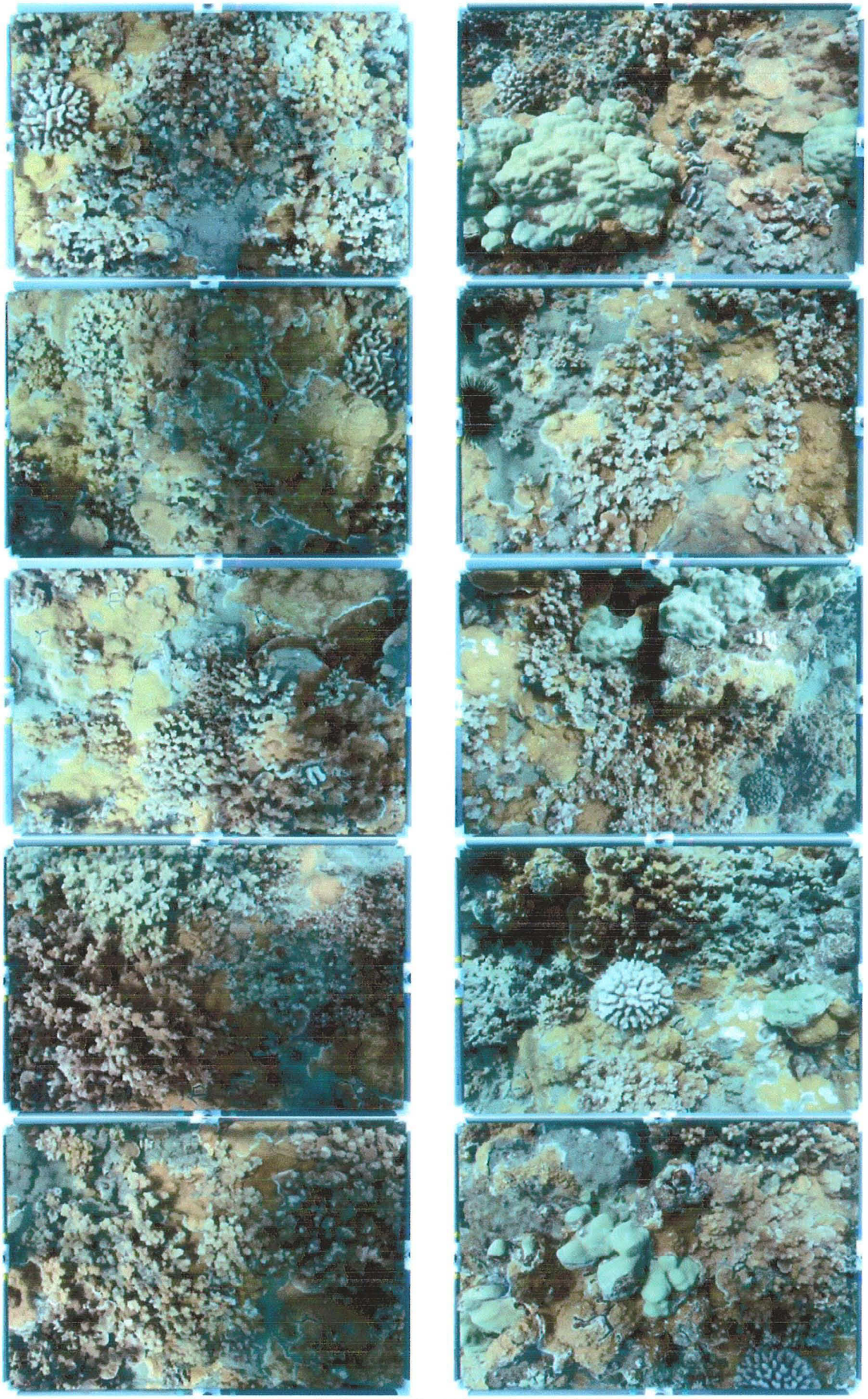

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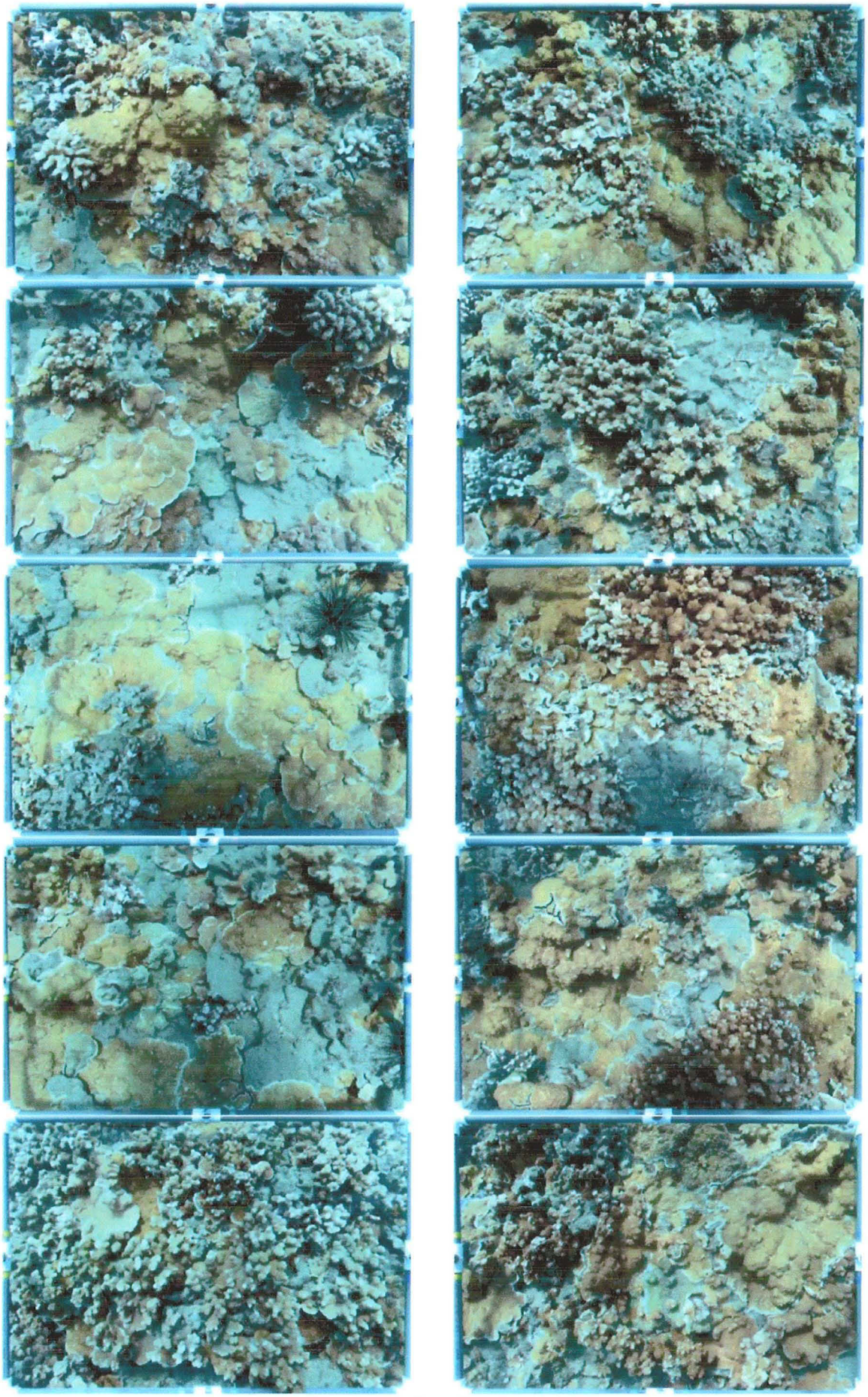

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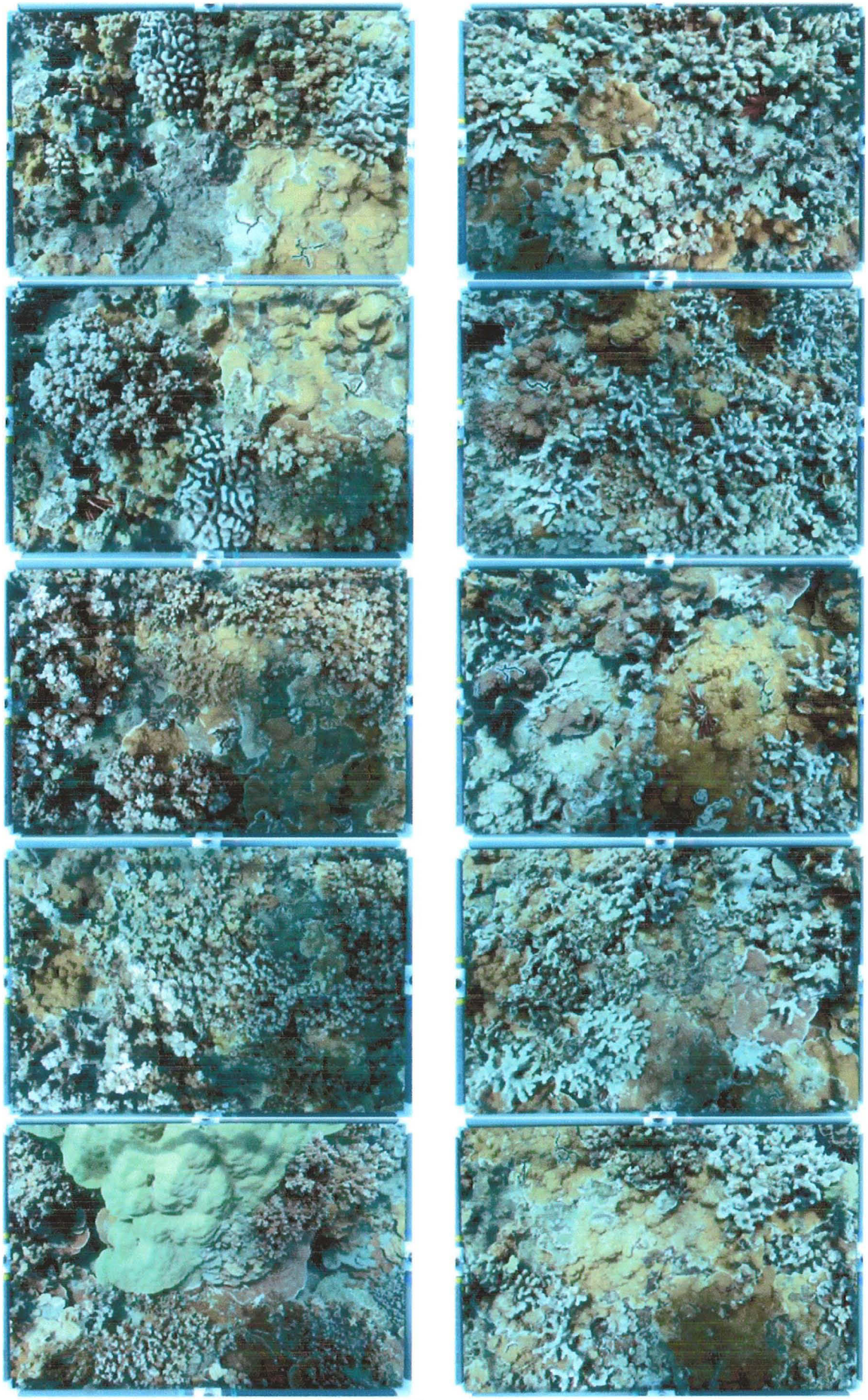

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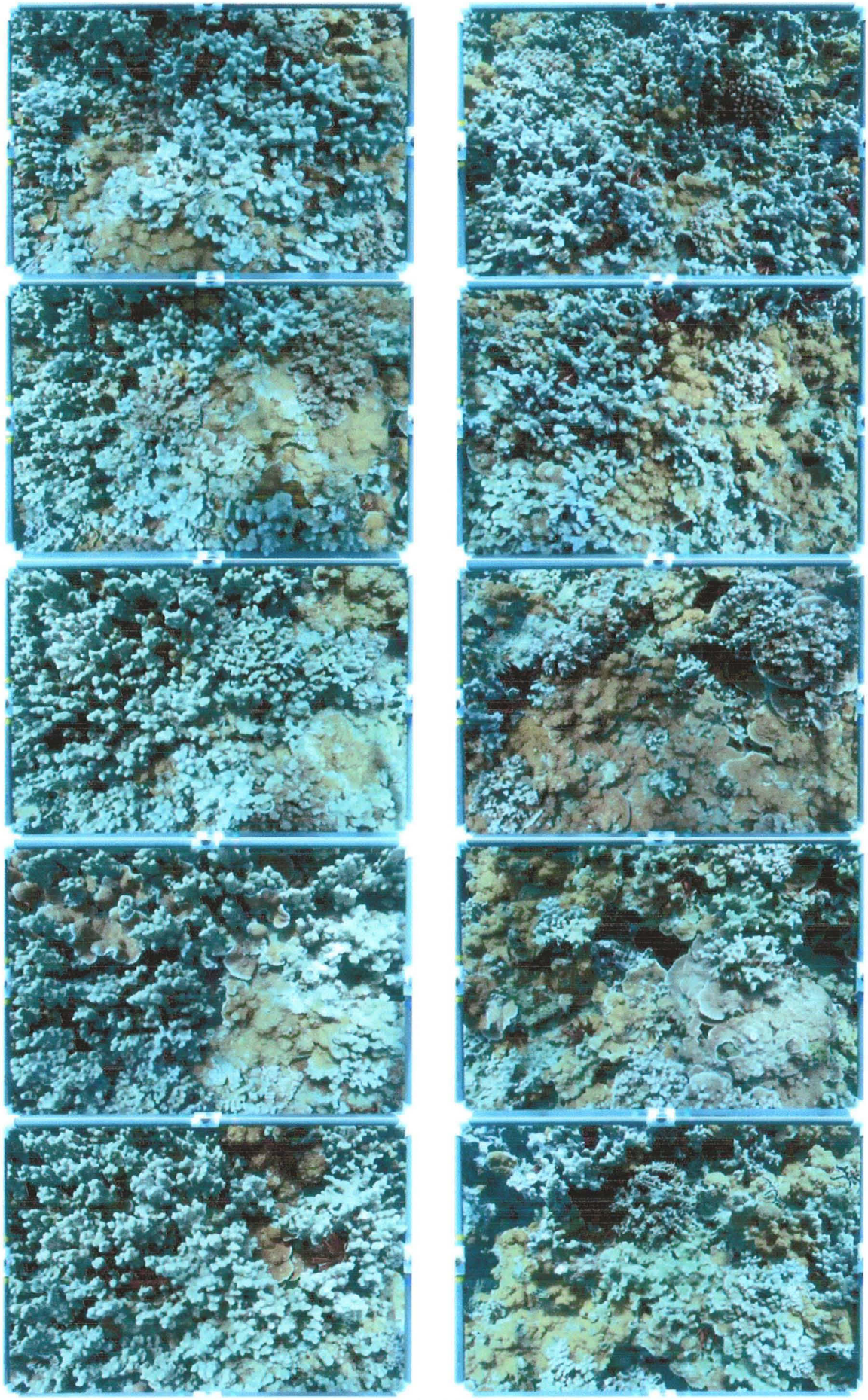

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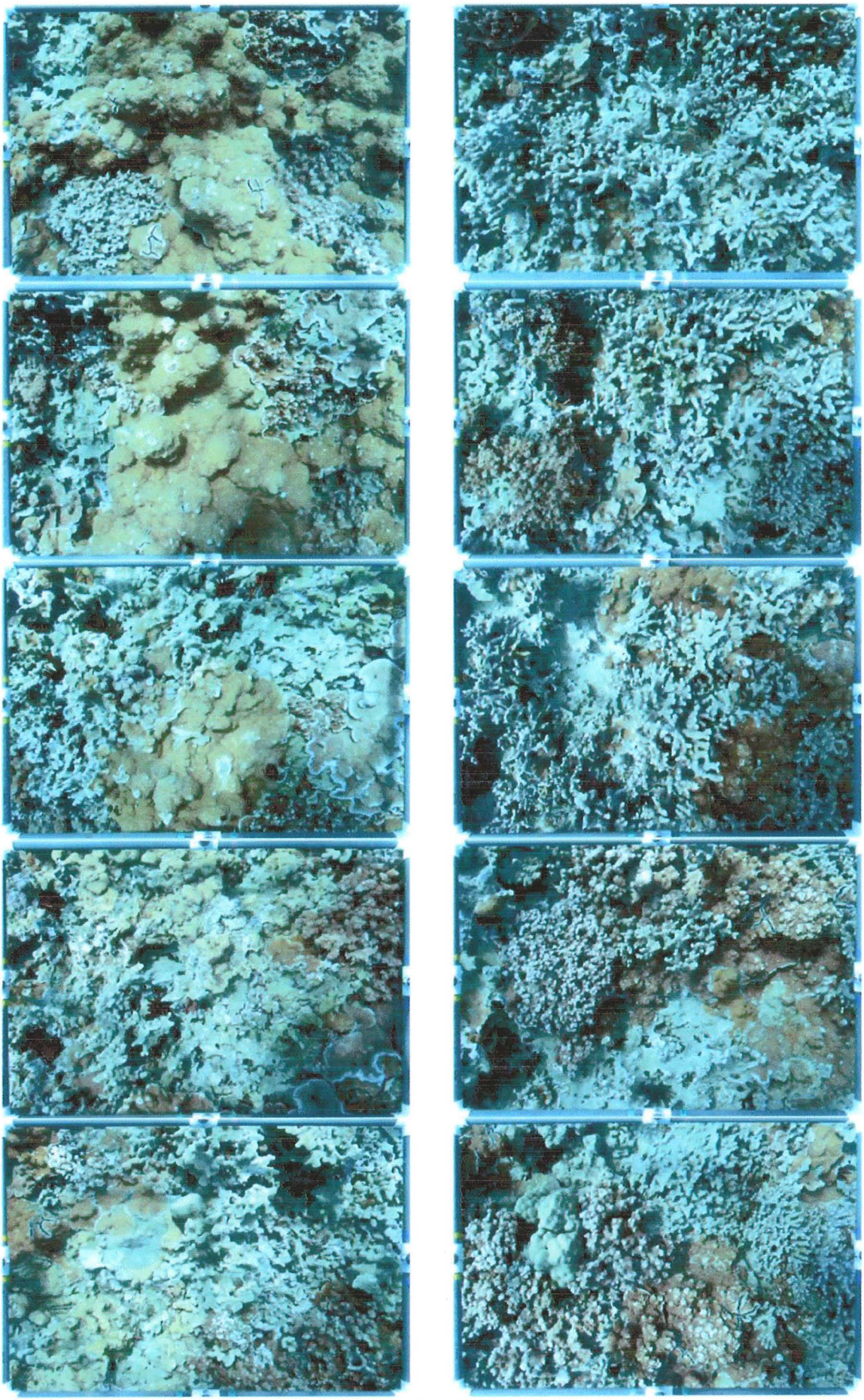

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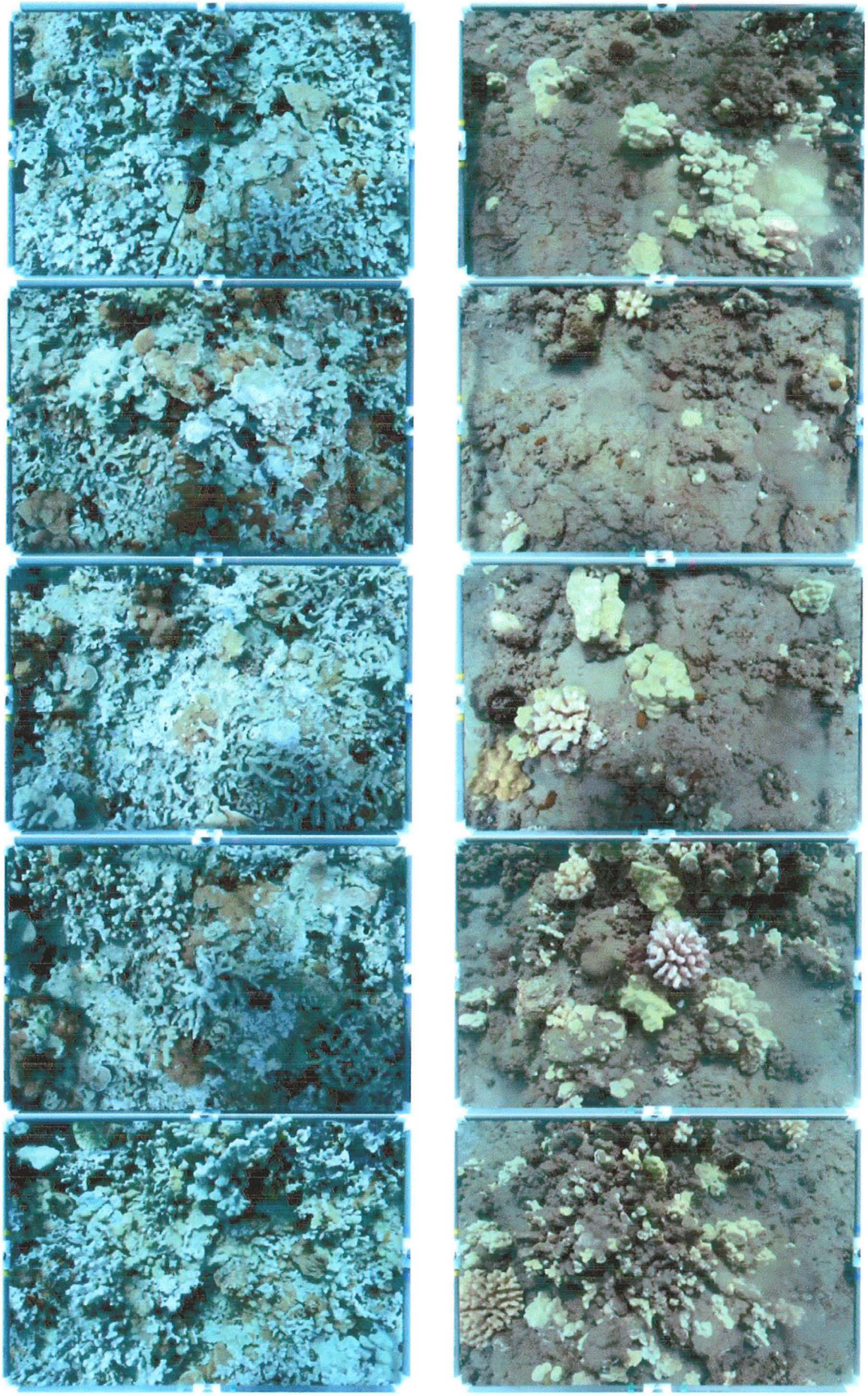

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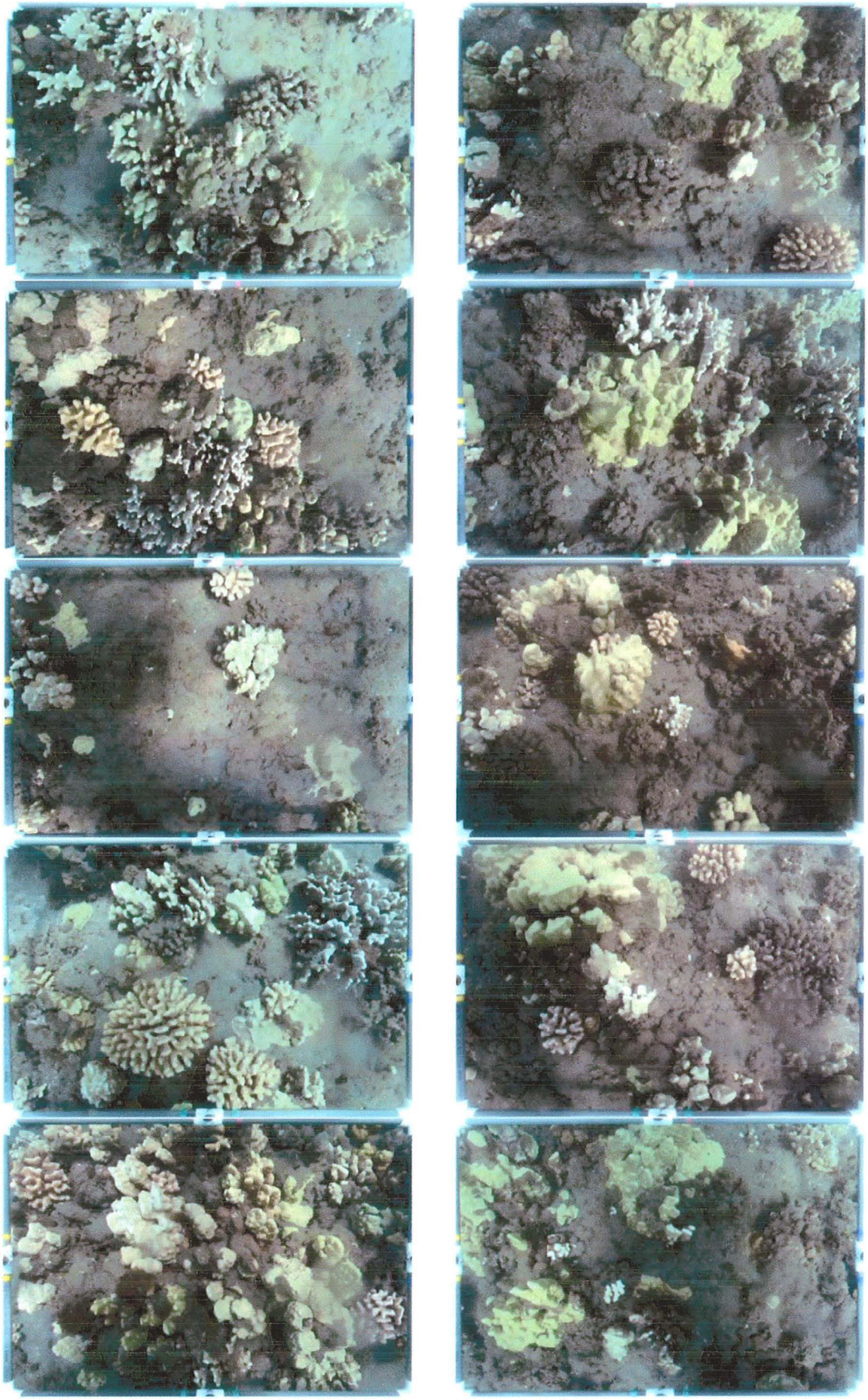

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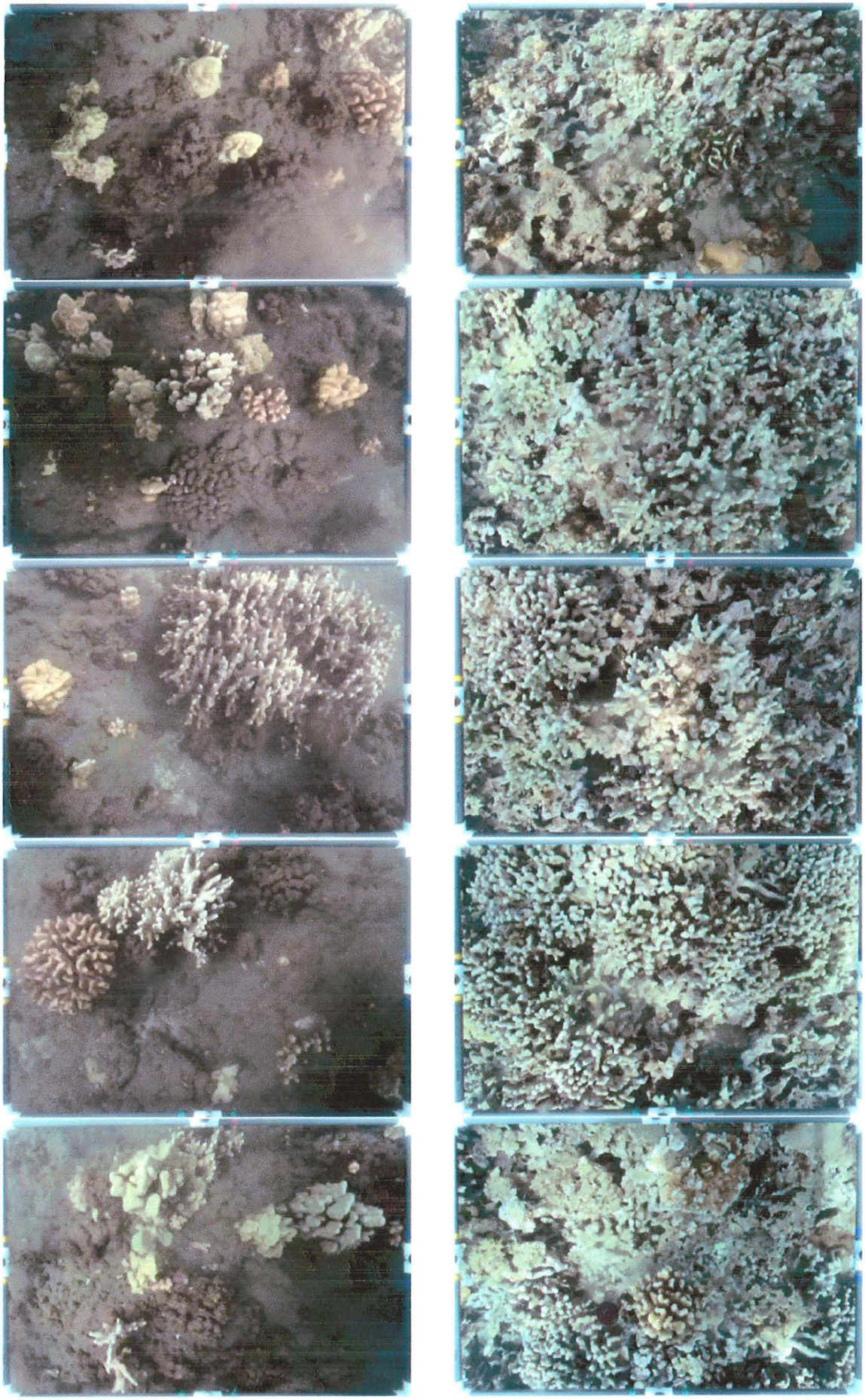
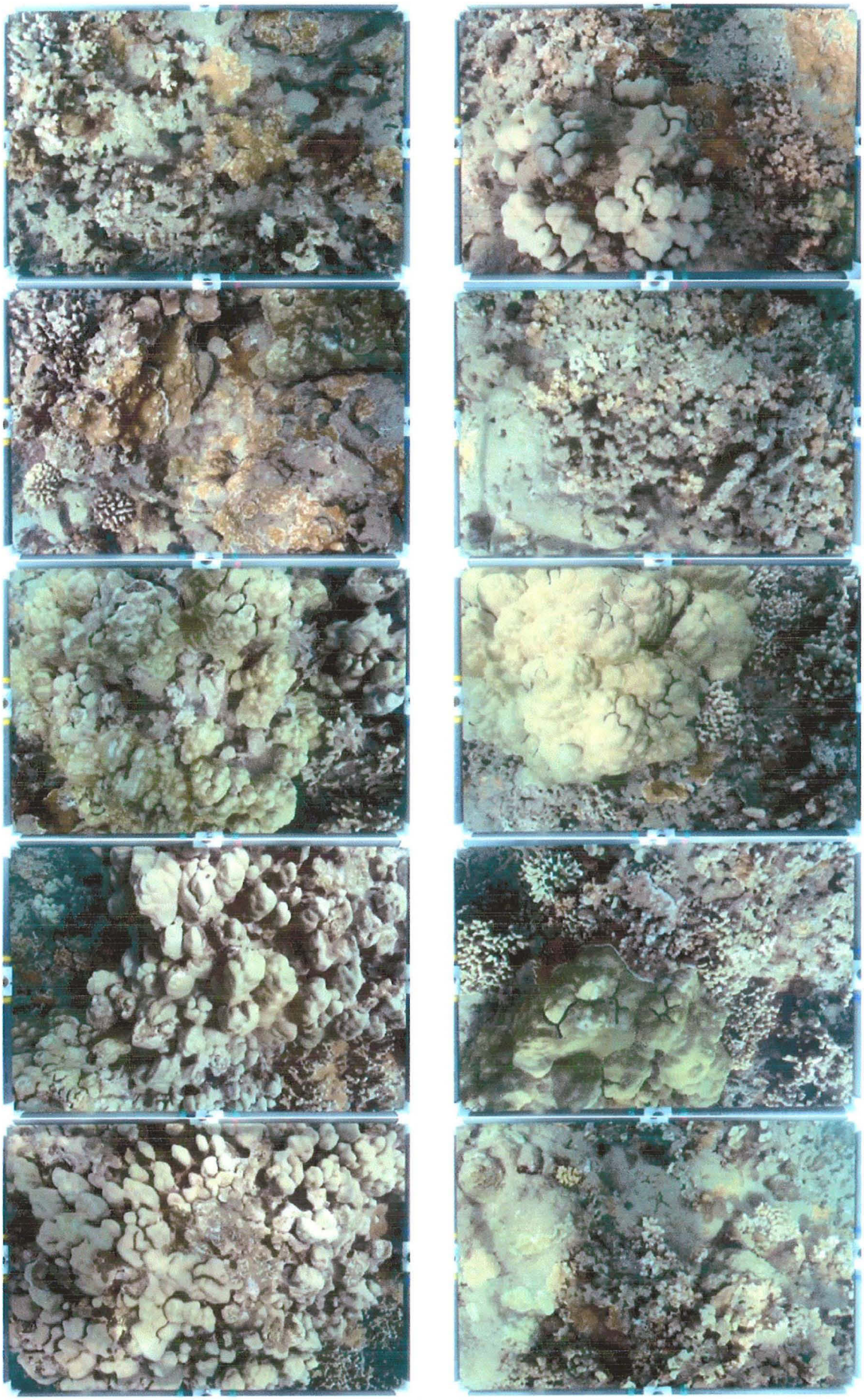


Olowalu Town Project Sites 100 and 168



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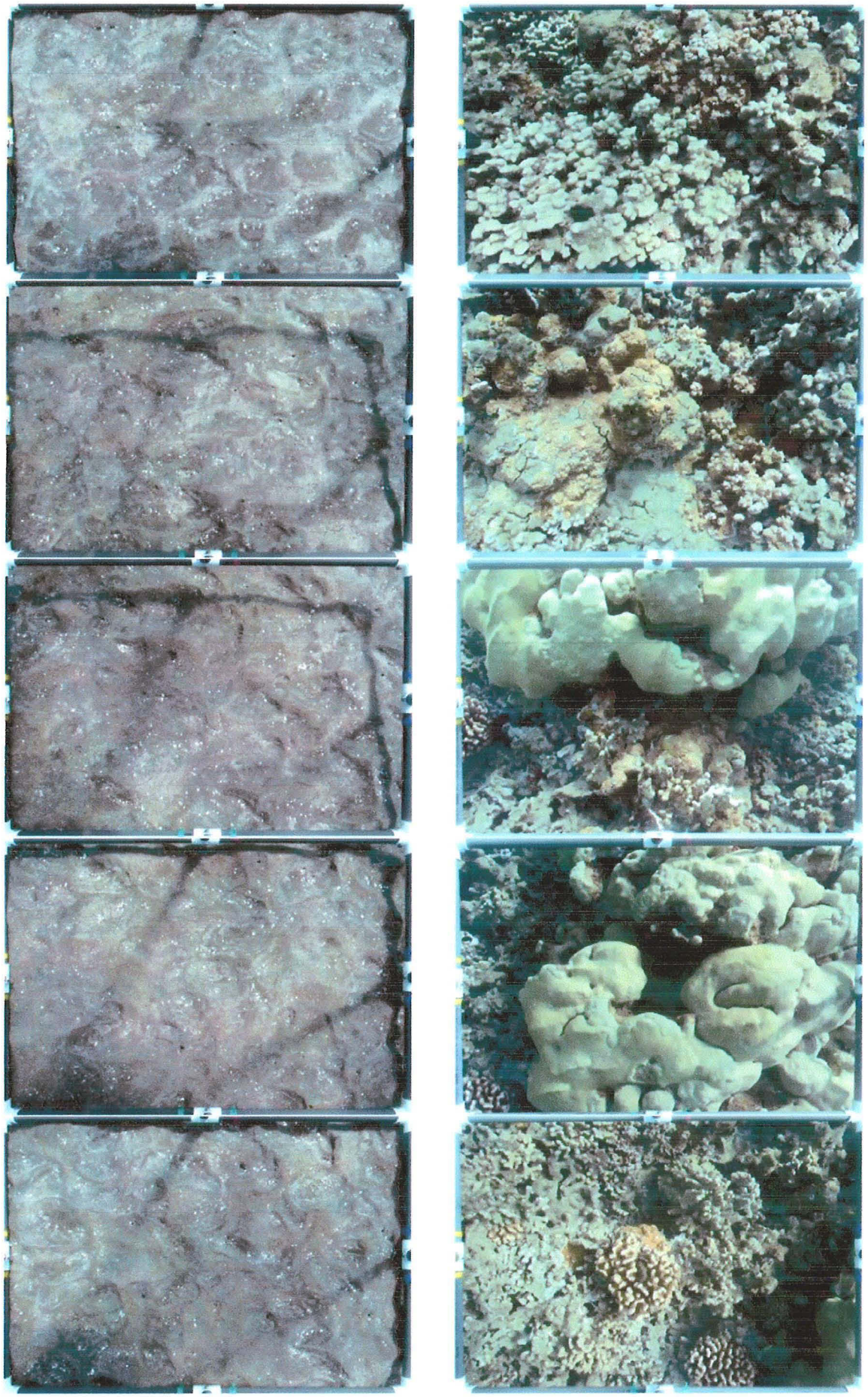
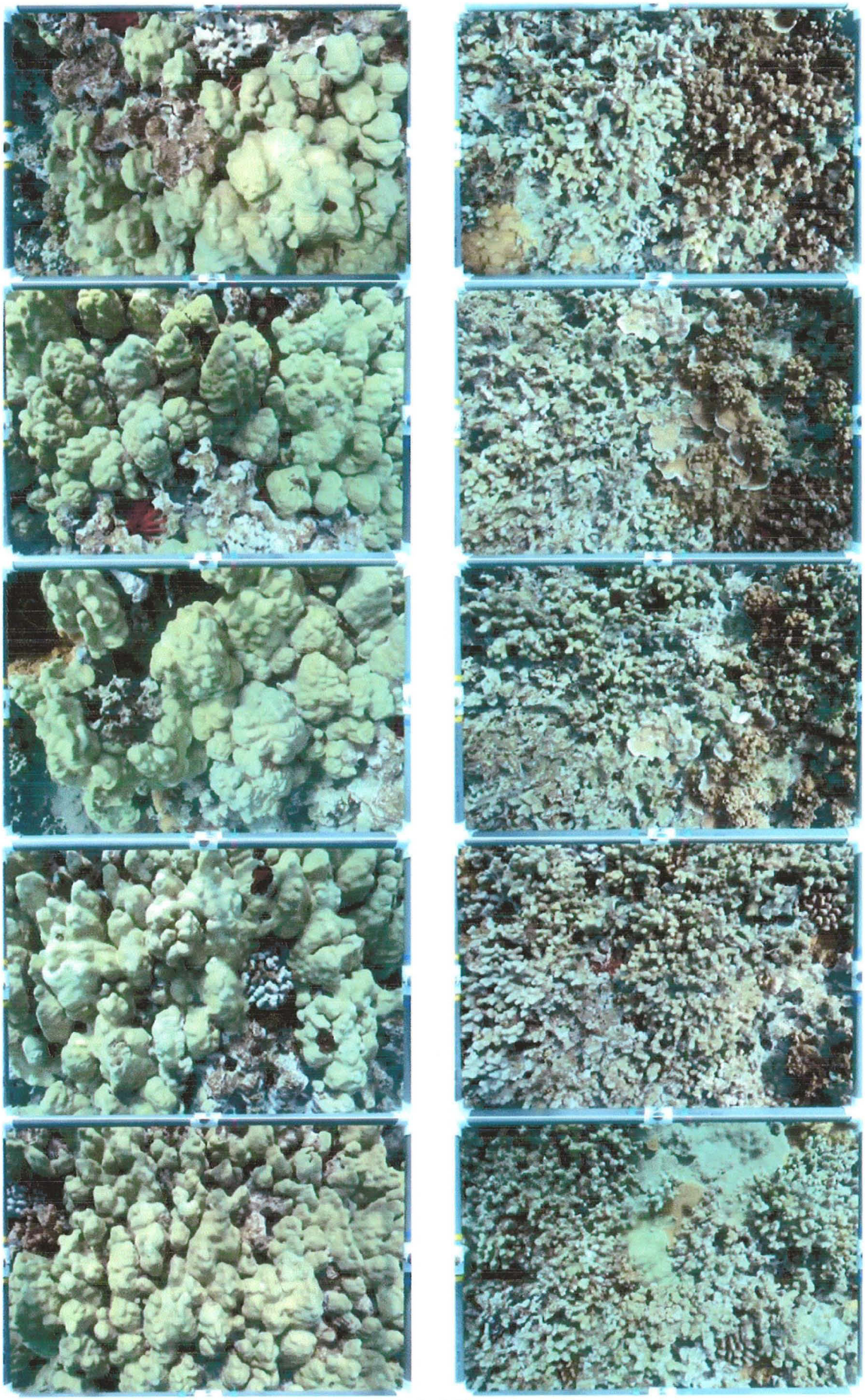


Olowalu Town Project Sites 171 and 172



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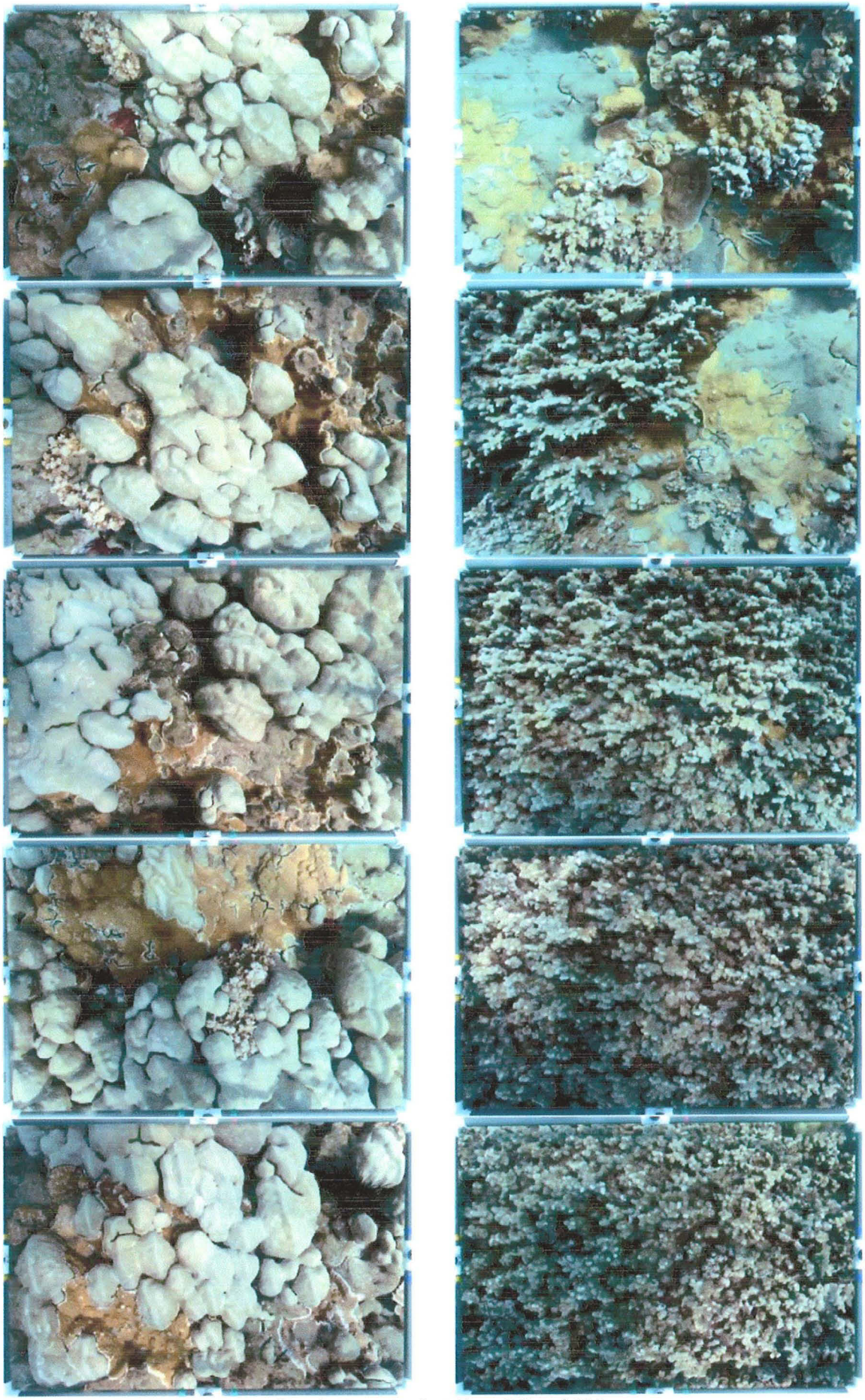

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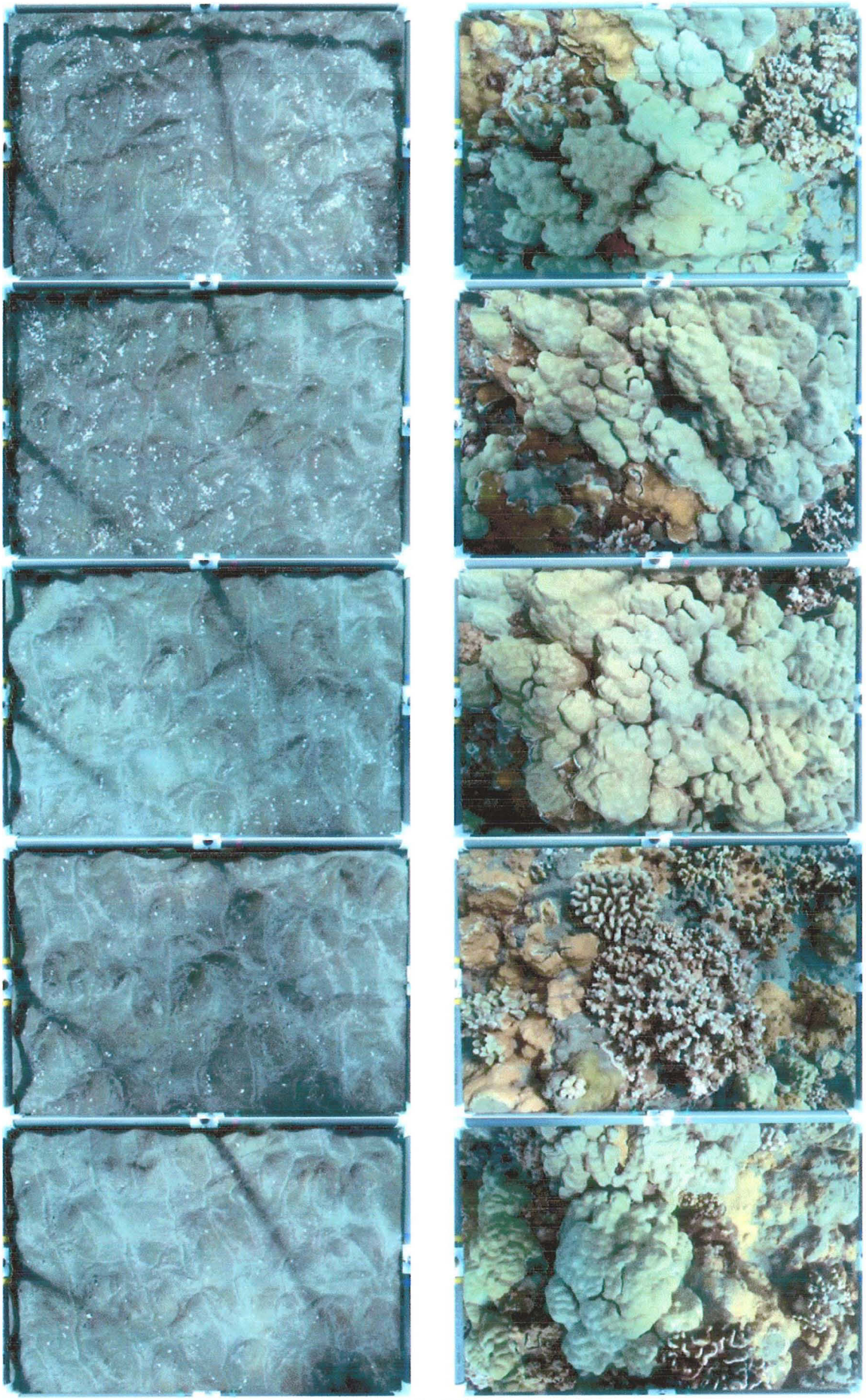

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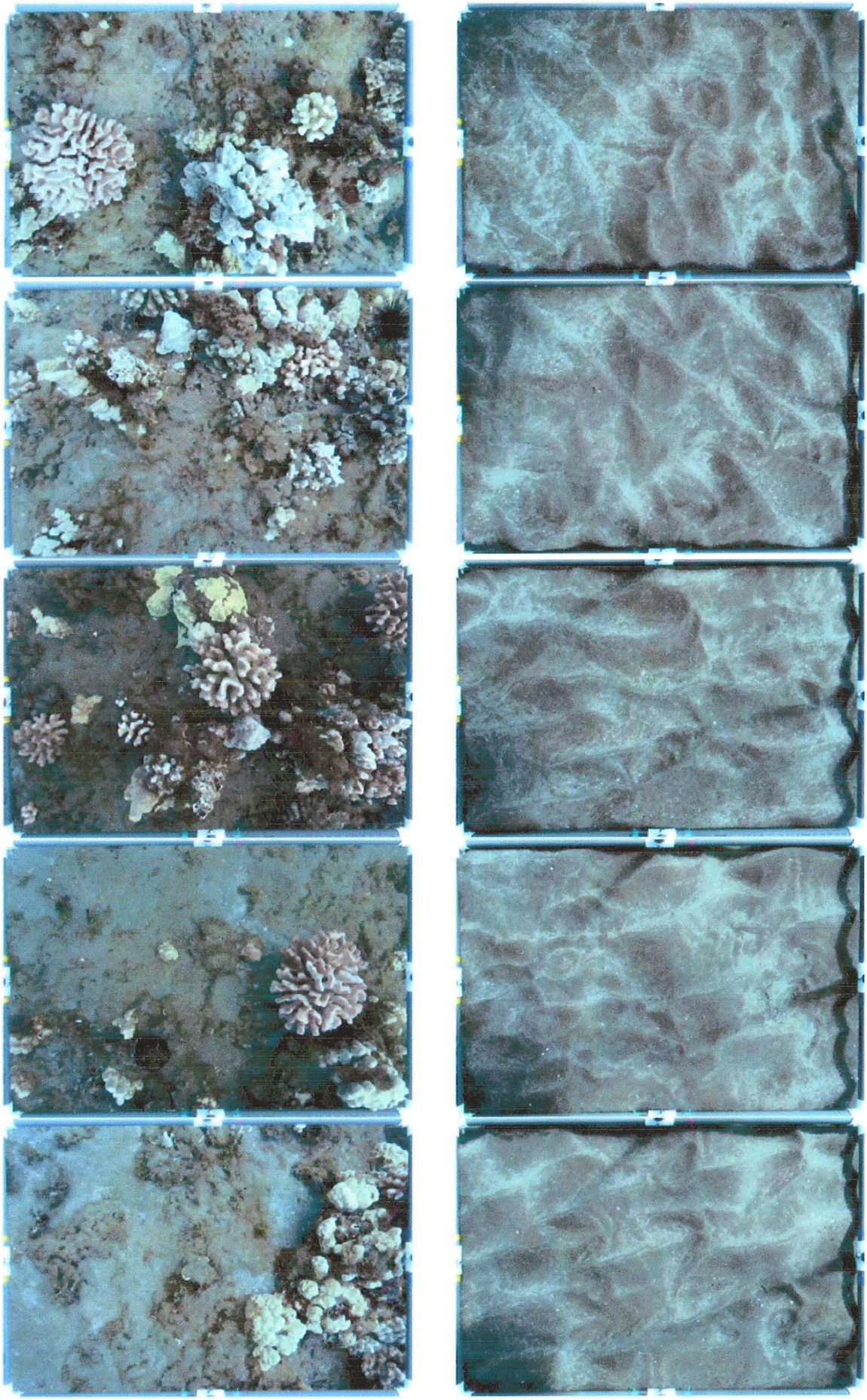

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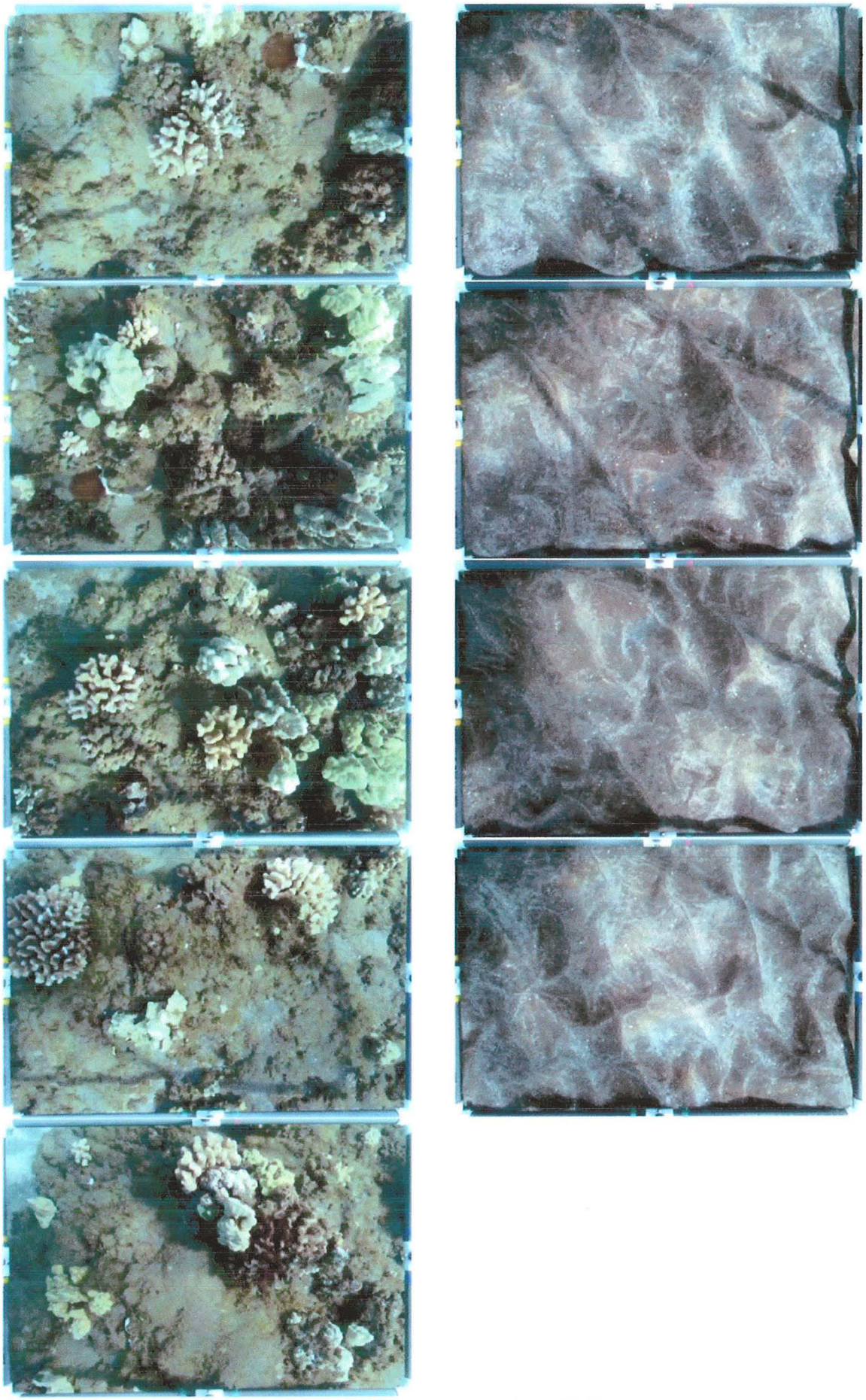

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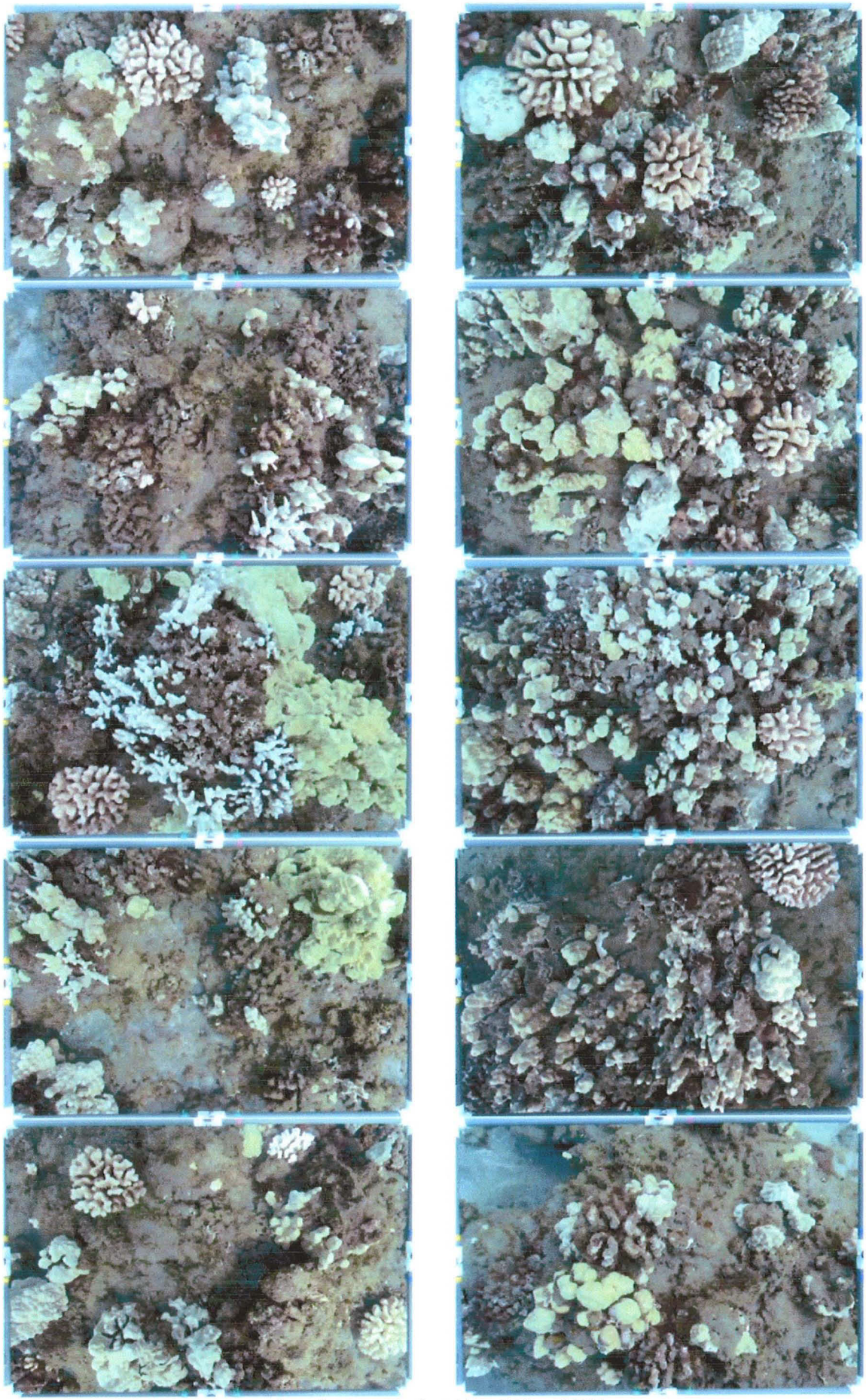

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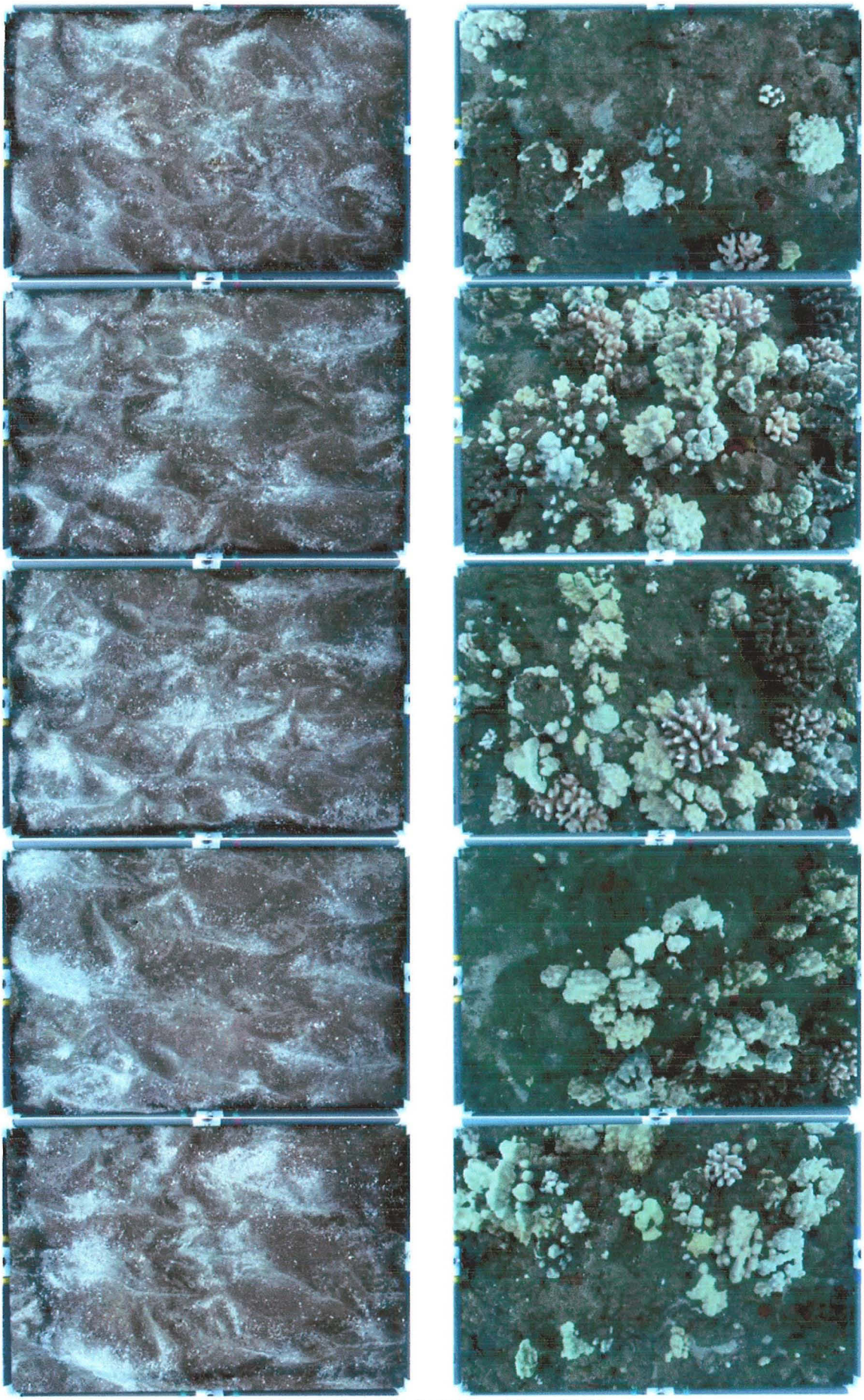

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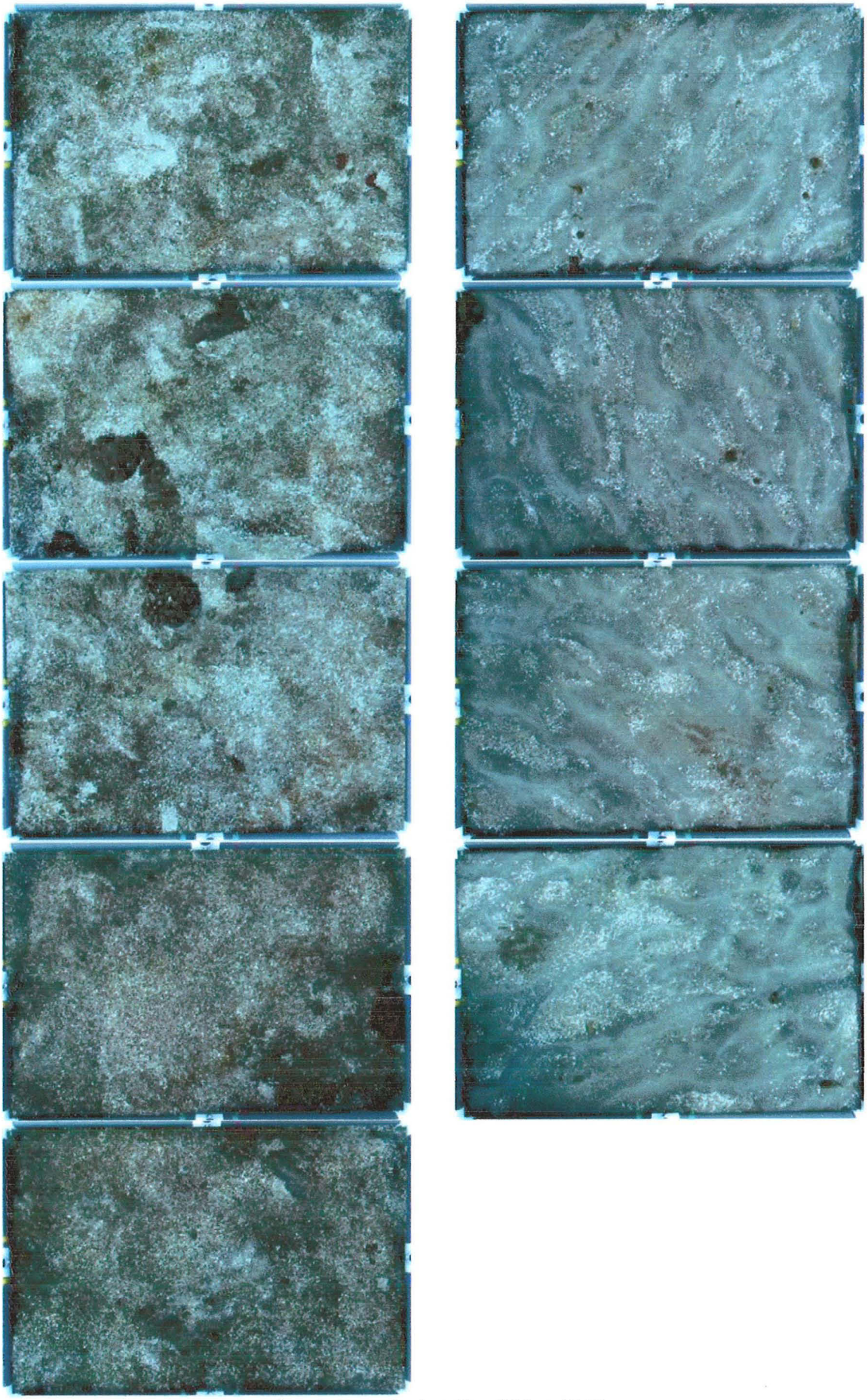
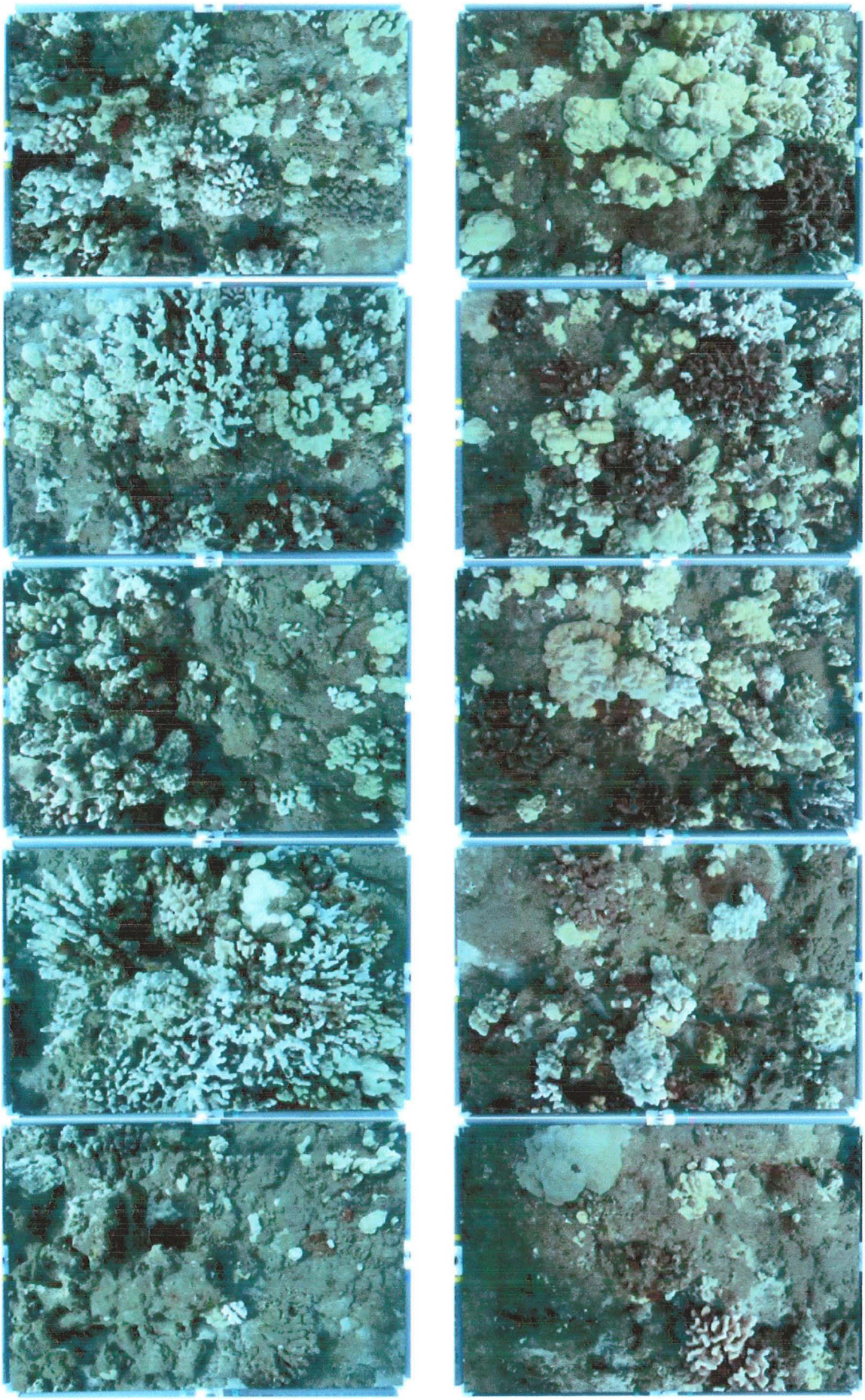


Olowalu Town Project Sites 568 and 569



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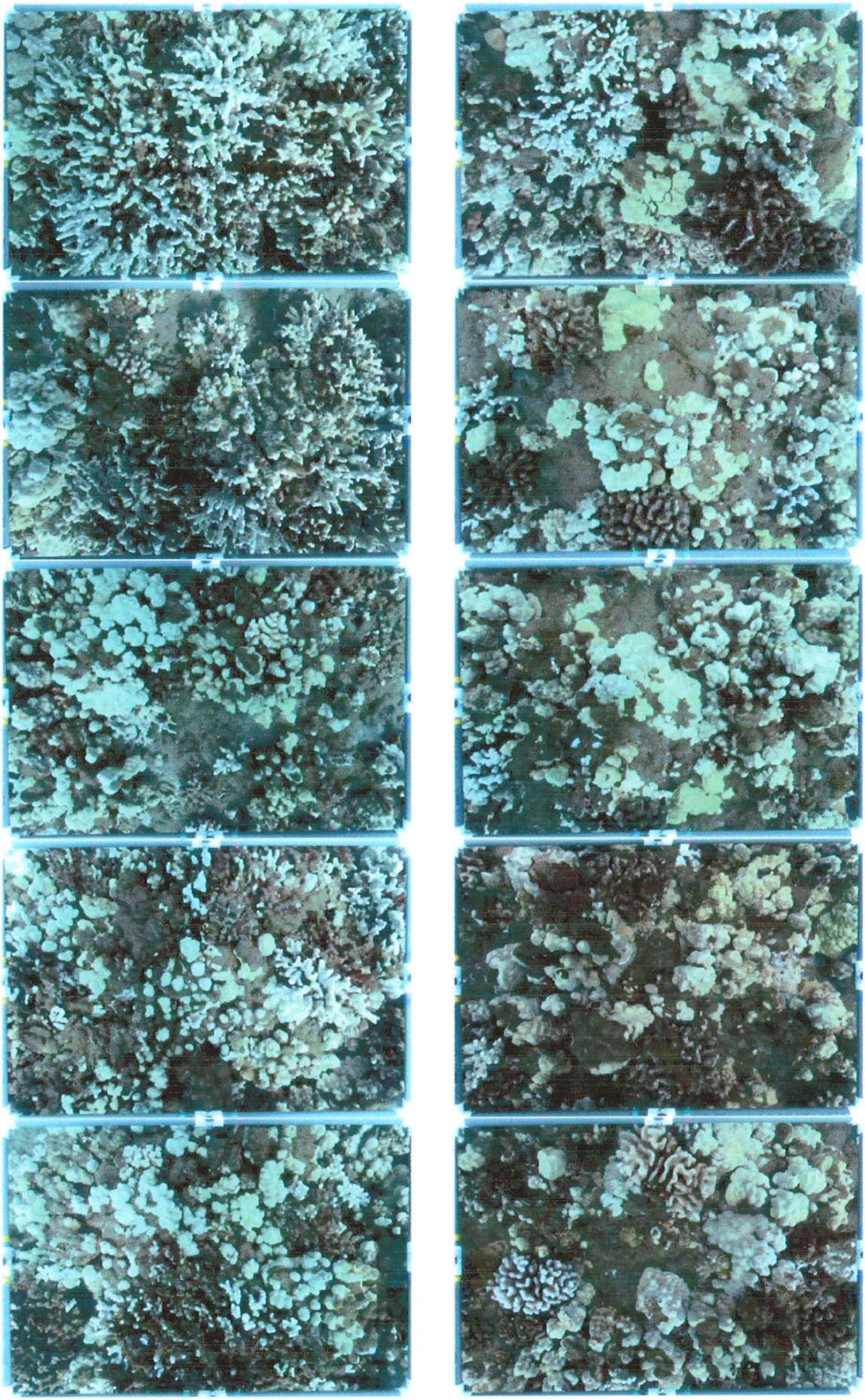

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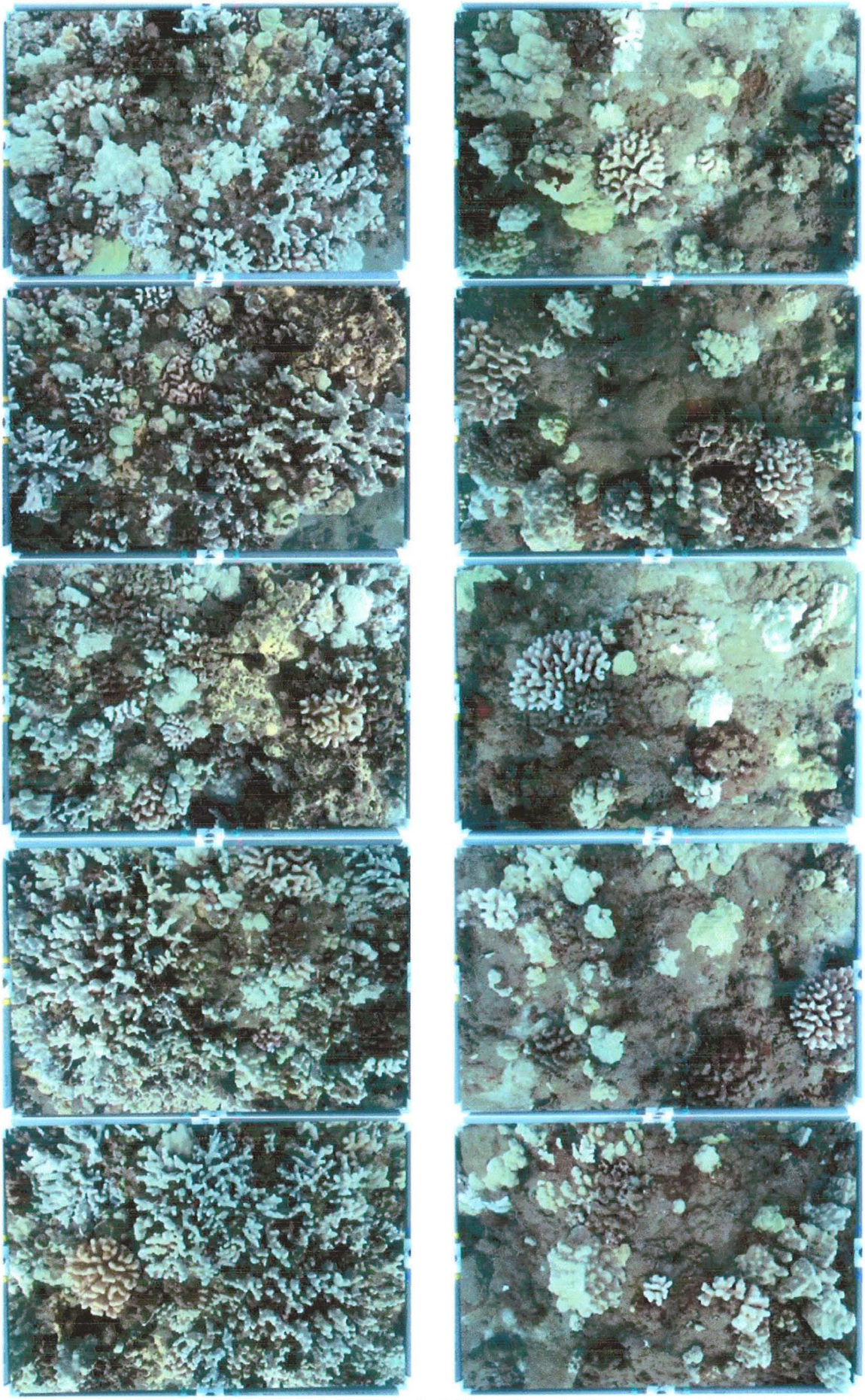

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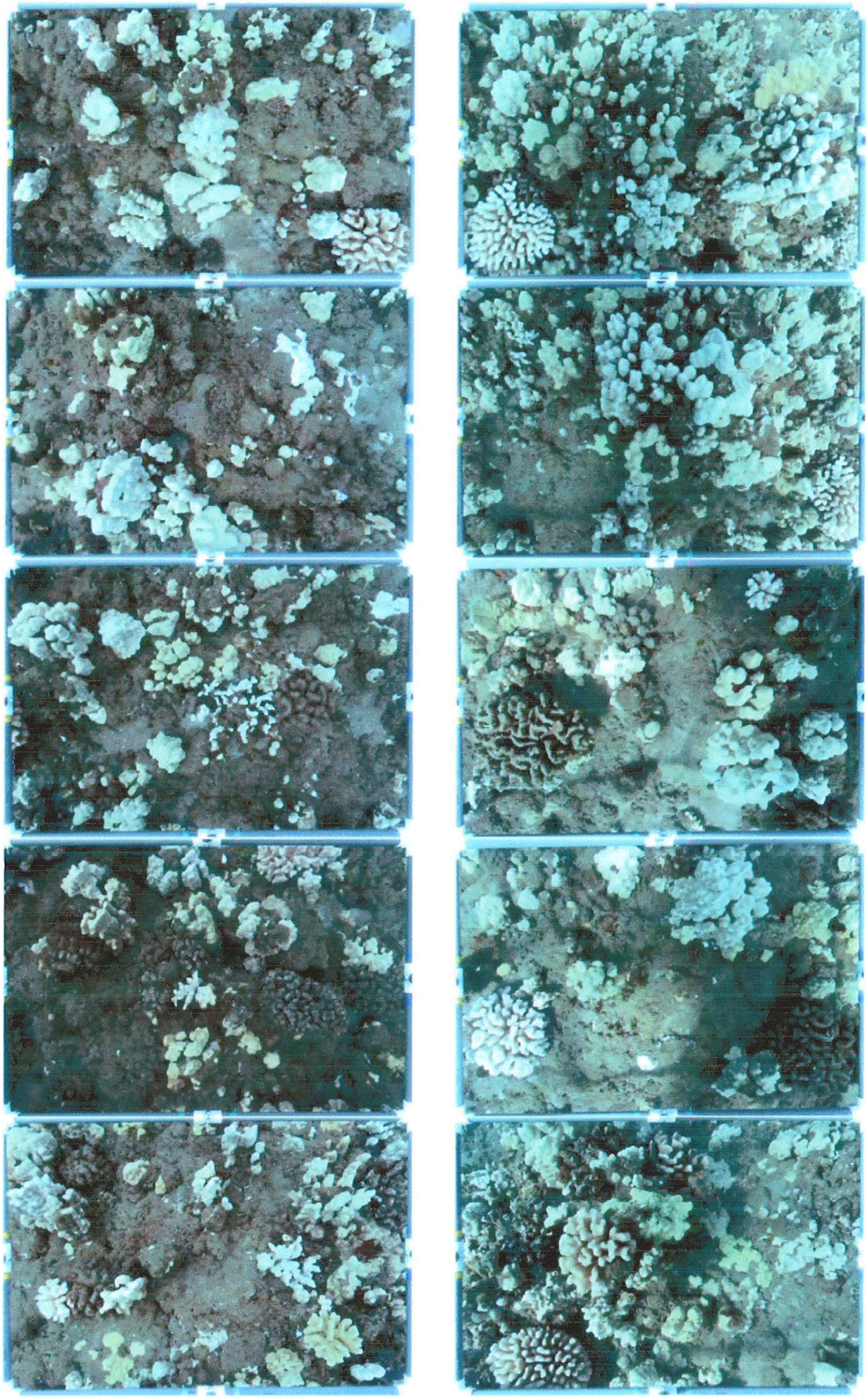

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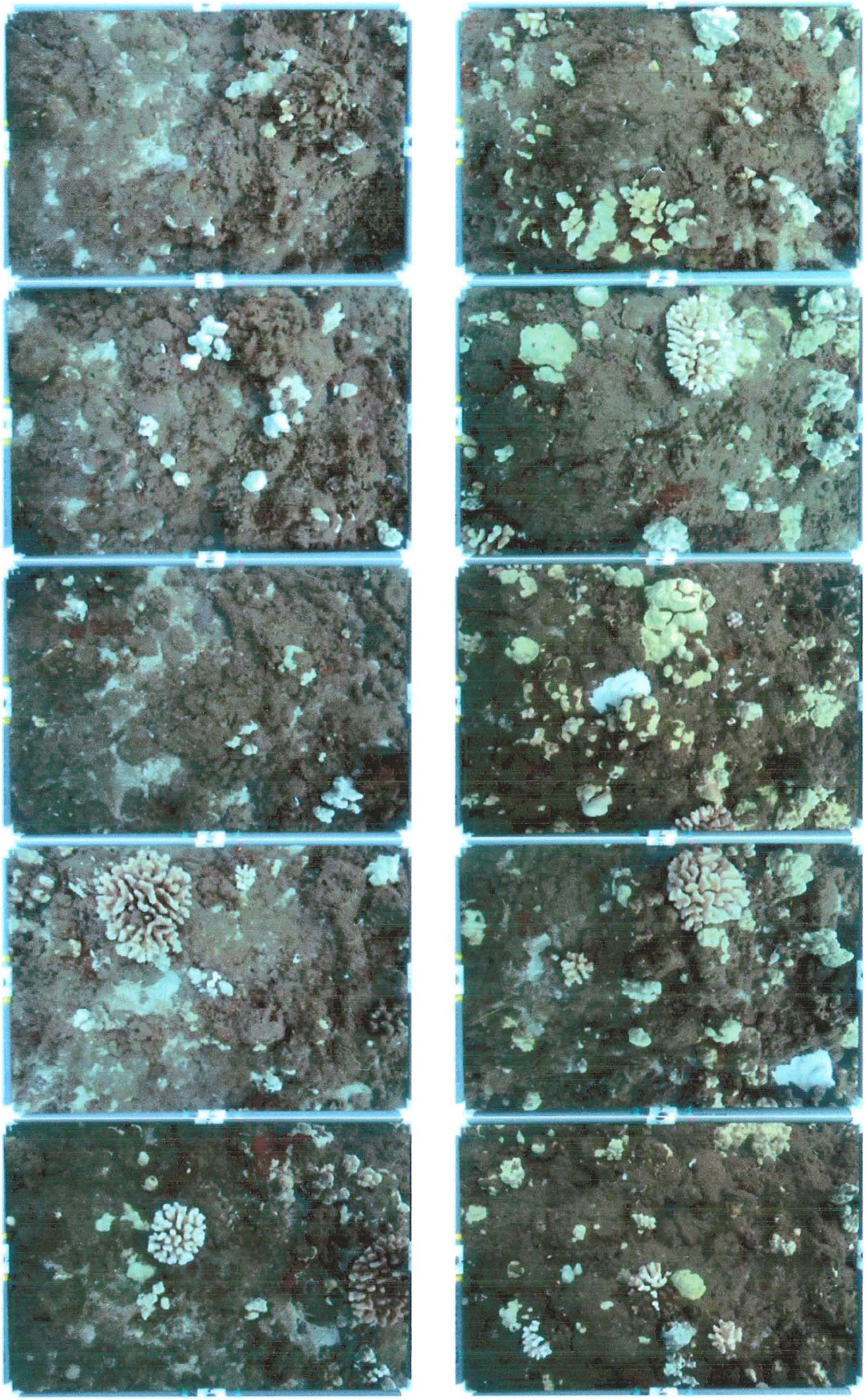
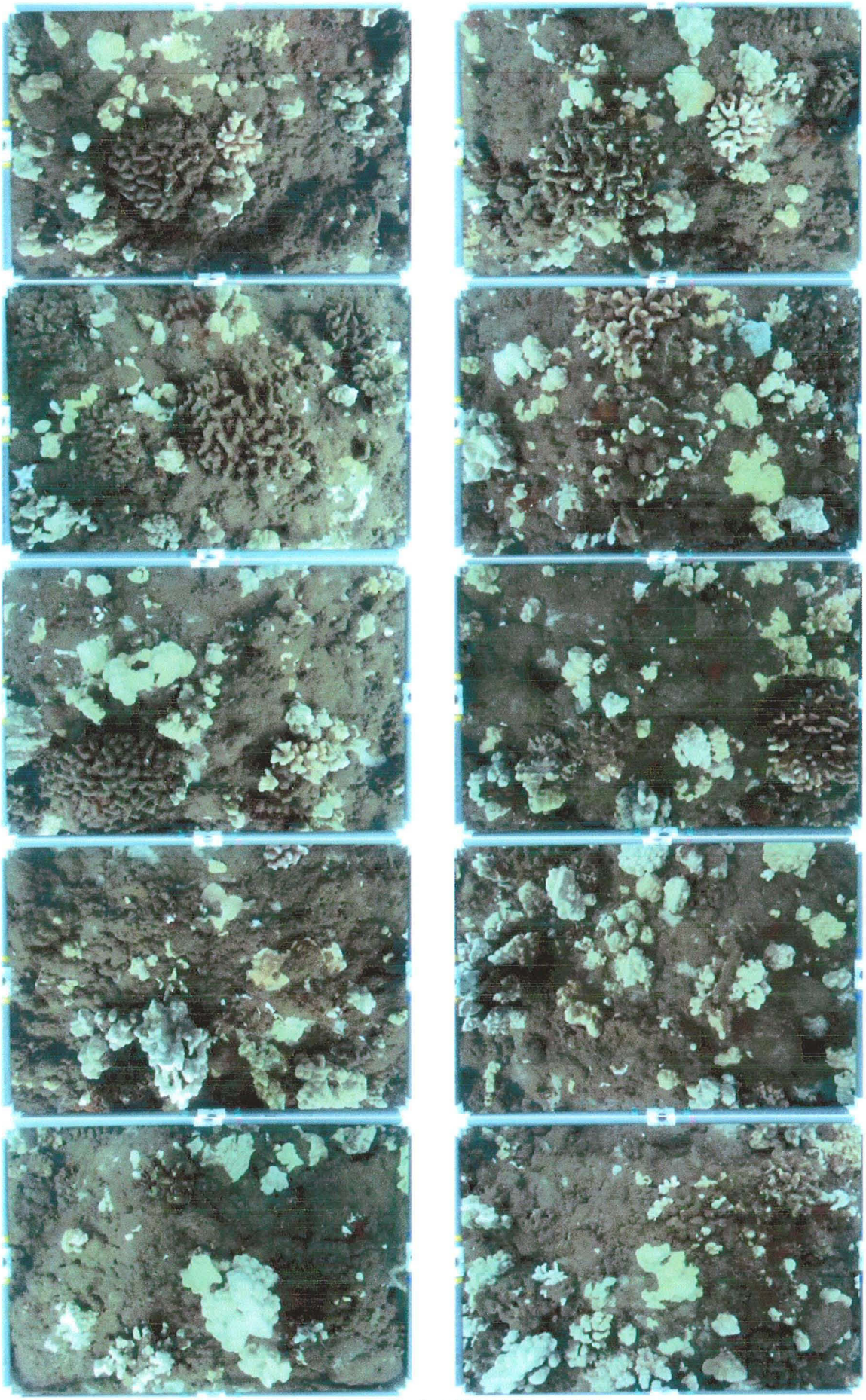


Olowalu Town Project Sites 578 and 579



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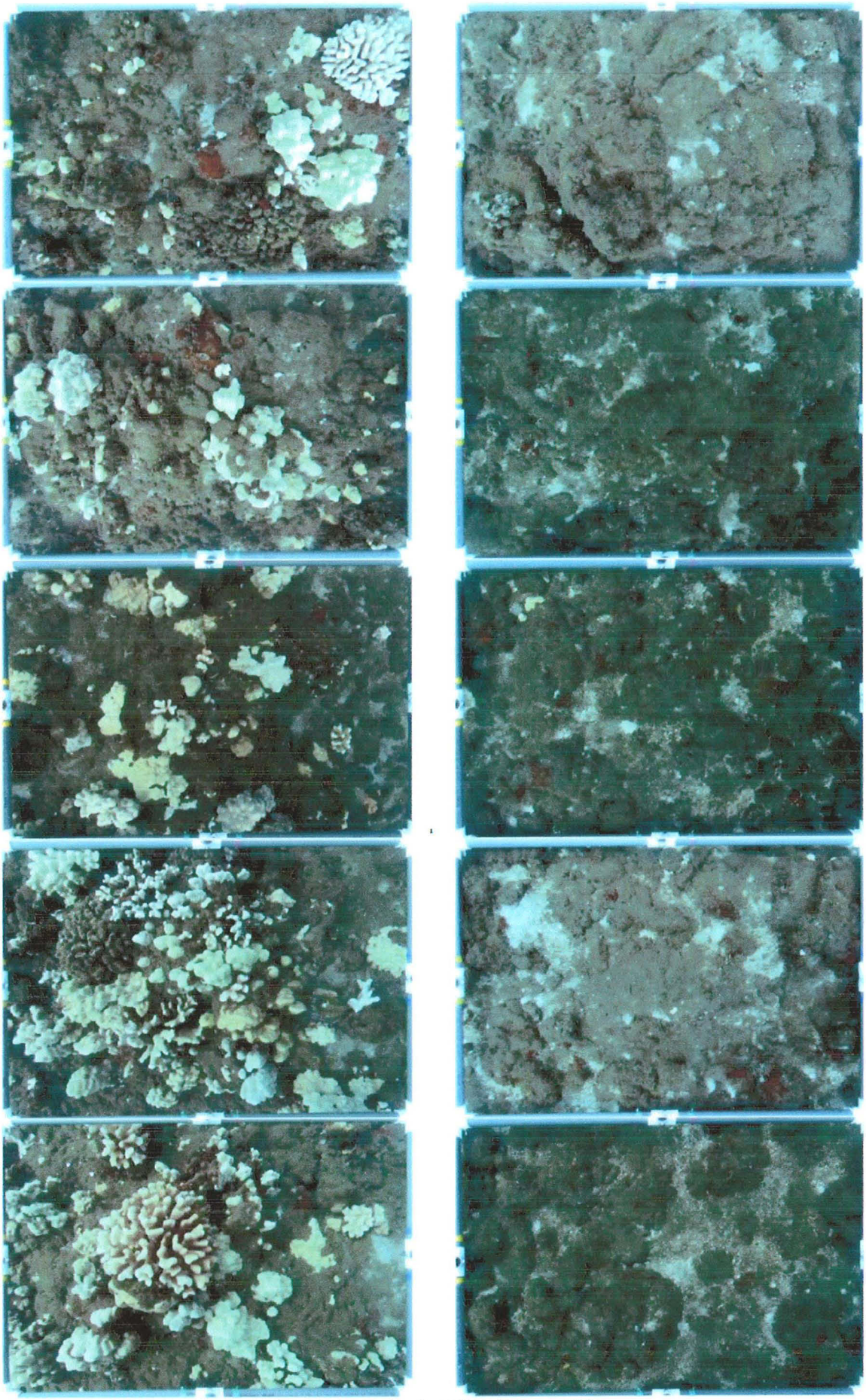

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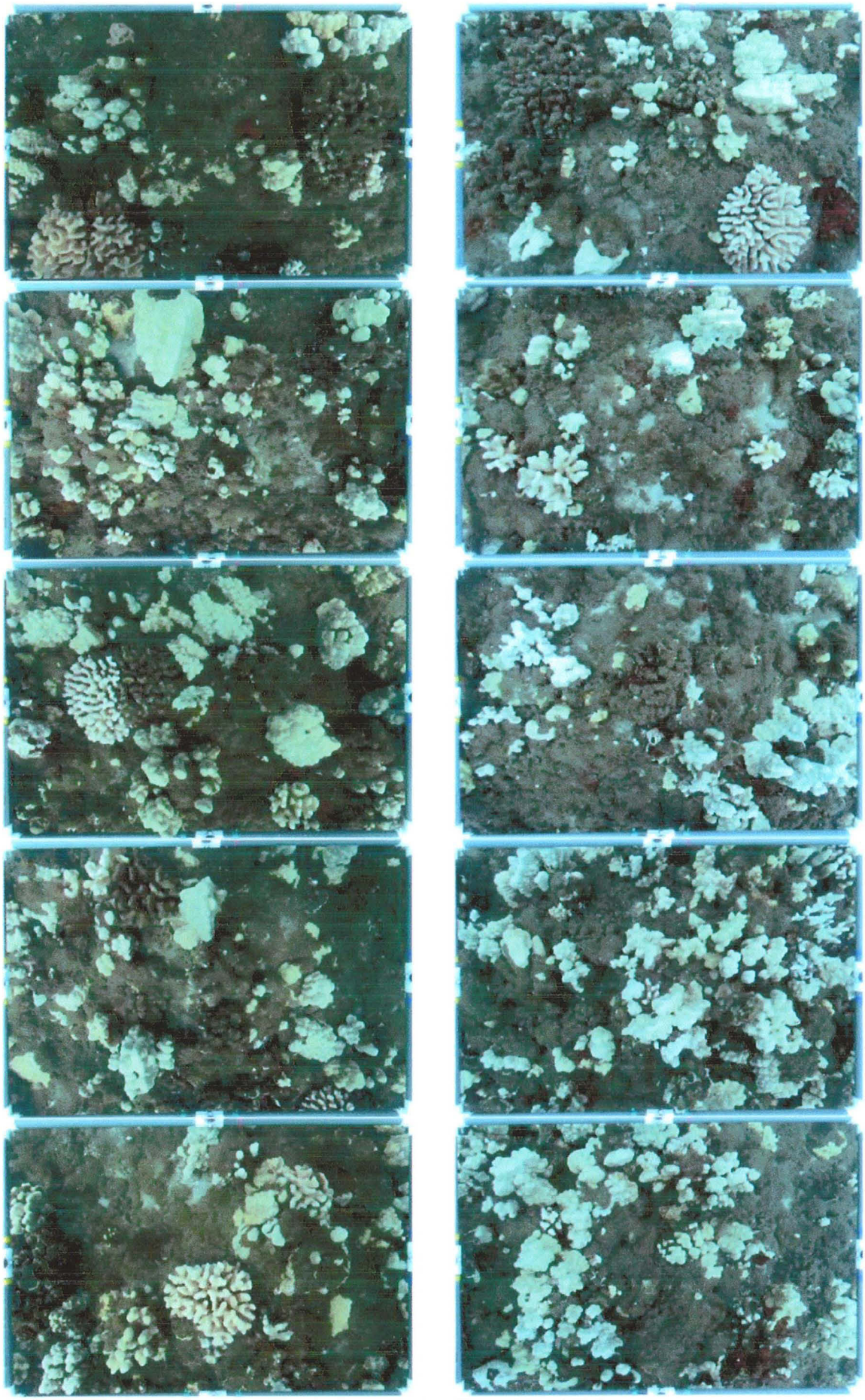

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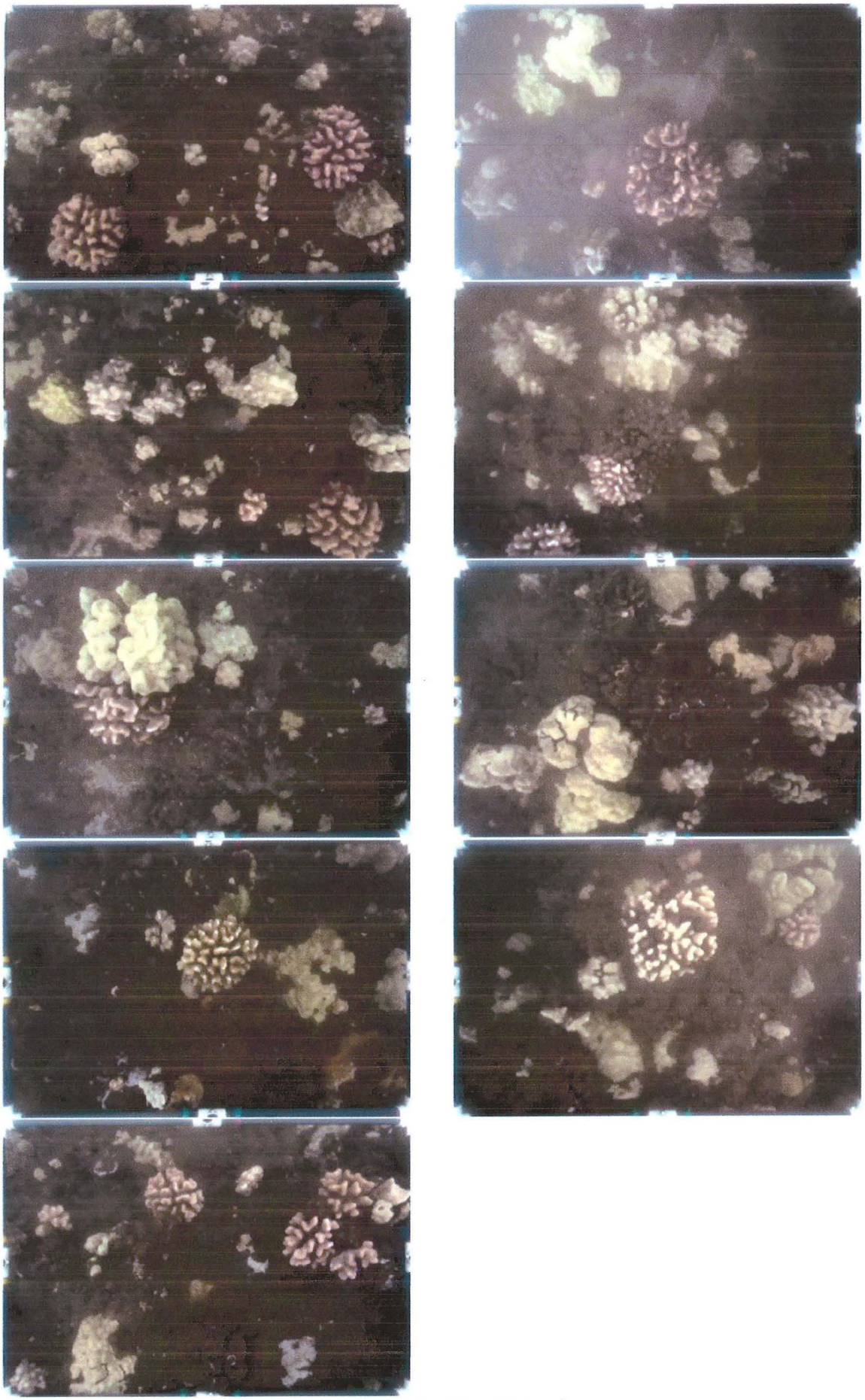

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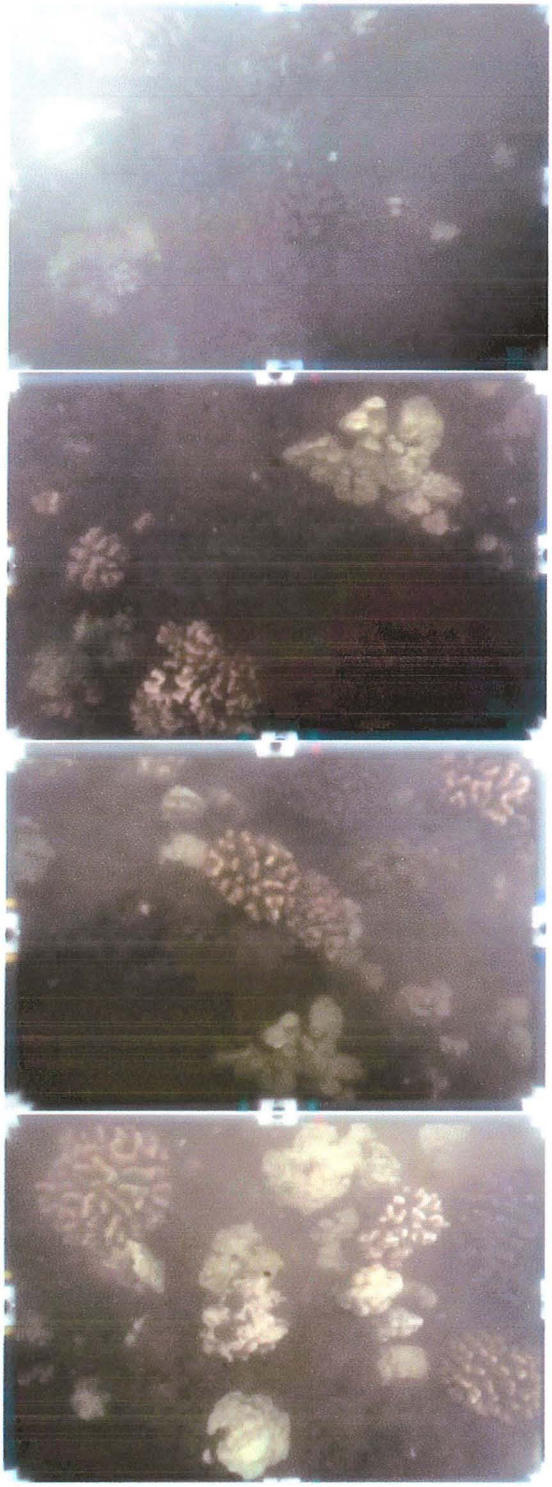
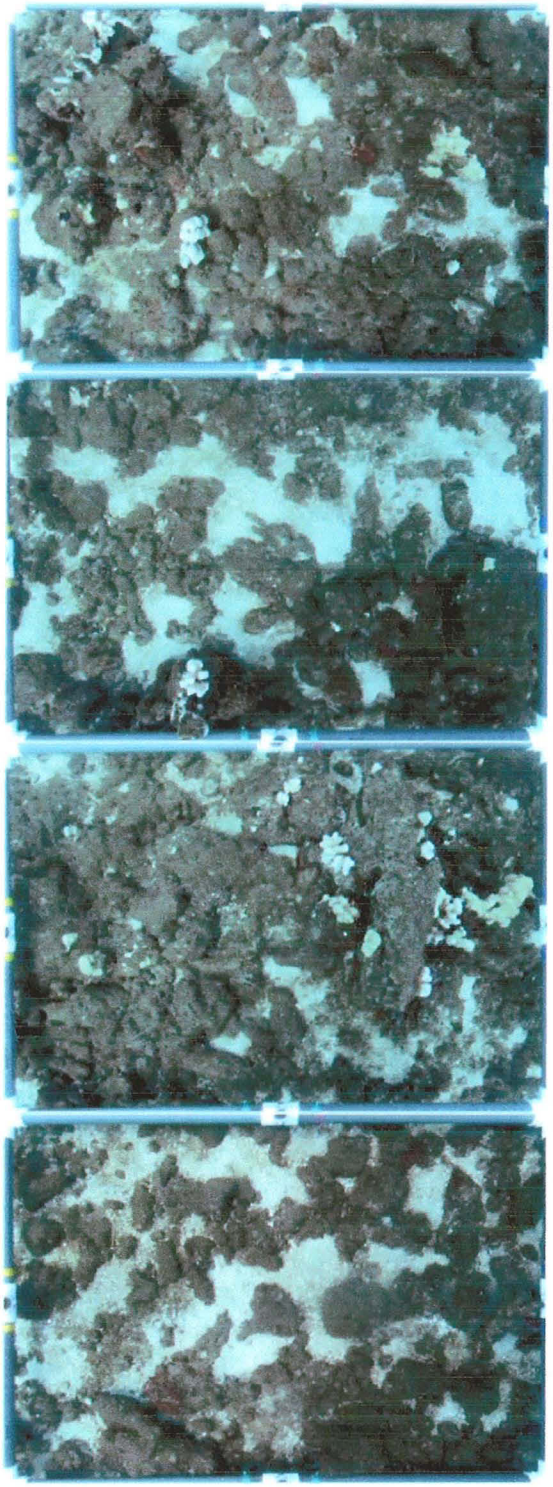
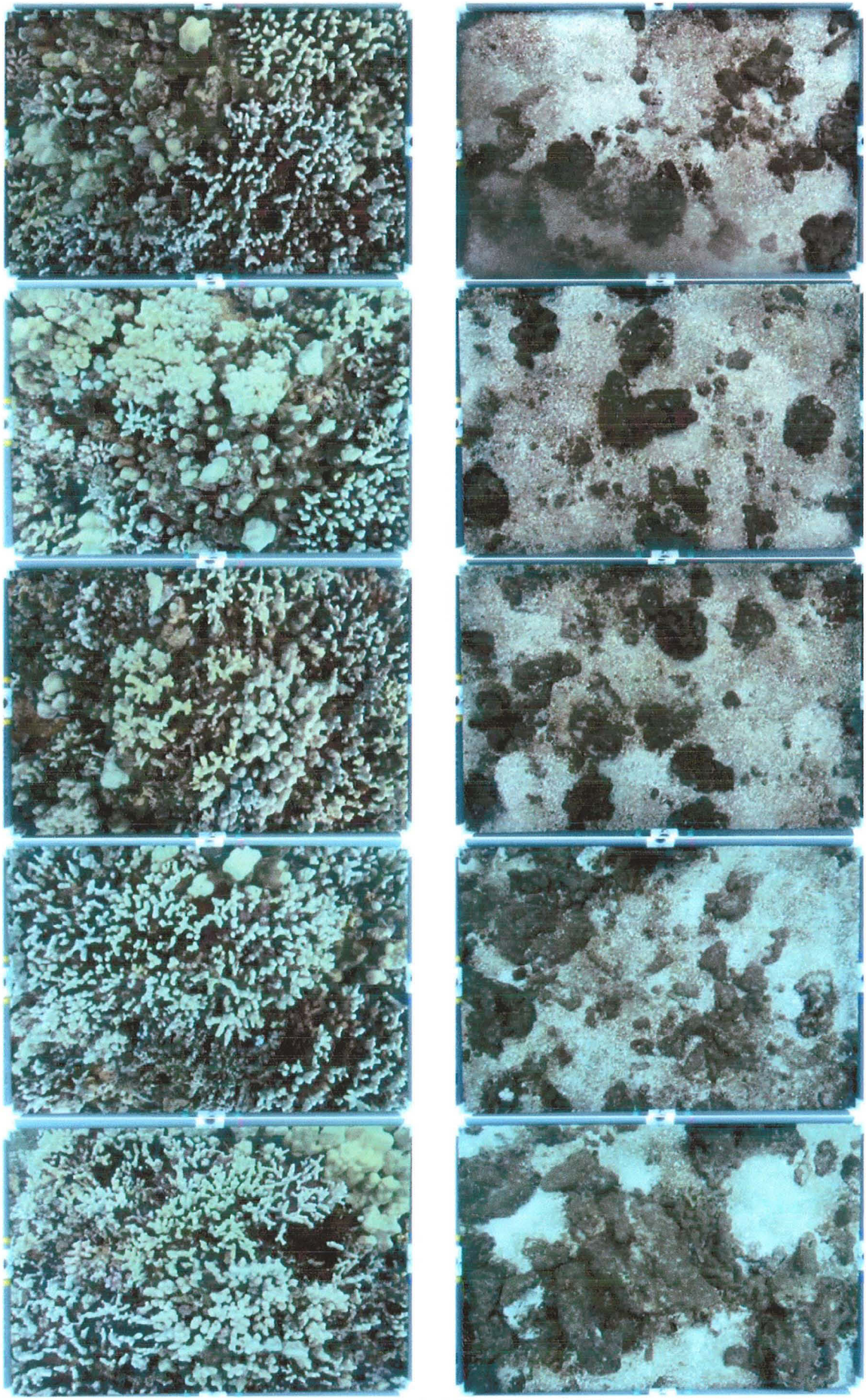




Olowalu Town Project Sites 589 and 590



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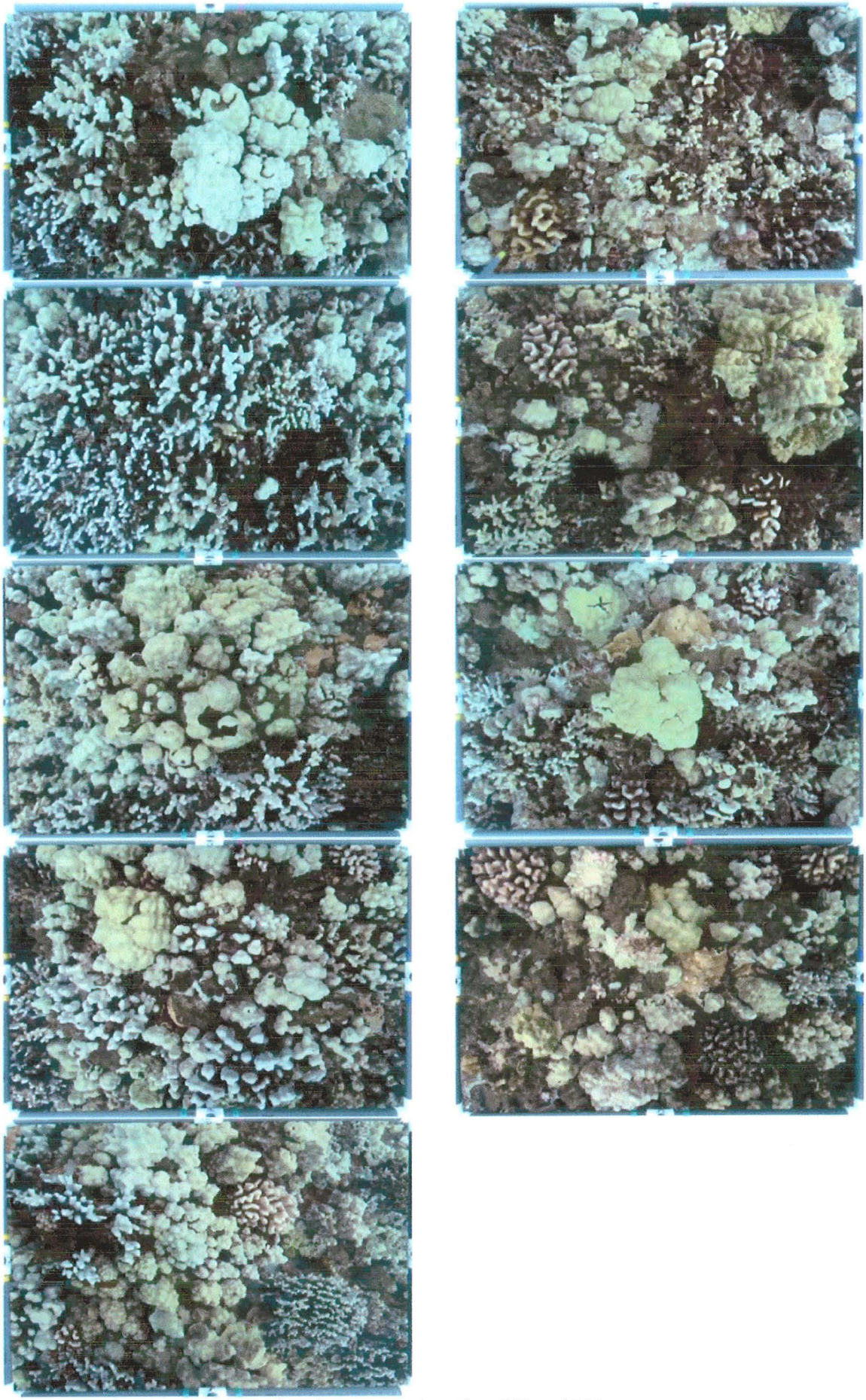
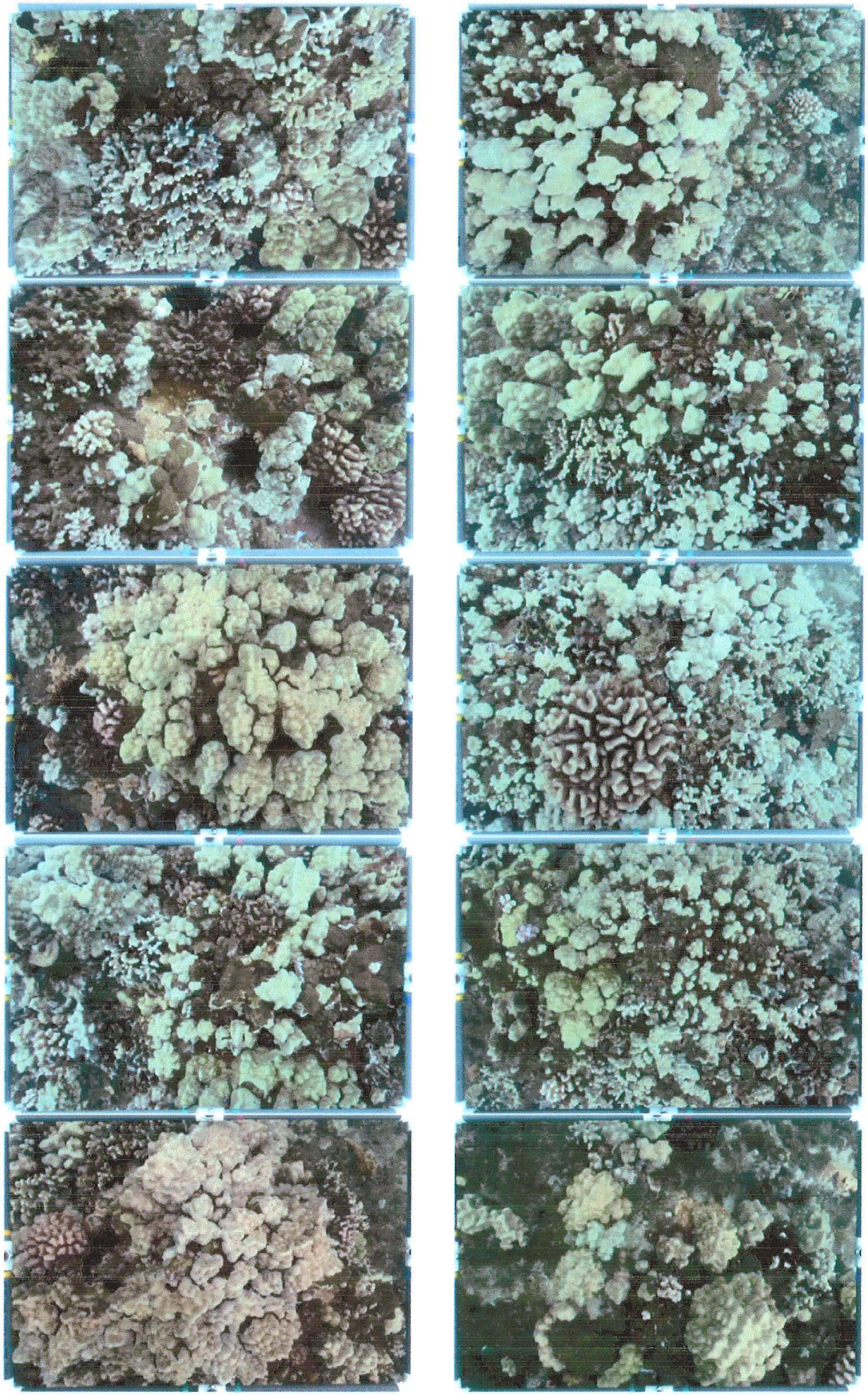


Olowalu Town Project Sites 593 and 594



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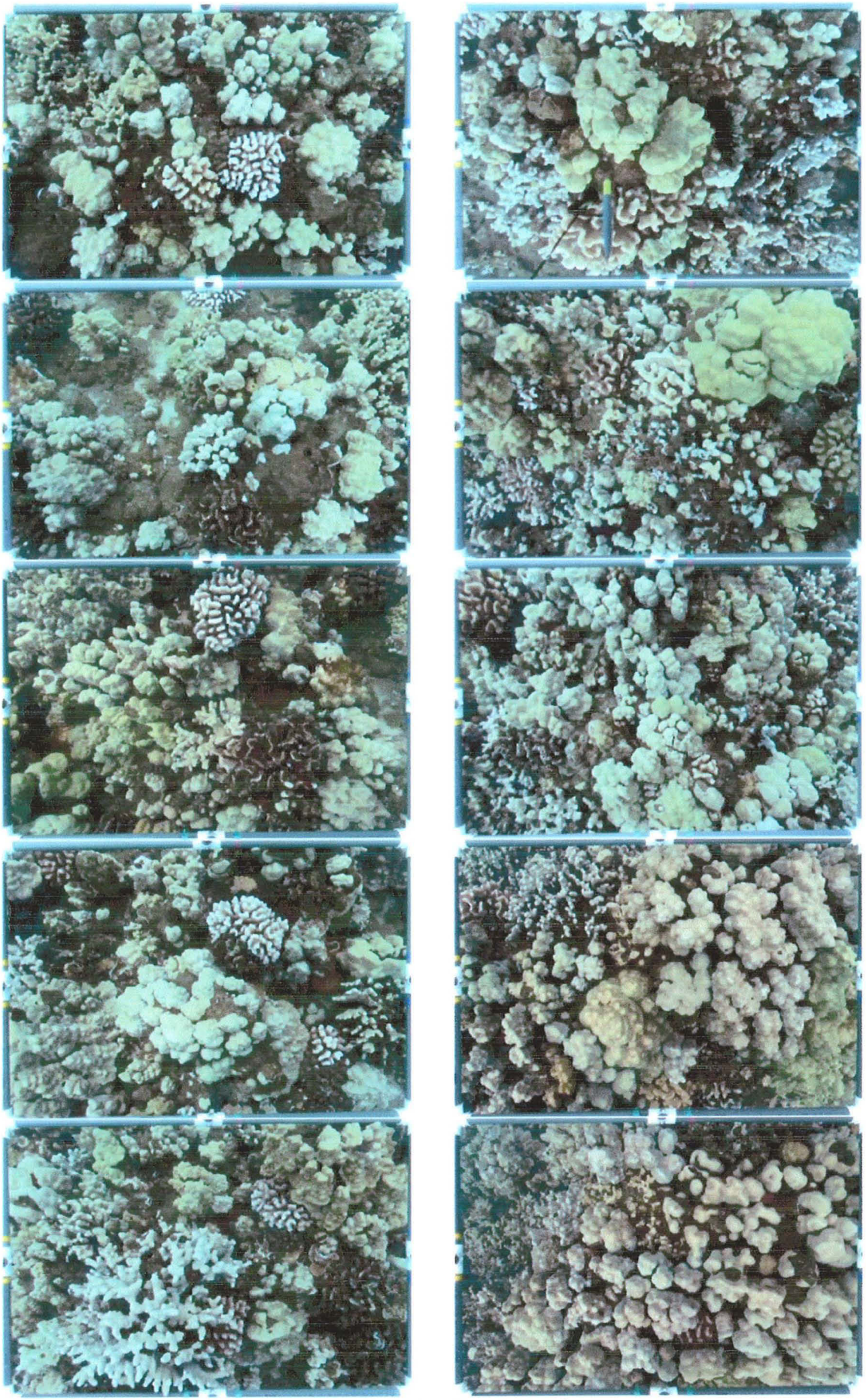

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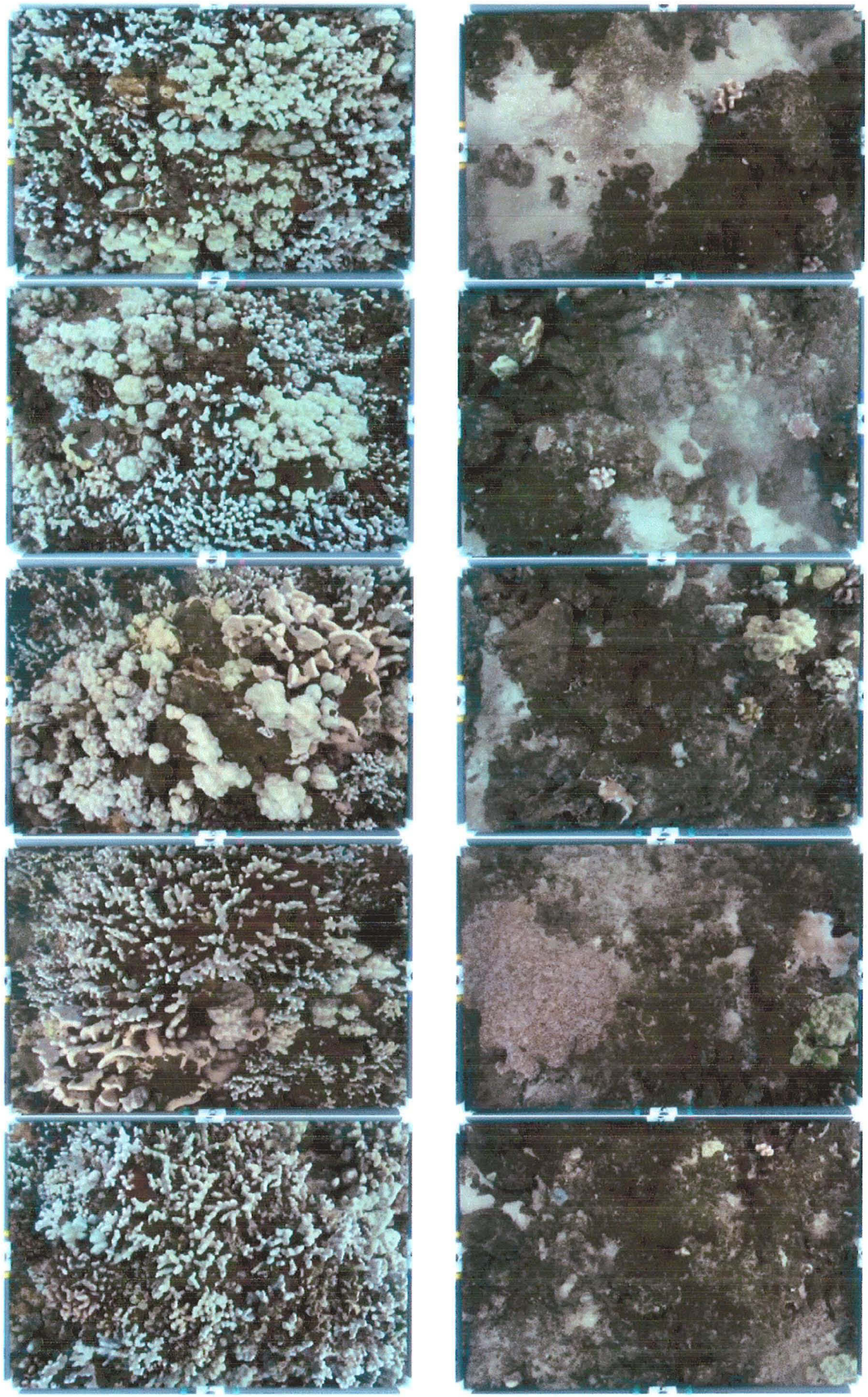

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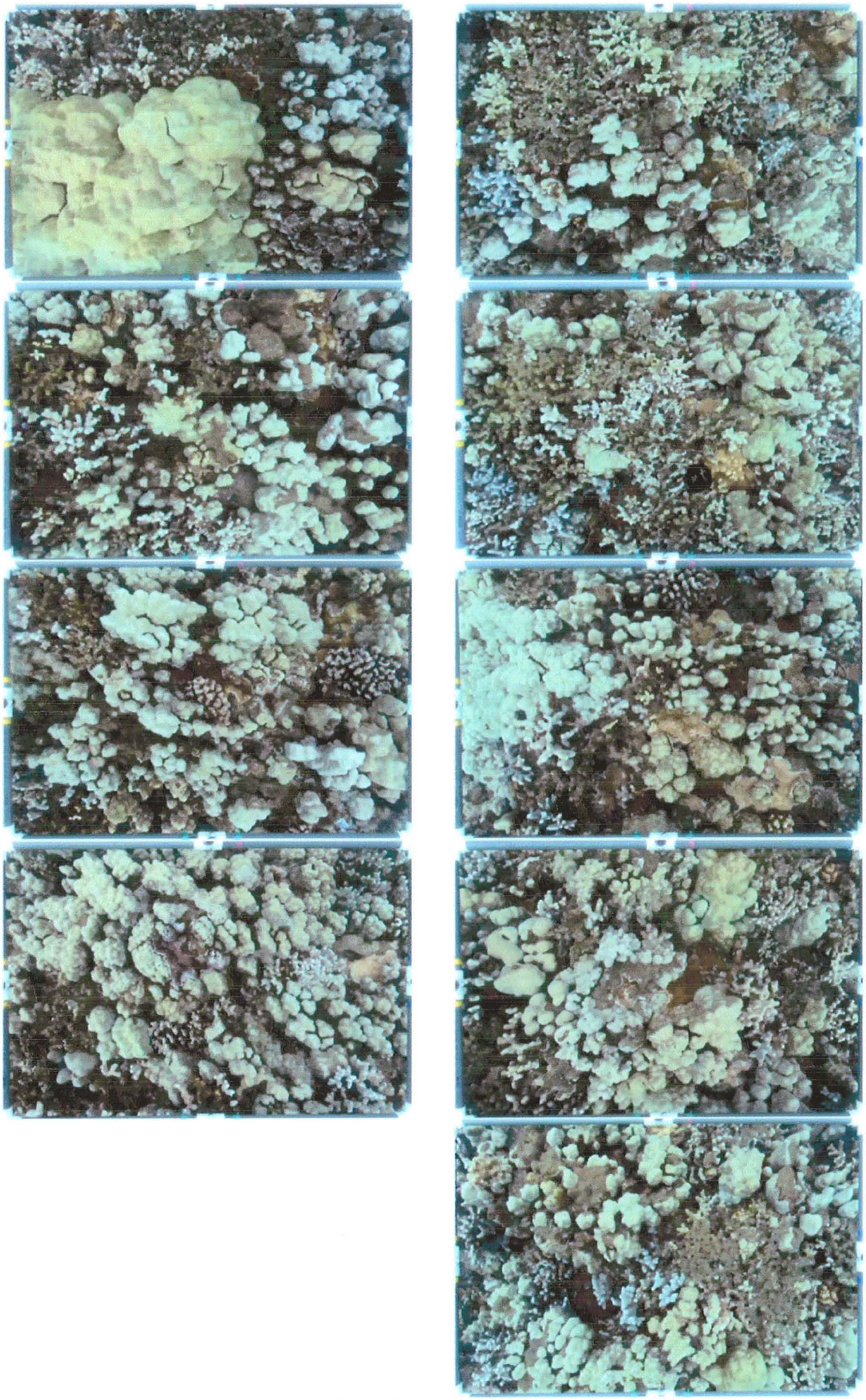

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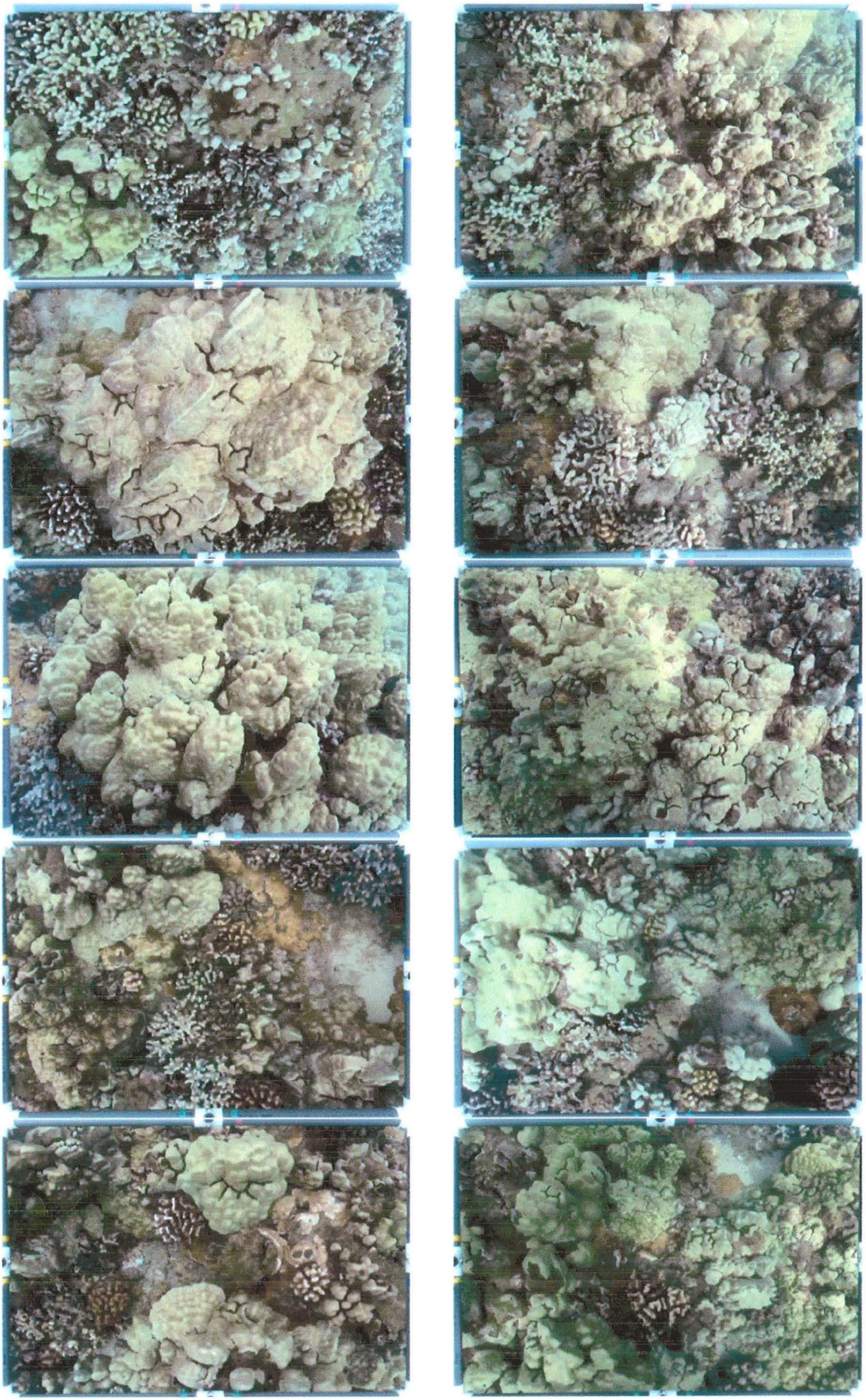

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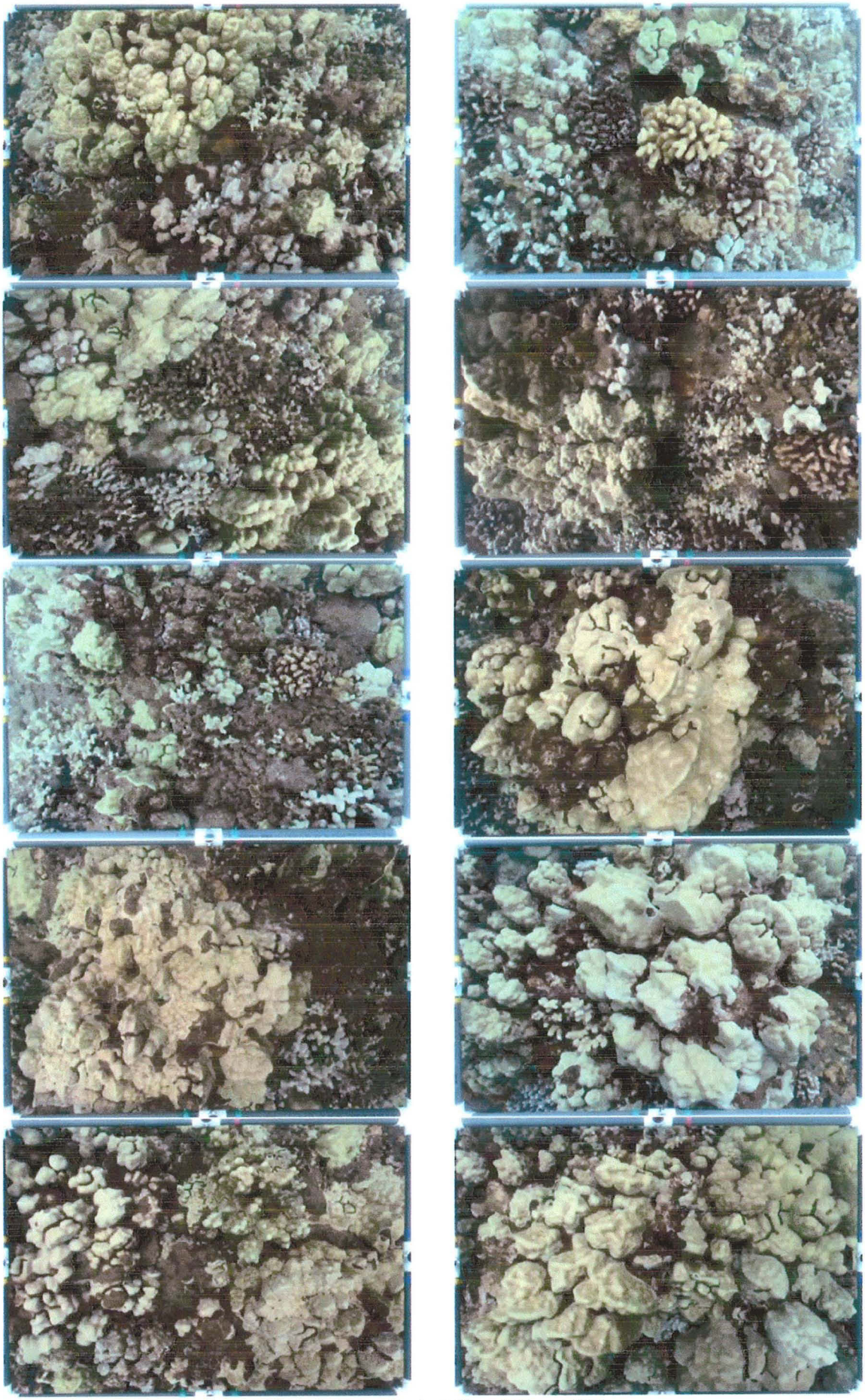

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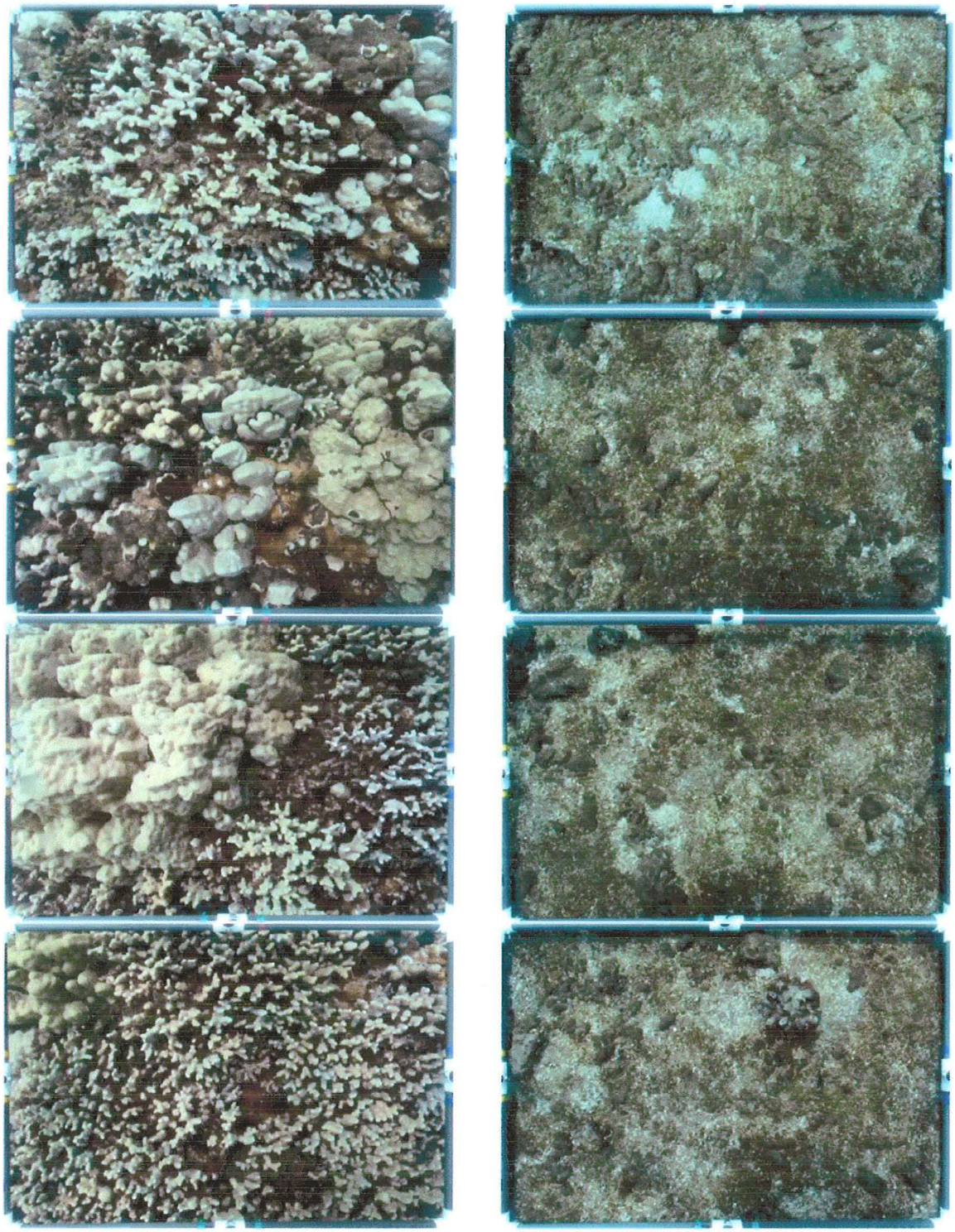

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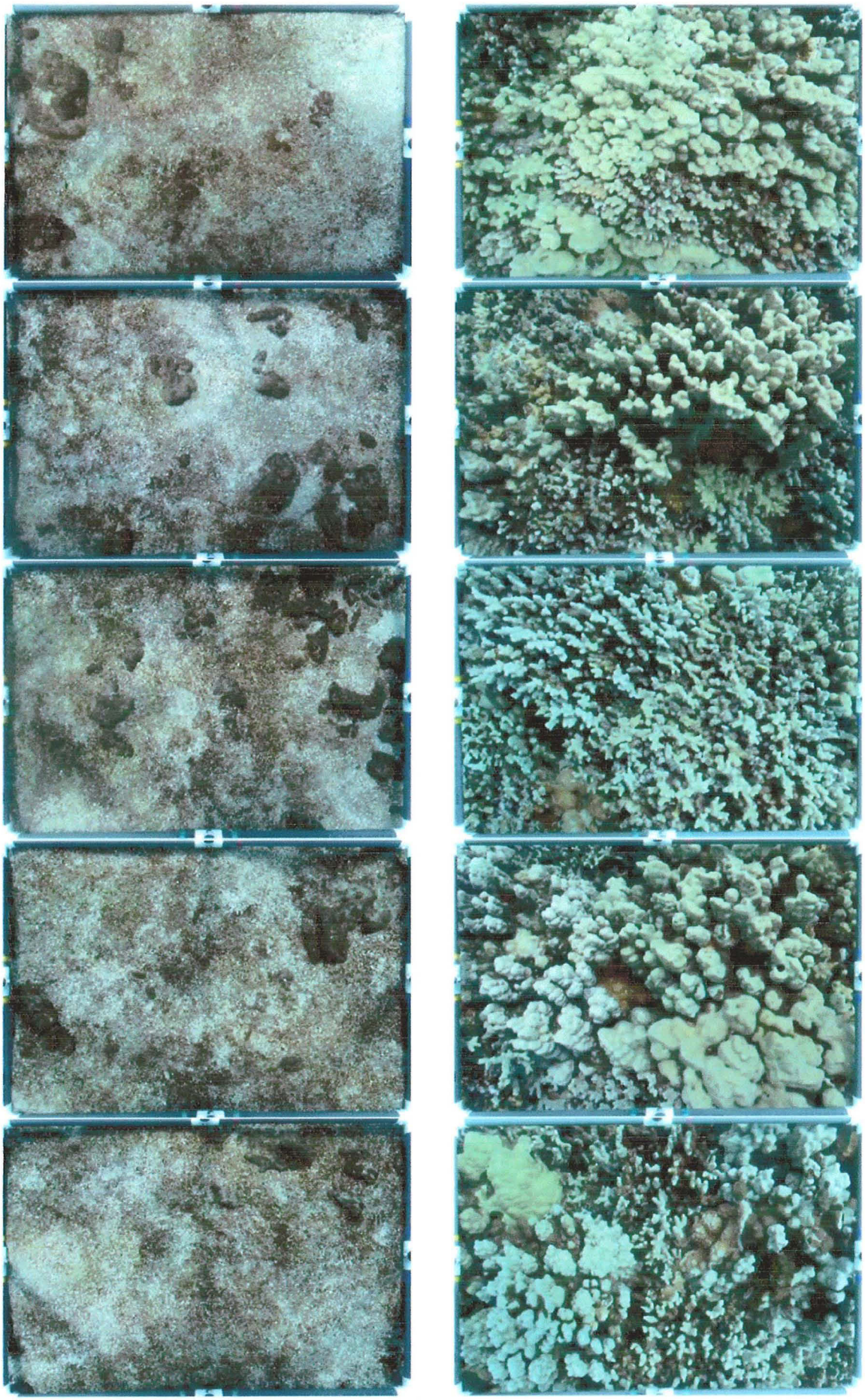

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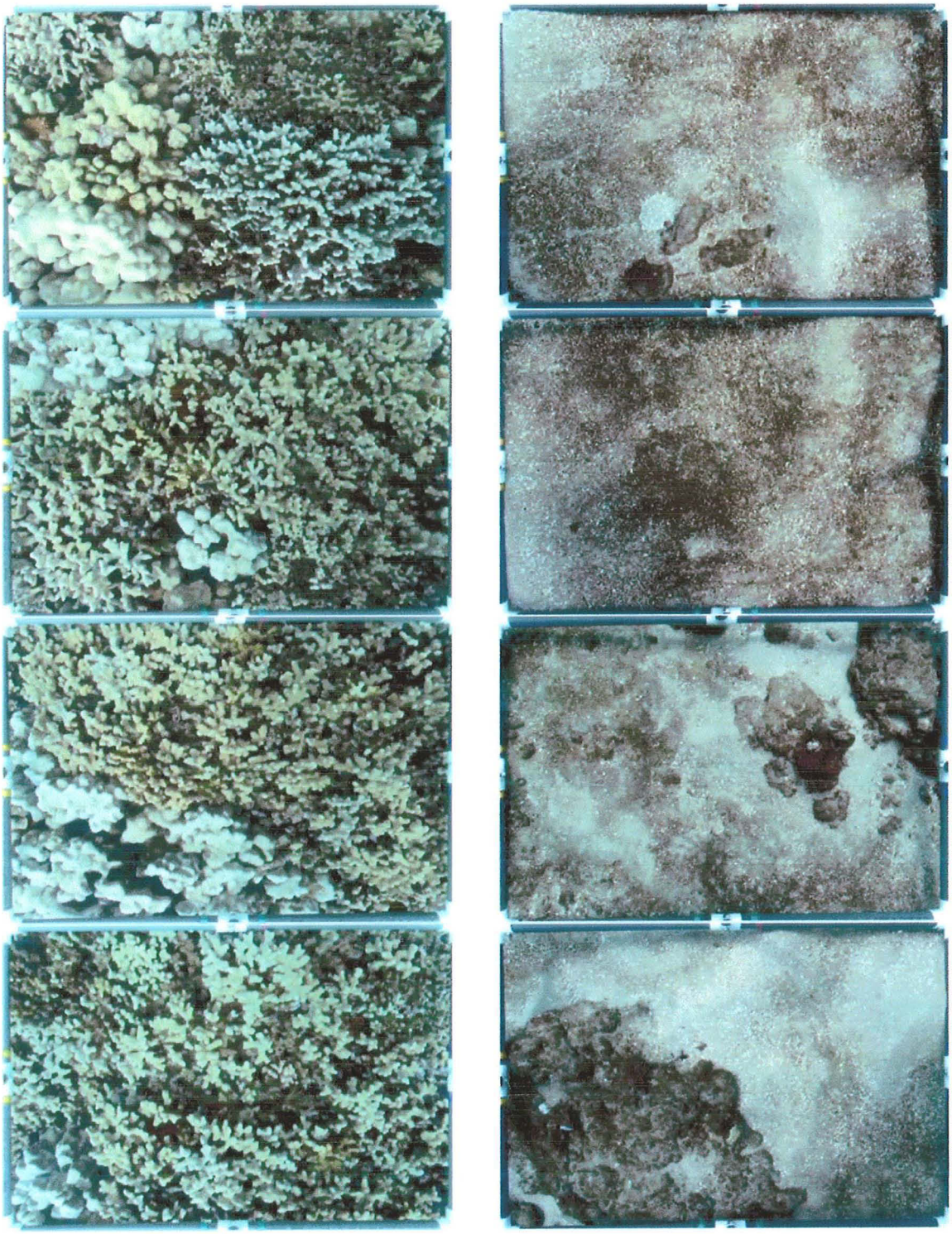

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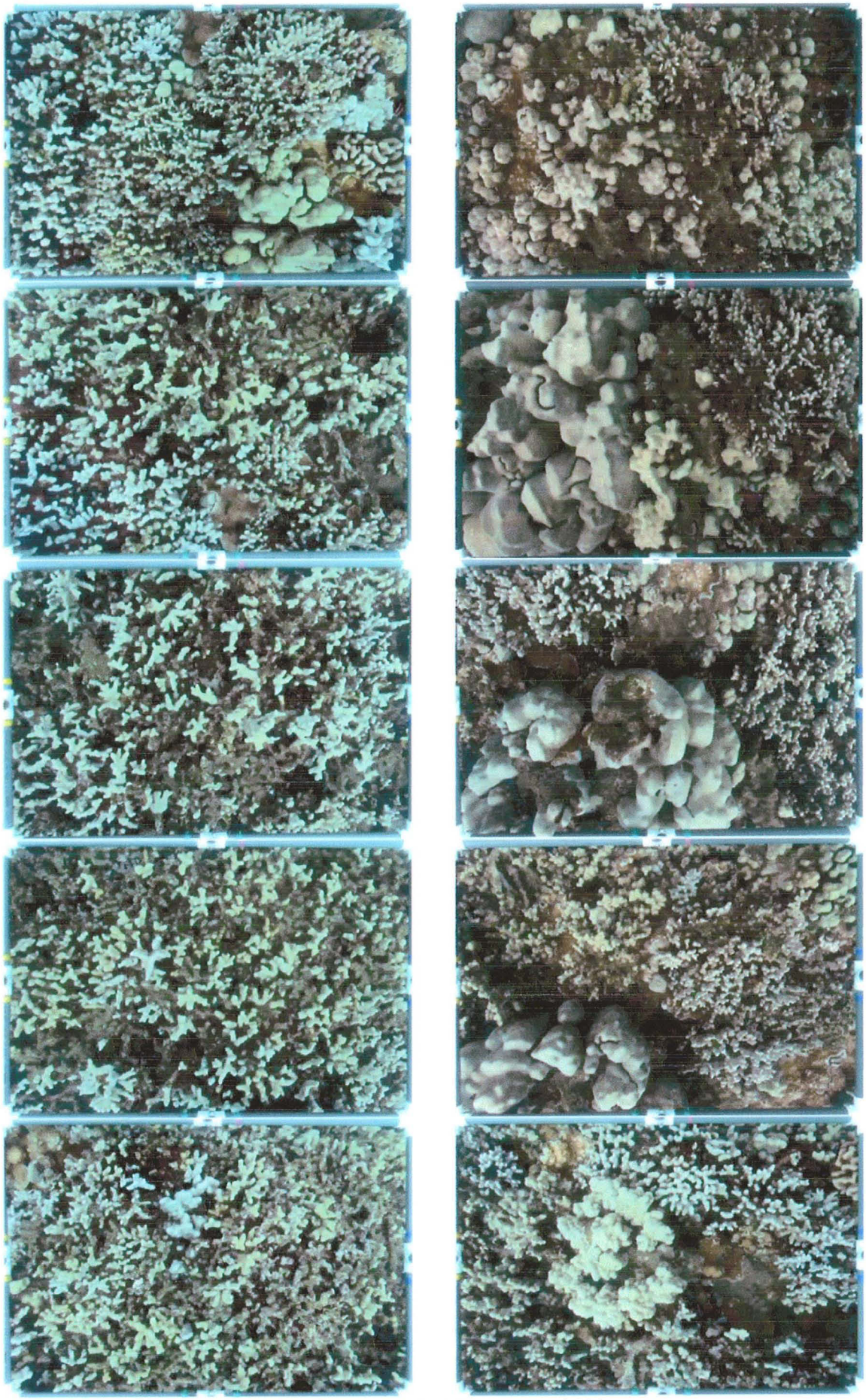

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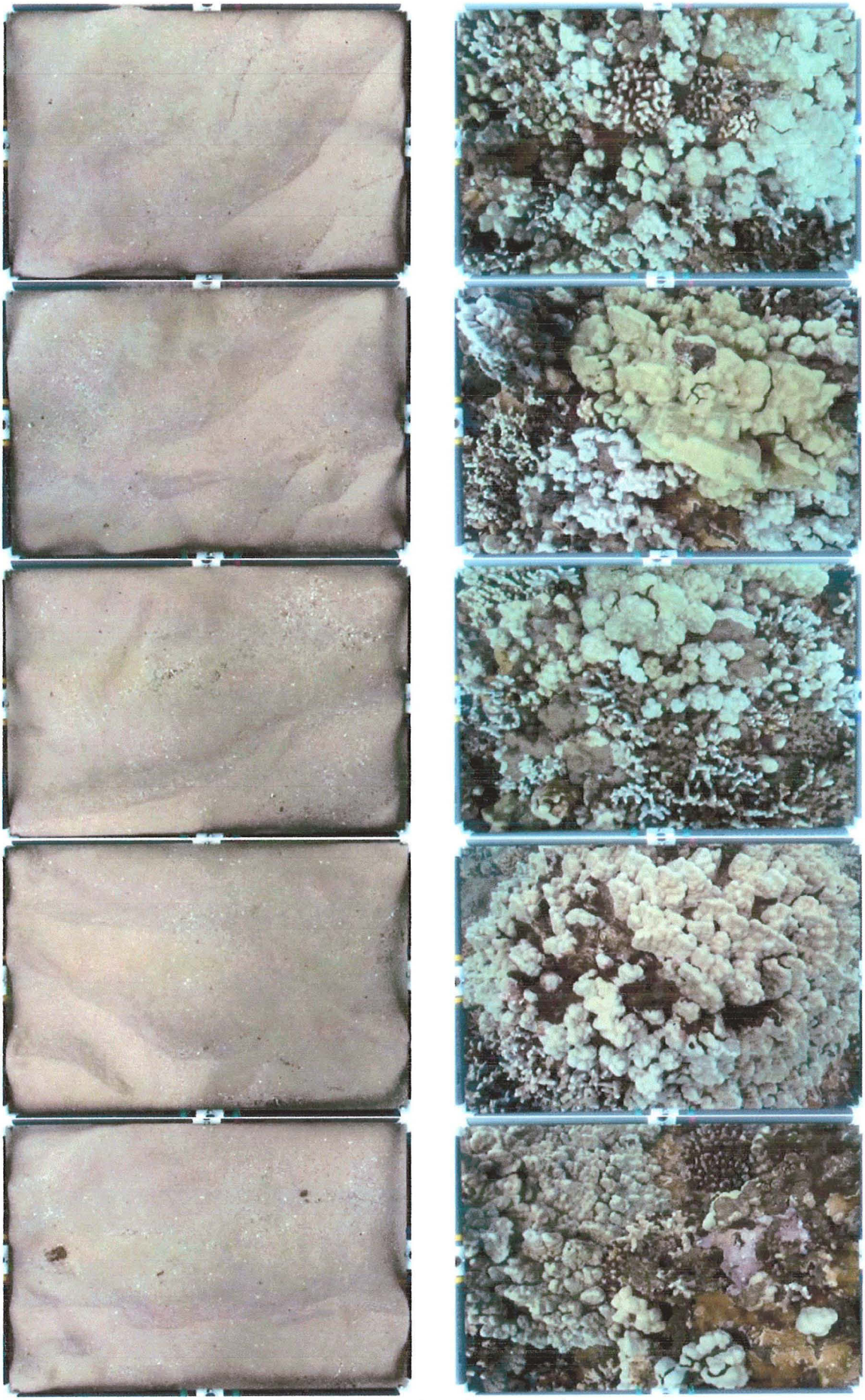

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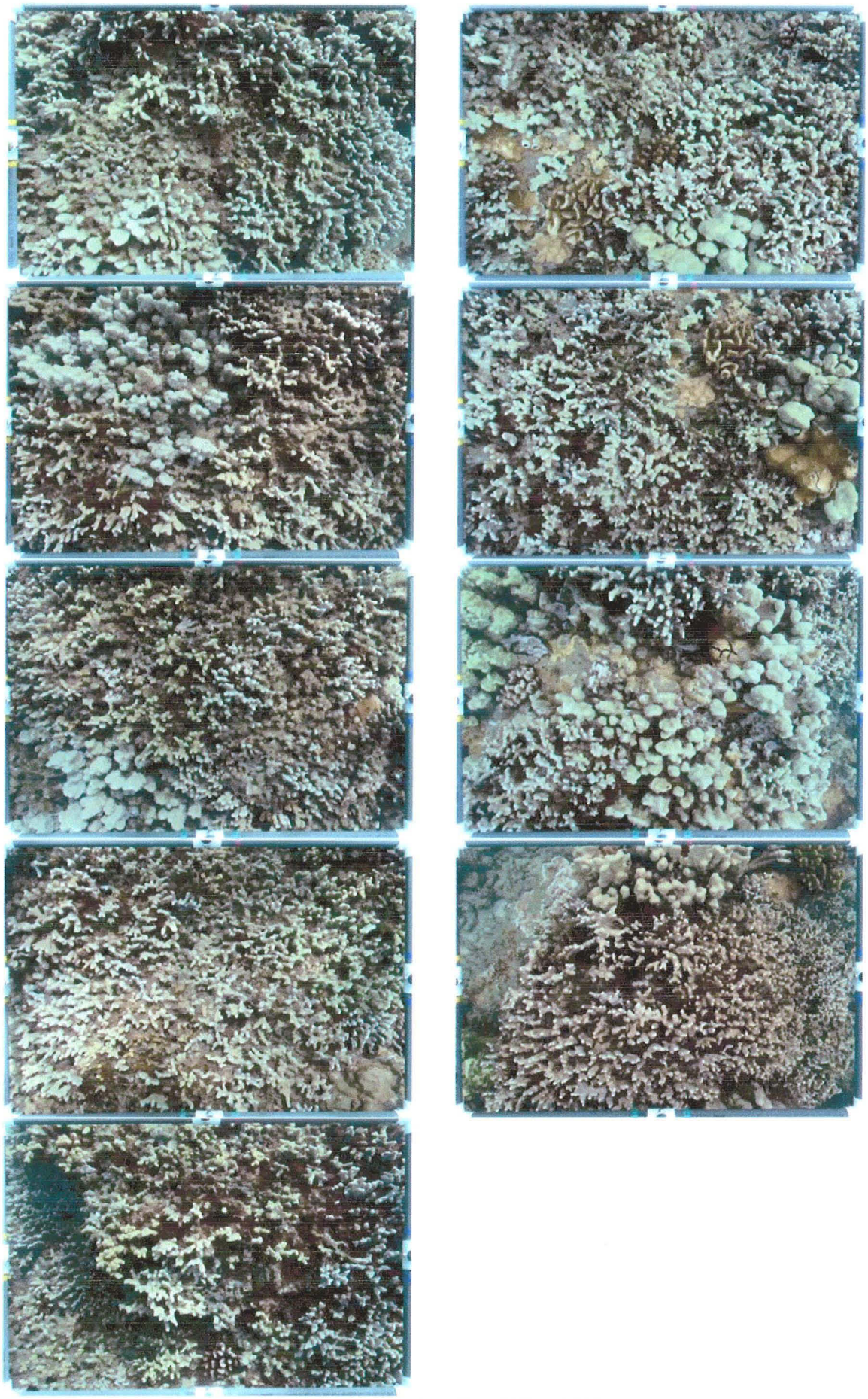

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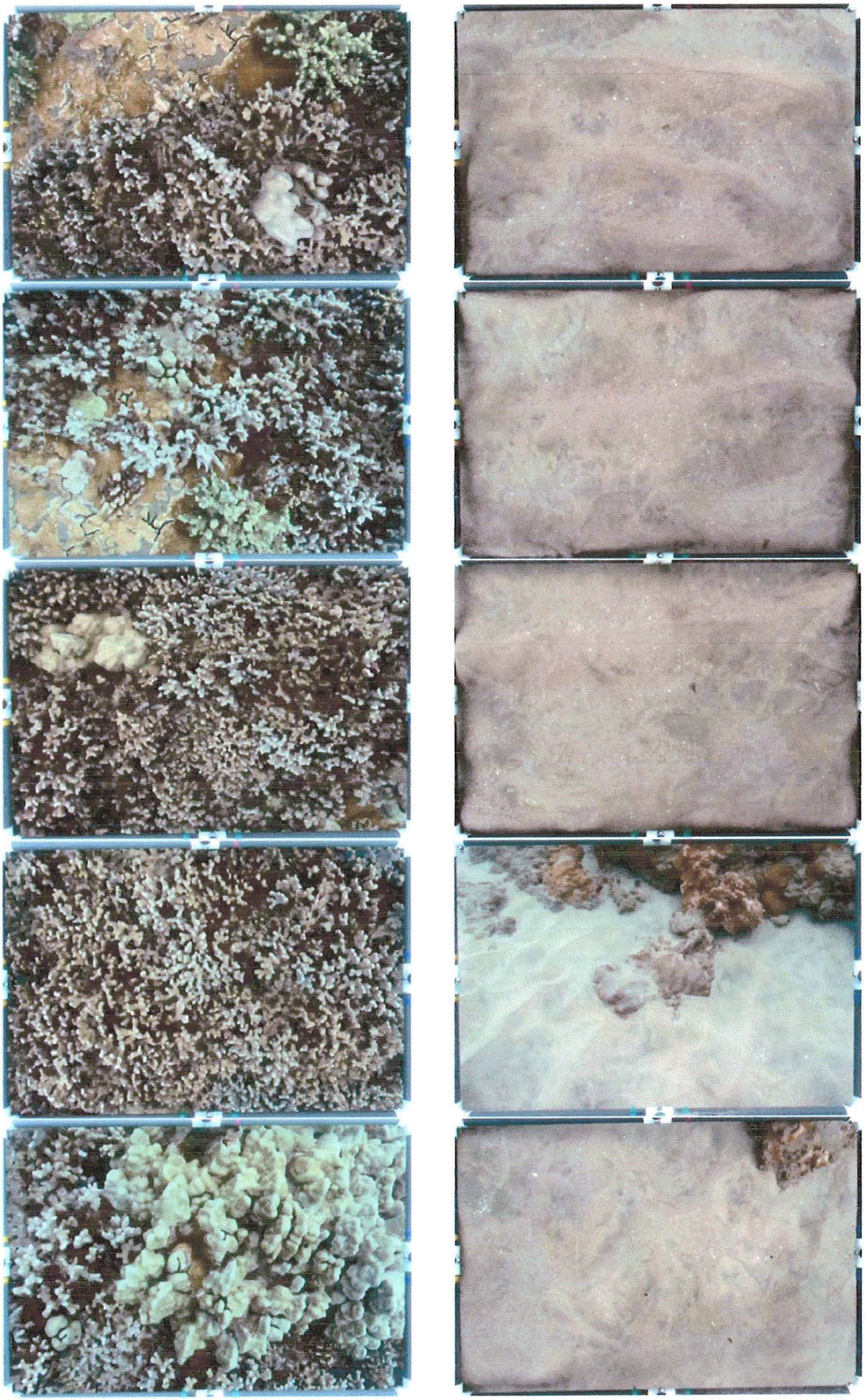

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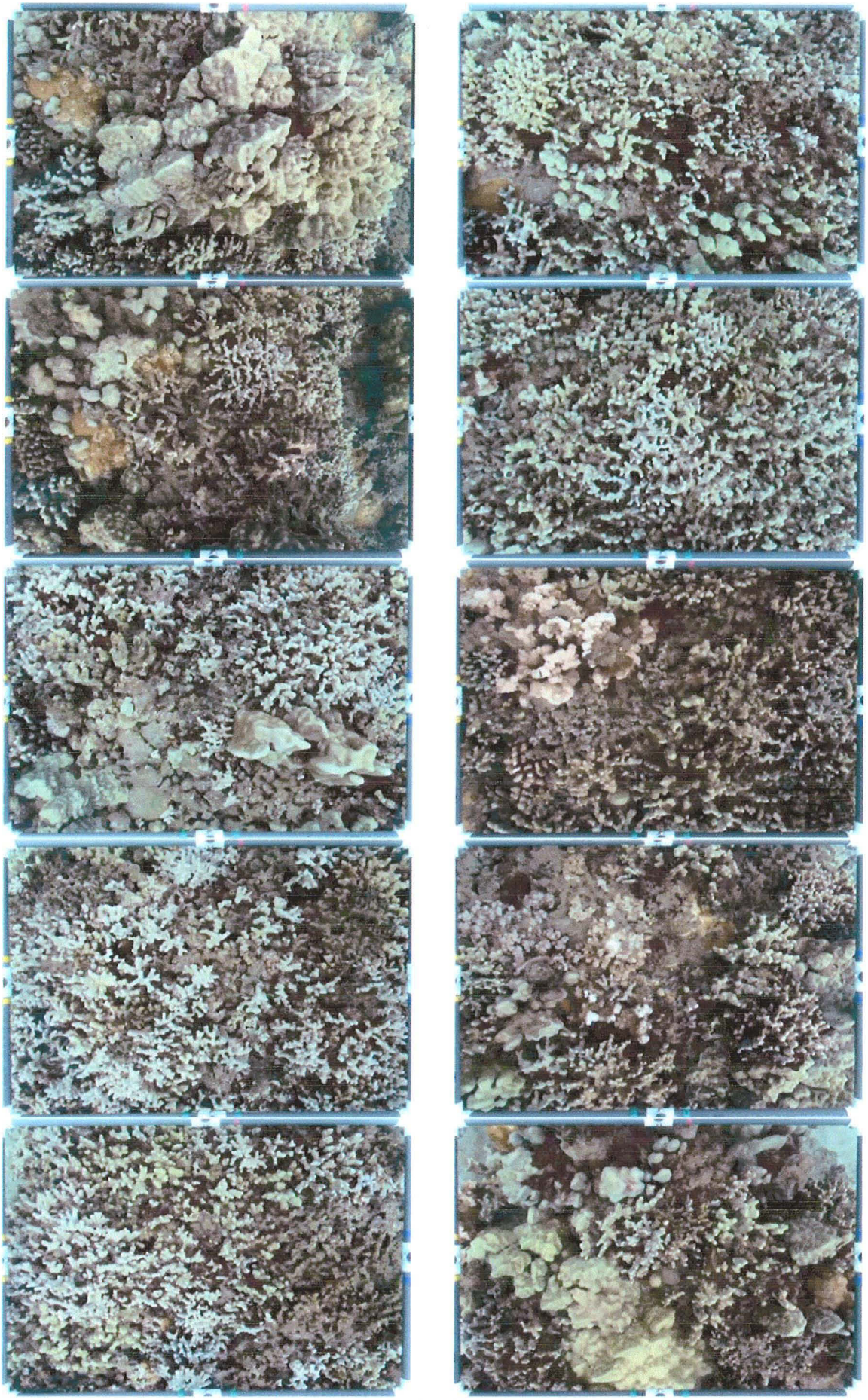

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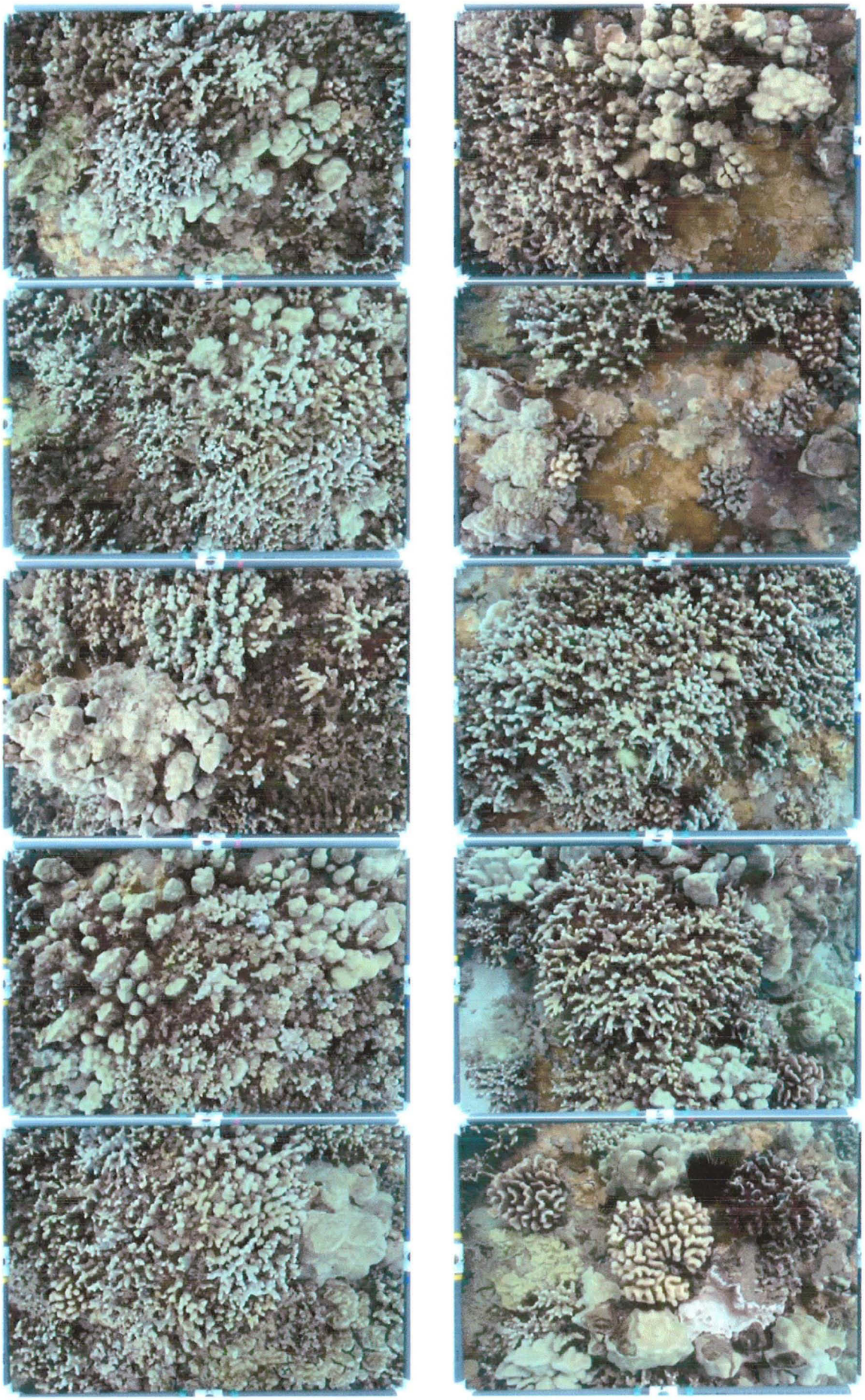

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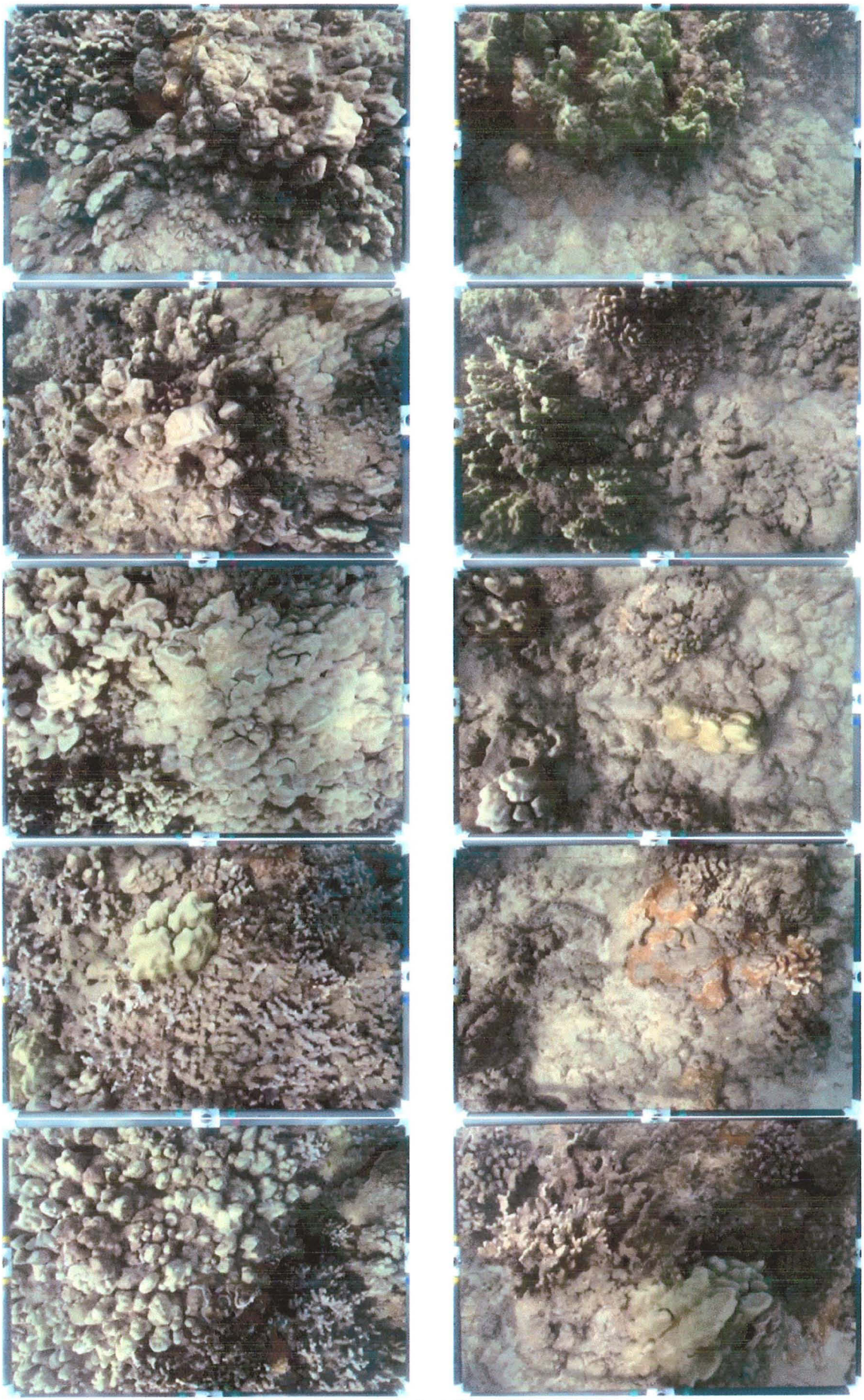

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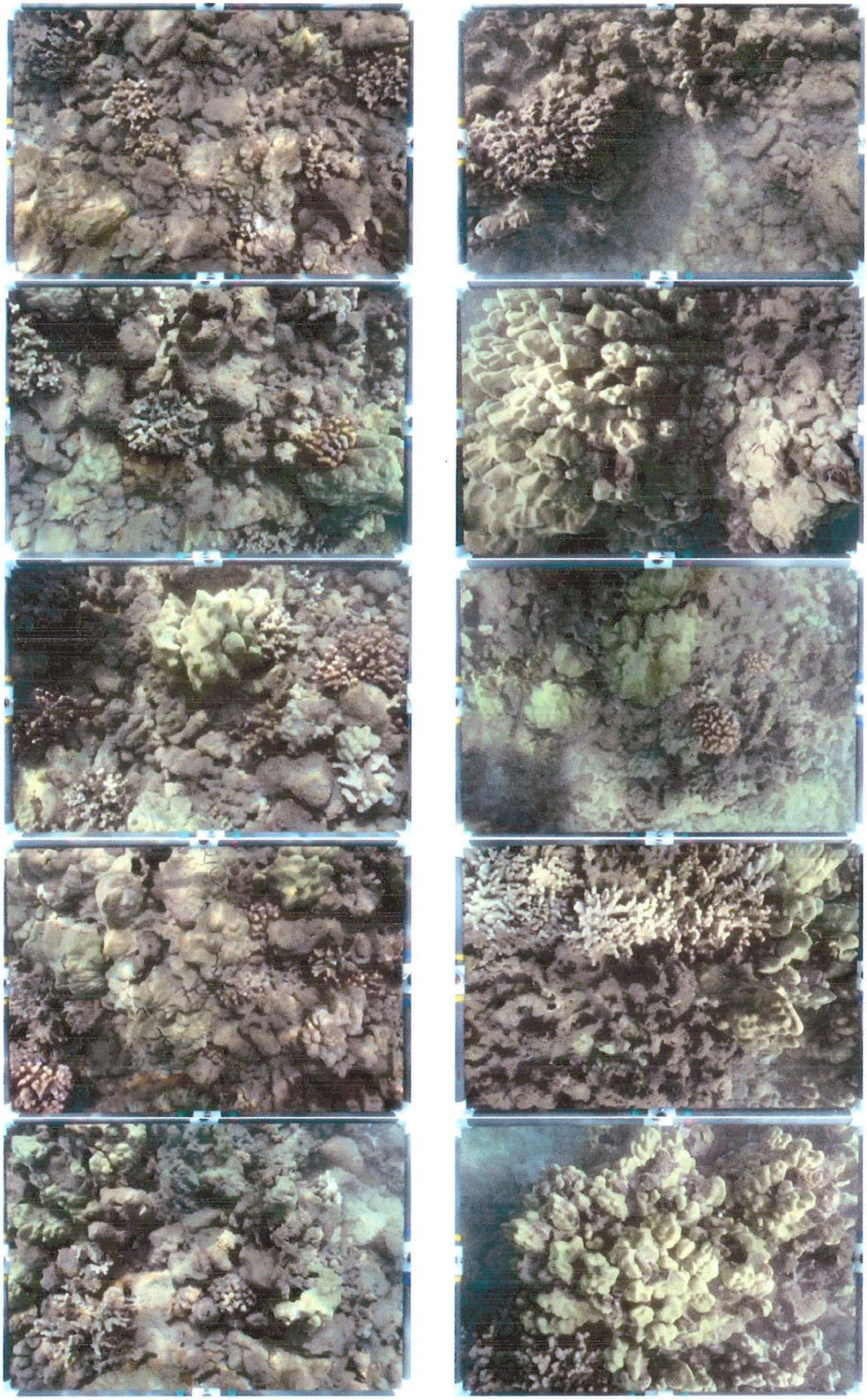

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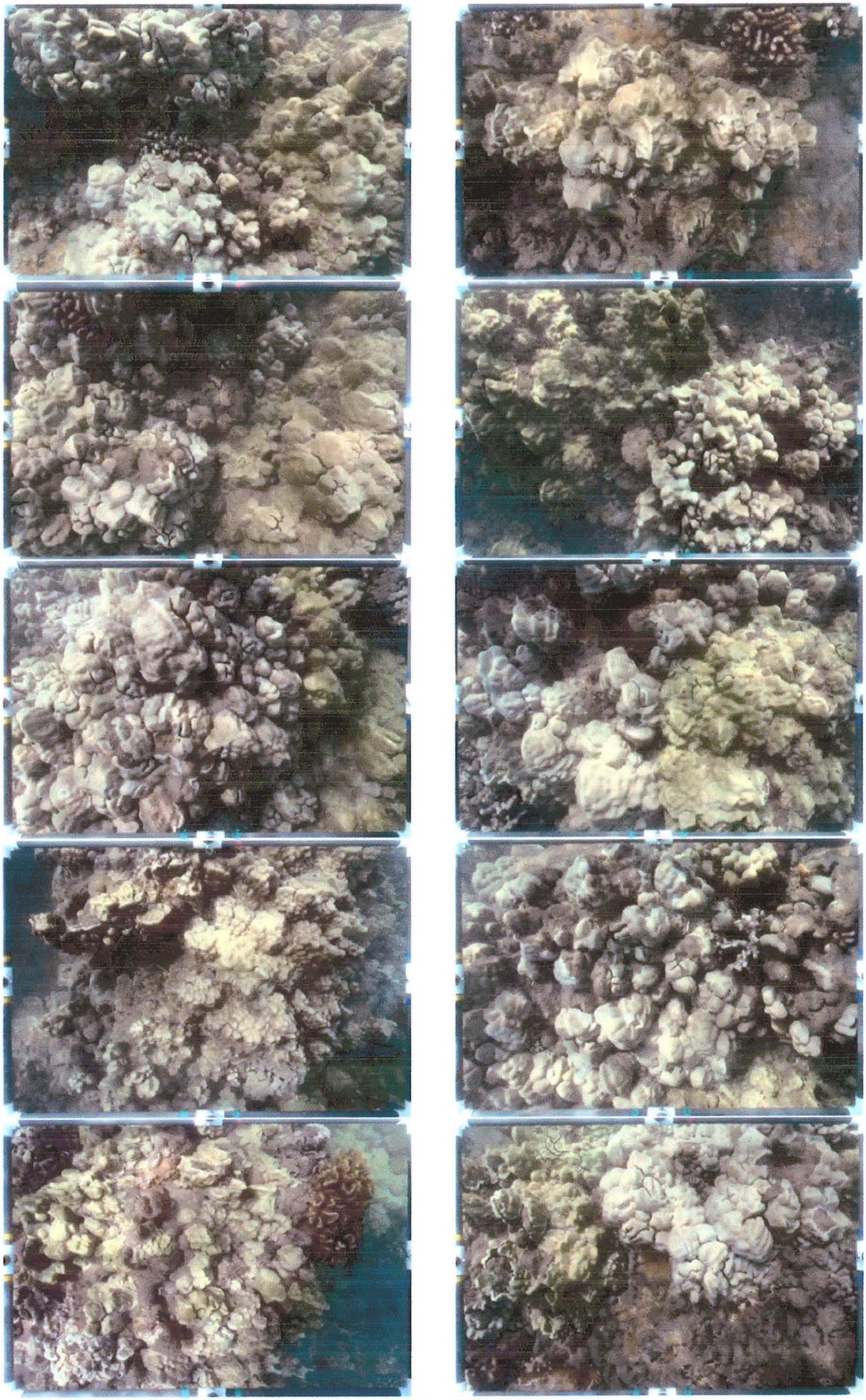

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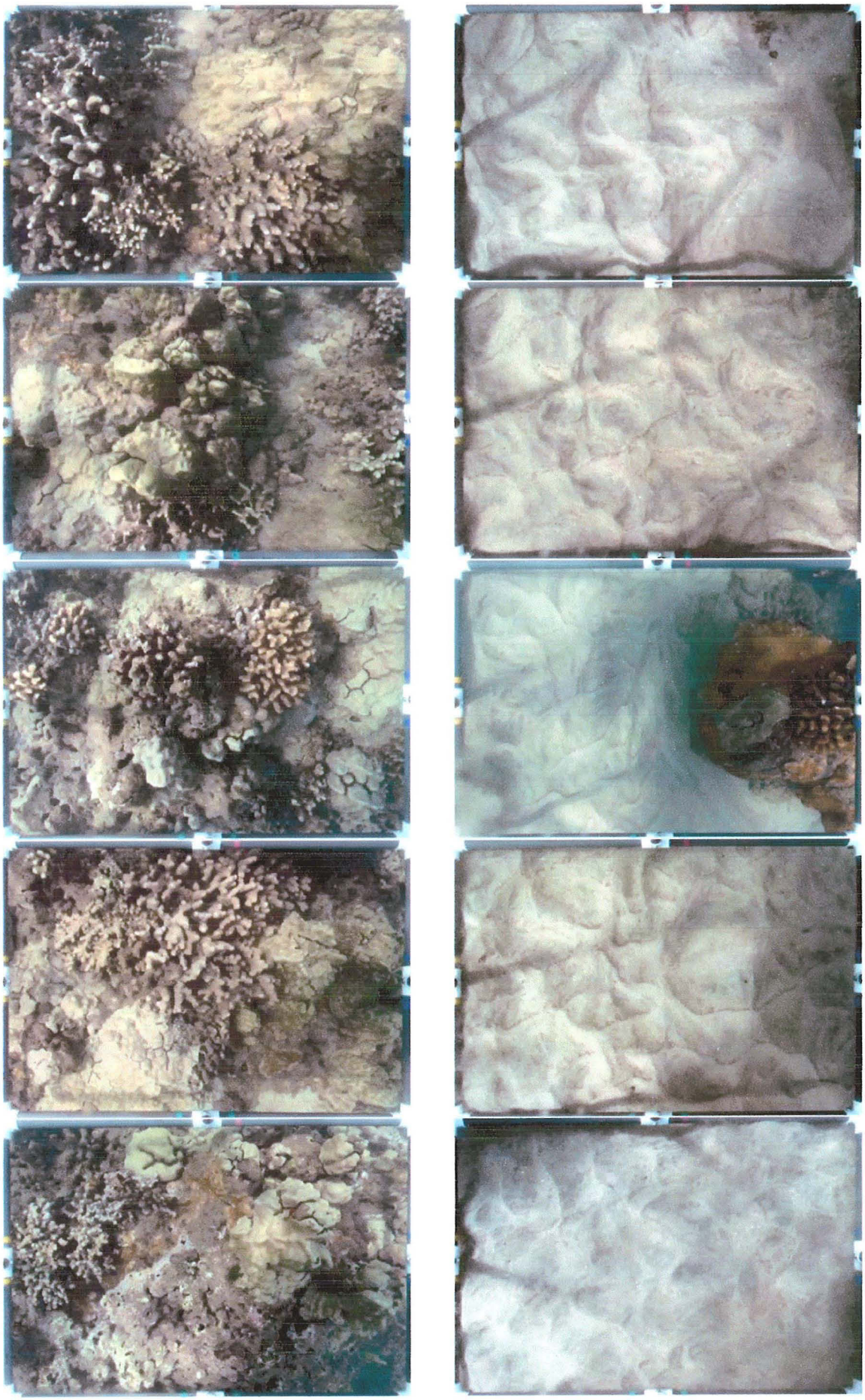

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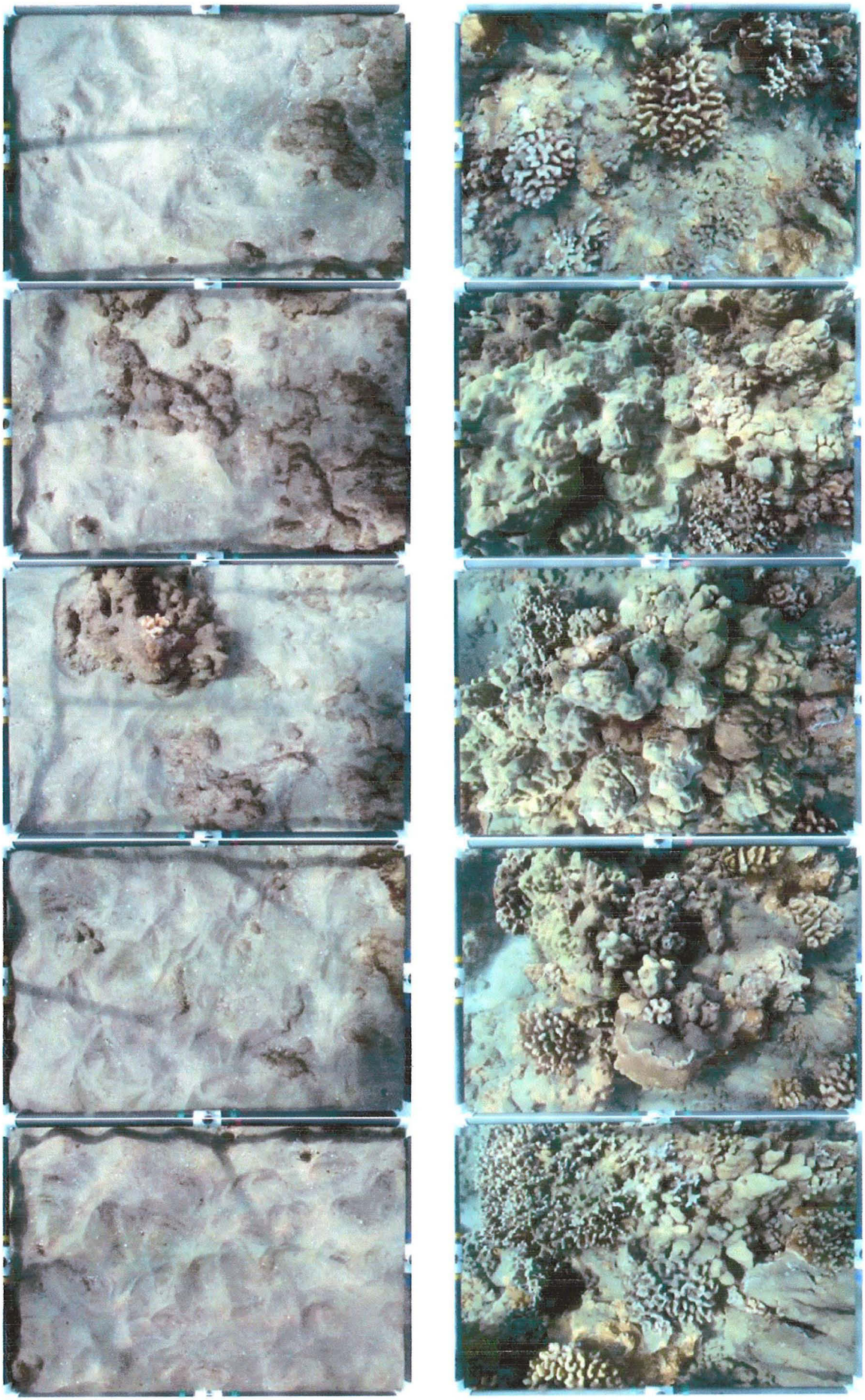

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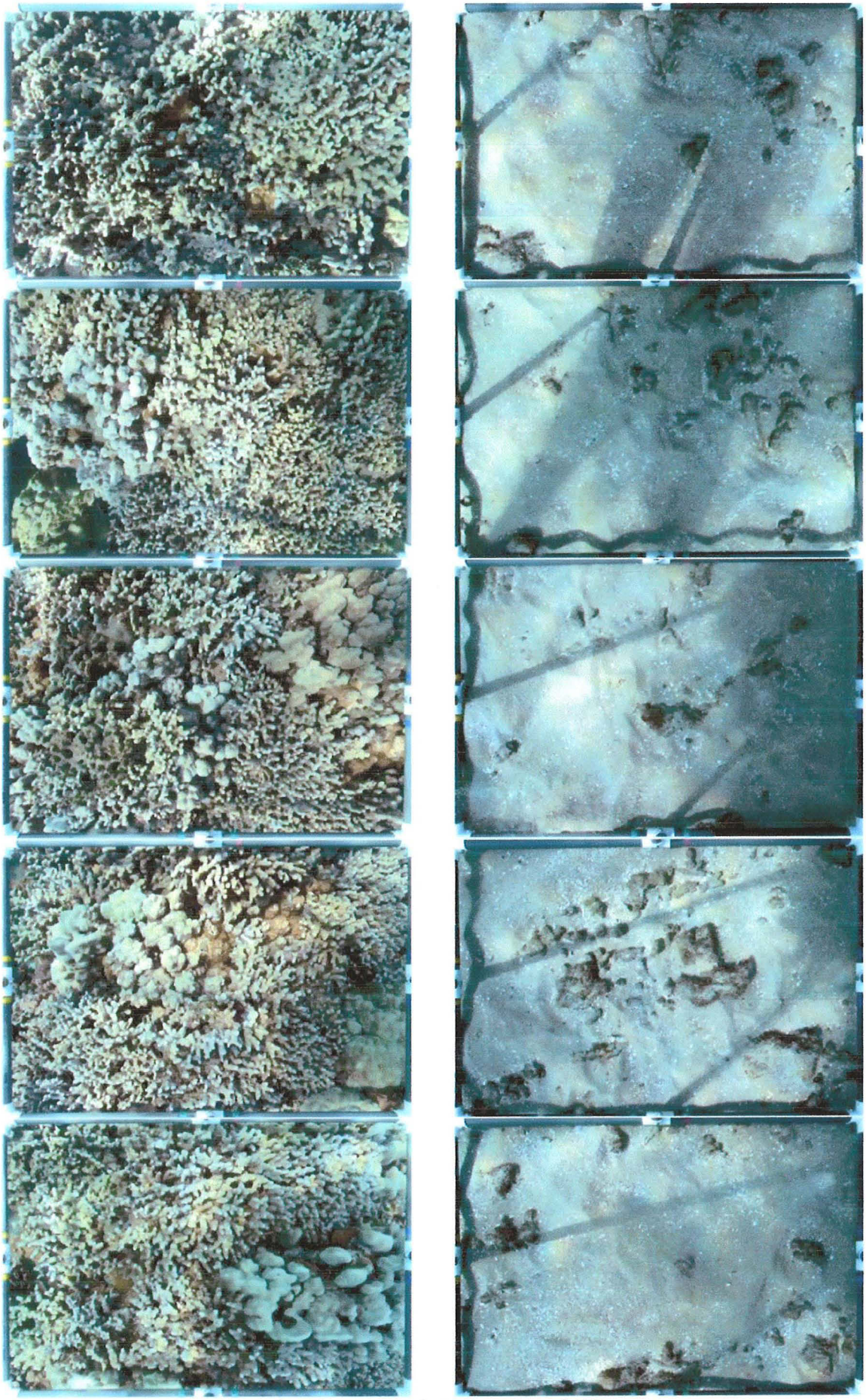

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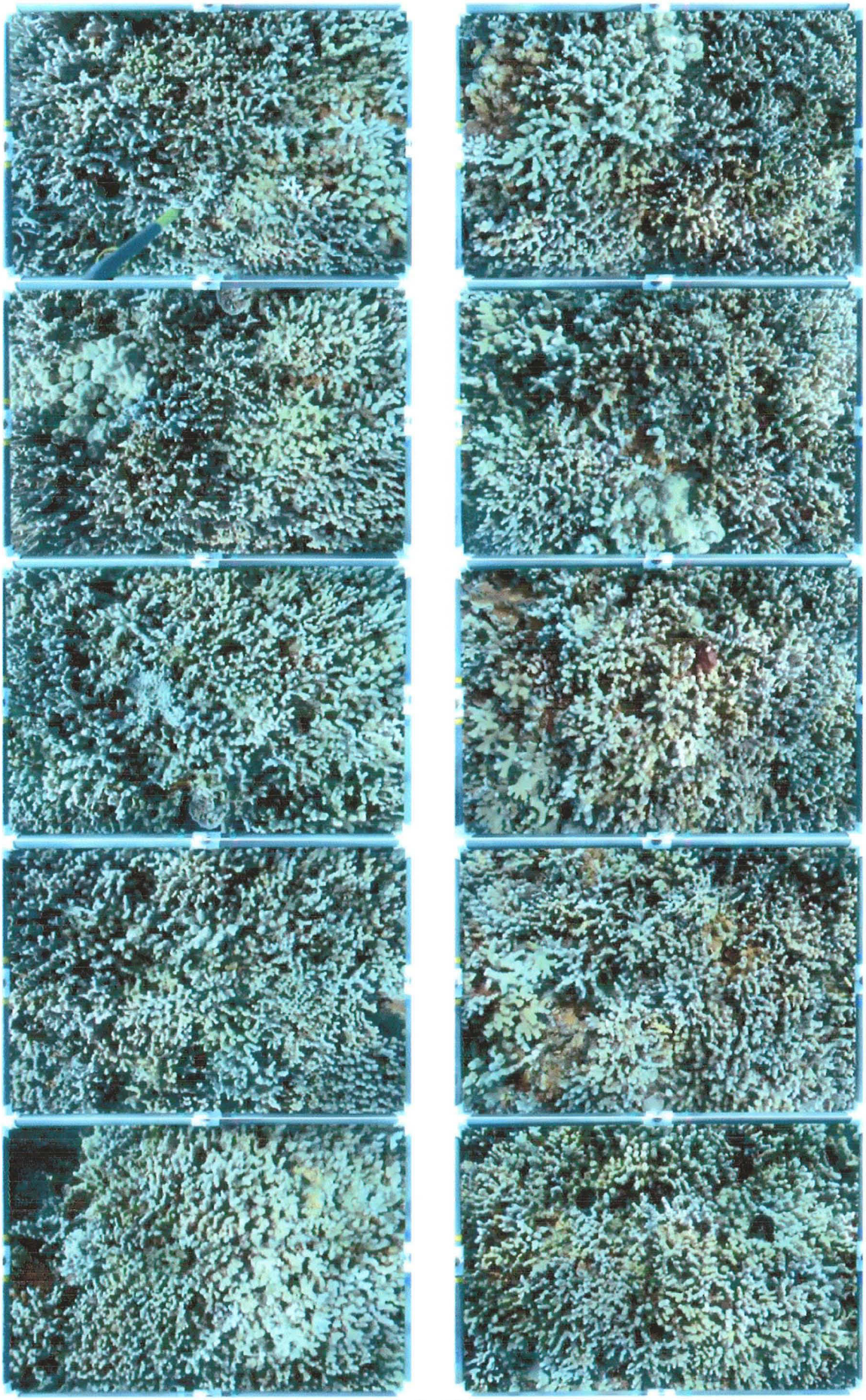

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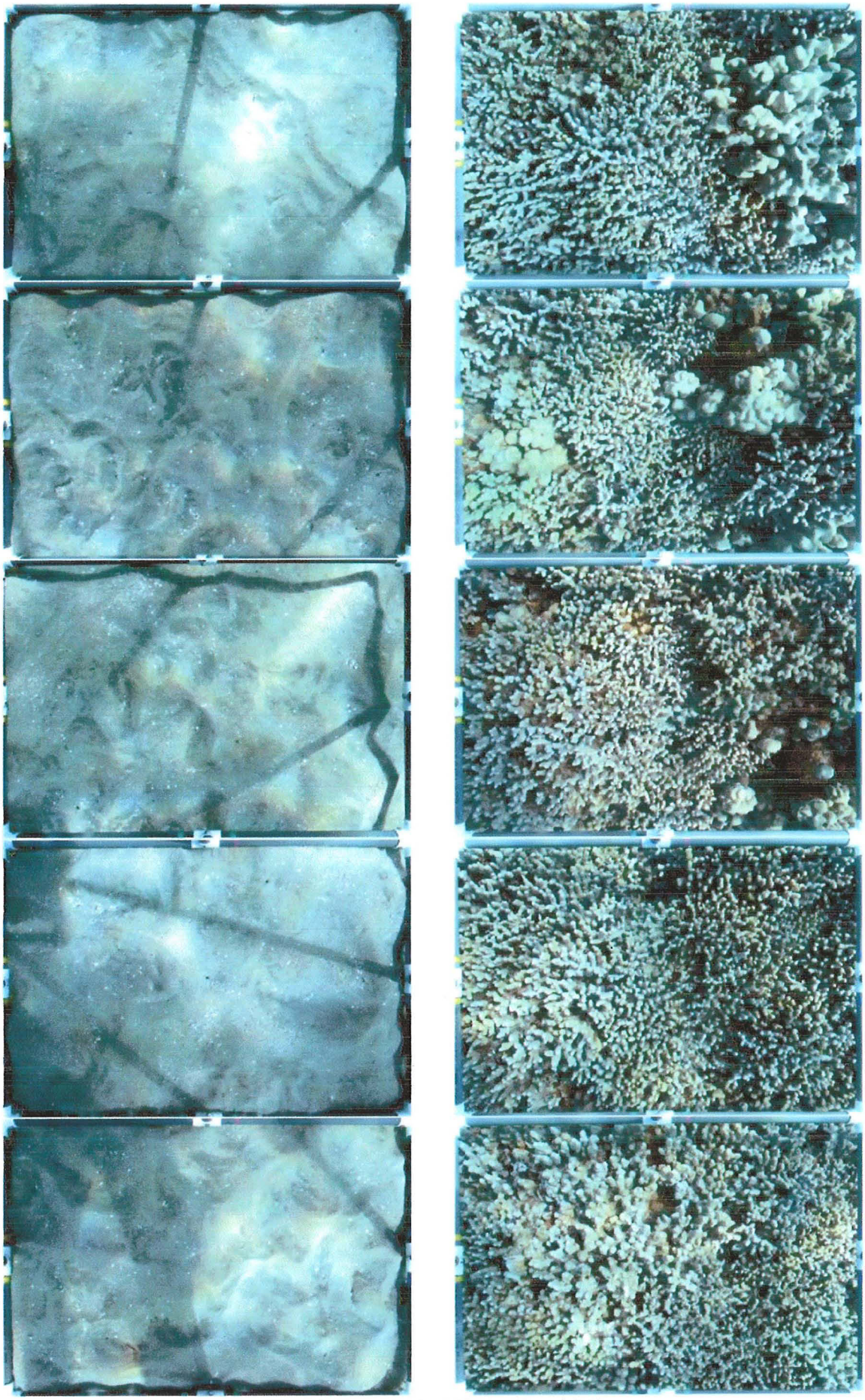

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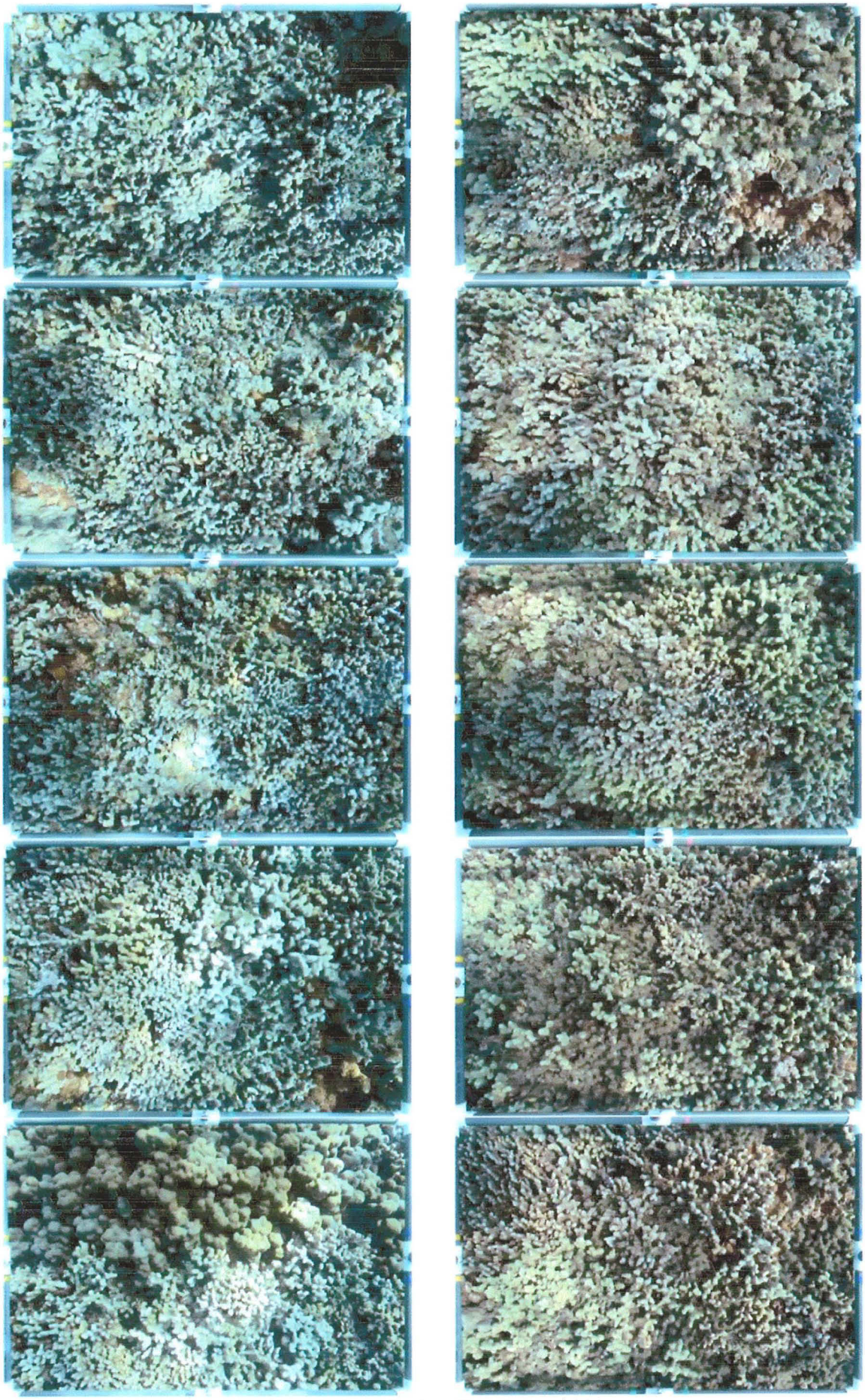

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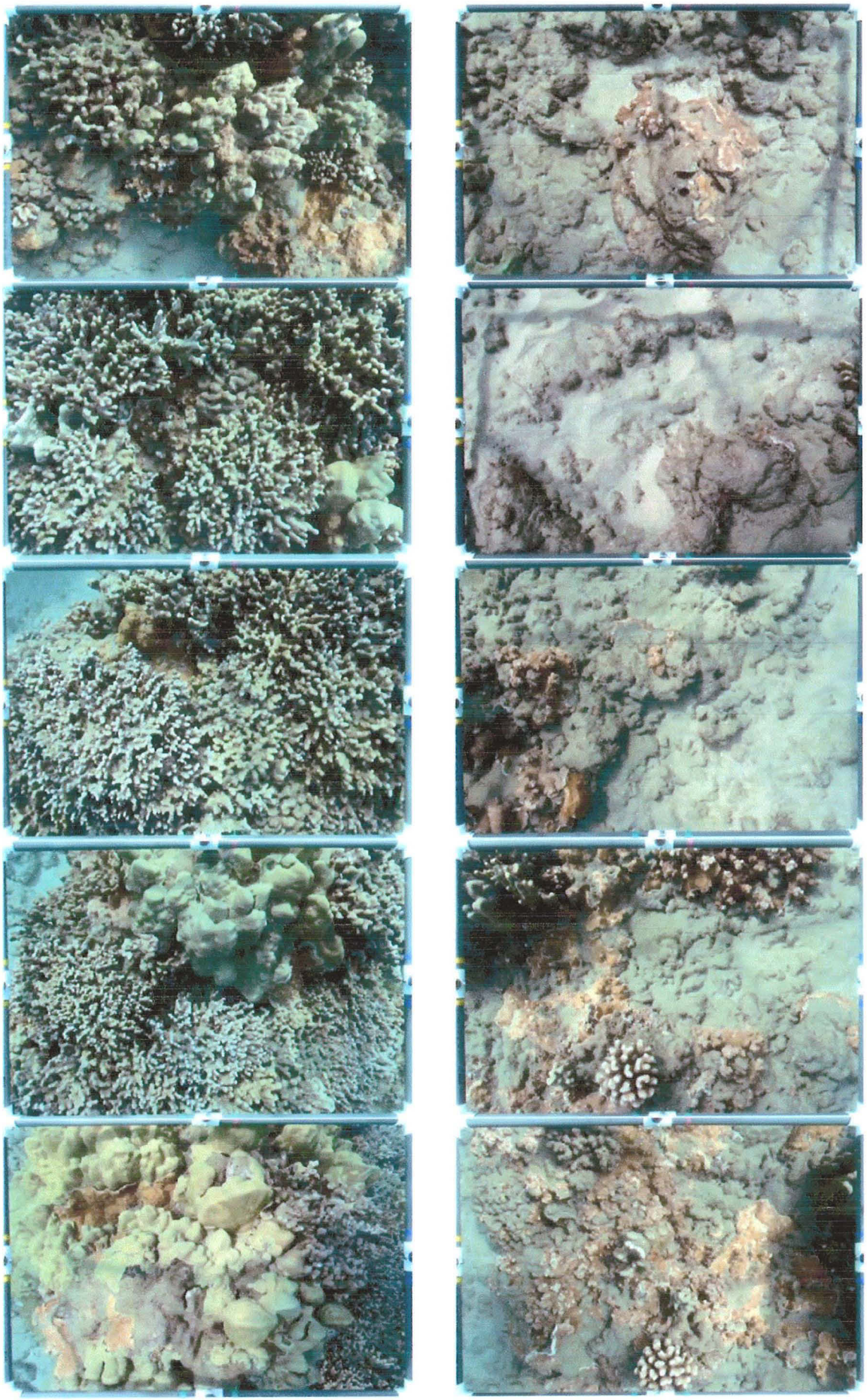

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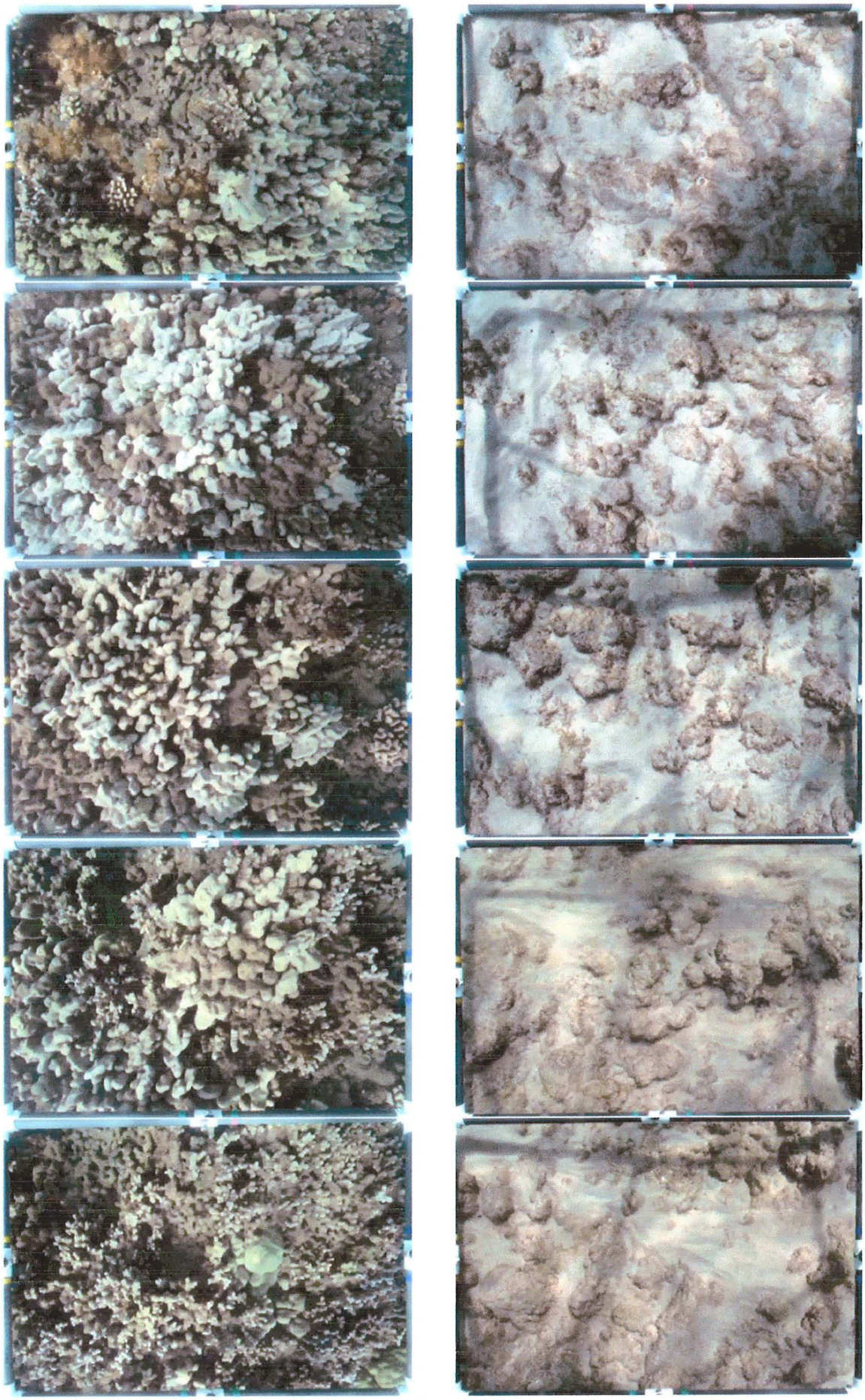

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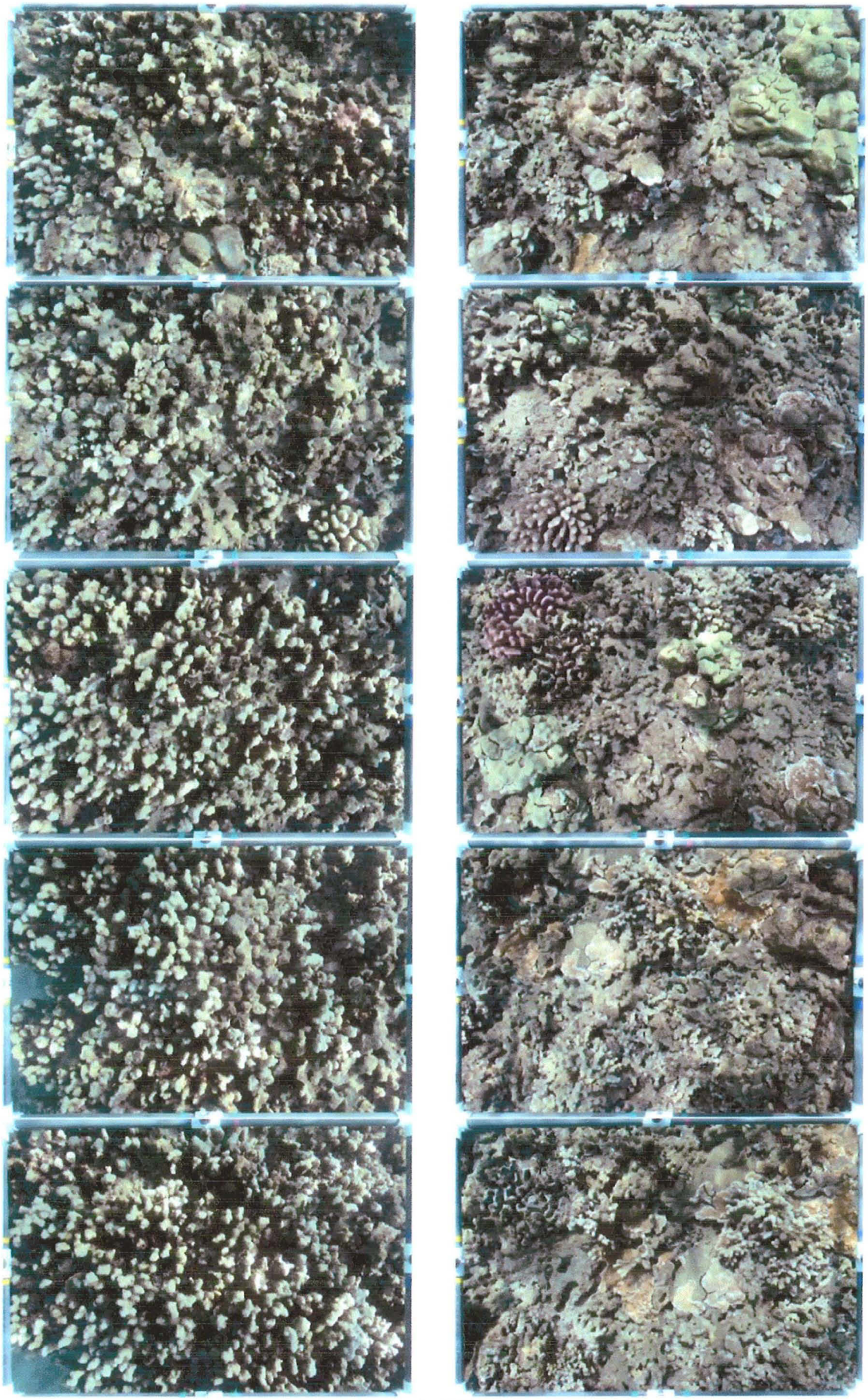

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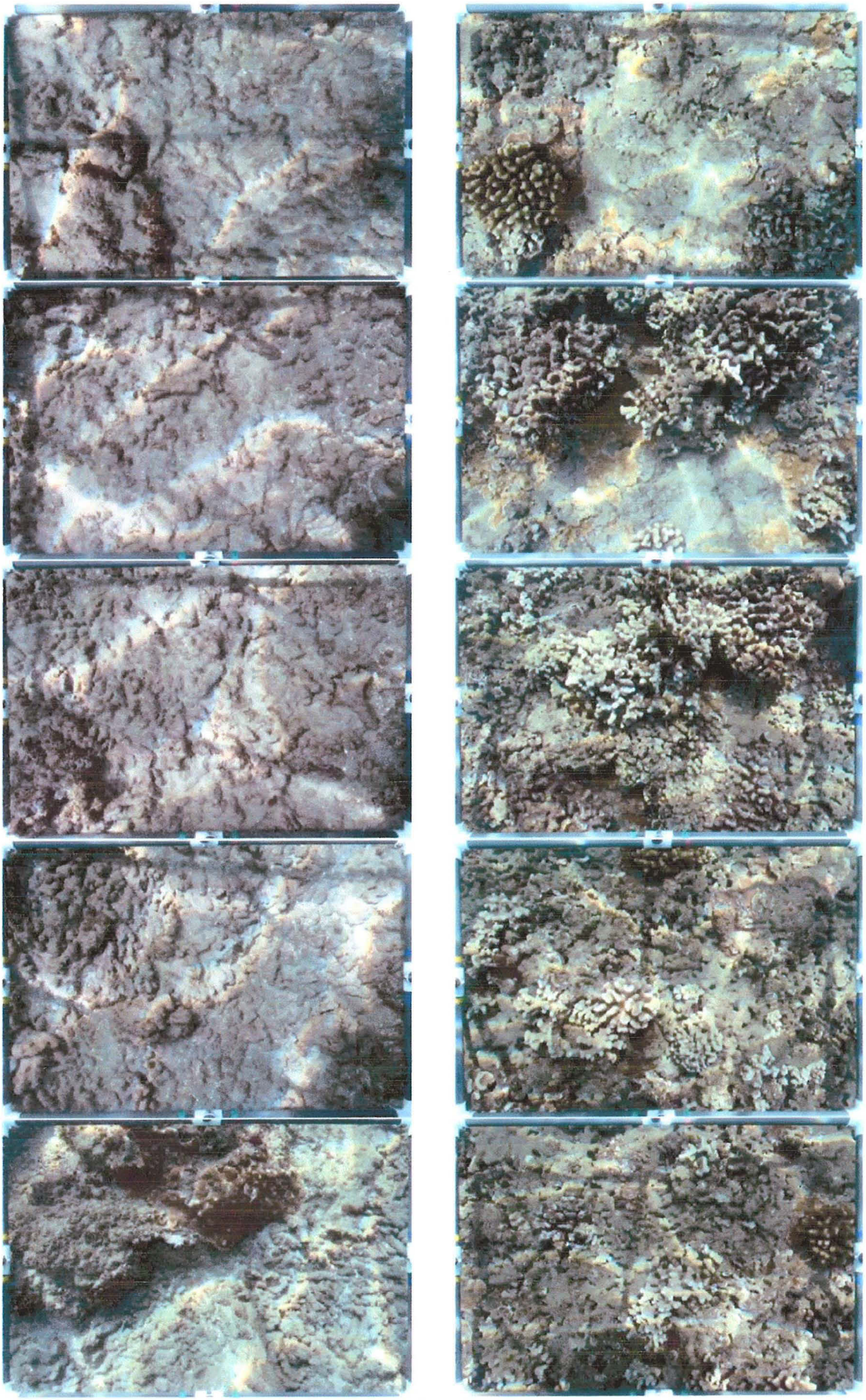

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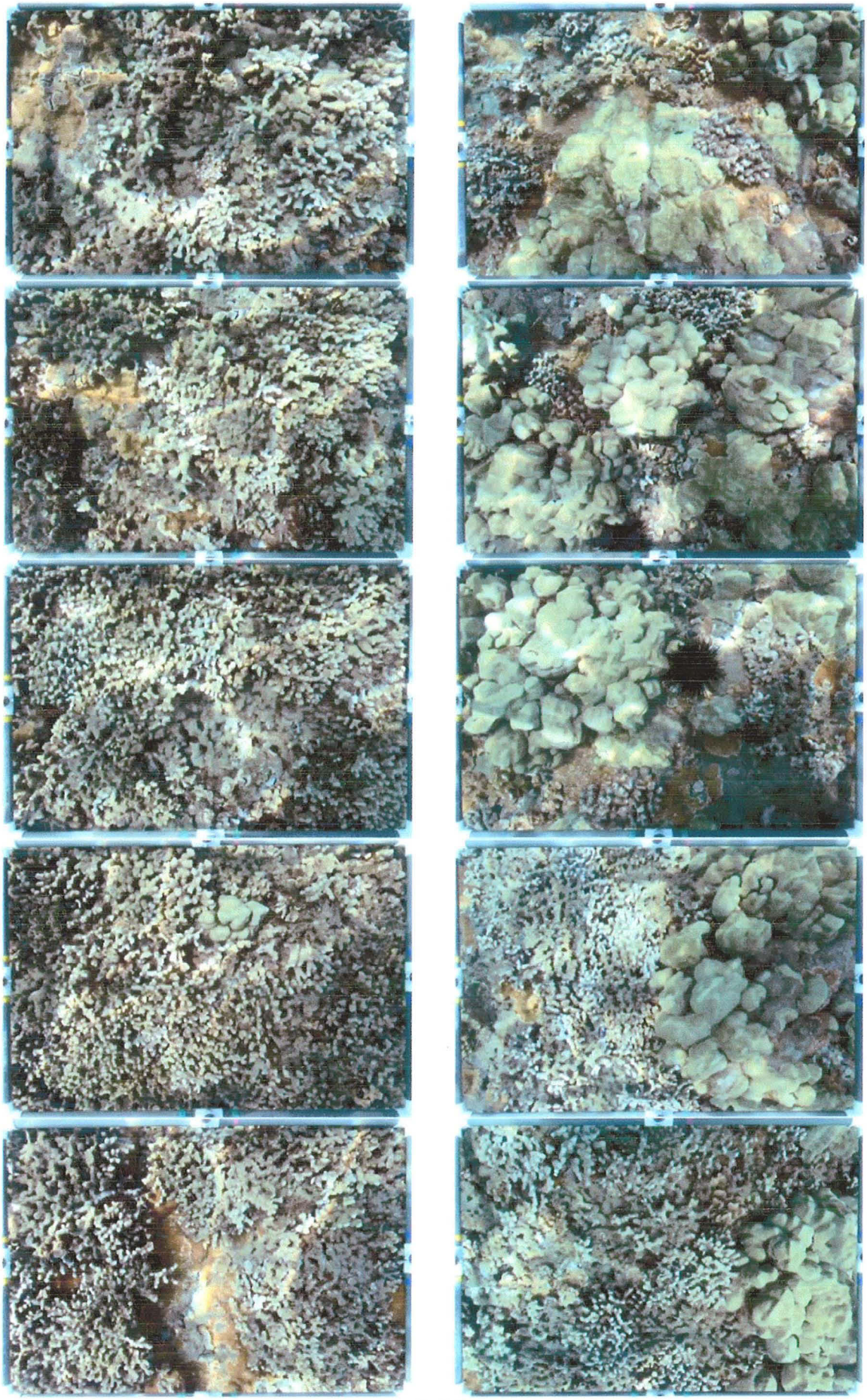

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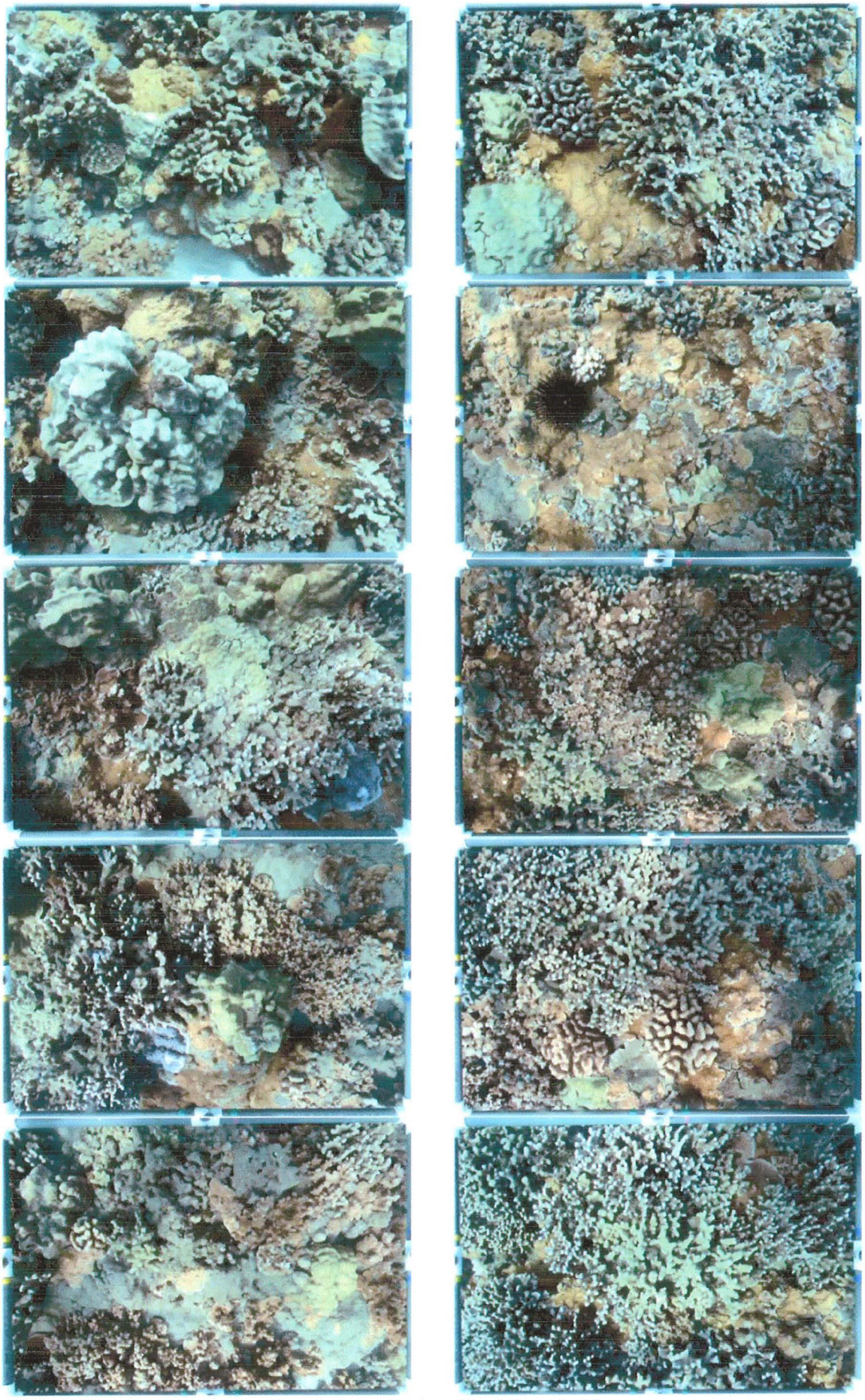

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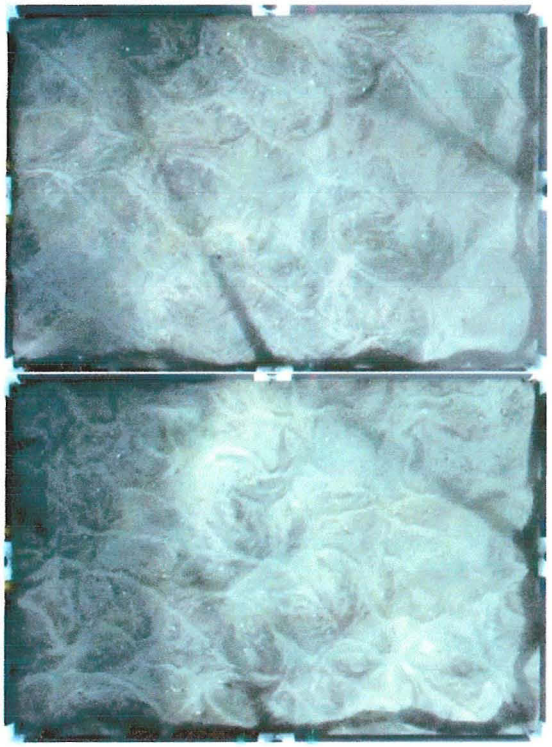

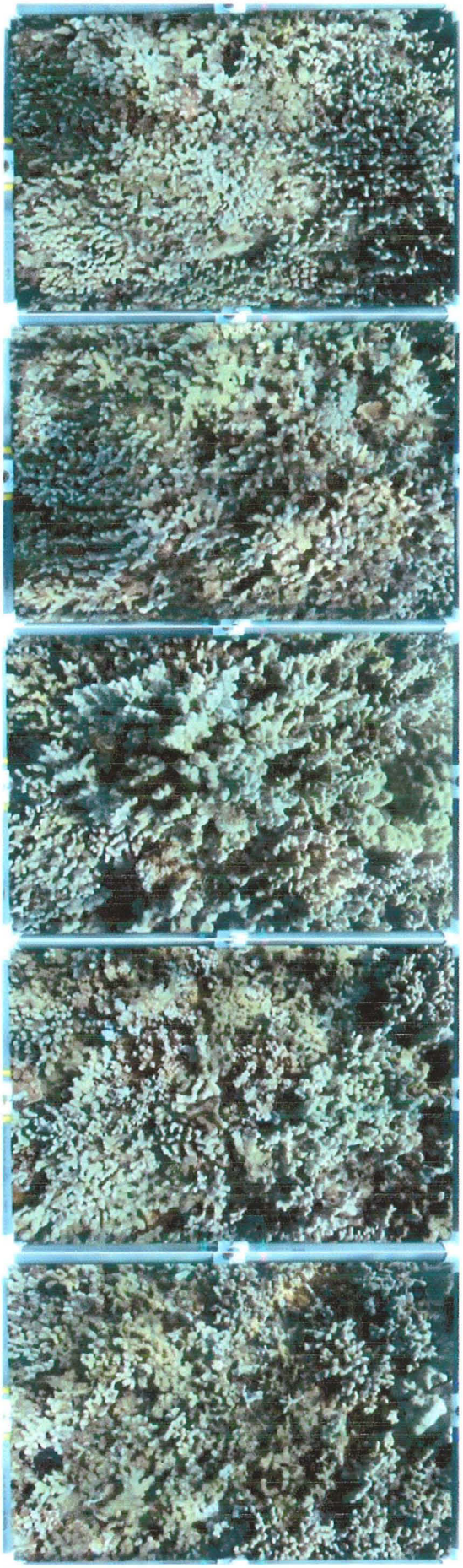

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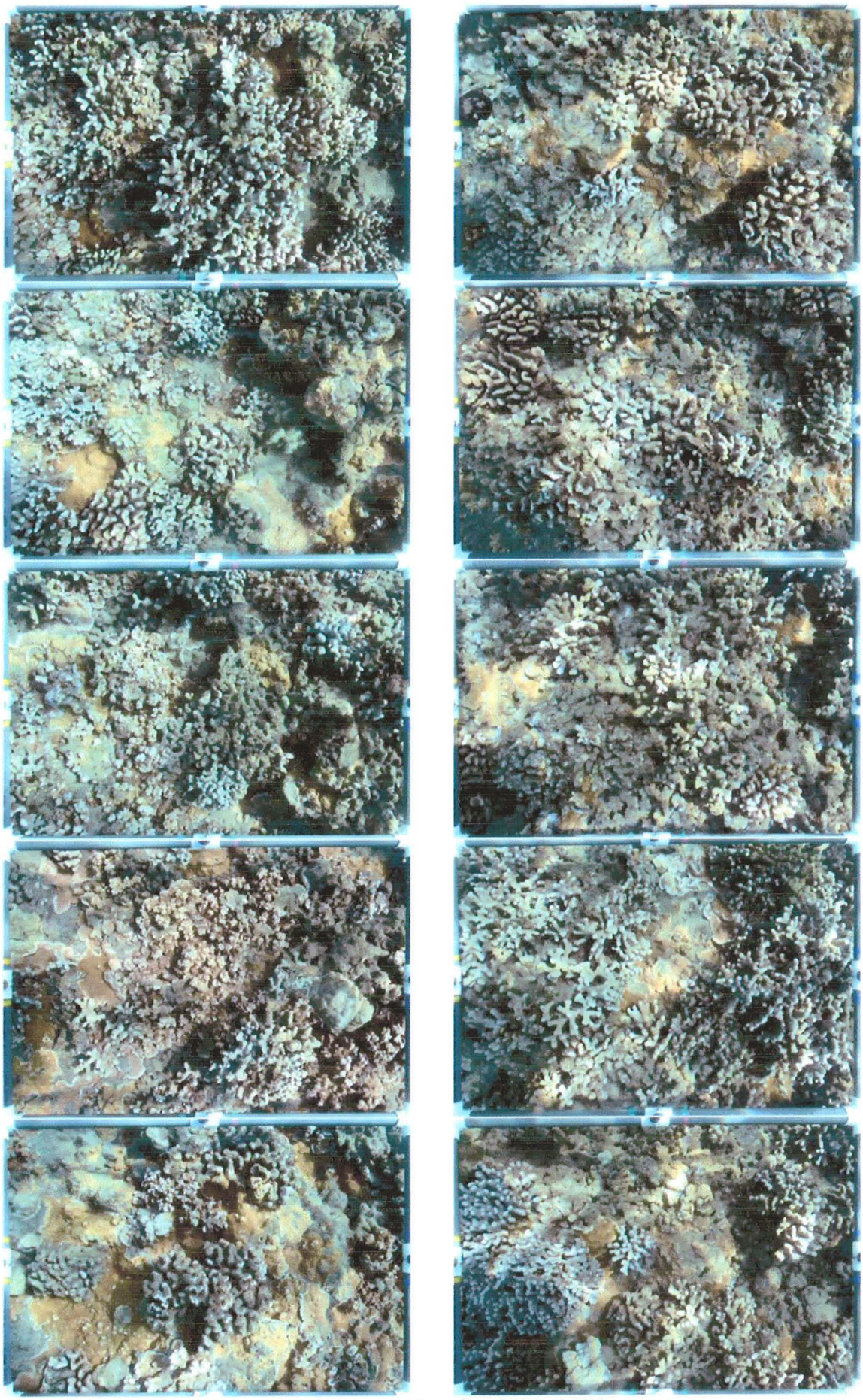

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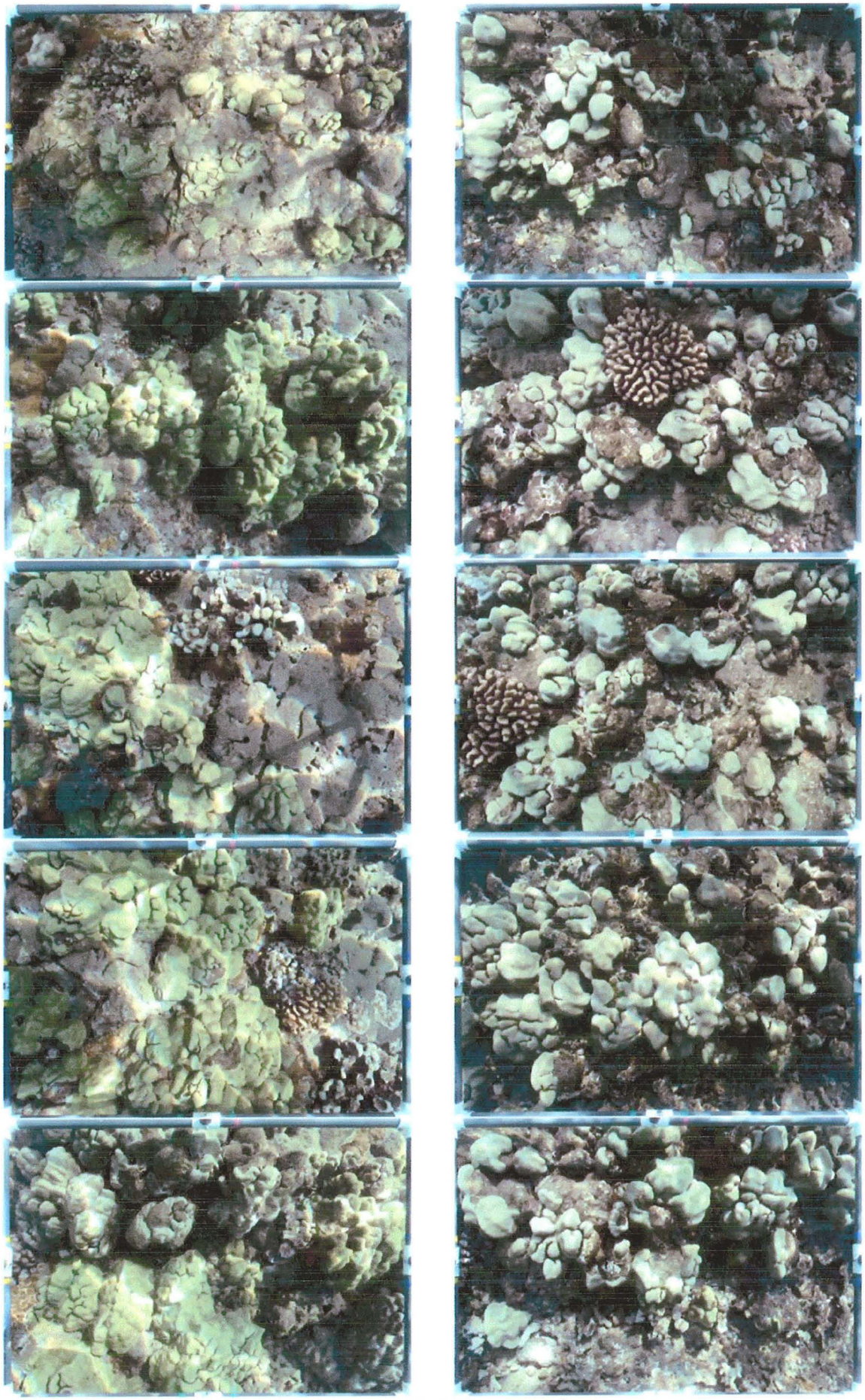

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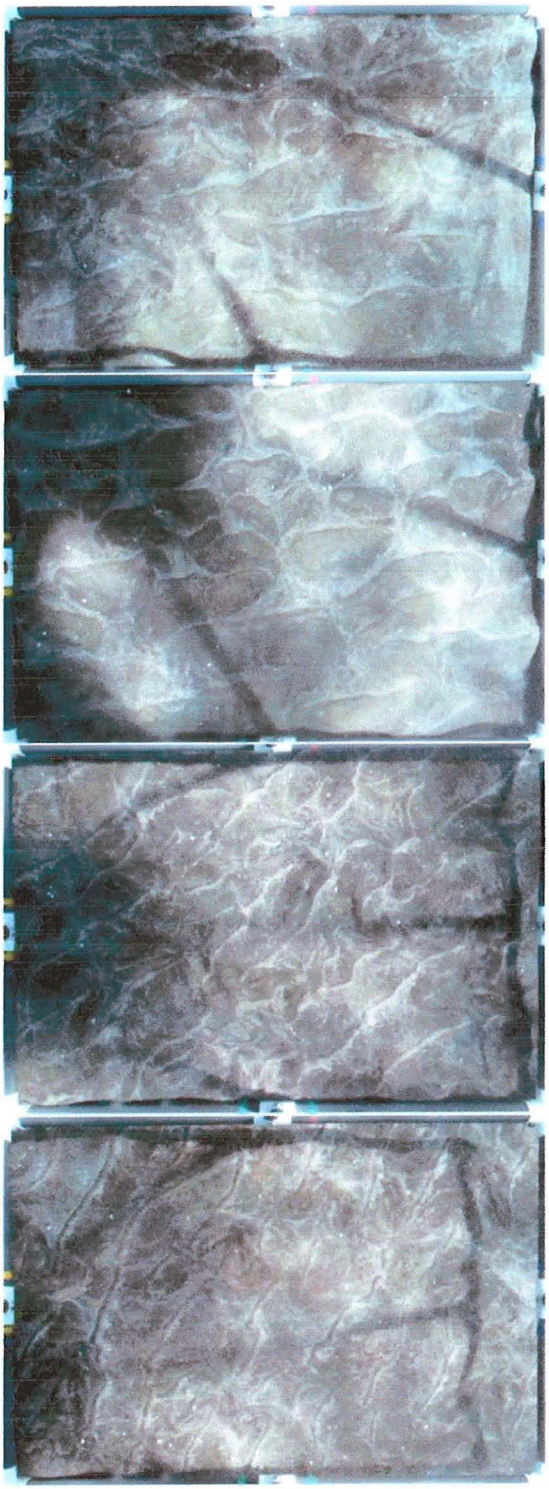

Olowalu Town Project Site 1000

APPENDIX E.

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 'opiuma (*Pithecellobium dulce*). Also of common occurrence are koa haole (*Leucaena leucocephala*), Java plum (*Syzygium cumini*), 'uhaloa (*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*), 'äkulikuli (*Sesuvium potulacastrum*), kou (*Cordia subcordata*), kipukai (*Heliotropium curassavicum*), koali awahia (*Ipomoea indica*), pohuehue (*Ipomoea pes-caprae*), naupaka kahakai (*Scaevola taccada*), 'ilima (*Sida fallax*), hau (*Talipariti tiliaceum*), milo (*Thespesia populnea*), 'uhaloa, 'a'ali'i, 'ili'e'e (*Plumbago zeylanica*) and pöpolo (*Solanum americanum*). Another 4 species were Polynesian introductions: kalo (*Colocasia esculenta*), niu (*Cocos nucifera*), Kö (*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 'opiuma. 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.

'Opiuma 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. 'Opiuma 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.	kö, 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.	äkulikuli	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.	pöhuehue	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 öpe'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

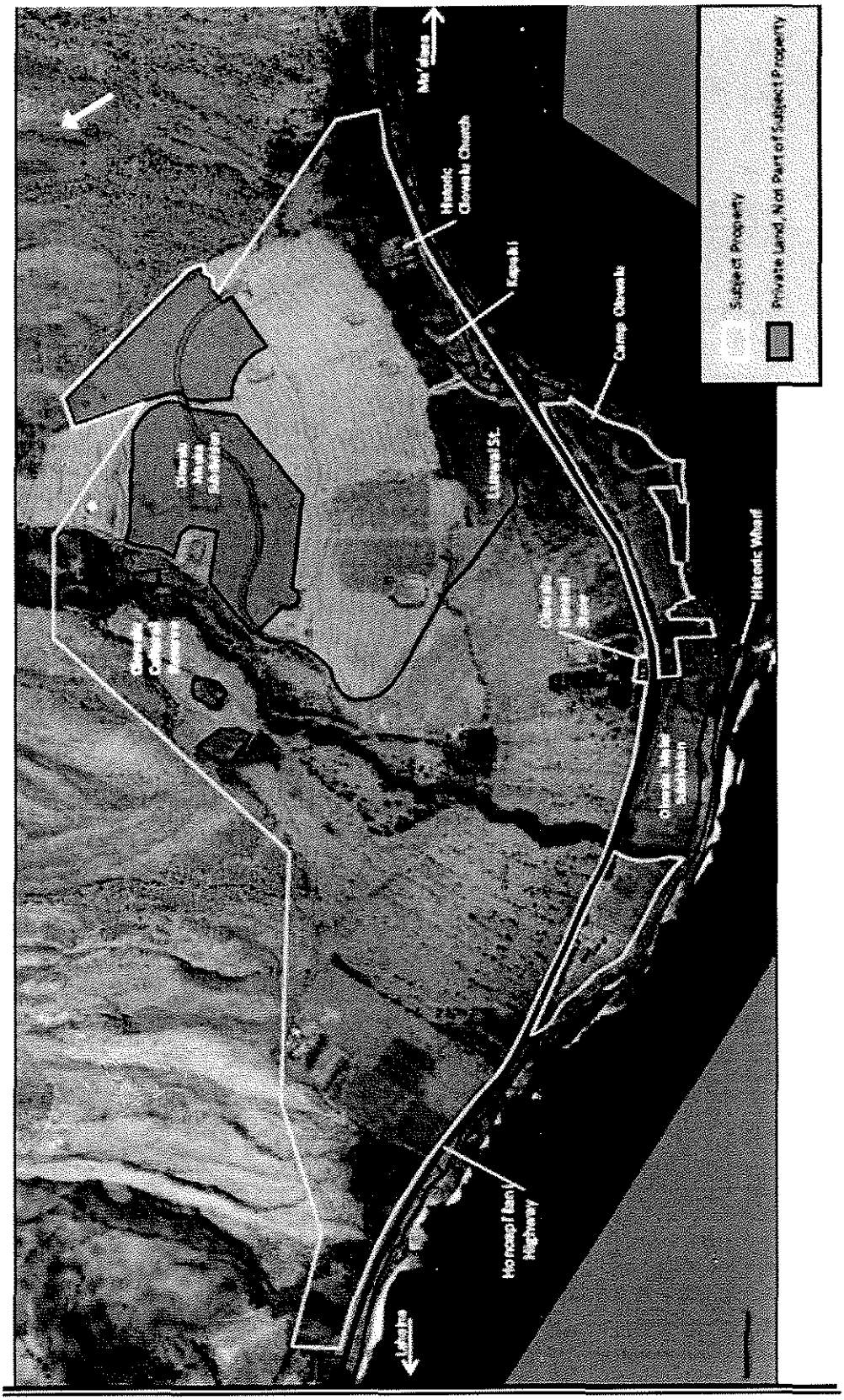

Figure 1 – Project Area

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APPENDIX E-1.

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 Kapā'iki village at Mōpua 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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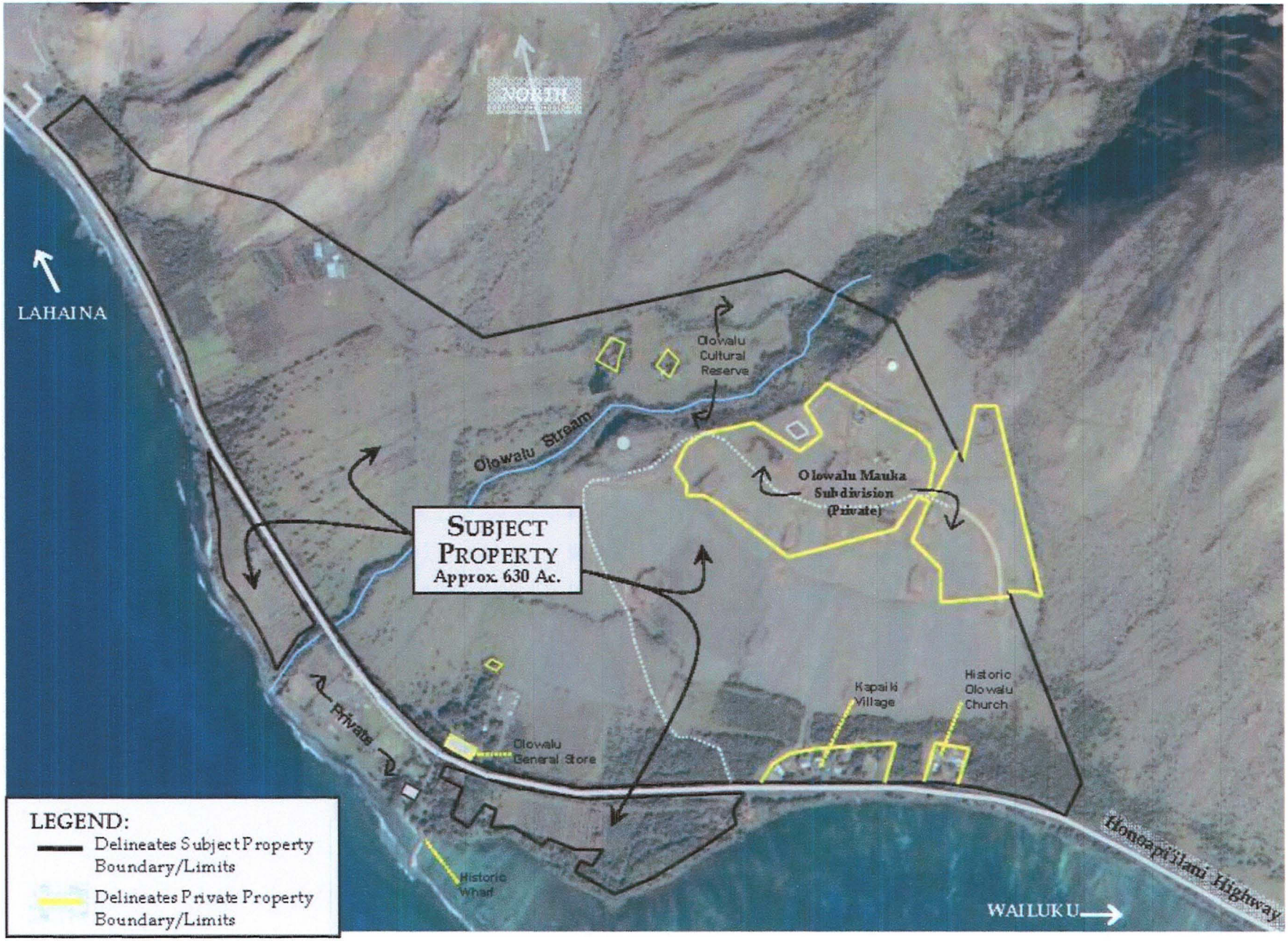

Figure 1 - Project Area

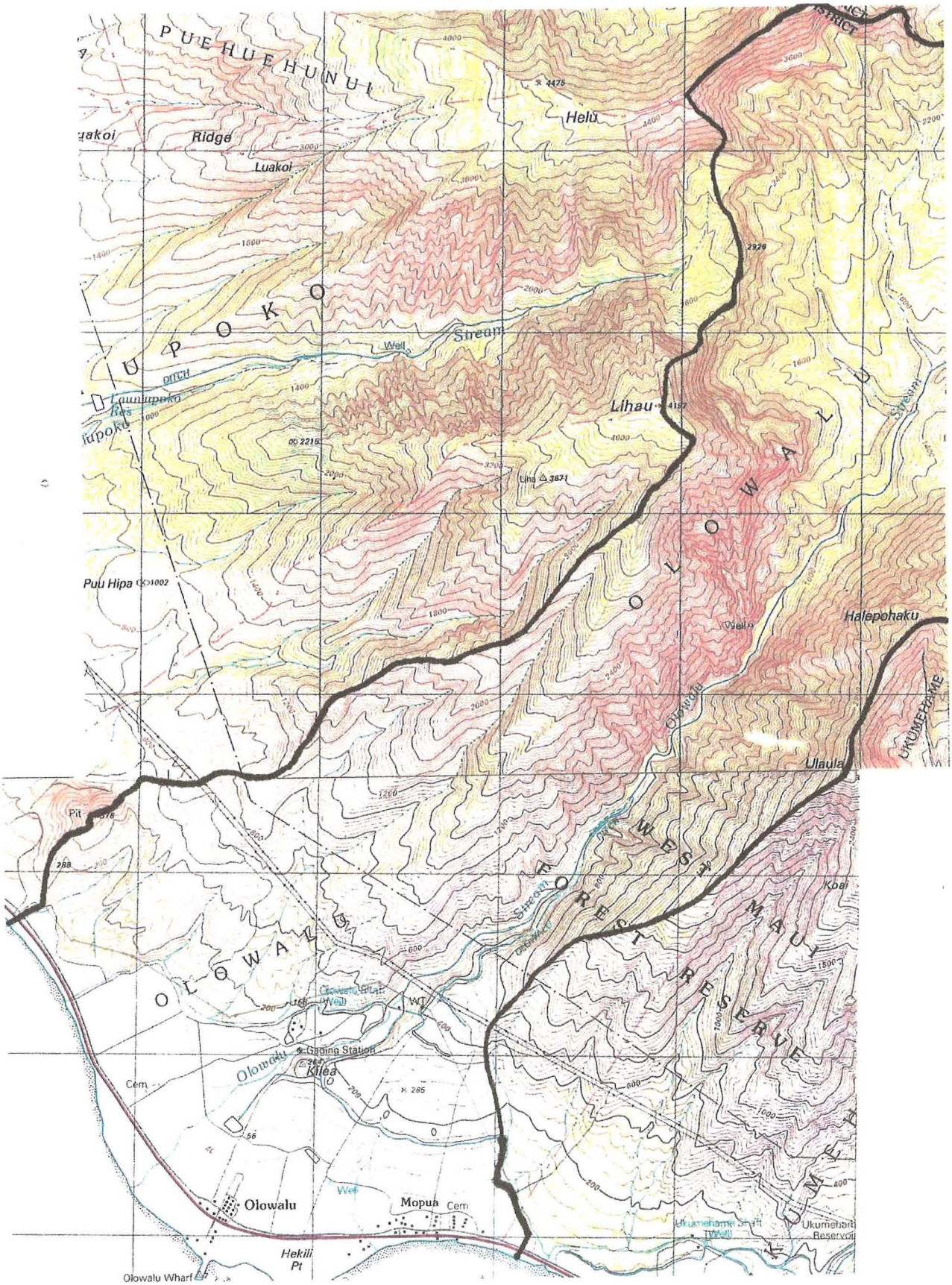

Figure 2 Combined watersheds of Tributaries

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	☐ 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: .

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[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 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 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]**

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[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.

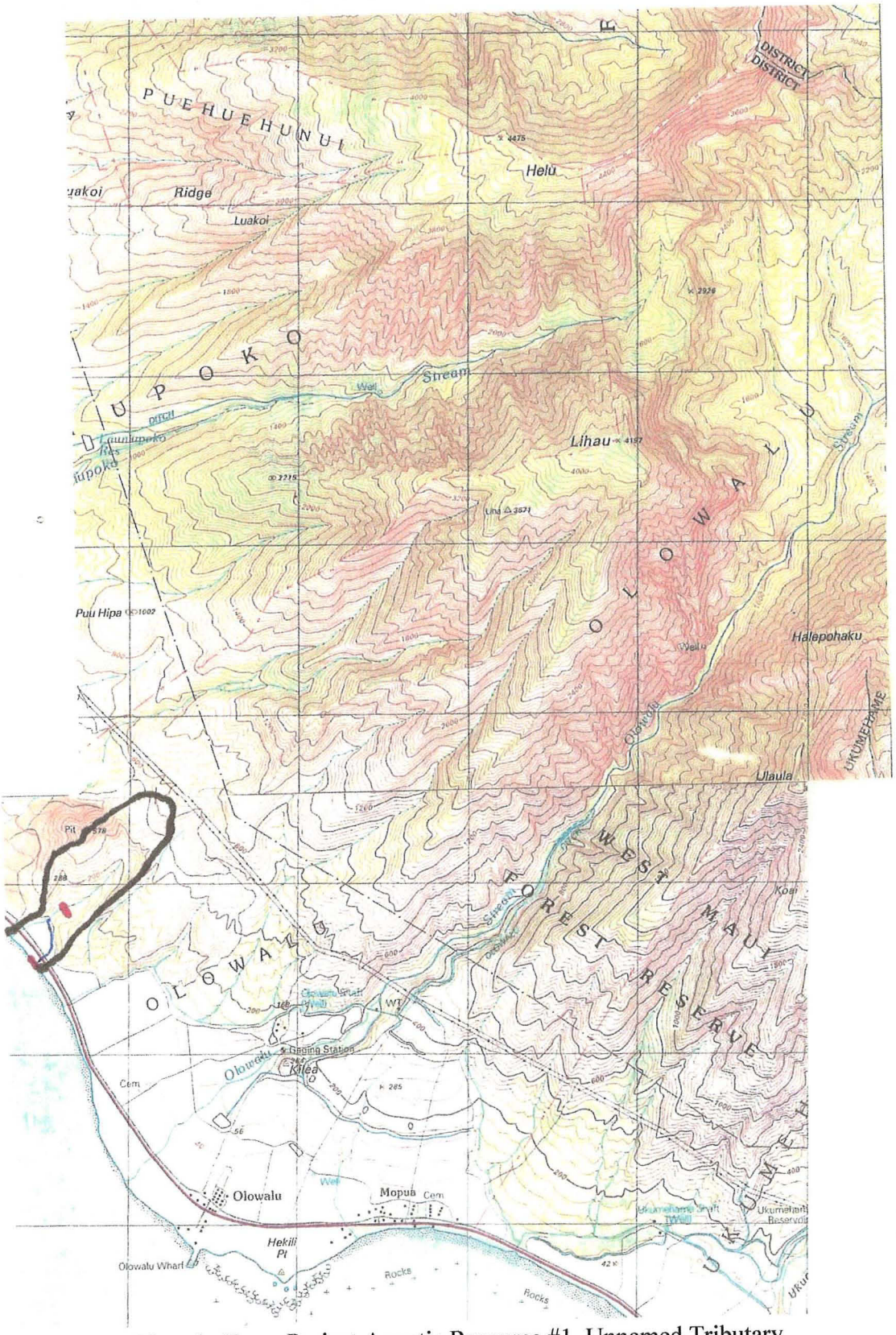
Provide acreage estimates for non-jurisdictional waters in the review area that do not meet the "Significant Nexus" standard, where such a finding is required for jurisdiction (check all that apply):
☐ Non-wetland waters (i.e., rivers, streams): linear feet, width (ft).
☐ Lakes/ponds: acres.
☐ Other 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 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:



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 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]

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[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): .

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[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).

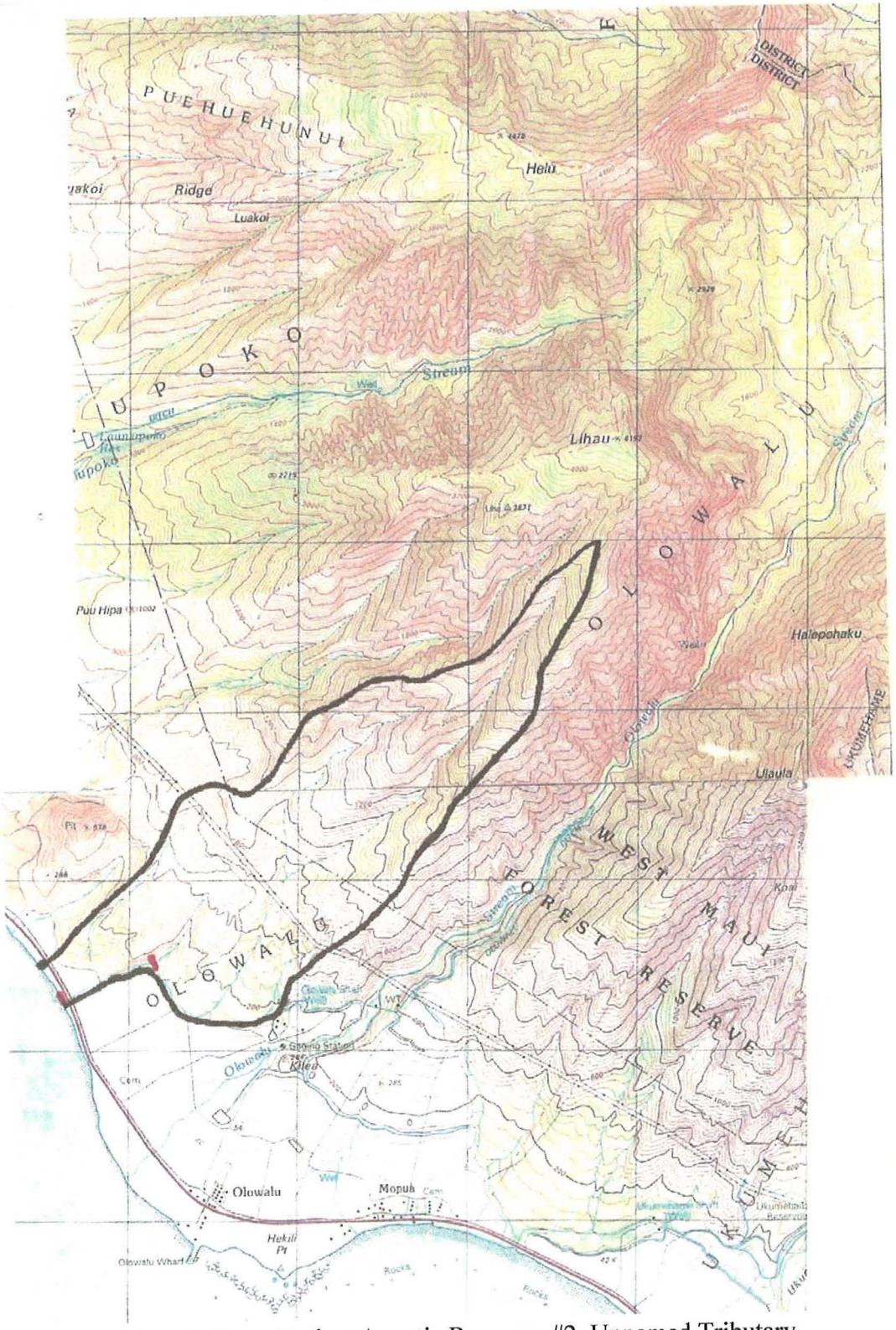
☐ Previous determination(s). File no. and date of response letter: .

☐ 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: .

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[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: 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

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).

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[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.
☐ 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): .

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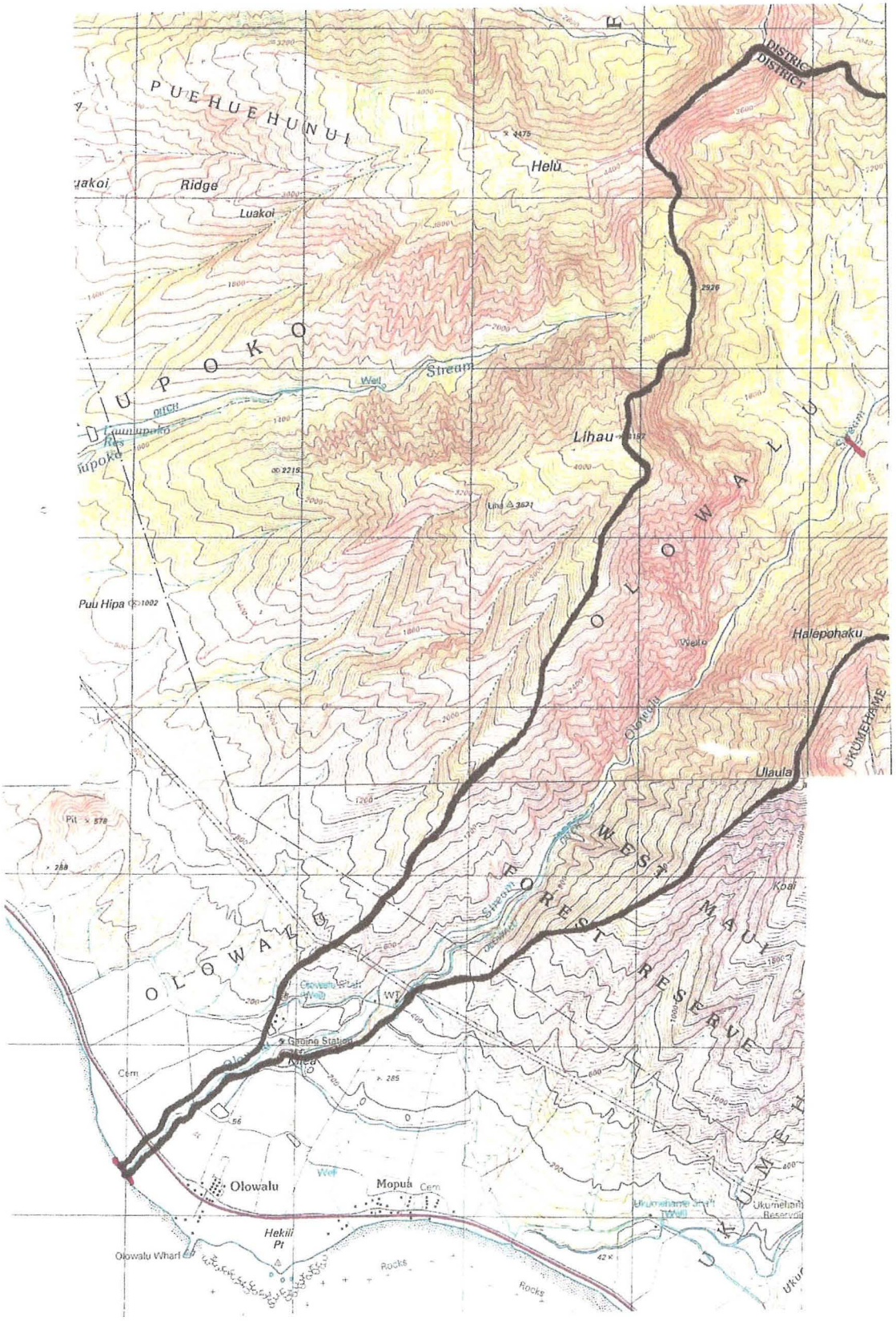
[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

- ☐ FEMA/FIRM maps: .
- ☐ 100-year Floodplain Elevation is: (National 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:



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: .

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[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: 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 presented above (1-6), or
☐ Demonstrate that water is isolated with a nexus to commerce (see E below).

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[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.

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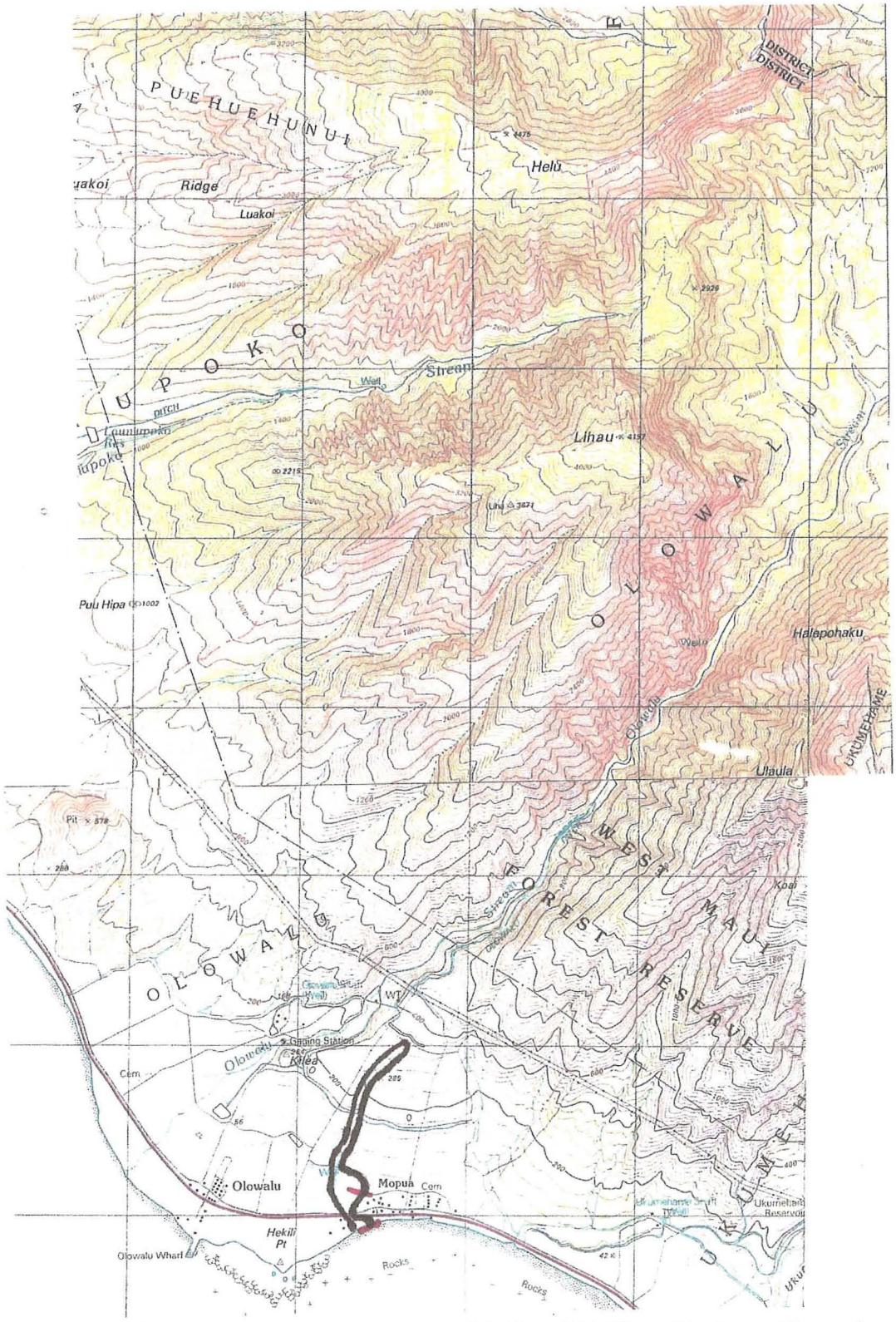
[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

- ☐ 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: .



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: .

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[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: .

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[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]

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[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)

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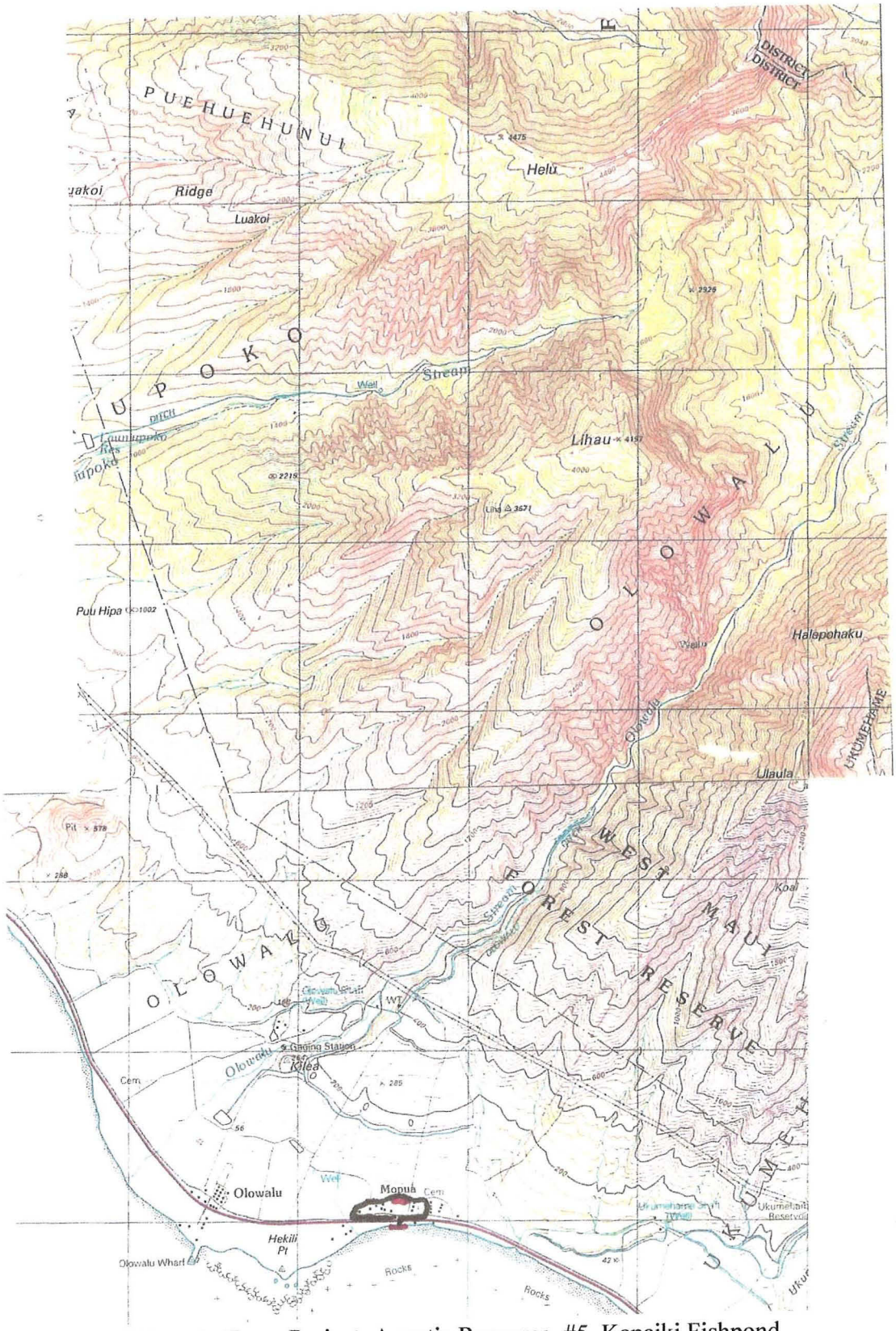
[10] **Prior to asserting or declining CWA jurisdiction based solely on this category, Corps Districts will elevate the action to Corps and EPA HQ for review consistent with the process described in the Corps/EPA *Memorandum Regarding CWA Act Jurisdiction Following Rapanos.***

☒ 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): .

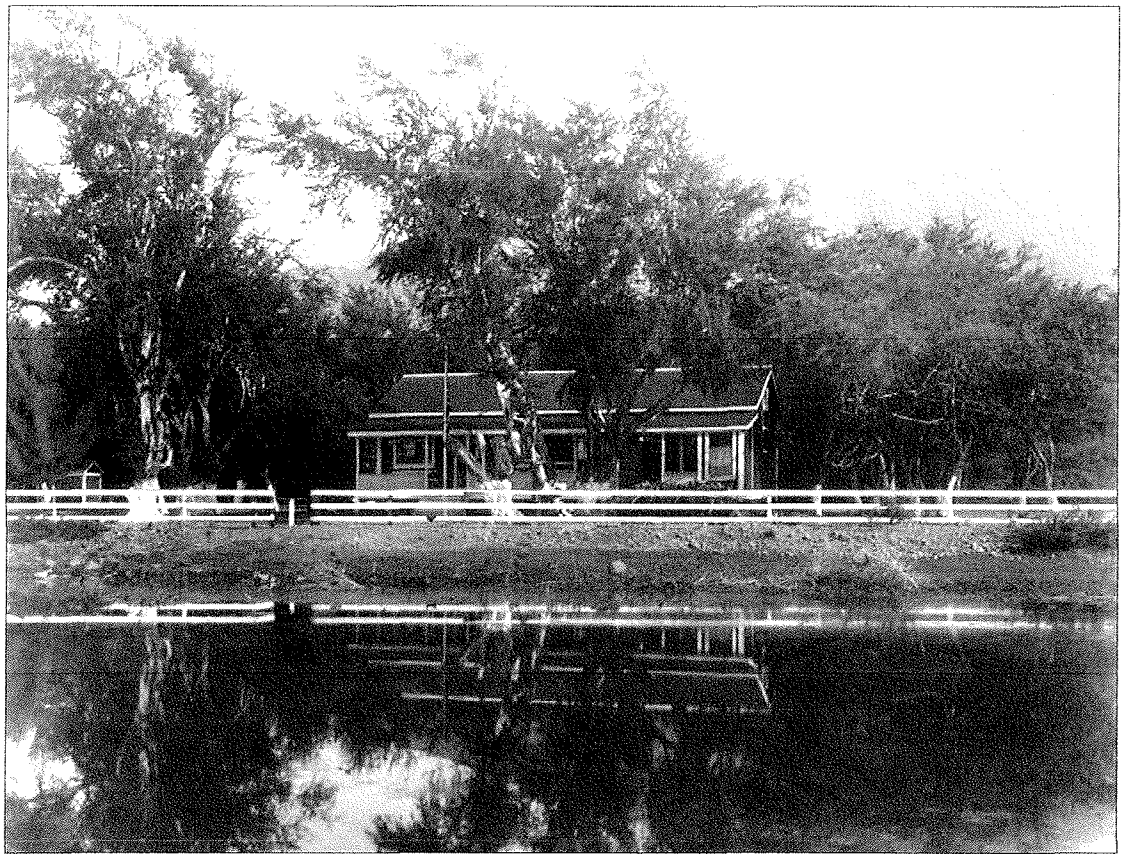
B. ADDITIONAL COMMENTS TO SUPPORT JD: .



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: .

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[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: .

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[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 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]**

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[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): .

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[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).

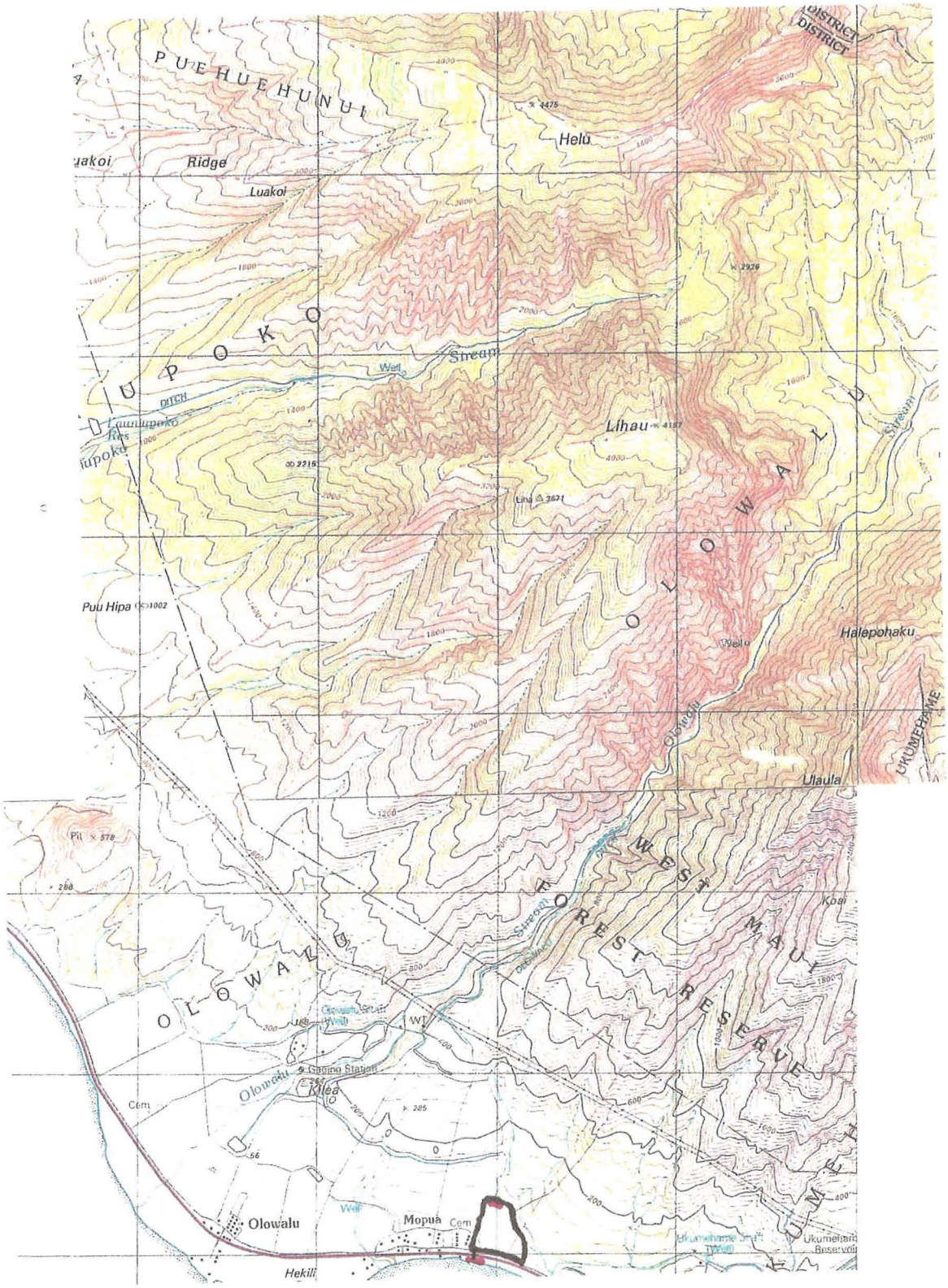
☐ Previous determination(s). File no. and date of response letter: .

☐ 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.

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

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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.

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

(DRAFT)

Prepared for

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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 (DRAFT)
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.

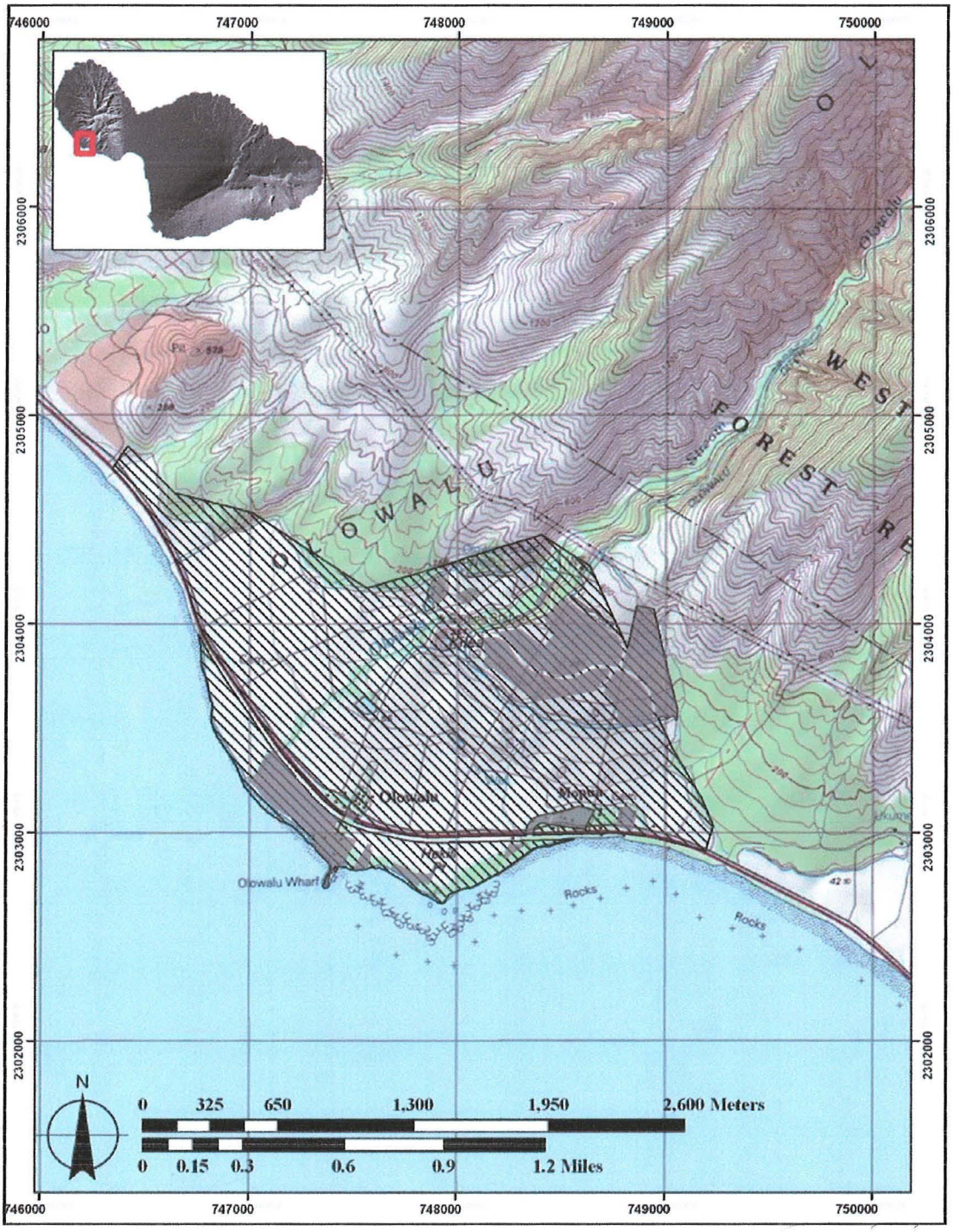

Figure 1. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

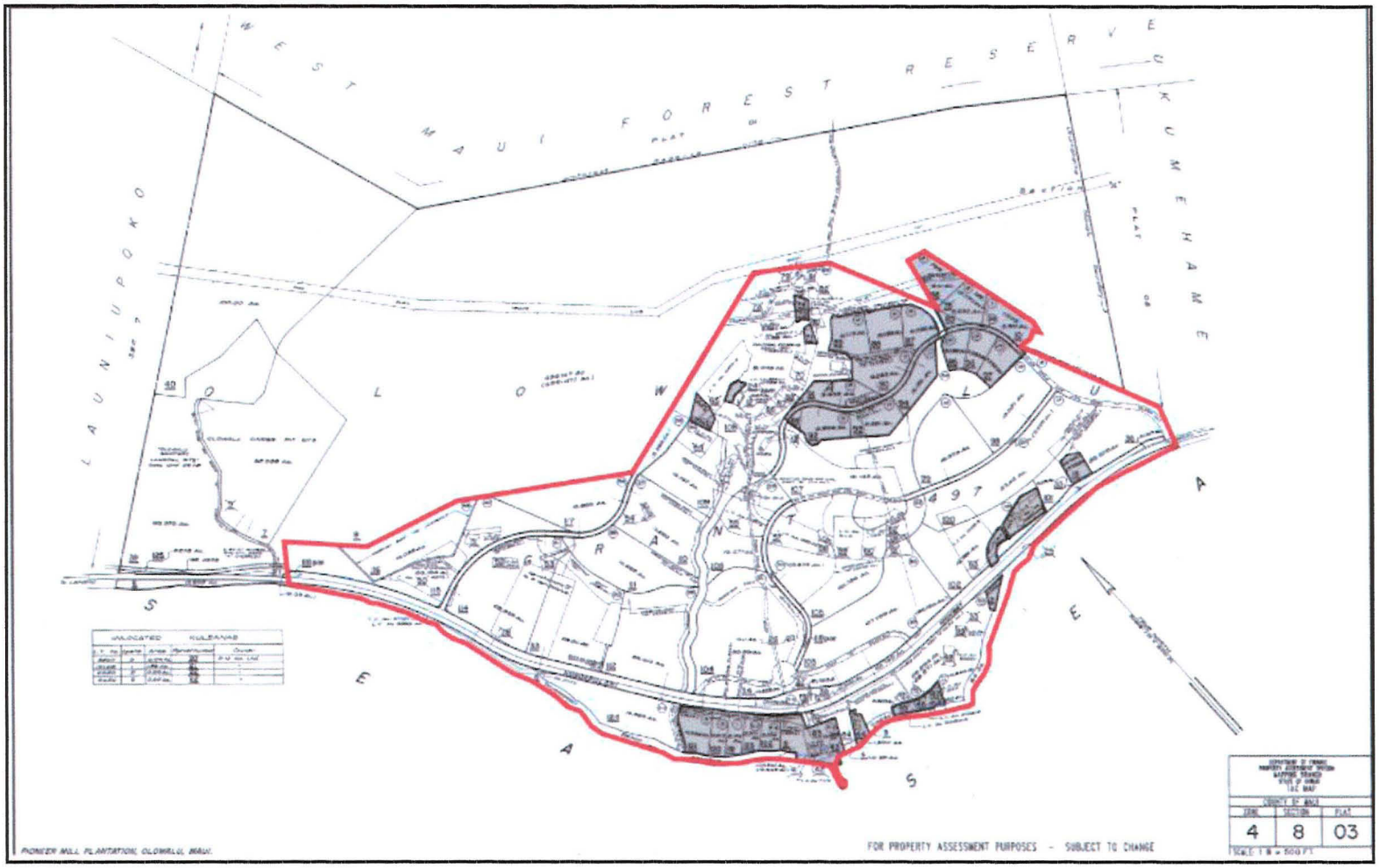

Figure 2. TMK (2) 4-8-03 showing the location of the current project area outlined in red, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

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.

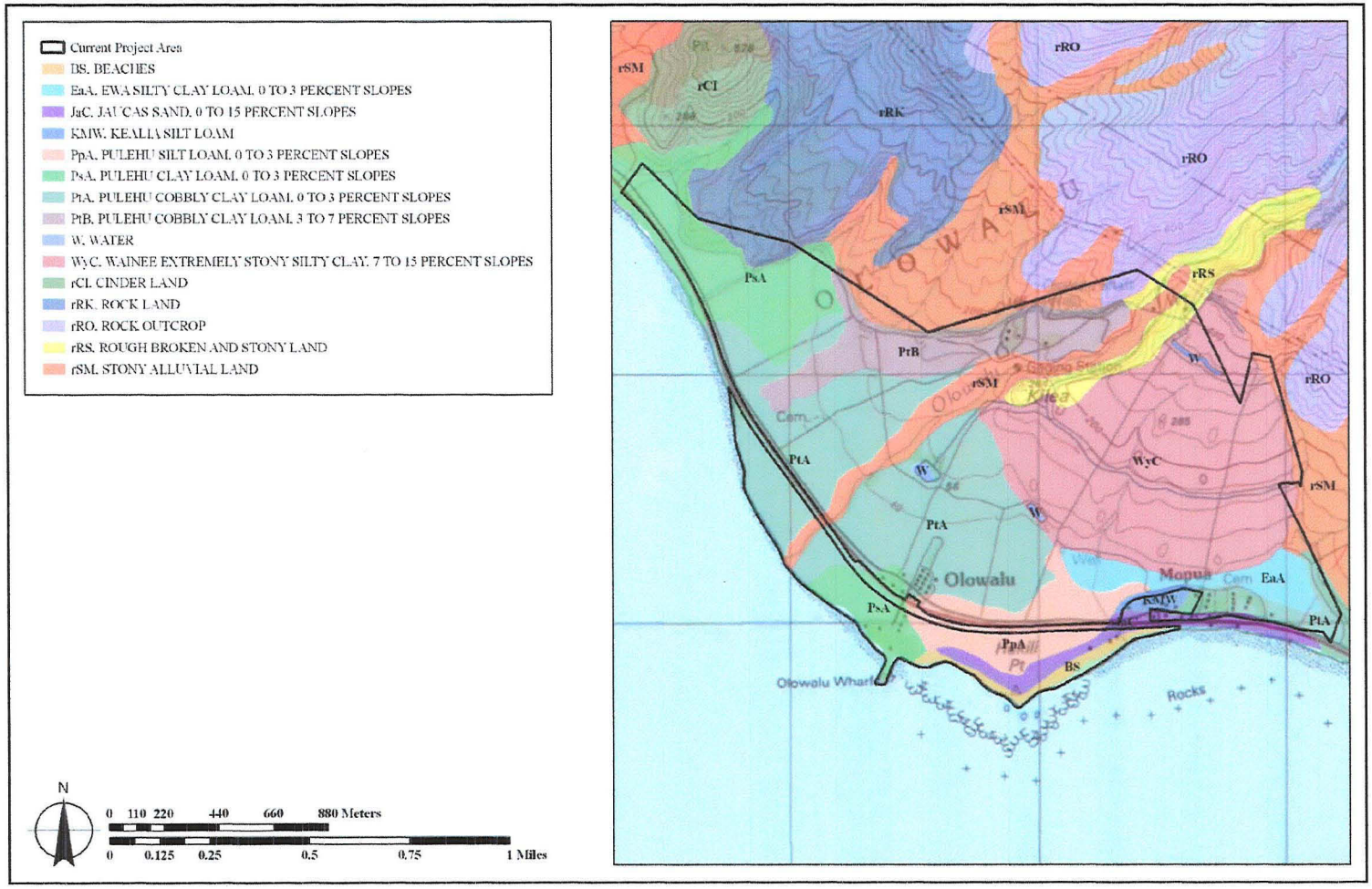

Figure 3. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the current project area relative to the local soil series (U.S. Department of Agriculture 2001)

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).

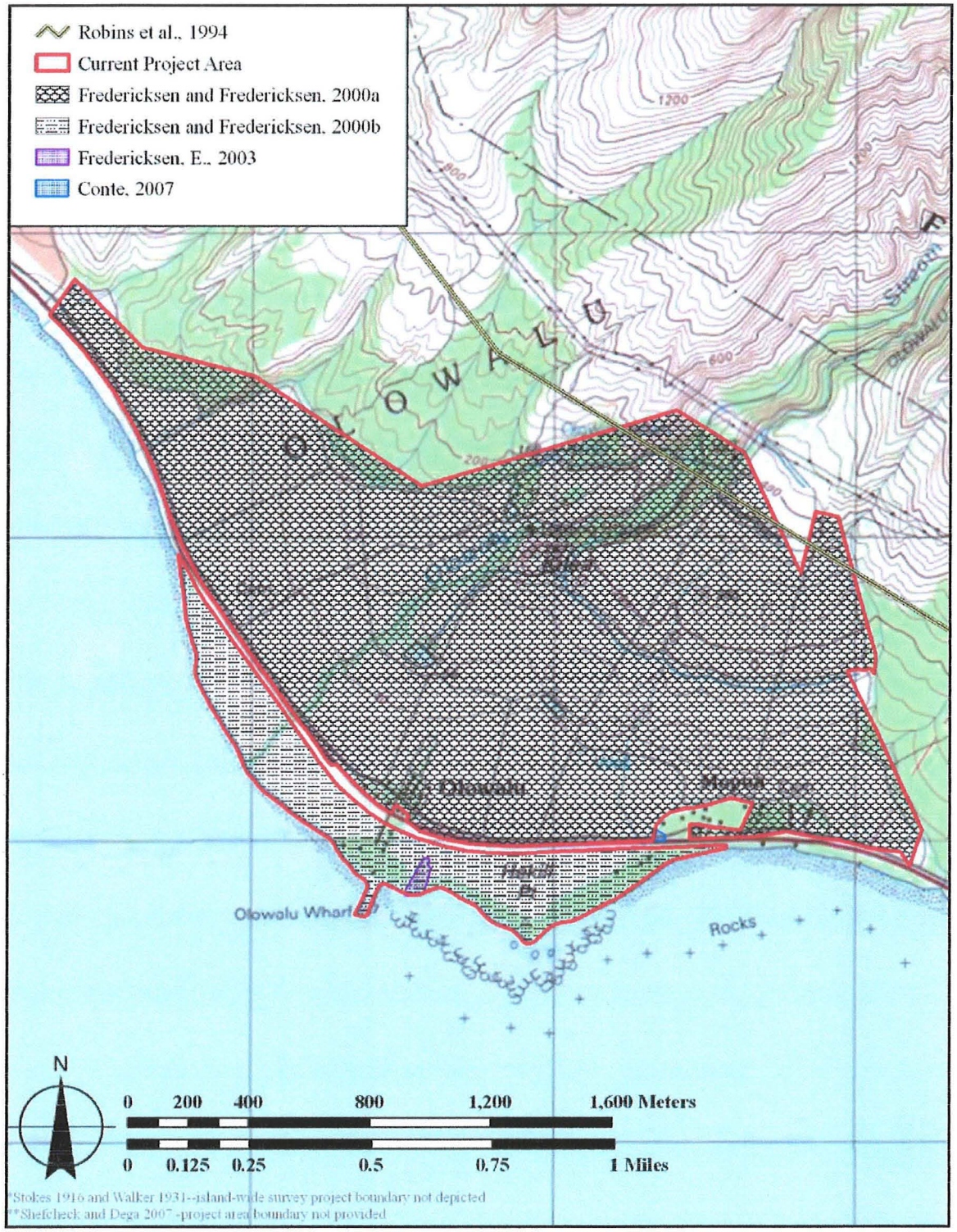

Figure 5. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the locations of previous archaeological studies within the current project area.

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 Constultant 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).

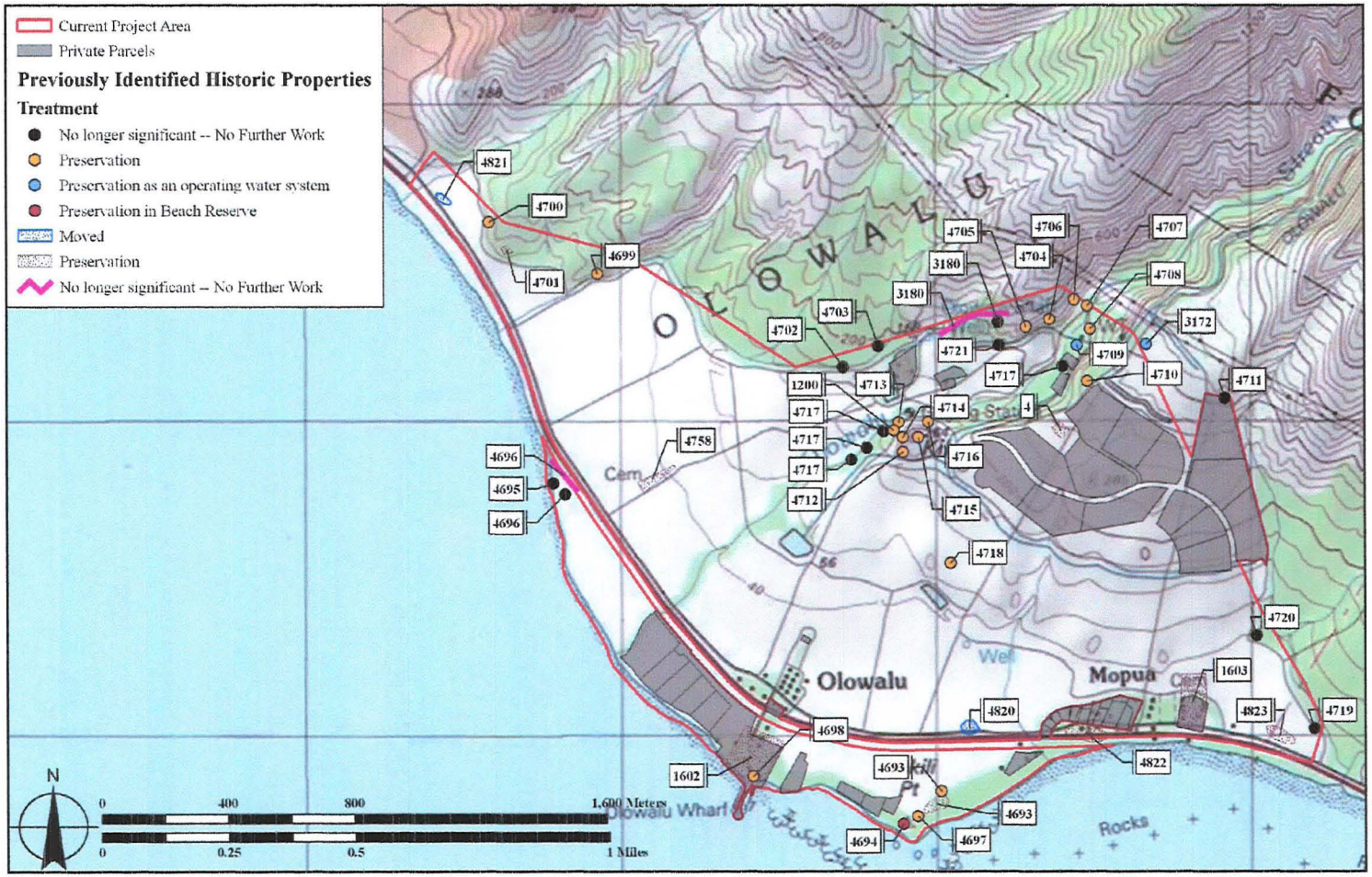

Figure 7. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing preservation commitments for historic properties within the current project area, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

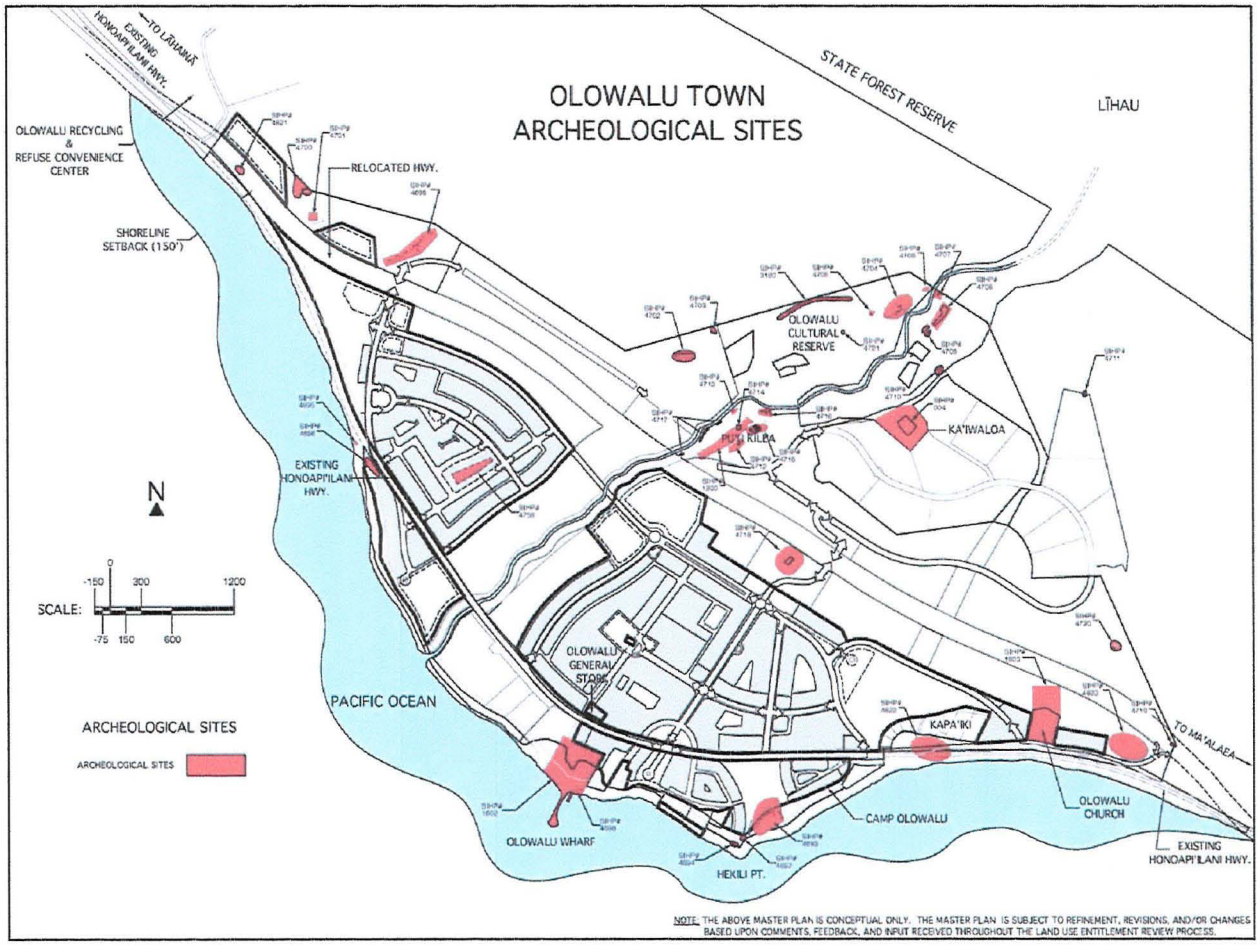

Figure 8. Archaeological sites with proposed preservation buffers (in orange) in relation to the Olowalu Town Master Plan (figure courtesy of Olowalu Town, LLC).

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).

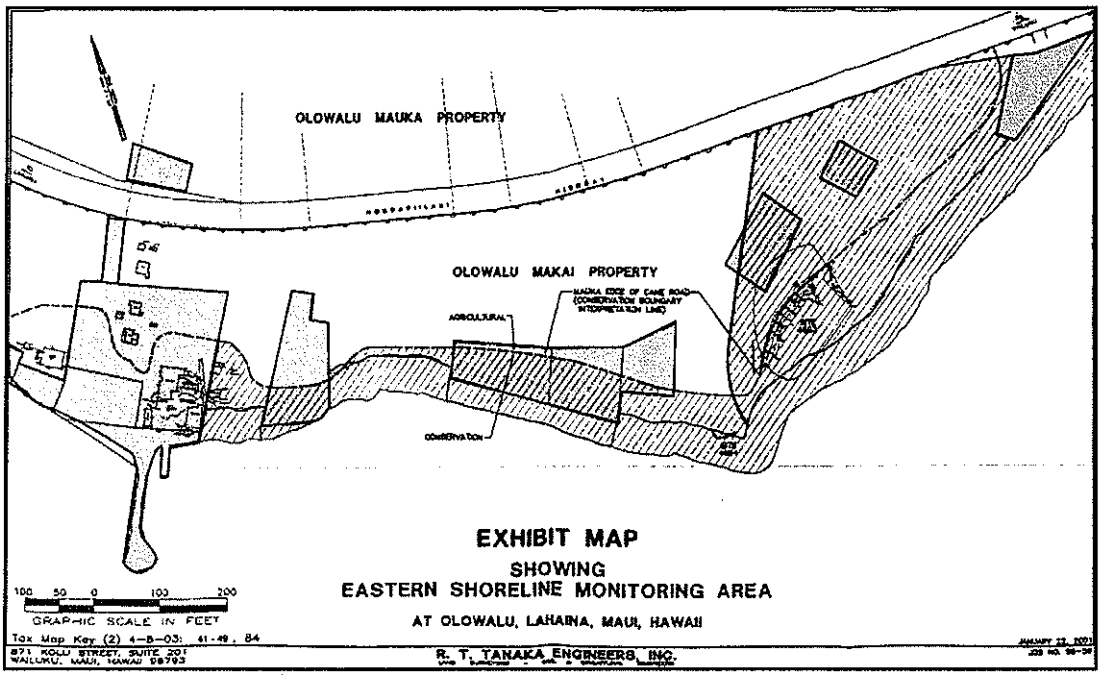

Figure 9. Map of eastern shoreline of the current project area showing the area of required archaeological monitoring in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray (Olowalu Elua Associates 2001:Appendix C).

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

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

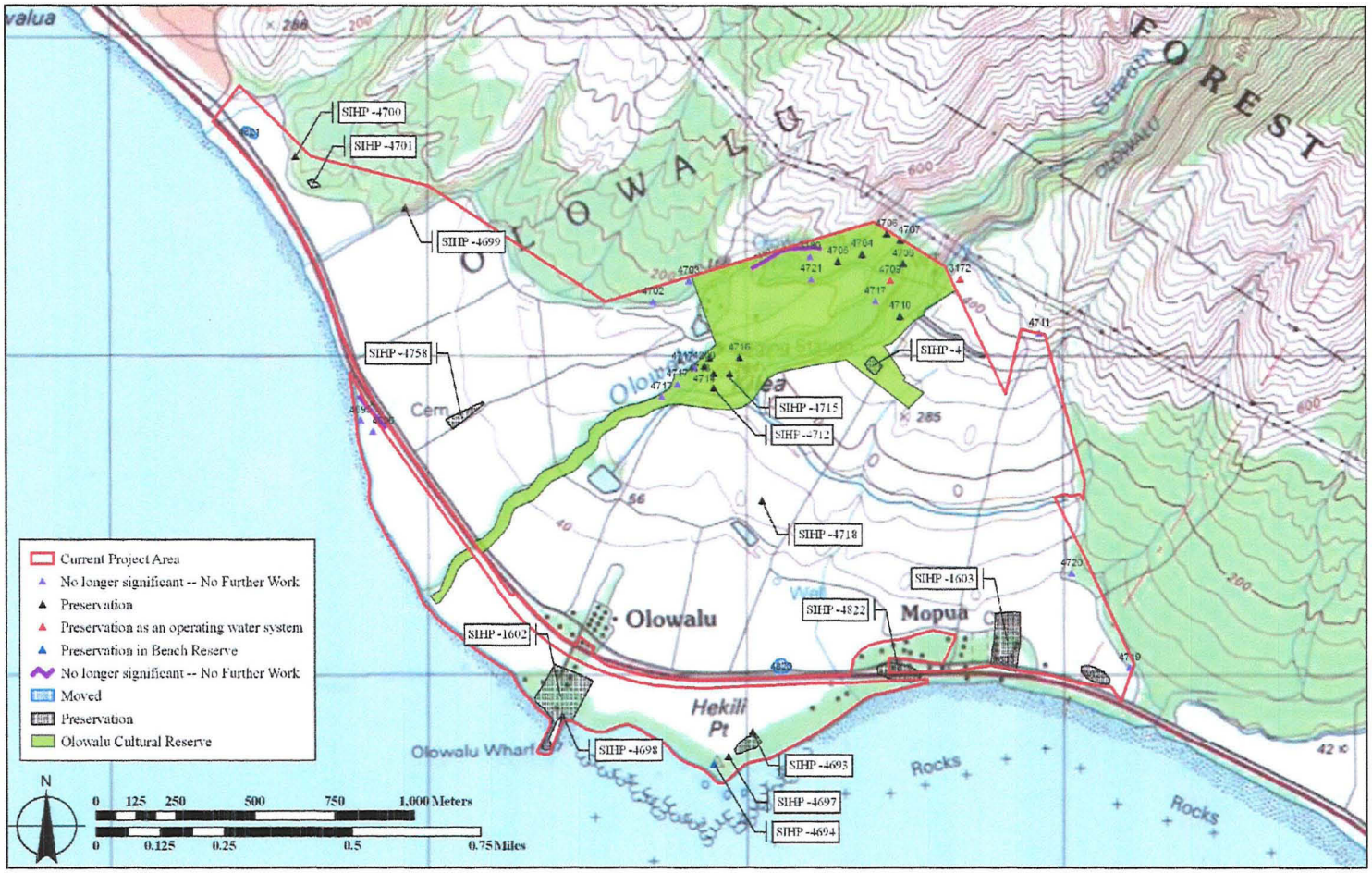

Figure 10. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing approximate historic property locations within the current project area with site identification labels for re-visited historic properties called out.

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.

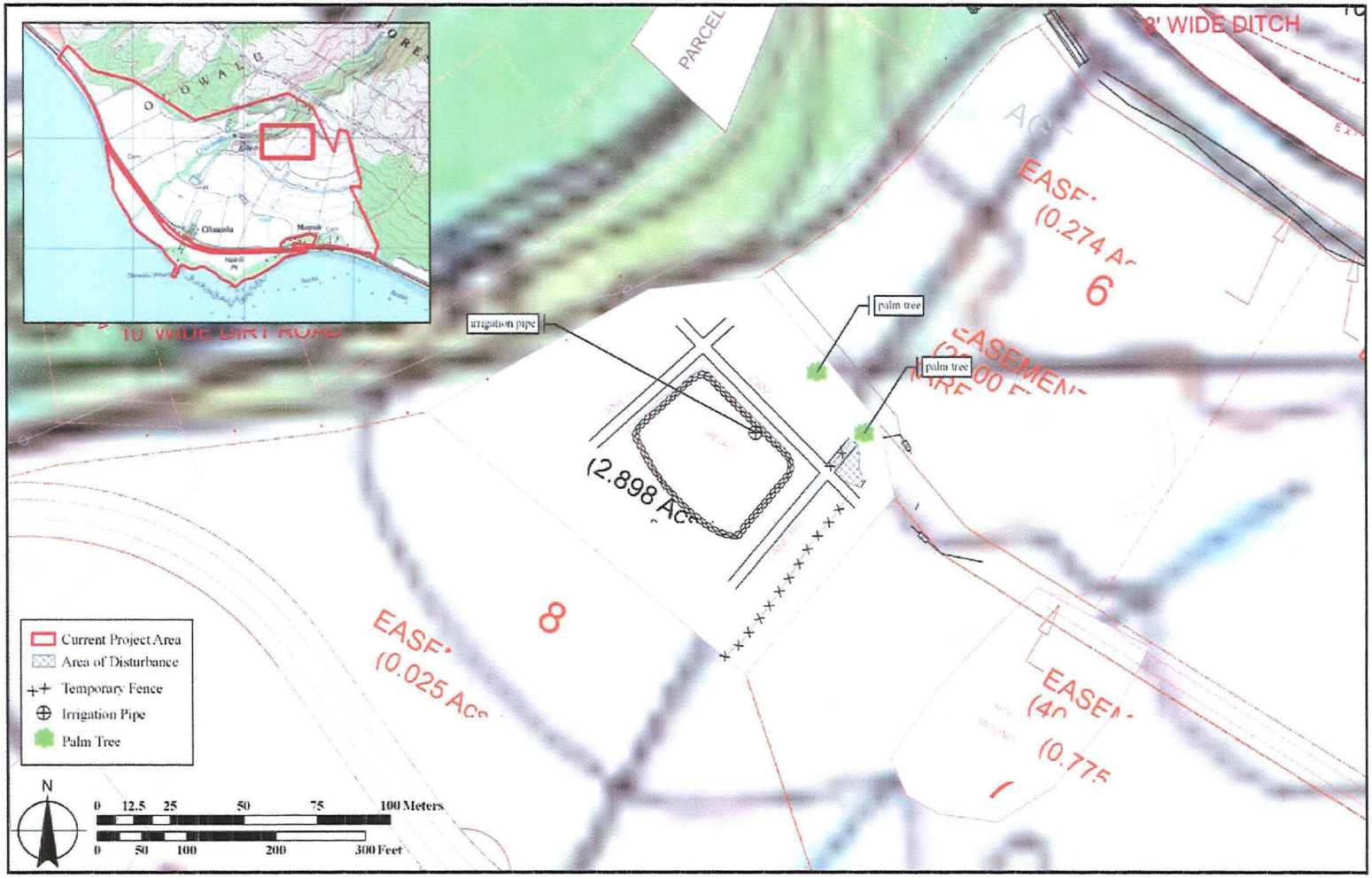

Figure 12. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-0004 location and 100 ft preservation buffer boundary in gray in relation to remnant temporary fence, Christmas Palms, and green waste push.

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.

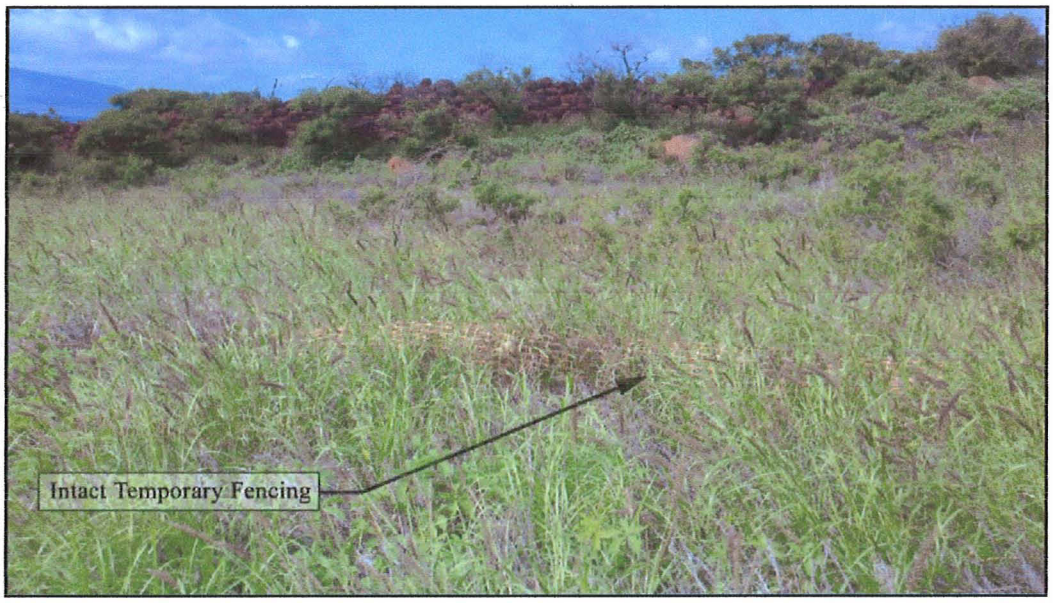

Figure 15. Remnant temporary fencing at SIHP 50-50-08-0004. View to north-northwest.

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

[22] See respective preservation plans for signage wording and detailed interpretive requirements

interior restricted to Native Hawaiian traditional cultural practices (pp.10-11); Buffer markers to consist of a native hedge and boulders (p.11)

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.

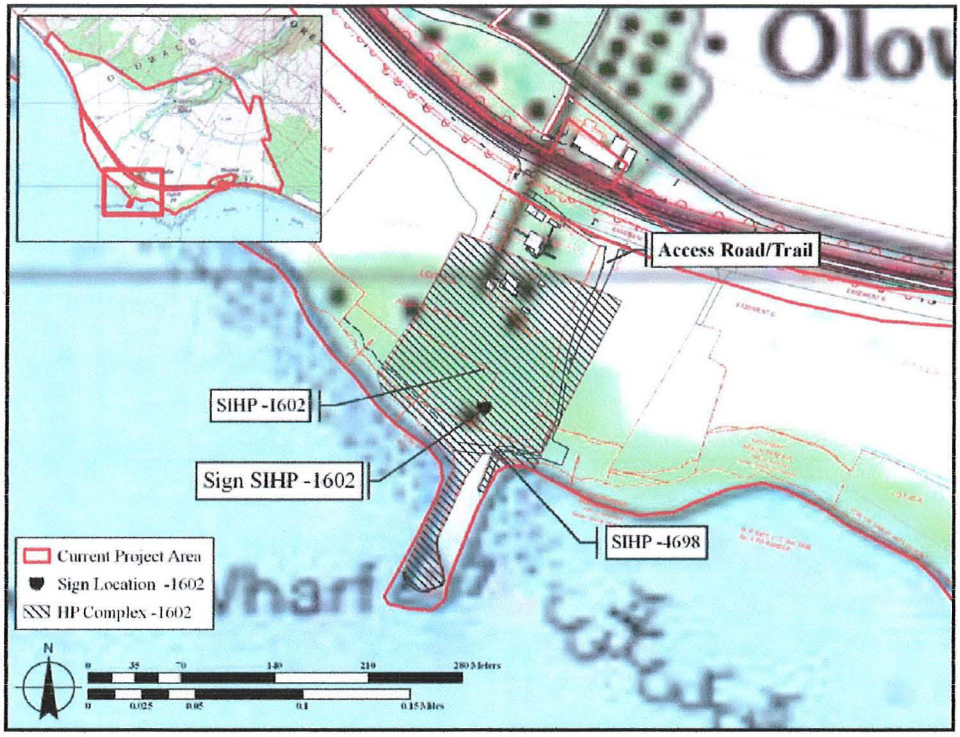

Figure 20. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-1602 preservation area, SIHP 50-50-08-4698, and interpretive sign location.

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.

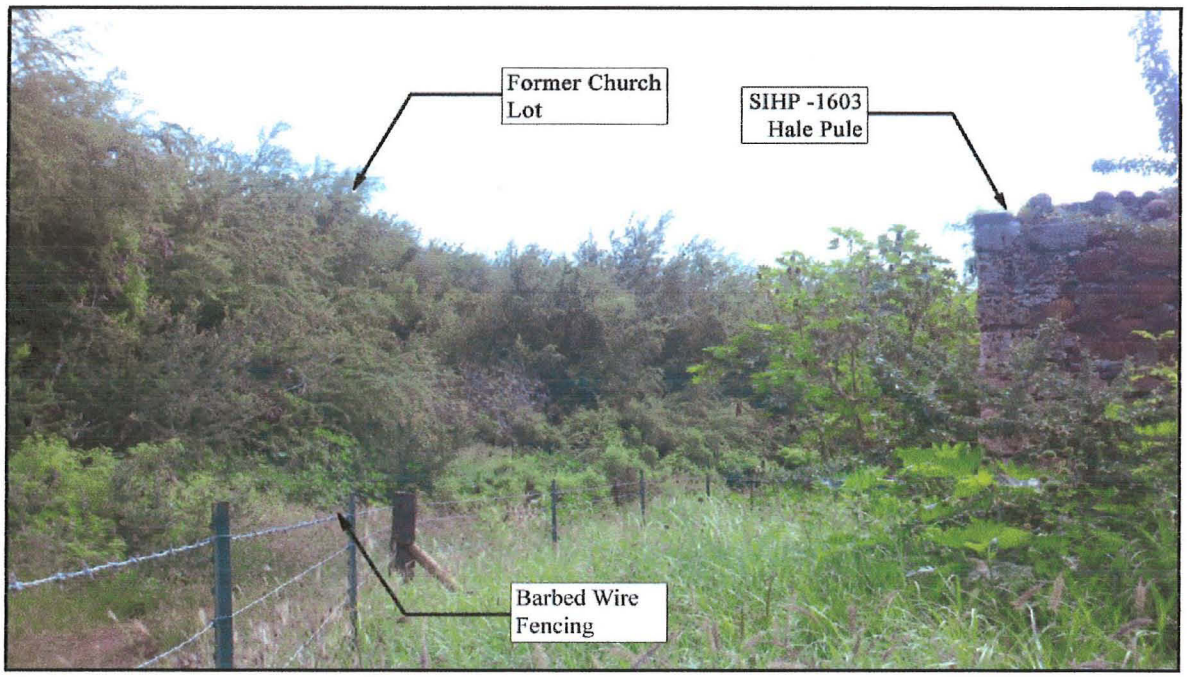

Figure 25. Area *mauka* of the stone church sanctuary, former church lot where unmarked grave plots were identified to the left of frame.

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

<u>Interim Preservation Measures</u>

Not Applicable

Figure 26. SIHP 50-50-08-4693, preservation area. View to northwest.

Figure 27. Camp Olowalu outdoor shower facility. View to northwest.

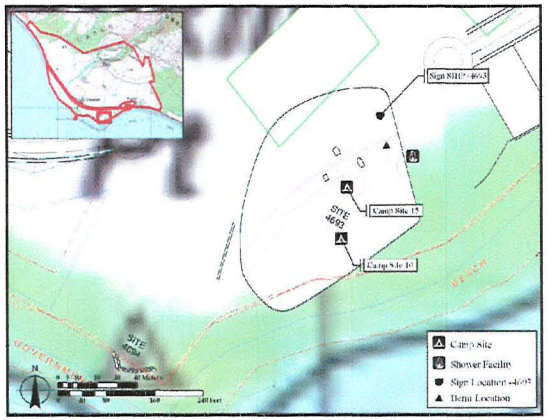

Figure 28. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the preservation area for SIHP 50-50-08-4693 in relation to the earthen berm (shown as both a solid and dotted red line within the preservation area), shower facility, previous location of former camp sites, and sign location.

Figure 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.

Figure 34. SIHP 50-50-08-4694, showing overall vegetation. View to northeast.

Figure 35. SIHP 50-50-08-4694 interpretive sign.

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 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.

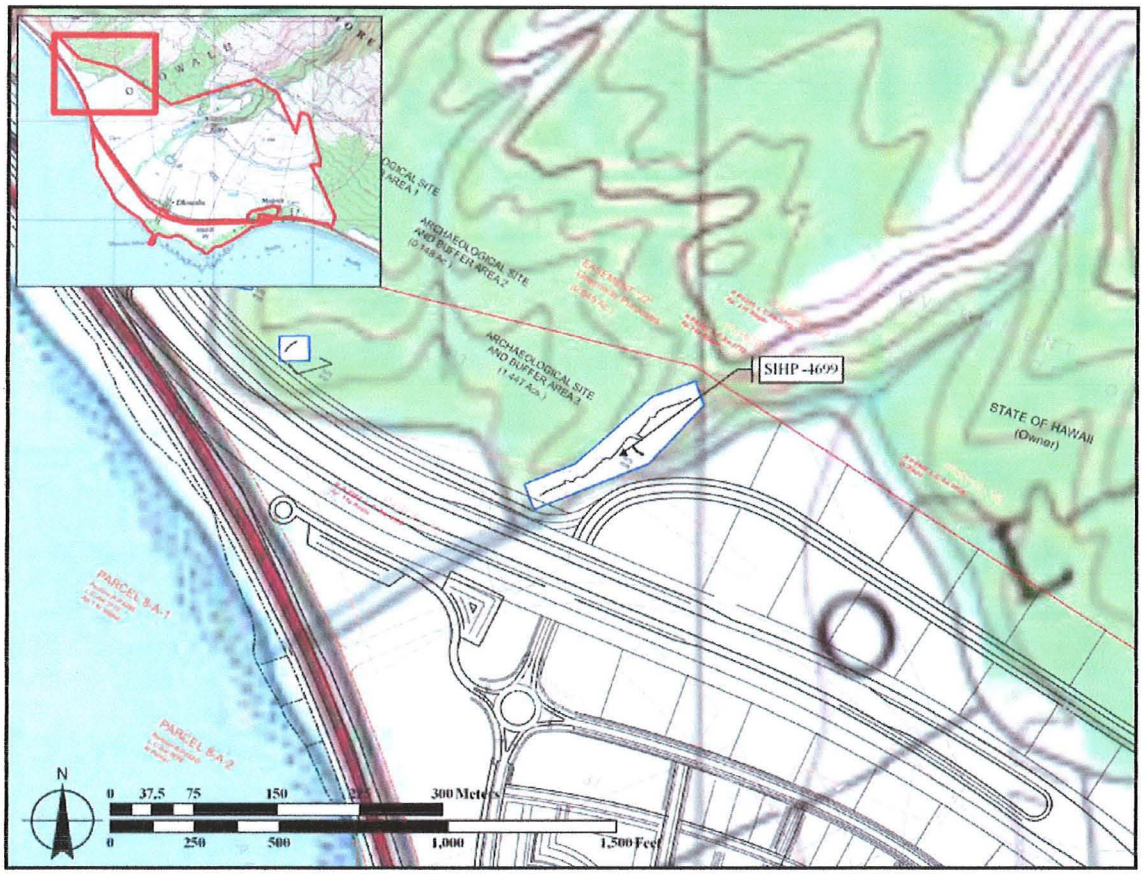

Figure 38. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4699 location in relation to proposed plans for Olowalu Town.

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.

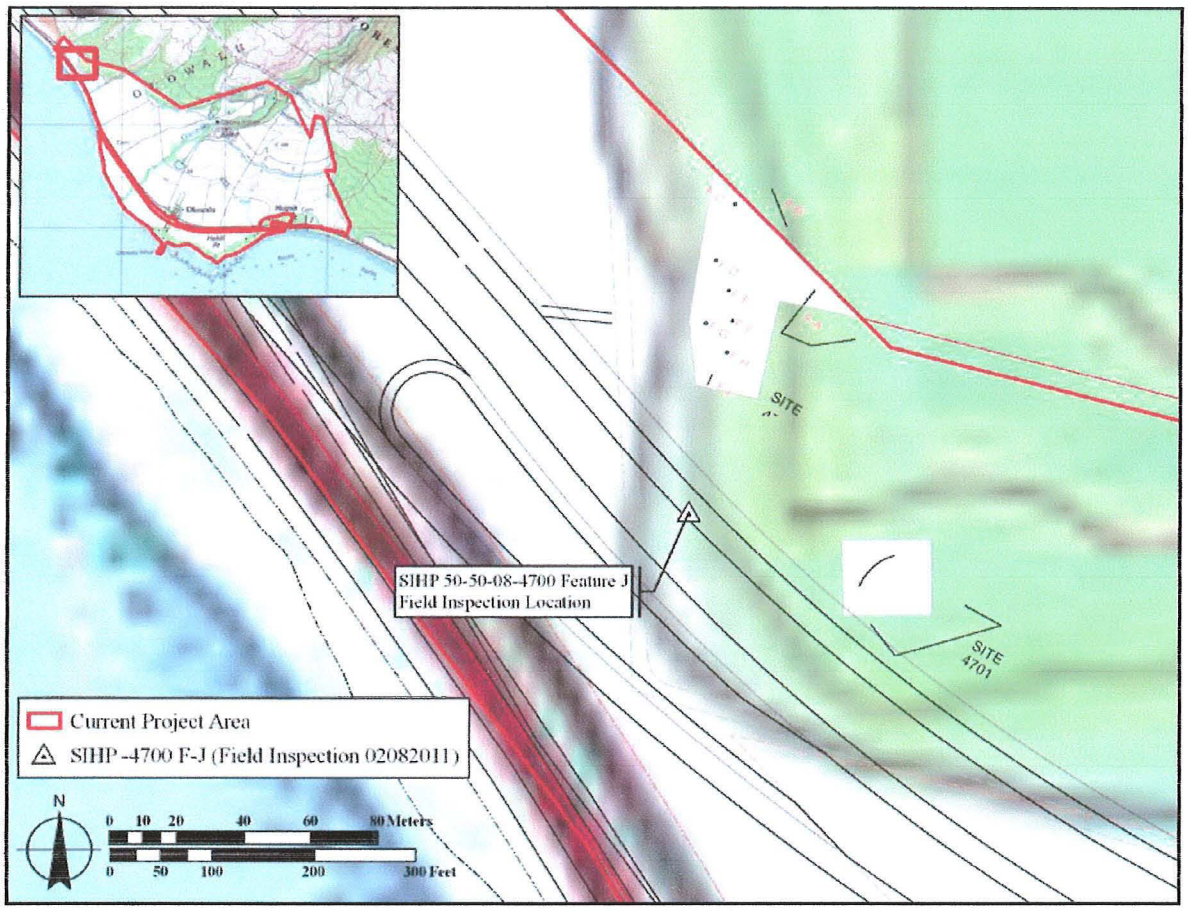

Figure 40. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4700 preservation area (white polygon) in relation to SIHP -4700 Feature J.

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.

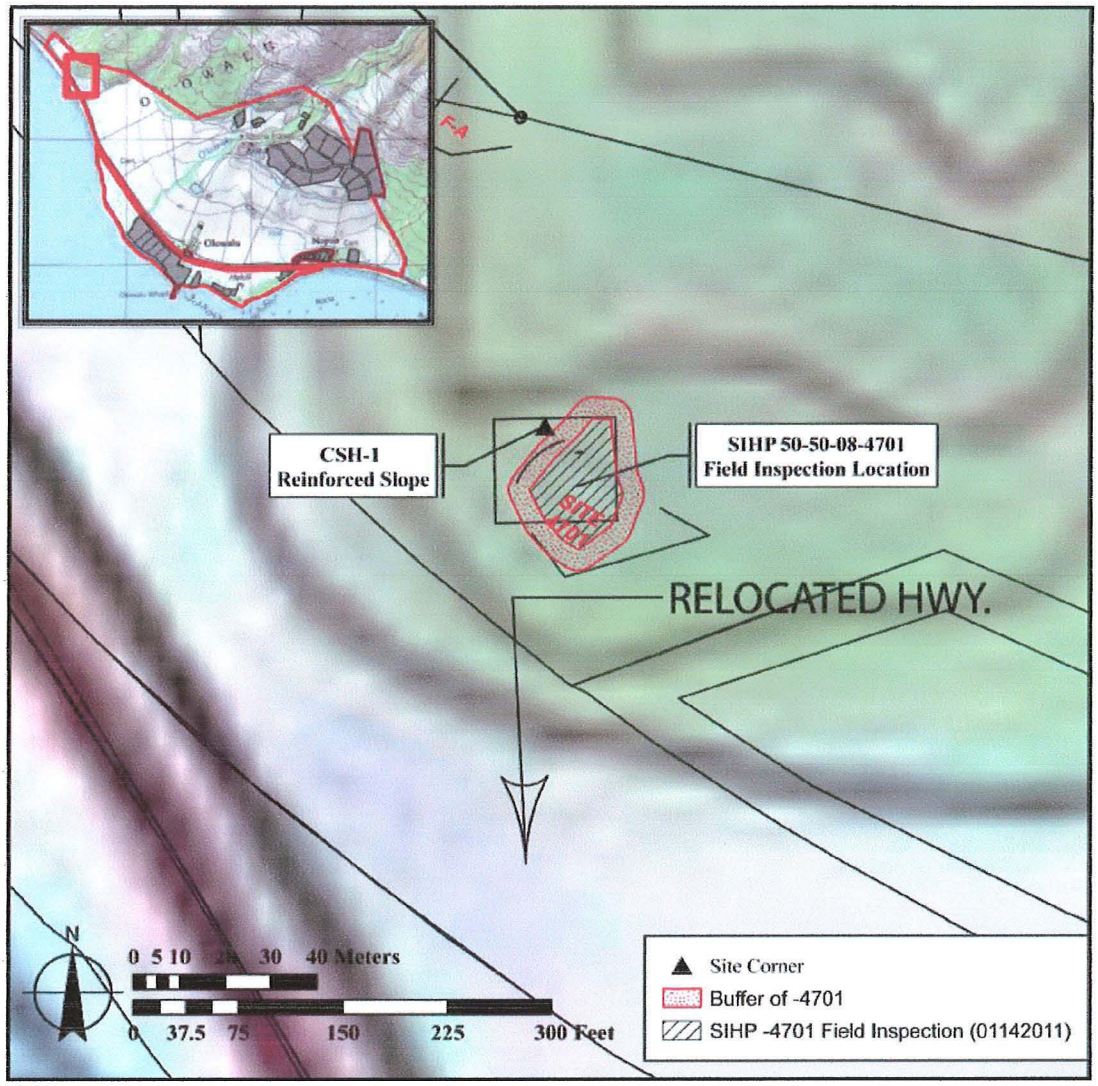

Figure 42. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4701 preservation area (white polygon) and outline (in black) as indicated on the survey CAD map in relation to the location recorded during the archaeological field inspection (shaded in black) 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.

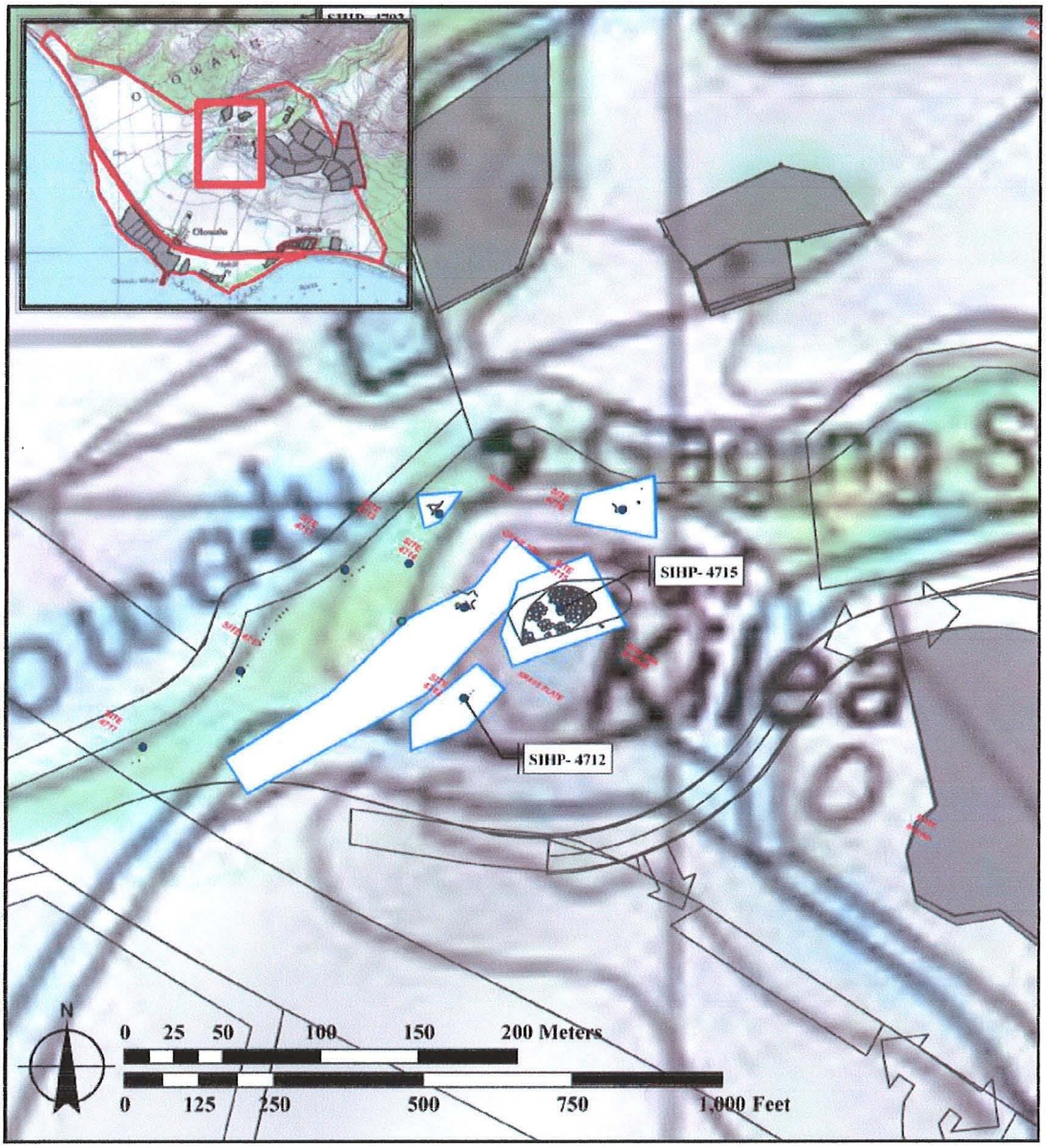

Figure 47. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4715 and -4715 location in relation to proposed plans for Olowalu Town (black lines), Olowalu Mauka Private Parcels (shaded gray), and archaeological site buffers (outlined in blue).

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.

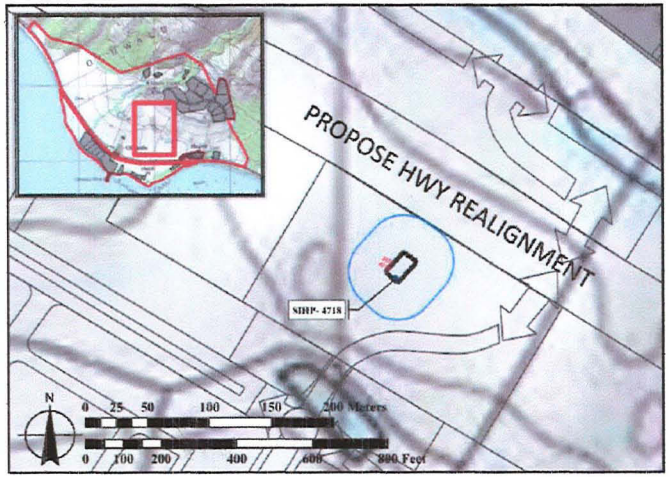

Figure 51. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing SIHP 50-50-08-4718 preservation area (outlined in blue) as indicated on the survey CAD map in relation to the proposed highway realignment.

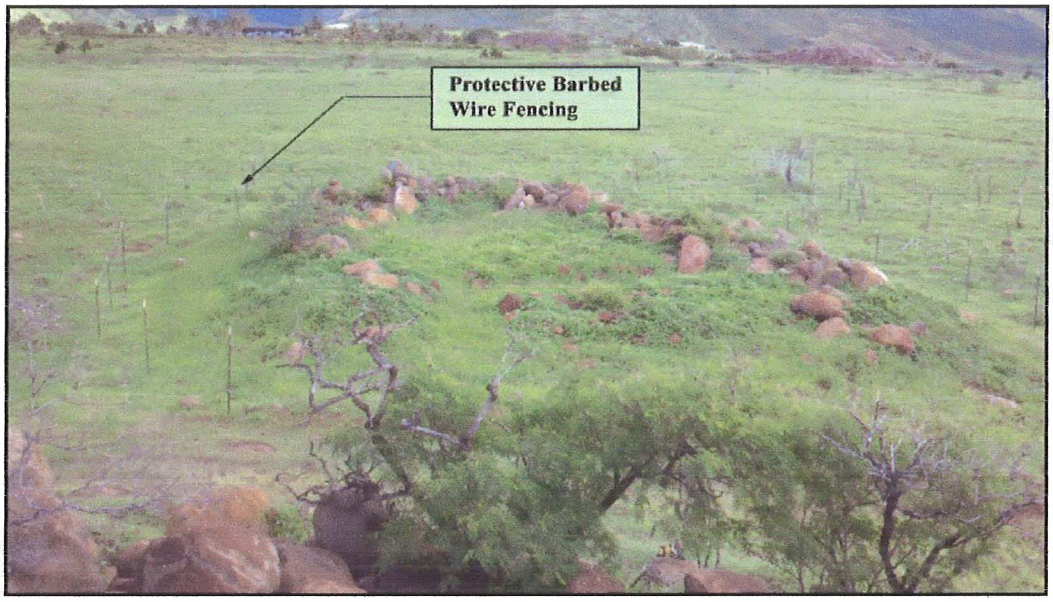

Figure 52. SIHP 50-50-08-4718. View to northeast.

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.

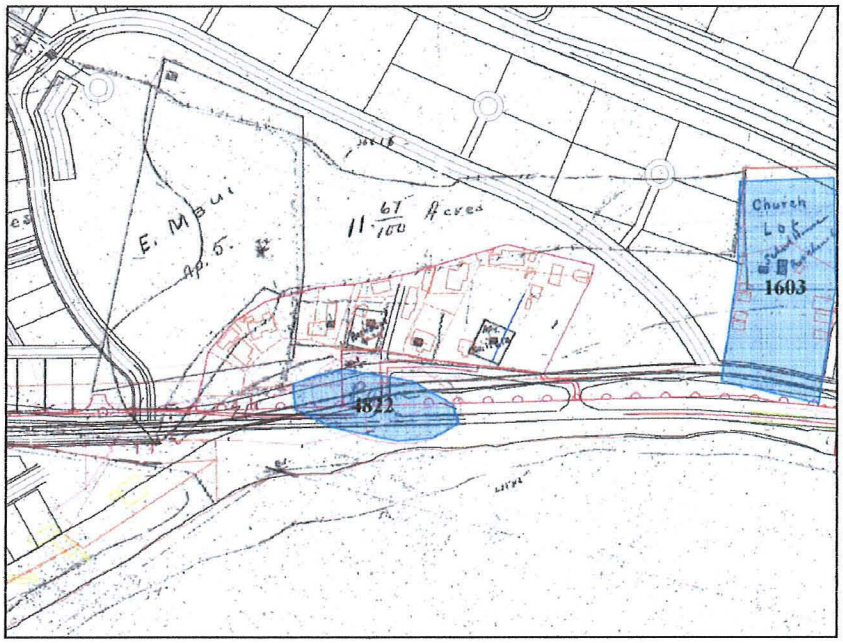

Figure 54. A portion of the 1881 Olowalu Sugar Plantation map (Monsarrat 1881) showing the former pond location and *kuleana* parcels of Kapa'iki Village in approximate relation to current historic property boundaries (shaded in blue), current built environment (outlined in red) and proposed Olowalu Town plans (outlined in black).

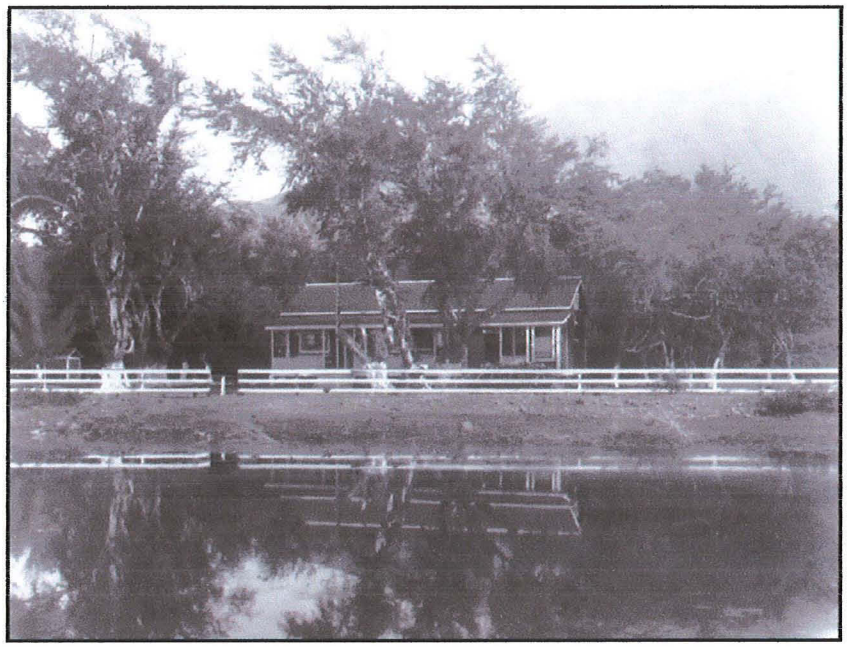

Figure 55. Ka Loko o Kapa'iki at Olowalu (foreground) and school house (middle ground) (Photo courtesy of Frampton and Ward, LLC.)

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).

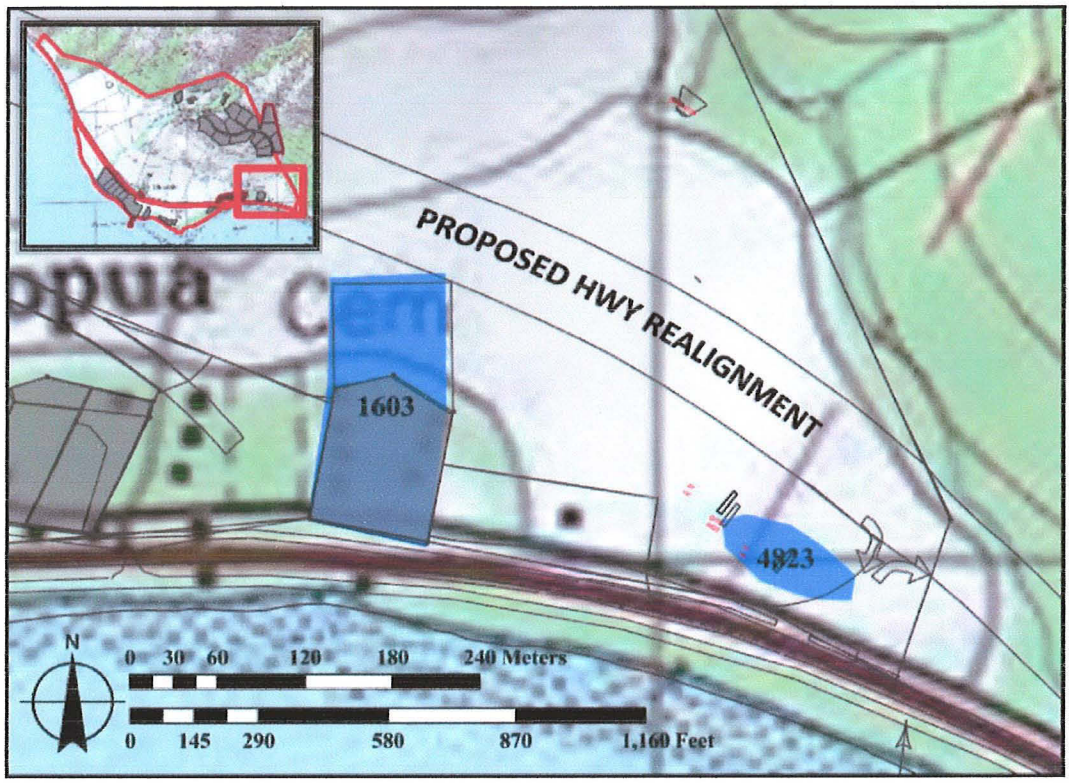

Figure 59. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing location of SIHP 50-50-08-4823 (shaded in blue) in relation to a proposed coastal access road (to the right of frame), private parcels not a part of the current proposed project shaded in gray.

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.

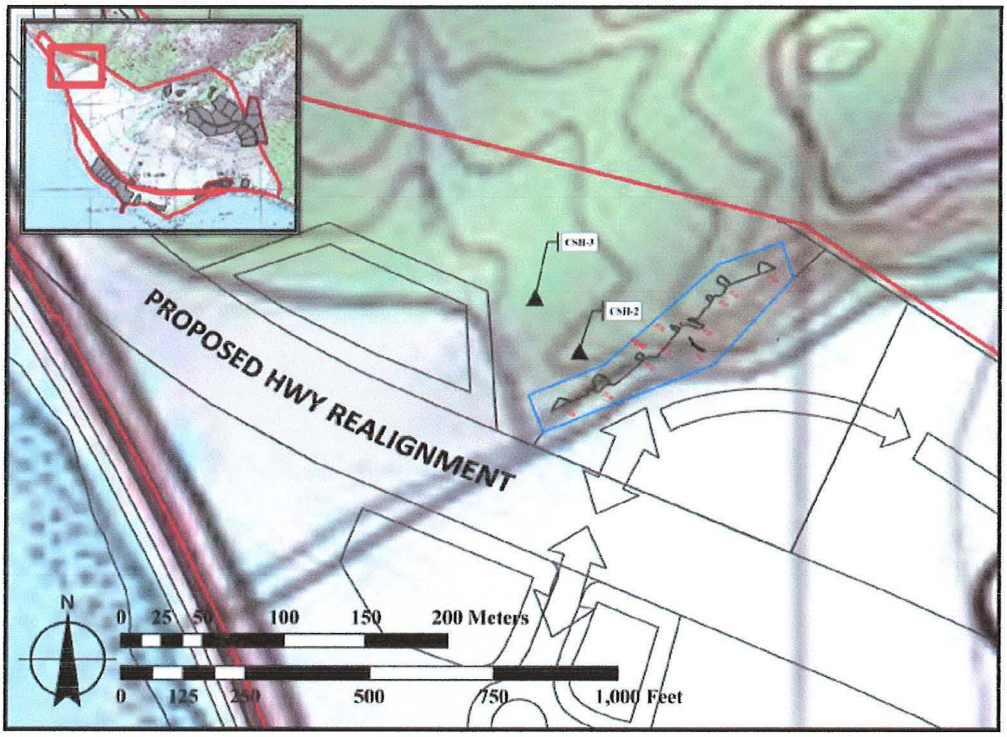

Figure 60. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing locations of branch coral scatters (CSH-2 and CSH-3).

Figure 61. Branch coral surface scatter (CSH-2). View to south.

Figure 62. Branch coral surface scatter (CSH-3). View to southeast.

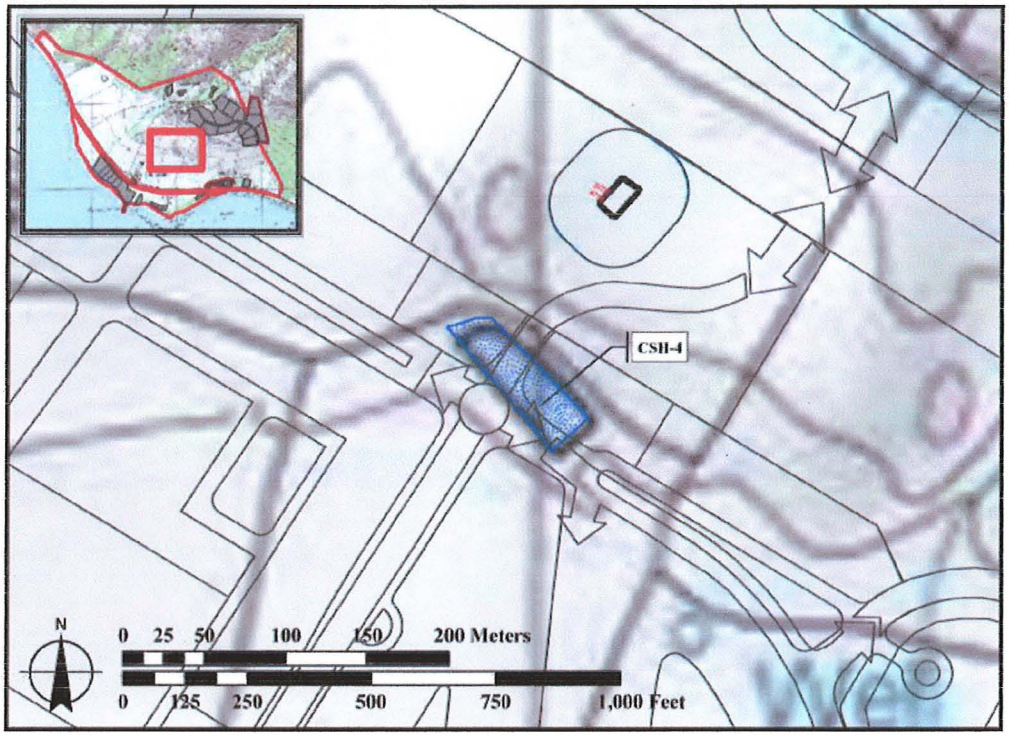

Figure 63. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the plantation-era reservoir (CSH-4).

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.

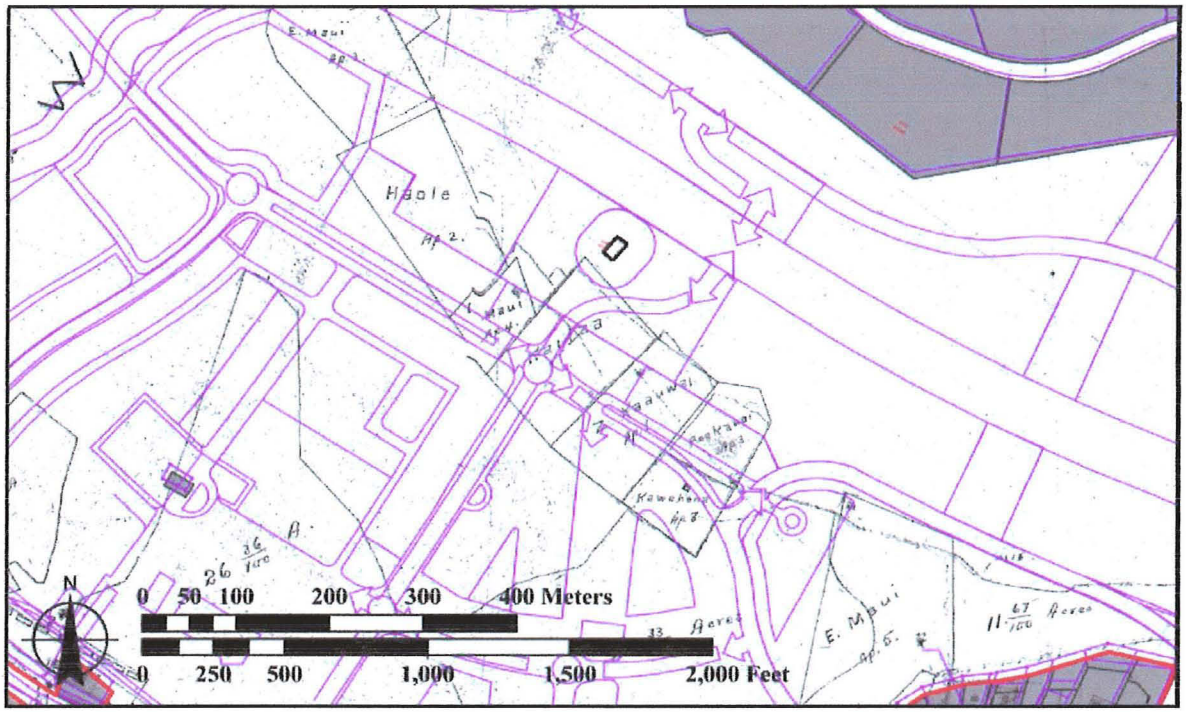

Figure 65. A portion of the 1881 Olowalu Sugar Plantation map (Monsarrat 1881) showing the *mauka kuleana* parcels in approximate relation to the proposed Olowalu Town plans (outlined in magenta).

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

Appendix B SHPD Correspondence

APPENDIX G.
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

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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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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.

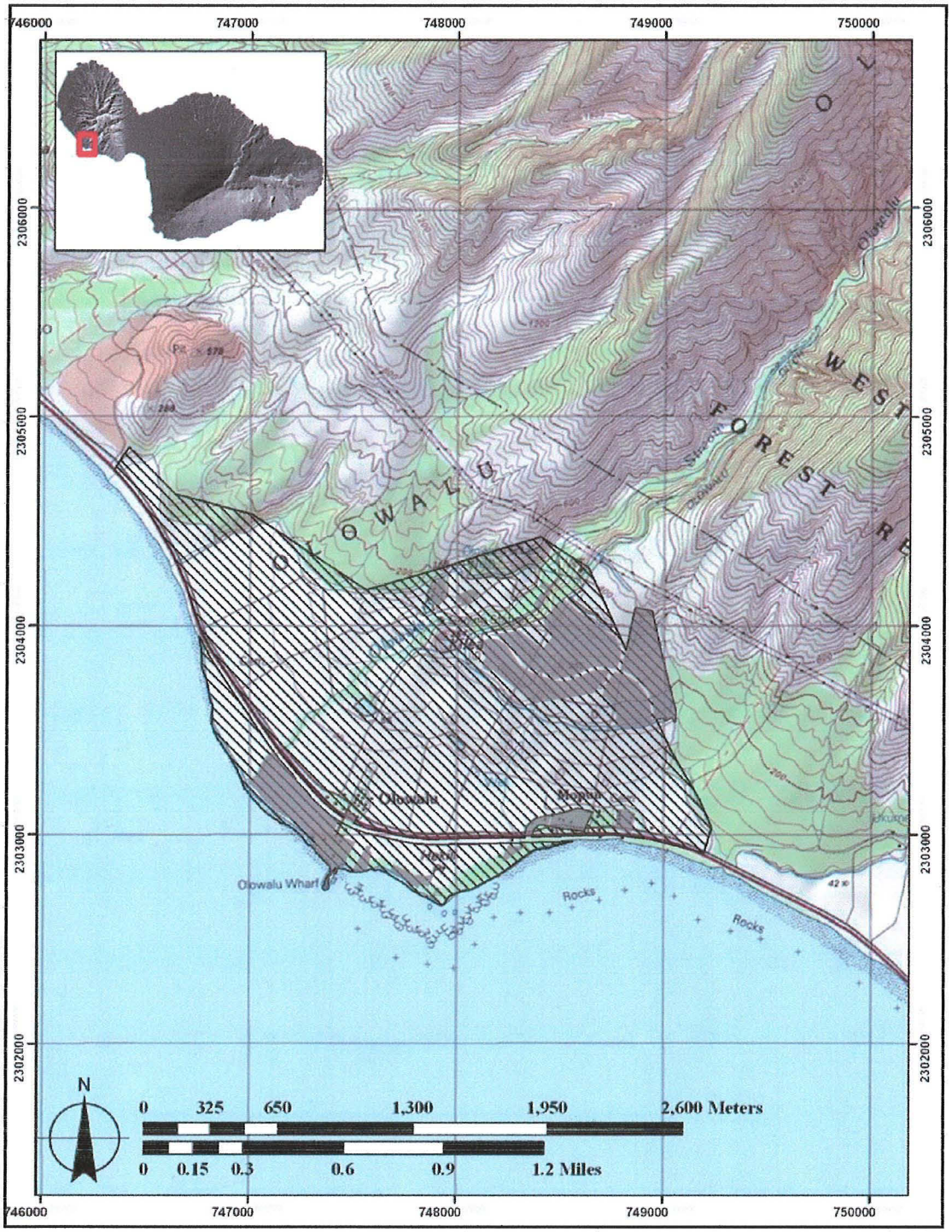

Figure 1. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

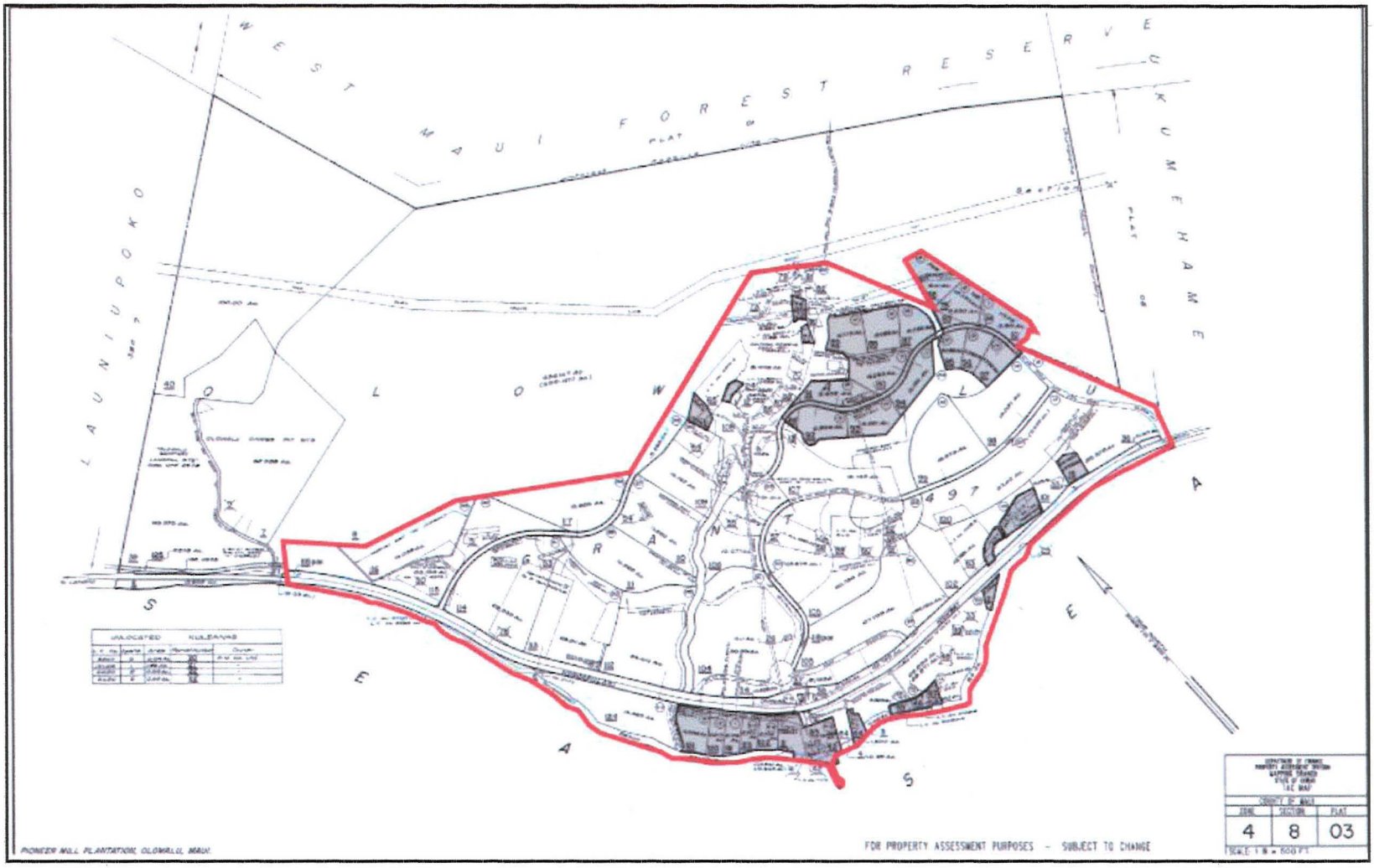

Figure 2. TMK (2) 4-8-03 showing the location of the current project area outlined in red, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

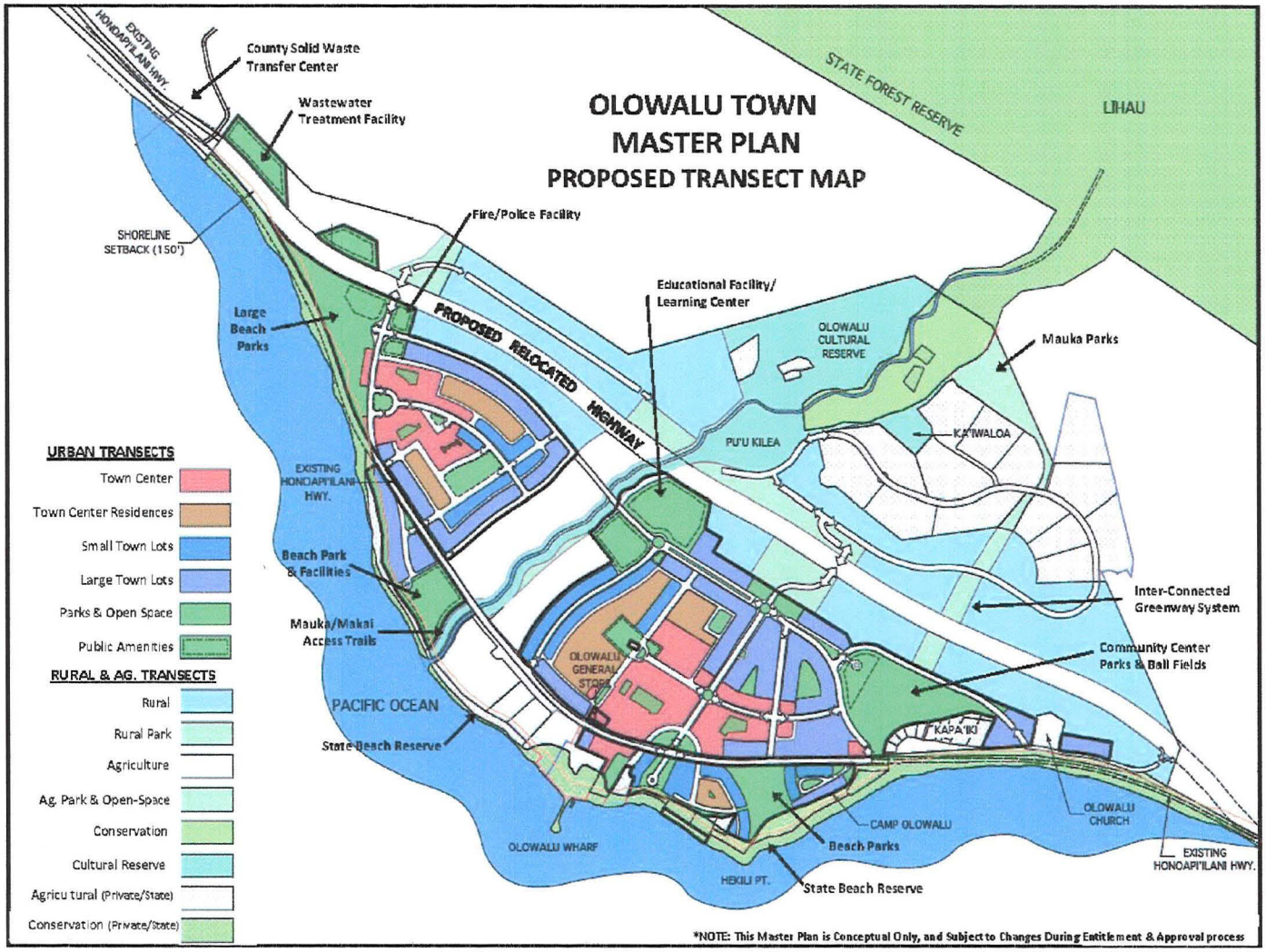

Figure 3. Conceptual drawing for the Proposed Olowalu Town Master Plan (figure courtesy of Olowalu Town, LLC.)

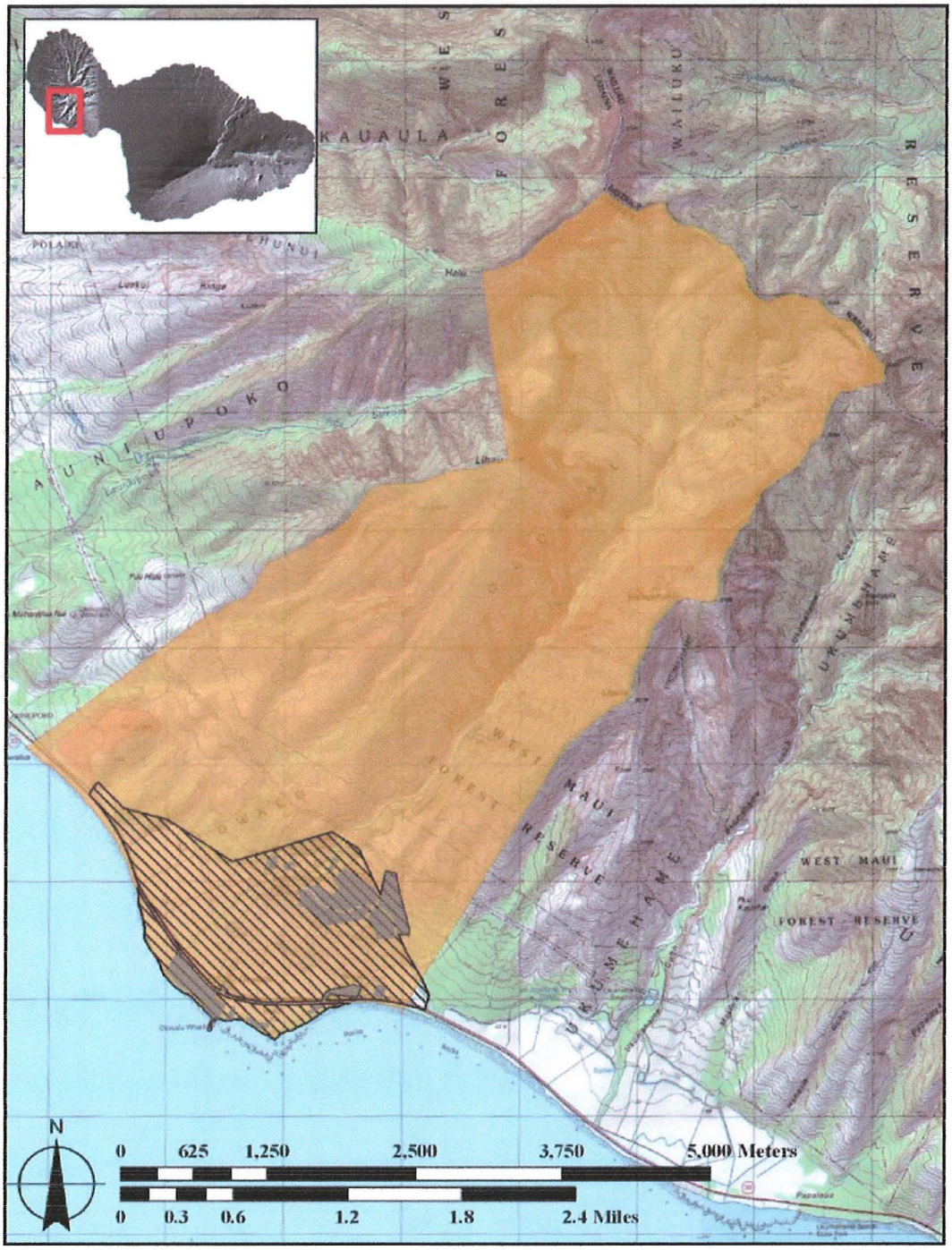

Figure 4. Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the location of the current project area in cross-hatch, the study area and Olowalu Ahupua'a shaded in orange, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray.

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.

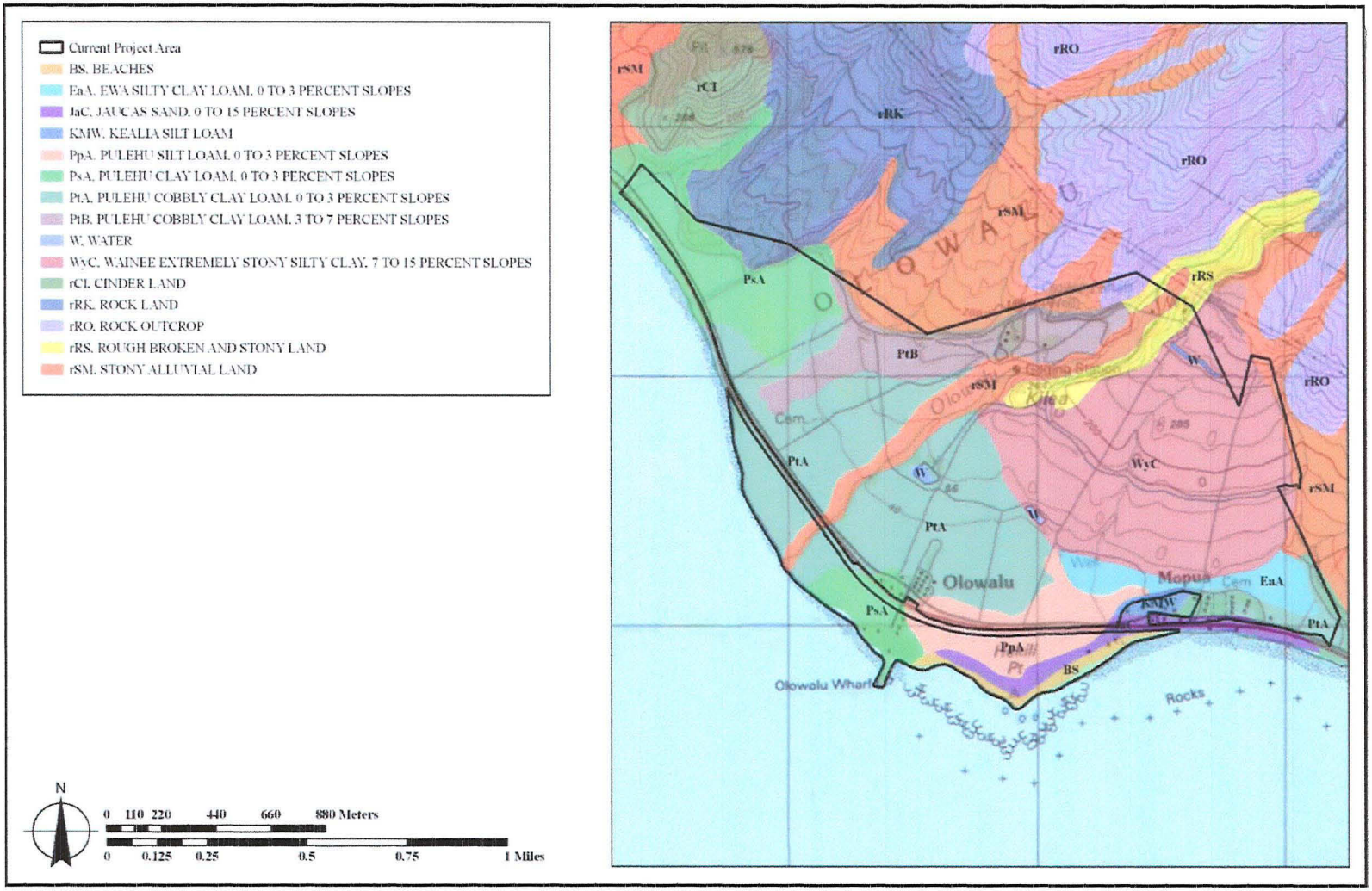

Figure 5. . Portion of the 7.5-minute USGS topographic map, Olowalu Quadrangle (1992) showing the current project area relative to the local soil series (U.S. Department of Agriculture 2001).

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).

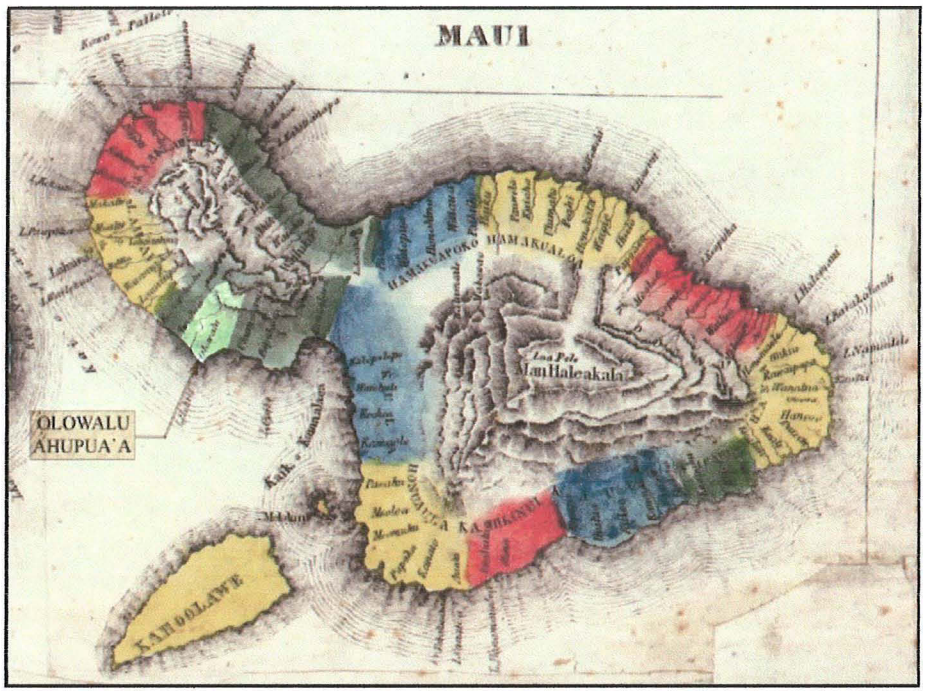

Figure 6. A portion of the S.P. Kalama Map (1837) showing the location of Olowalu Ahupua'a in relation to the *moku* of Maui Island.

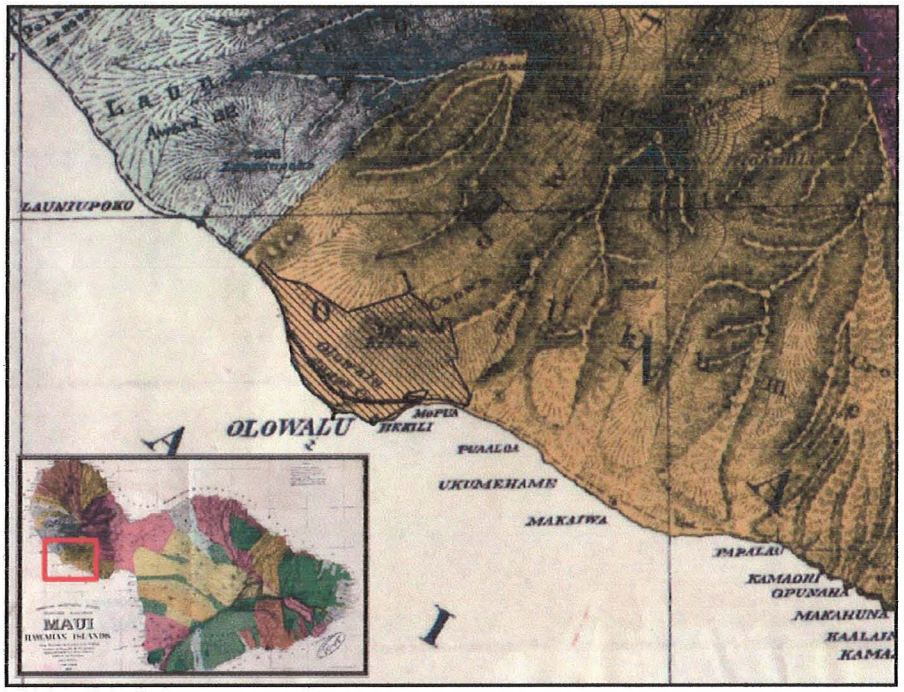

Figure 7. A portion of the F.S Dodge map (1885) showing Olowalu Ahupua'a in relation to the traditional *moku* of Lāhainā (crown lands in yellow).

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

[1] a land subdivision of an *ahupua'a* with its own name and defined boundary

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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.

	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

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).

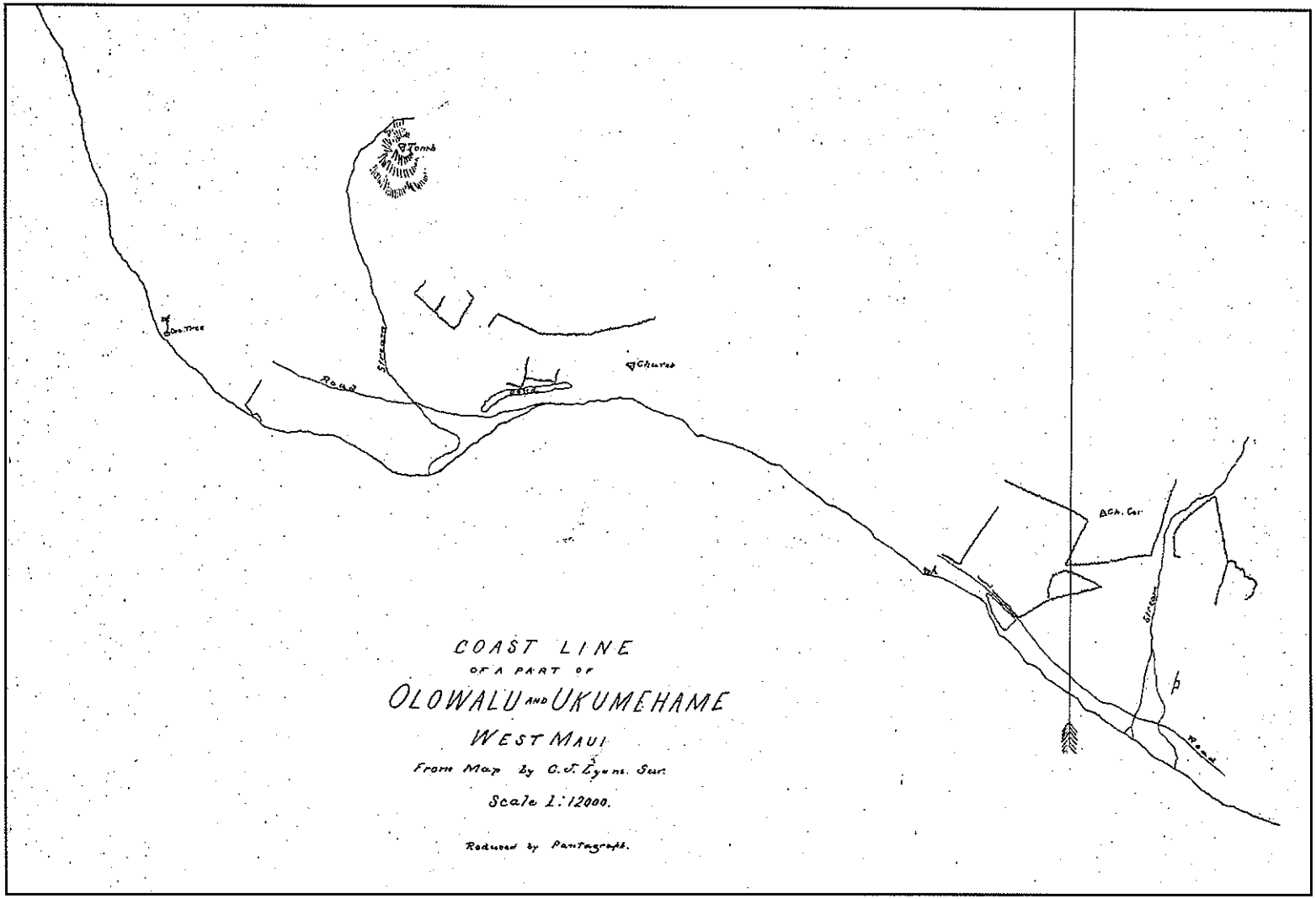

Figure 9. Original route of Olowalu Stream, as surveyed by C.J. Lyons (Dodge 1879), as opposed to the rerouted stream of modern day Olowalu (see Figure 1).

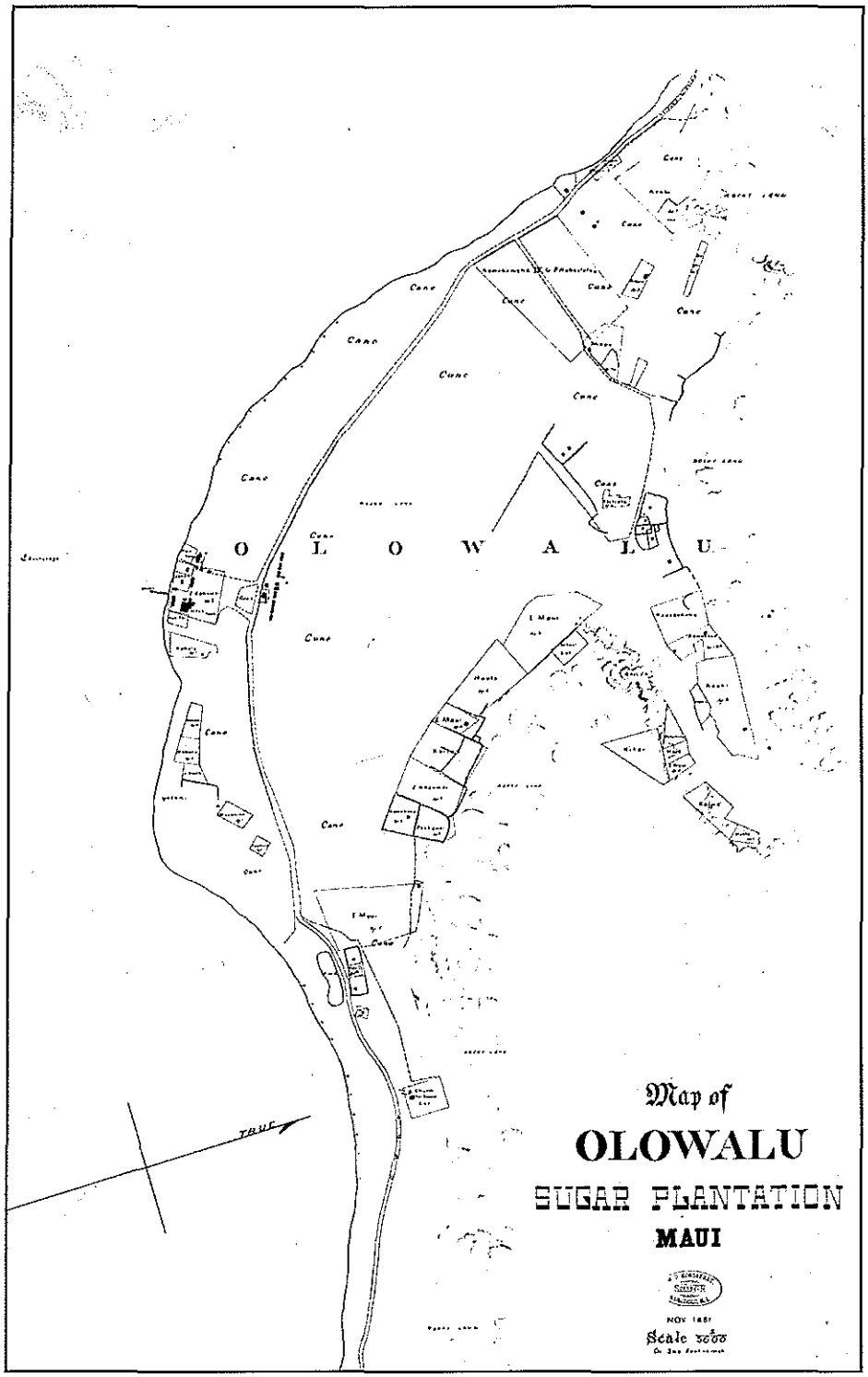

Figure 10. Distribution of *kuleana* awards within Olowalu Ahupua'a, note concentration along the base of Olowalu Valley and former location of Olowalu Stream bed (Monsarrat 1881).

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/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[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 Kawaialoa 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 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

[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 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[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.

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 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).

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 Shimaoka	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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P.O. Box 1114
Kailua, Hawai'i 96734
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Maui Island
1860 Main Street
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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.**

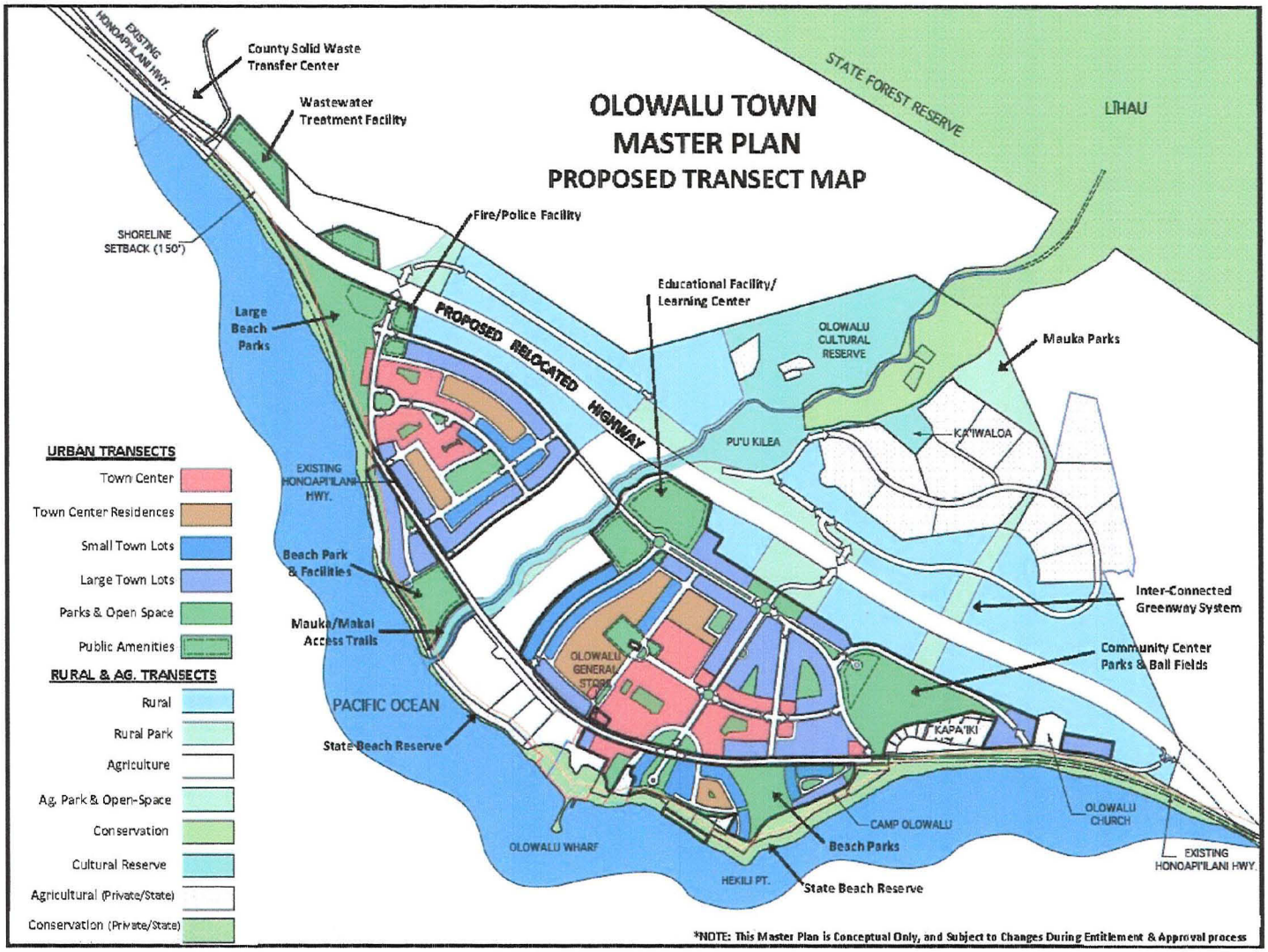
I invite you to contact me, Tanya Lee-Greig at 1-808-242-9882. You may also contact me by e-mail at leegreig@culturalsurveys.com if you have any mana'o or information you would like to share.

Mahalo a nui,

Tanya L. Lee-Greig

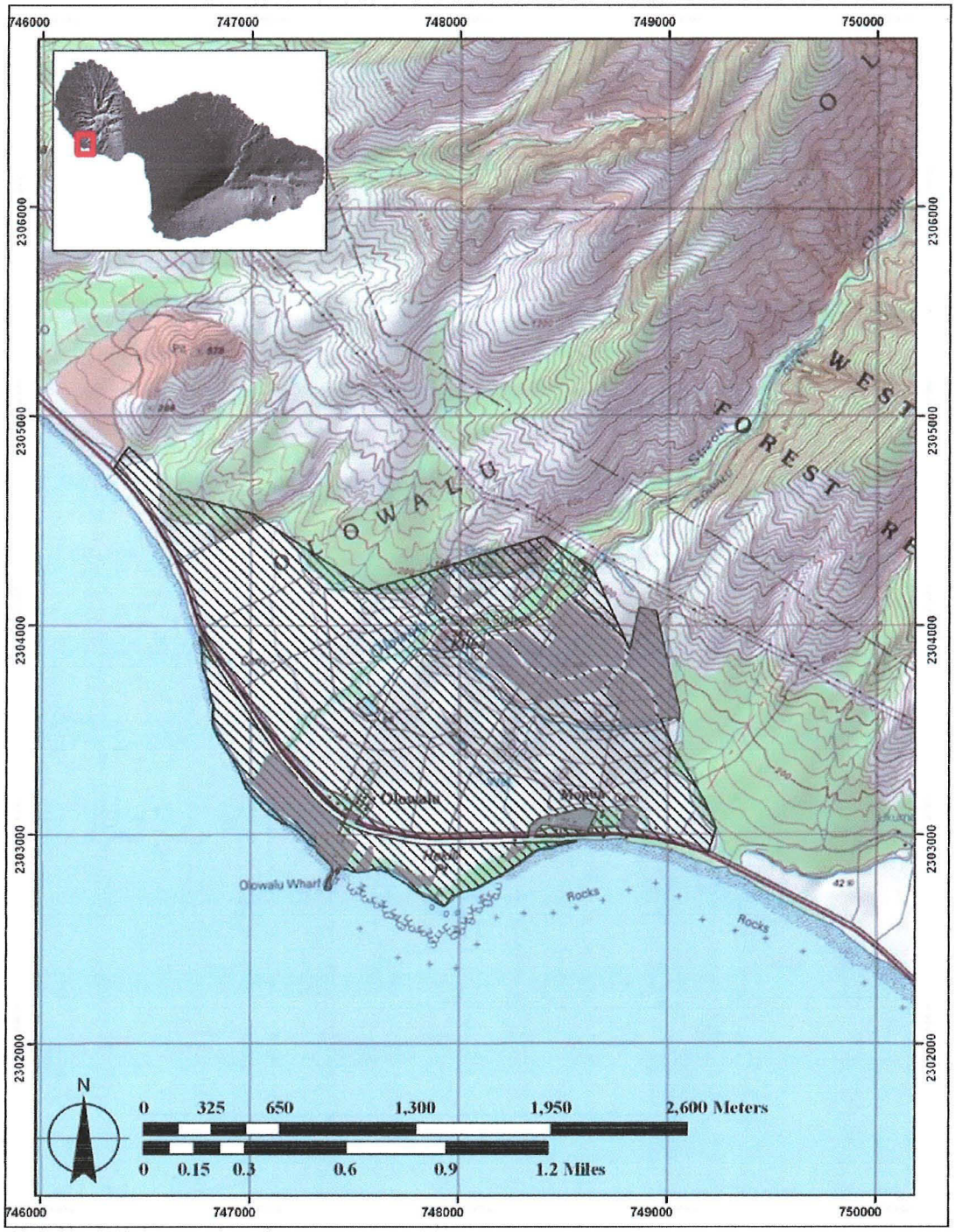
Cultural Surveys Hawai'i, Inc.

Thursday, January 19, 2012

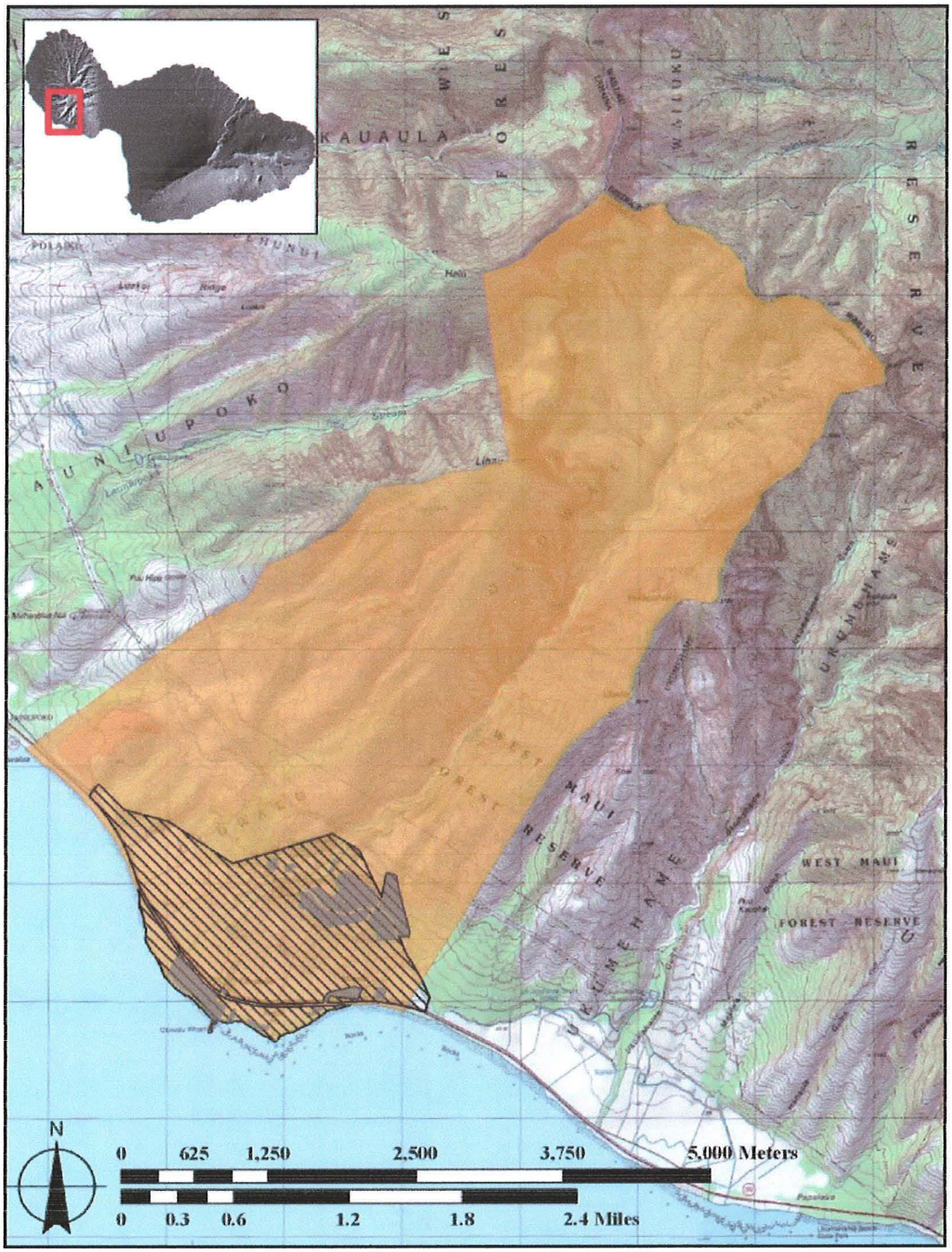


Conceptual drawing for the Proposed Olowalu Town Master Plan (figure courtesy of Olowalu Town, LLC.)

Thursday, January 19, 2012

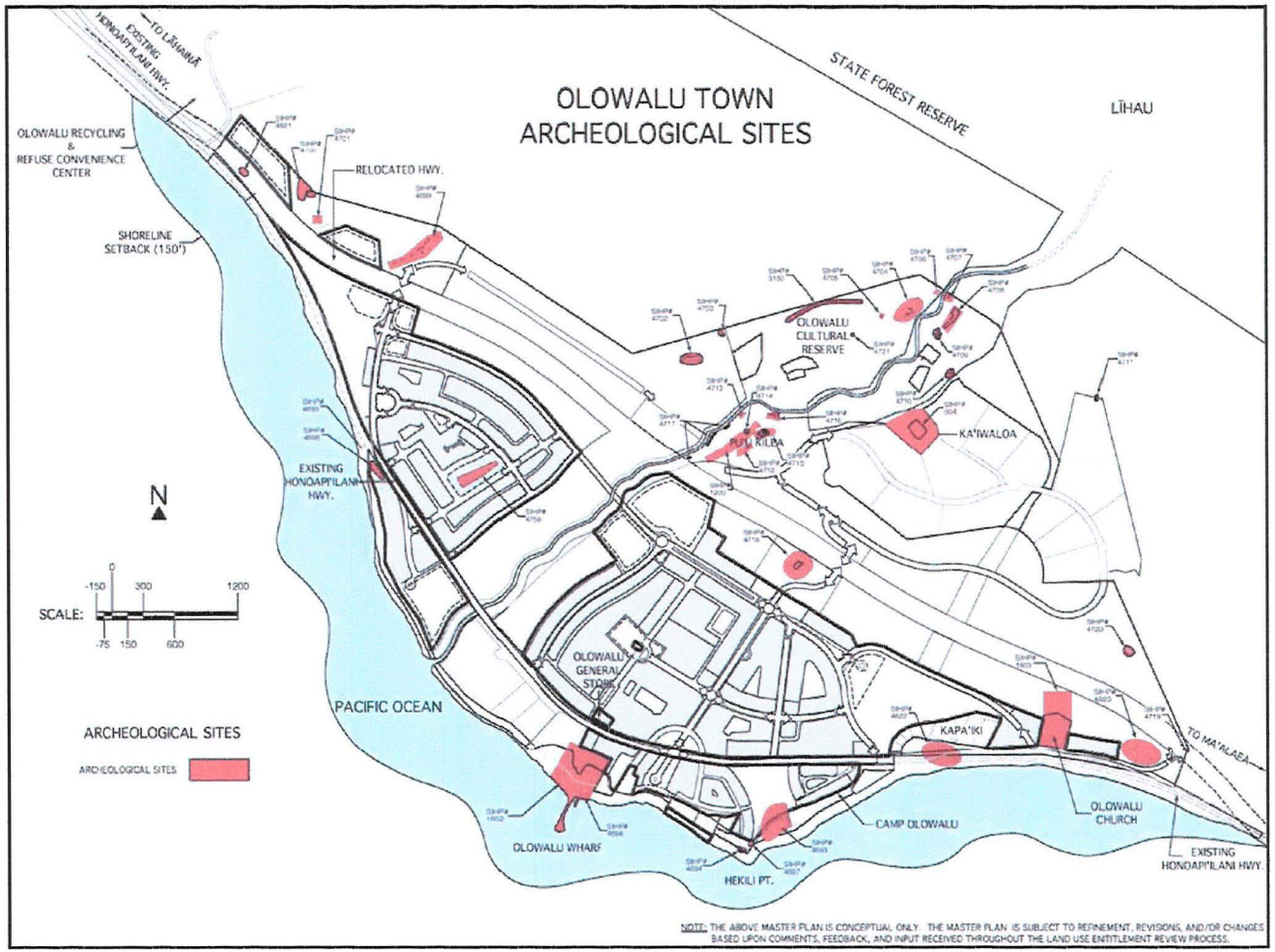


Portion of the 1992 7.5-minute USGS topographic map, Olowalu Quadrangle showing the location of the current project area in cross-hatch, privately owned parcels not included in the Olowalu Town Master Plan shaded in gray



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.

Thursday, January 19, 2012



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.

Air Quality Study

AIR QUALITY STUDY

FOR THE PROPOSED

OLOWALU TOWN PROJECT

OLOWALU, MAUI

Prepared for:

Frampton & Ward, LLC

October 2011

B.D. NEAL & ASSOCIATES

Applied Meteorology • Air Quality • Computer Science

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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

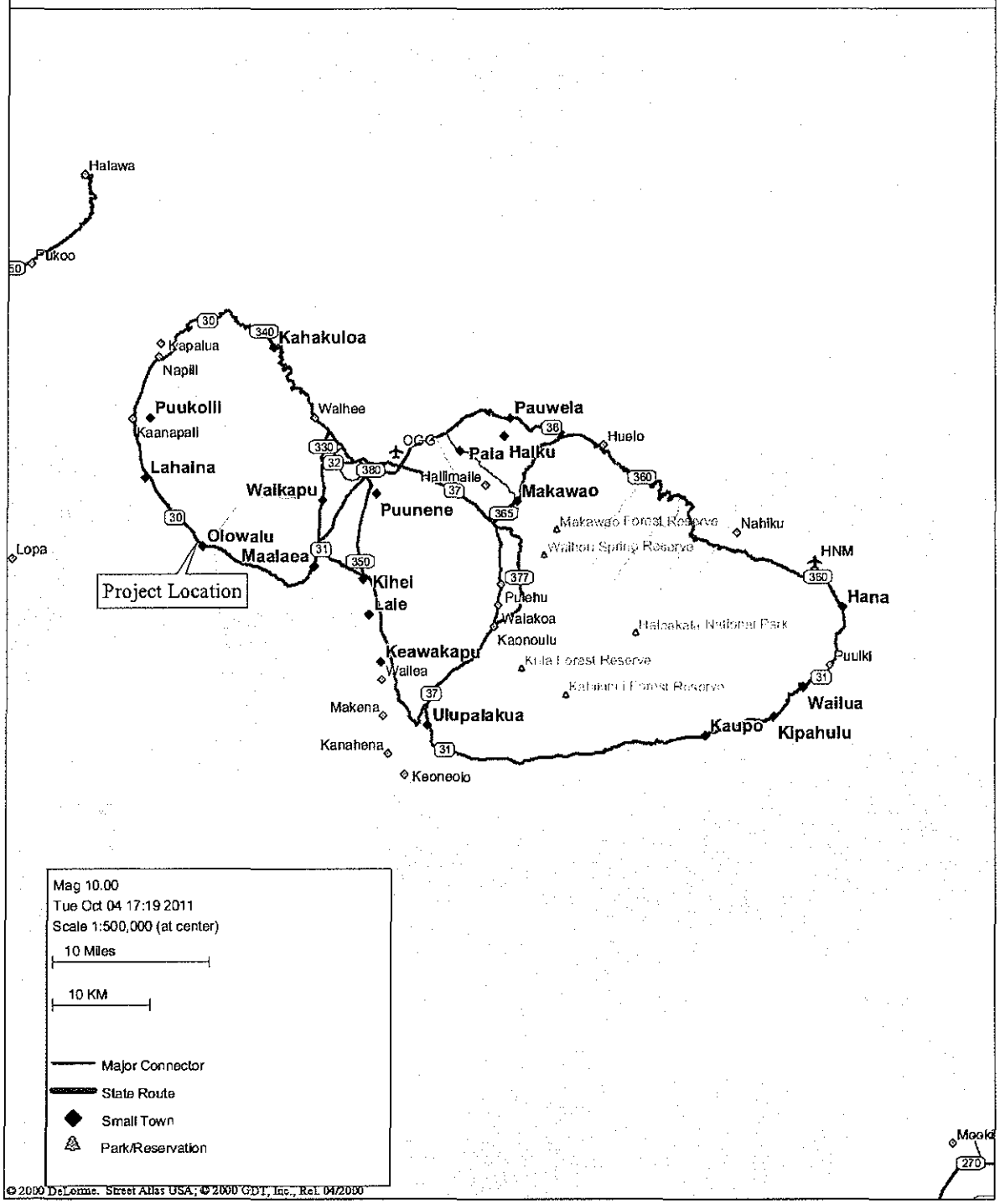

Table 1

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.

Preliminary Acoustic Study

PRELIMINARY ACOUSTIC STUDY FOR THE HONOAPIILANI HIGHWAY REALIGNMENT AT OLOWALU TOWN LAHAINA, MAUI

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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.

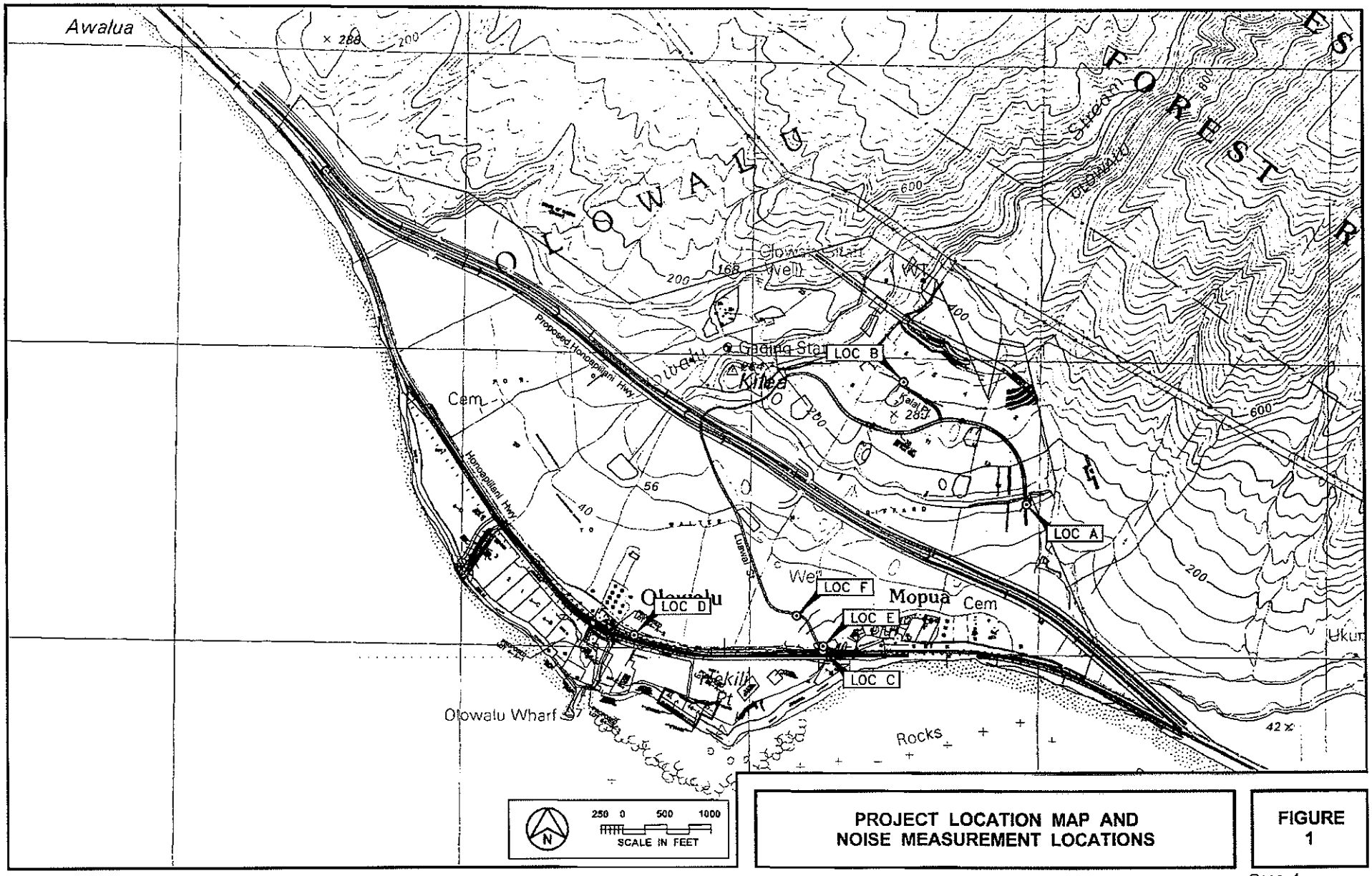
CHAPTER II. GENERAL STUDY METHODOLOGY

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



PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS

FIGURE 1

TABLE 1
TRAFFIC AND BACKGROUND NOISE MEASUREMENT RESULTS

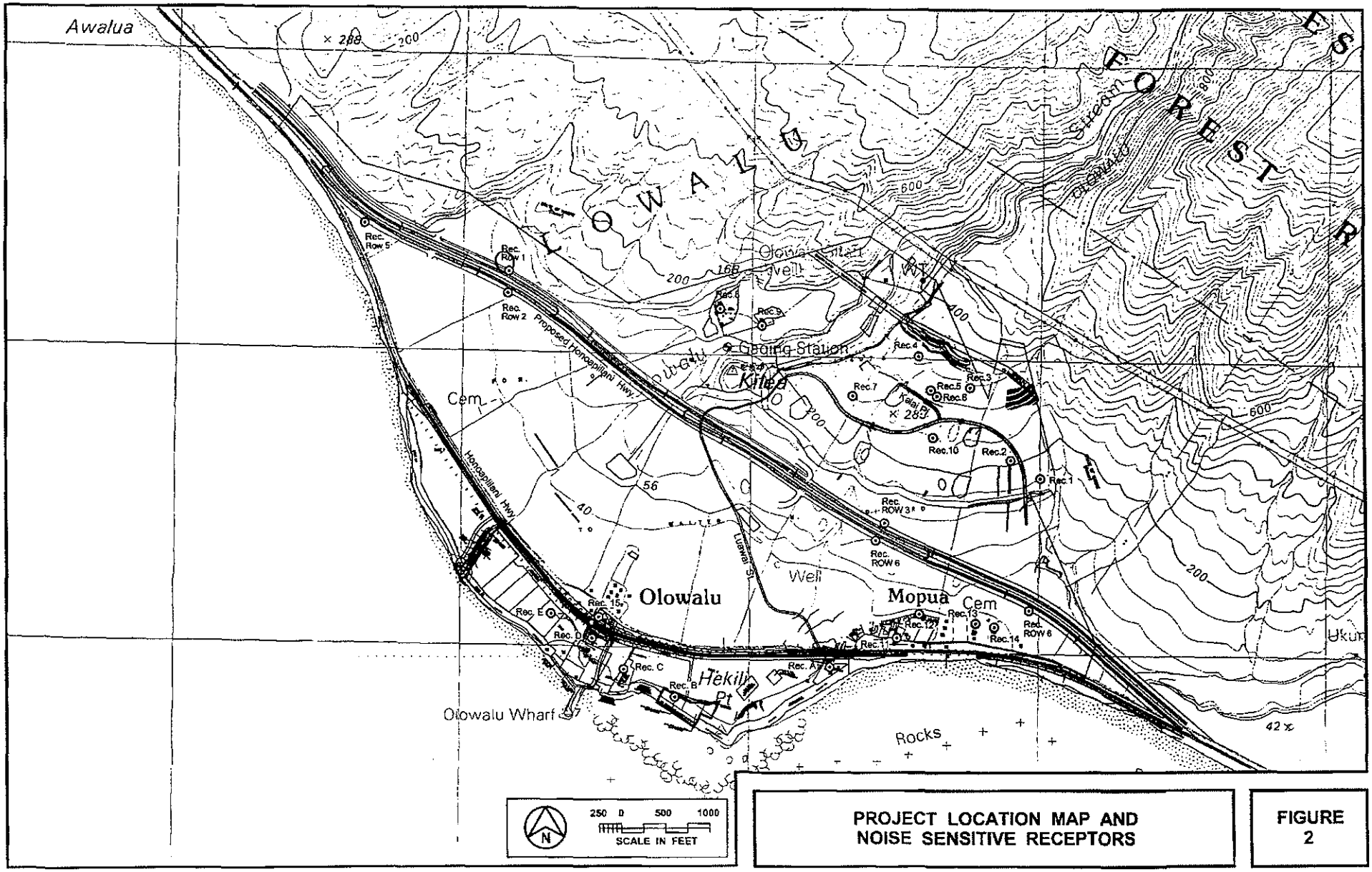
	LOCATION	Time of Day (HRS)	Ave. Speed (MPH)	Hourly Traffic Volume AUTO	M.TRUCK	H.TRUCK	Measured Leq (dB)	Predicted Leq (dB)
A	At east end of Luawai Street (7/10/11)	0944 TO 1014	N/A	N/A	N/A	N/A	42.2	N/A
B	At west end of Kalai Place (7/10/11)	1032 TO 1102	N/A	N/A	N/A	N/A	38.0	N/A
C	60 FT from the center-line 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.

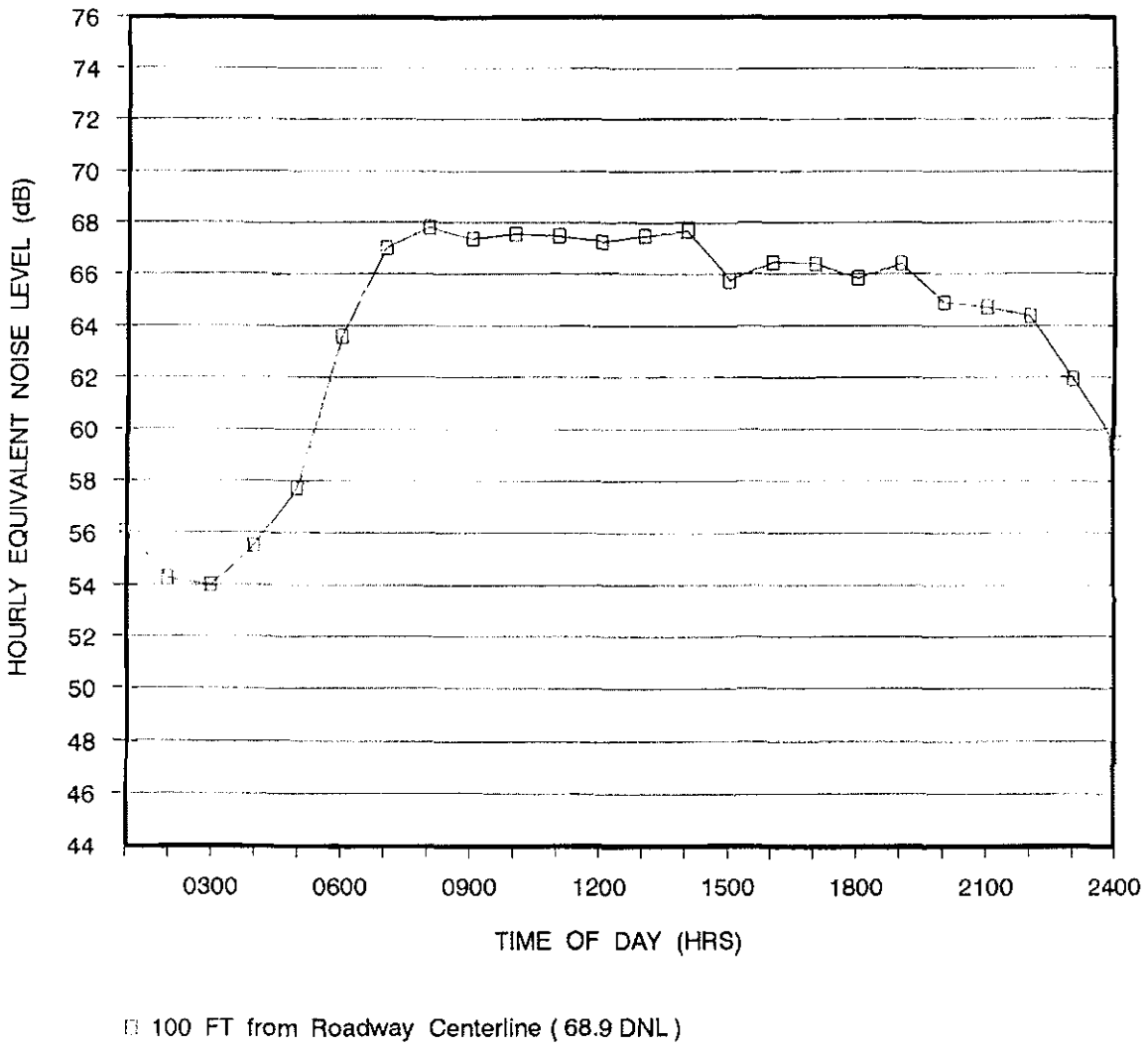
of noise sensitive properties along the new highway alignment, the potential for future traffic noise levels exceeding the Federal Housing Administration, Housing and Urban Development (FHA/HUD) noise standard was also examined. For the purposes of determining noise acceptability for funding assistance 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)		71 Leq SETBACK (FT)	
	EXISTING	CY 2020	EXISTING	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)		75 DNL SETBACK (FT)	
	EXISTING	CY 2020	EXISTING	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)		FUTURE (CY 2020) Leq 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

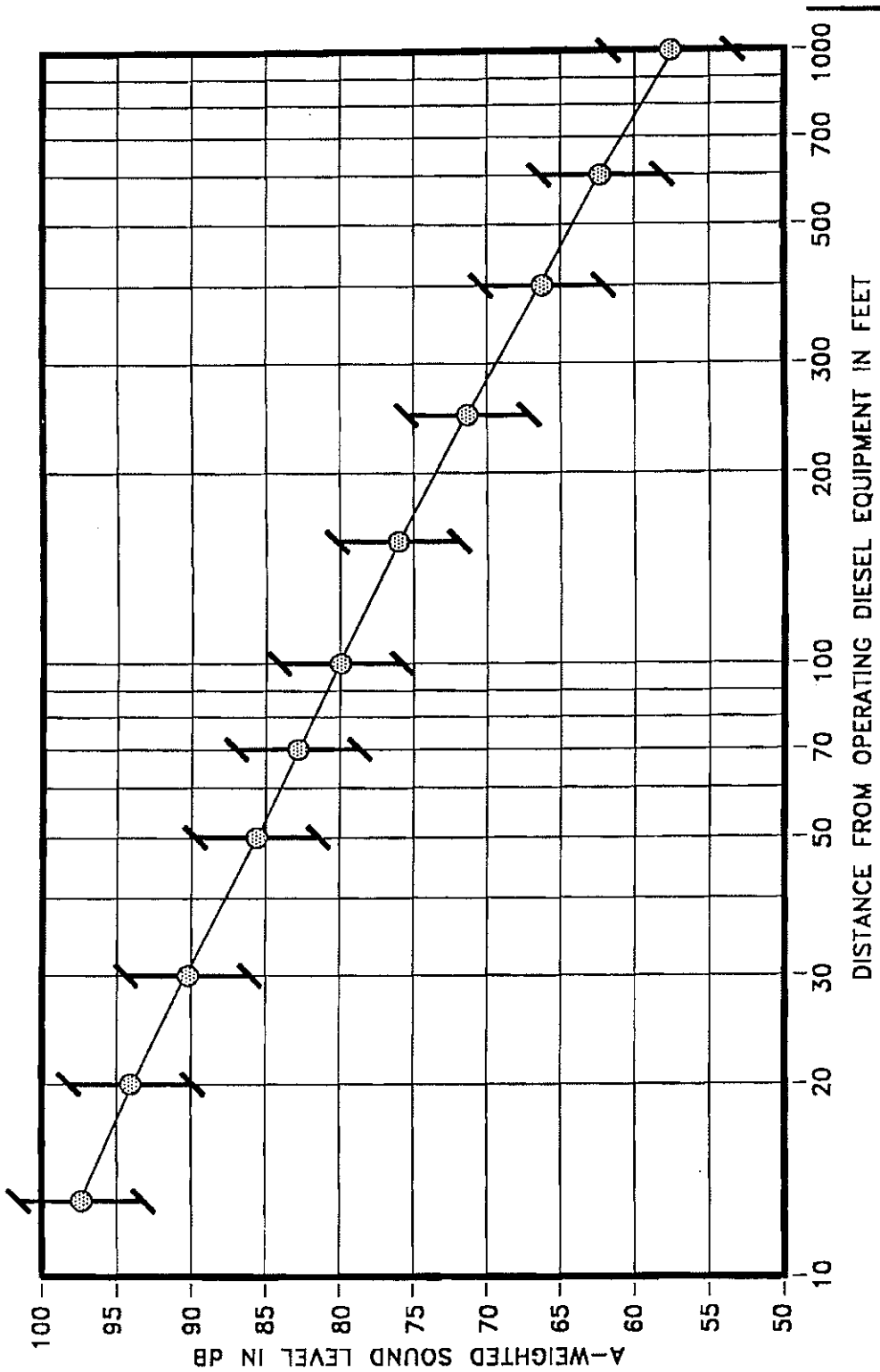
General Construction. Short-term noise impacts associated with construction activities along the existing highway may occur. These impacts can occur as a result of the relatively low background noise levels at existing dwelling units closest to the anticipated construction corridor. The total duration 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.

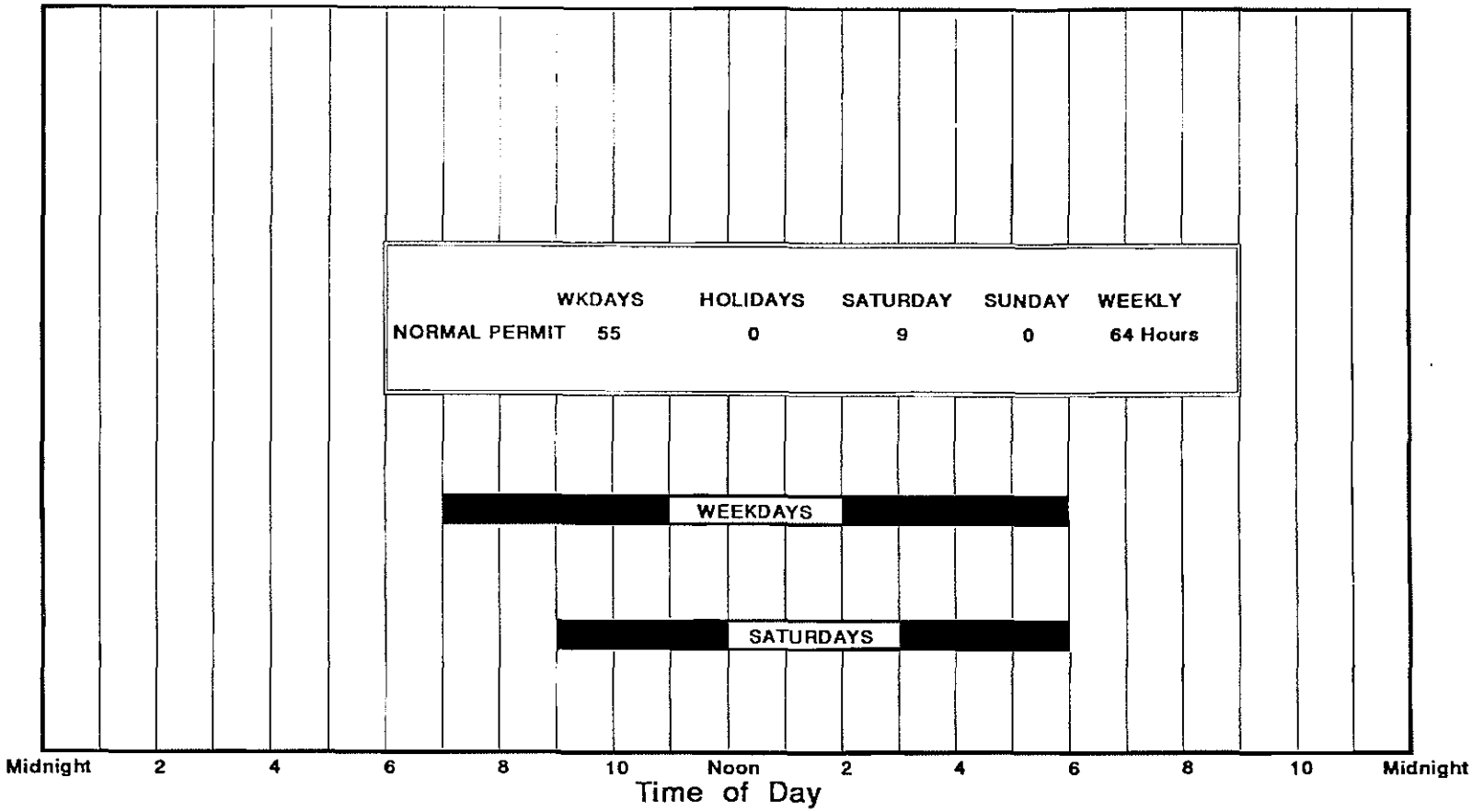
In addition, the use of quieted portable engine generators and diesel equipment should be specified for use within 500 FT of noise sensitive properties. Heavy truck and equipment staging areas should also be located at areas which are at least 500 FT from noise sensitive properties whenever possible. 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



AVAILABLE WORK HOURS UNDER DOH PERMIT PROCEDURES FOR CONSTRUCTION NOISE

FIGURE 5

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

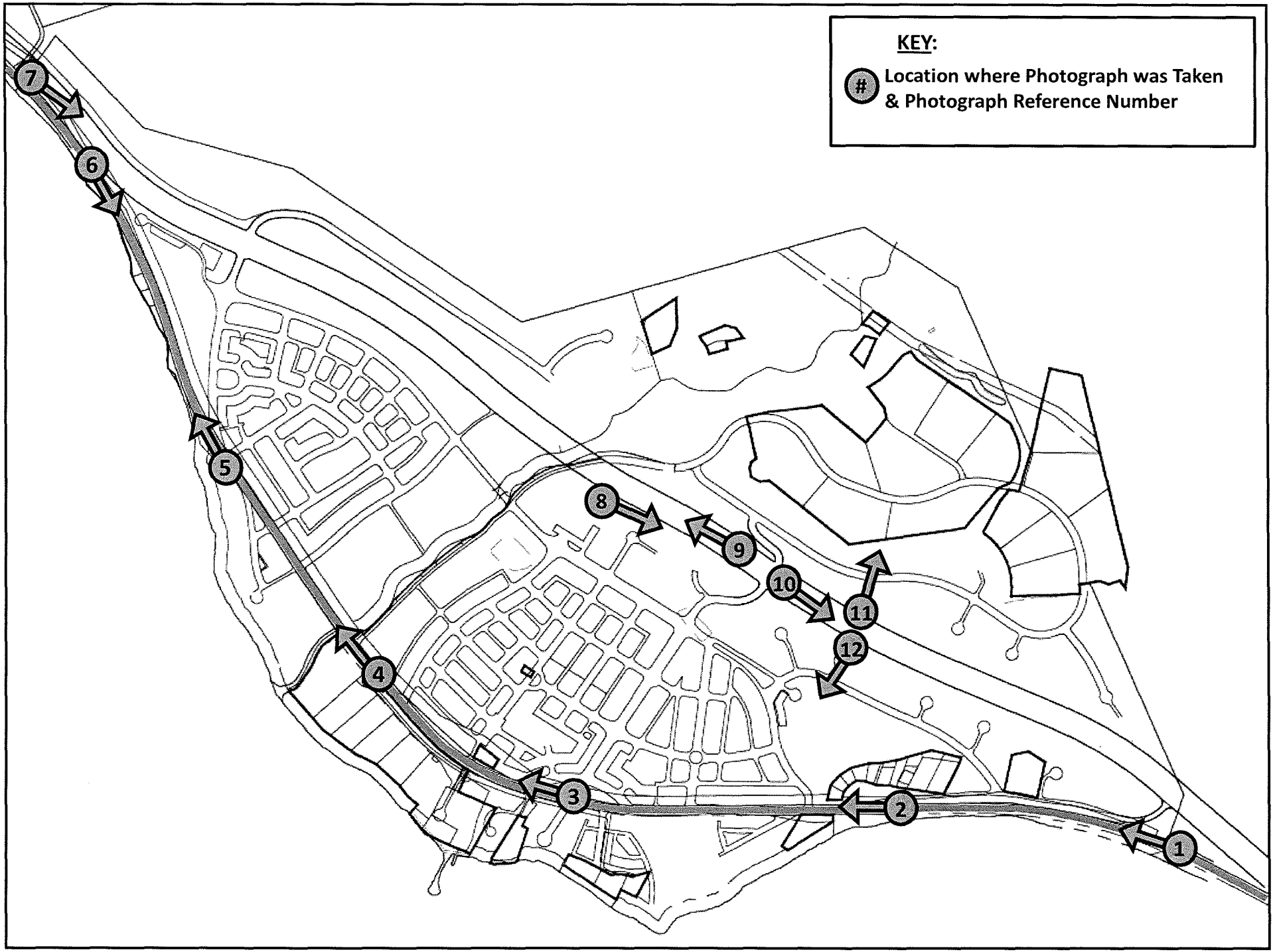
ROADWAY LANES	**** CY 2011 *****		CY 2020 (NO BUILD)		CY 2020 (BUILD)	
	AM VPH	PM VPH	AM VPH	PM VPH	AM VPH	PM VPH
Along Existing Honoapiilani Highway:						
At Solid Waste Transfer Station (WB)	865	935	995	1,075	N/A	N/A
At Solid Waste Transfer Station (EB)	606	841	697	967	N/A	N/A
Two-Way	1,471	1,776	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.

View Analysis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Location where Photograph was Taken & Photograph Reference Number
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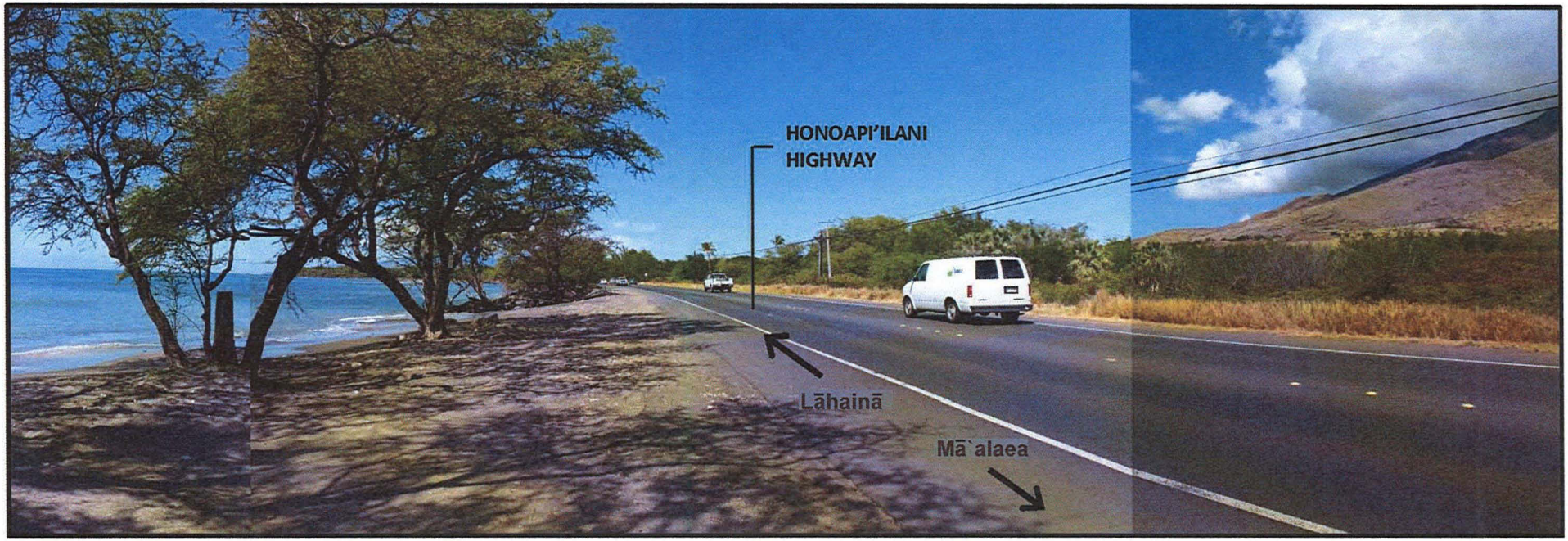
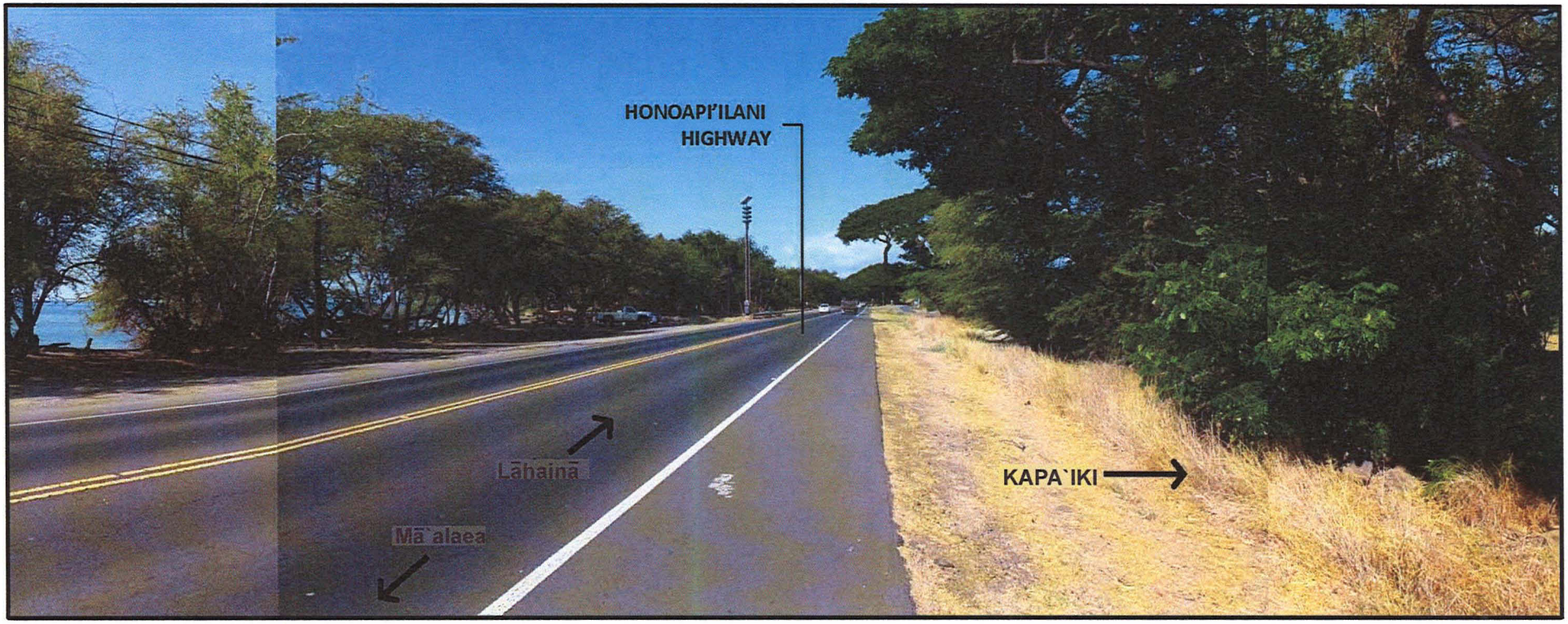
PHOTOGRAPH NO. 1

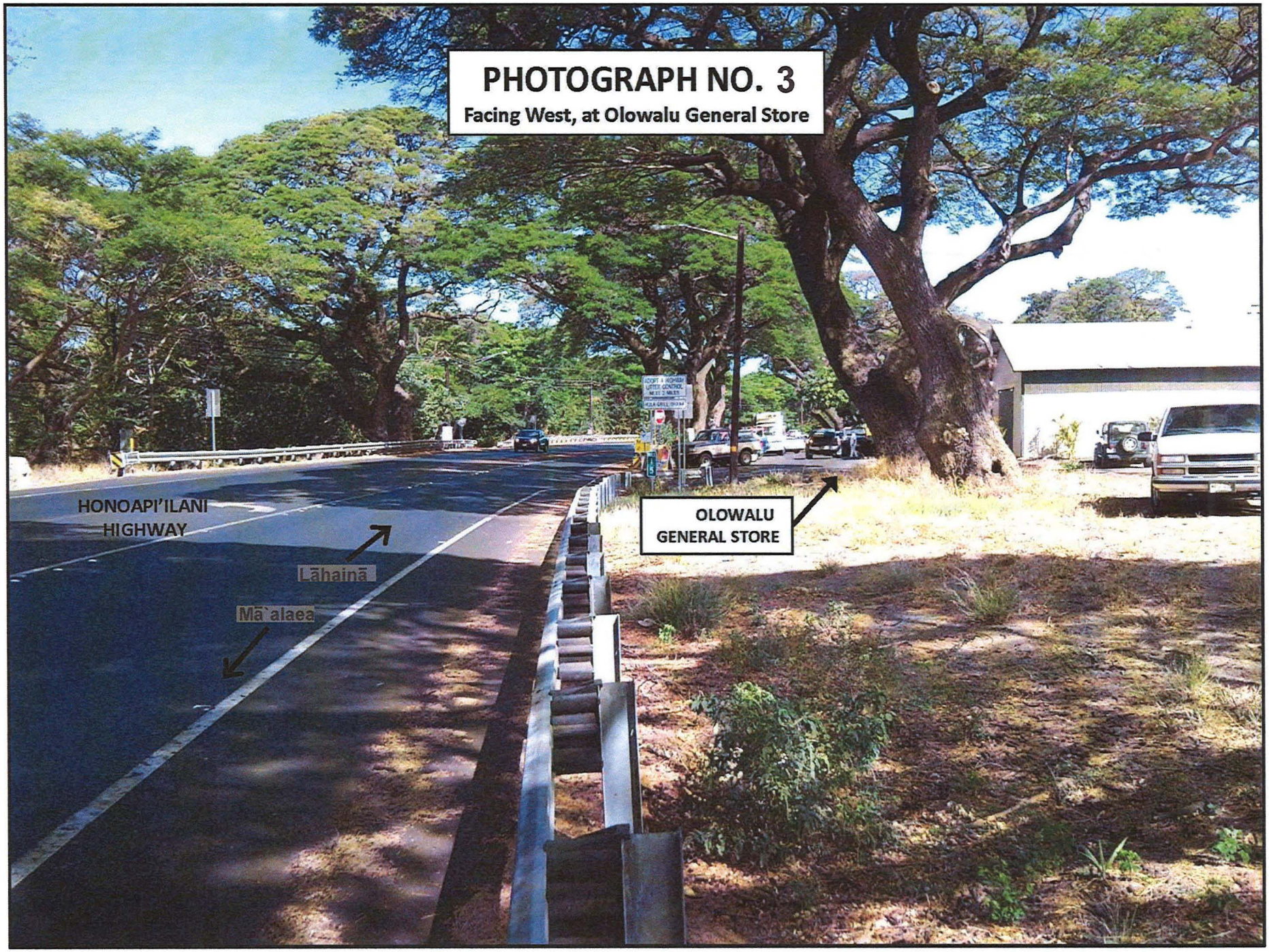
Facing West, near State Highway Mile Marker No. 14



PHOTOGRAPH NO. 2

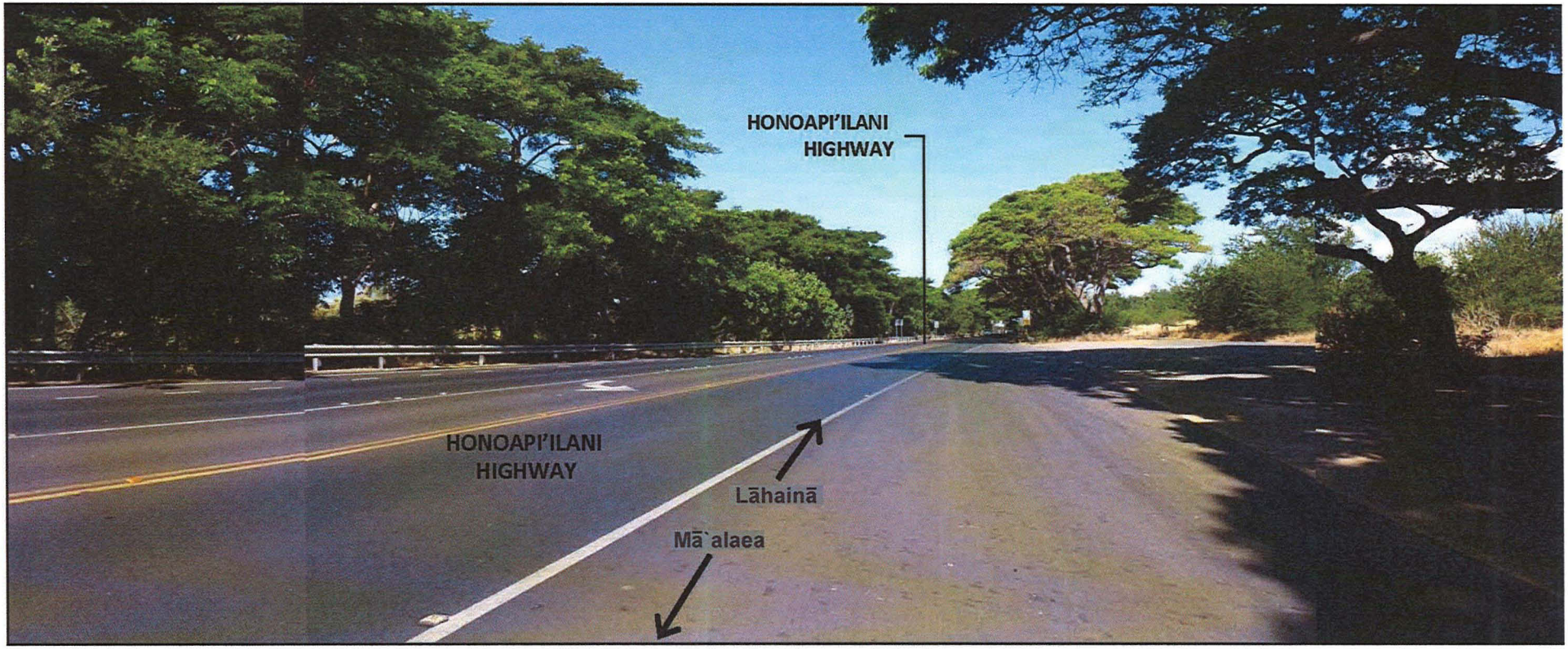
Facing West, near Kapa`iki




PHOTOGRAPH NO. 3
Facing West, at Olowalu General Store
HONOAPI'ILANI HIGHWAY
Lāhainā
Mā`alaea
OLOWALU GENERAL STORE

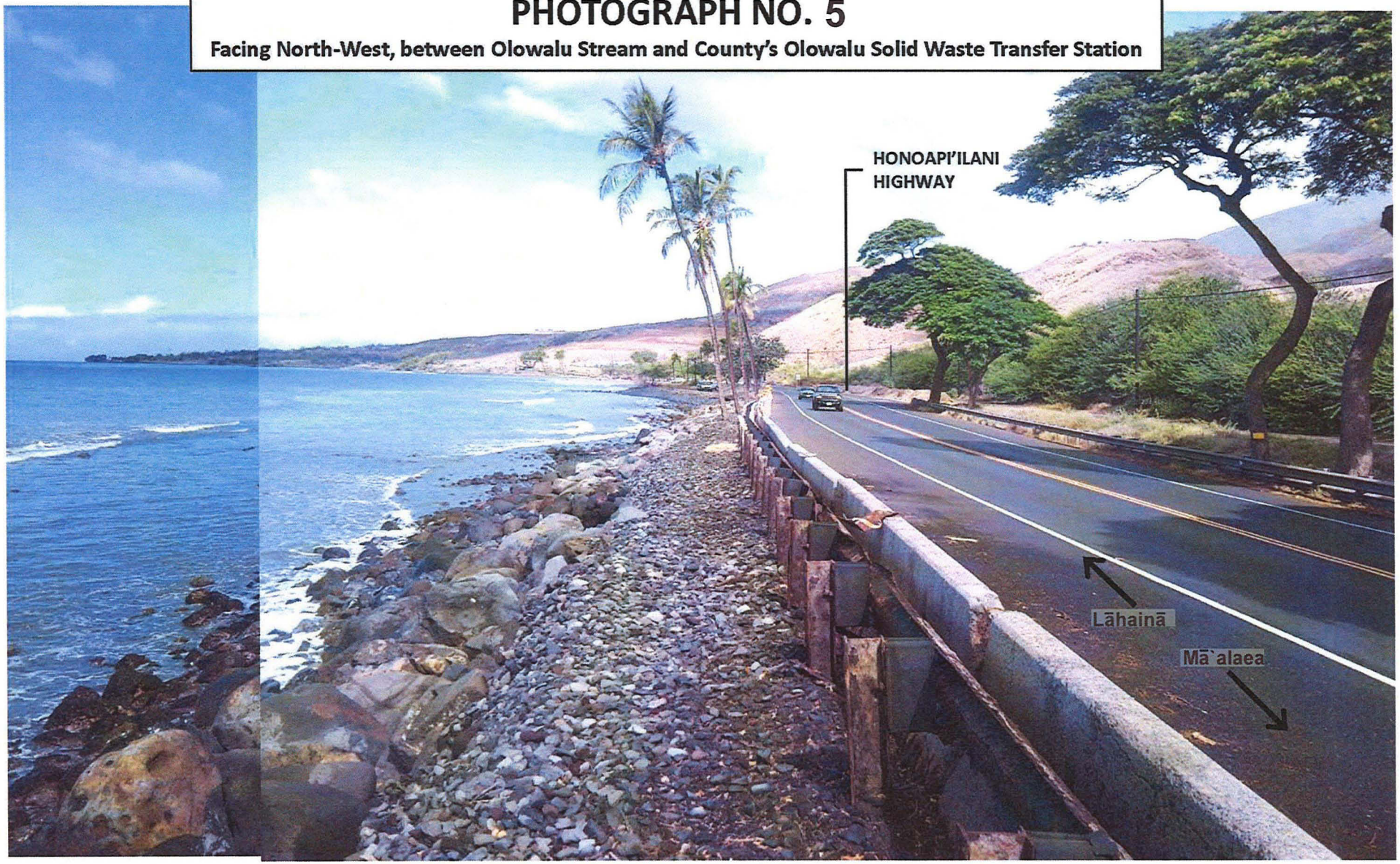
PHOTOGRAPH NO. 4

Facing North-West, between Olowalu General Store and Olowalu Stream



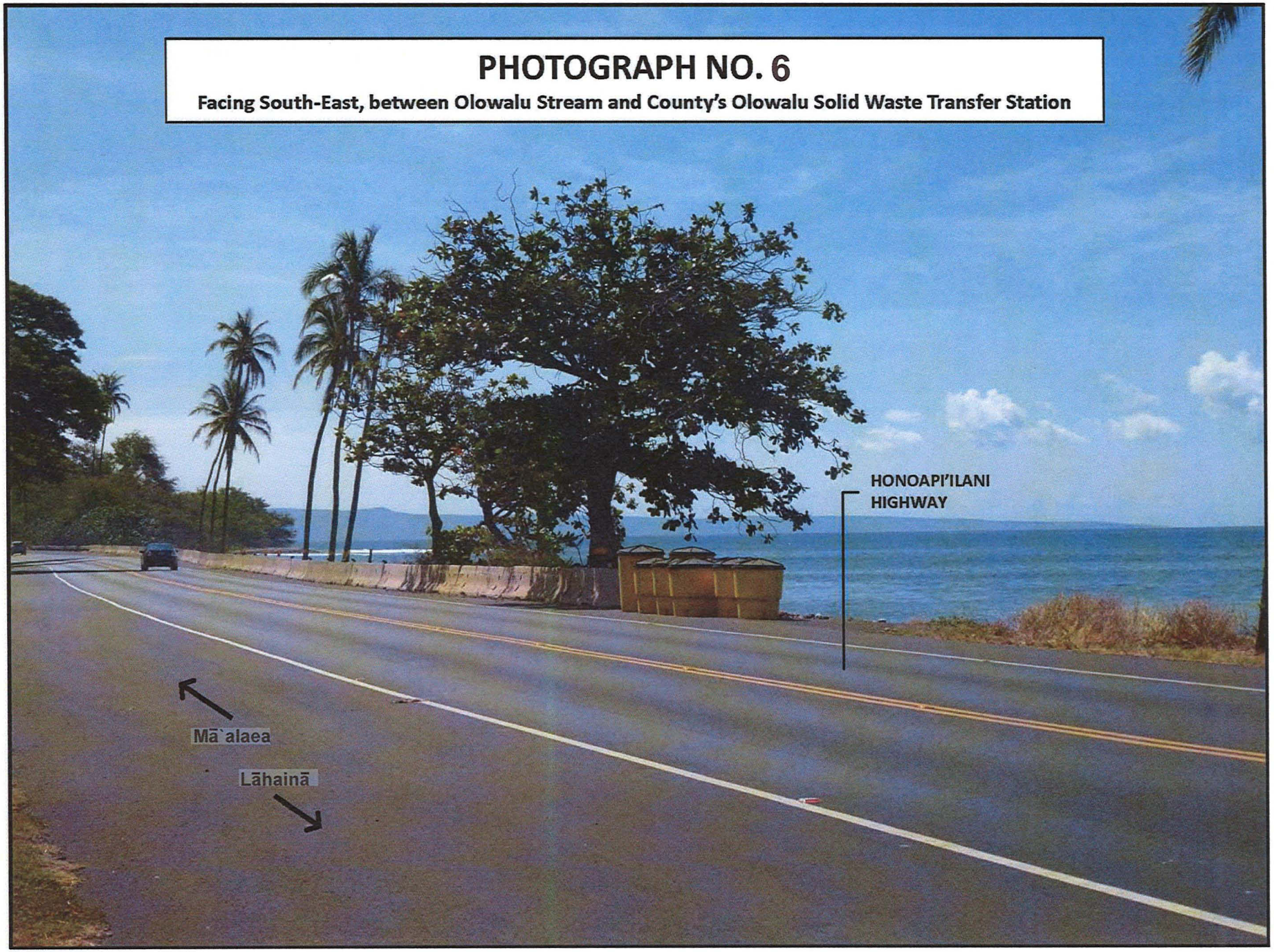
PHOTOGRAPH NO. 5

Facing North-West, between Olowalu Stream and County's Olowalu Solid Waste Transfer Station



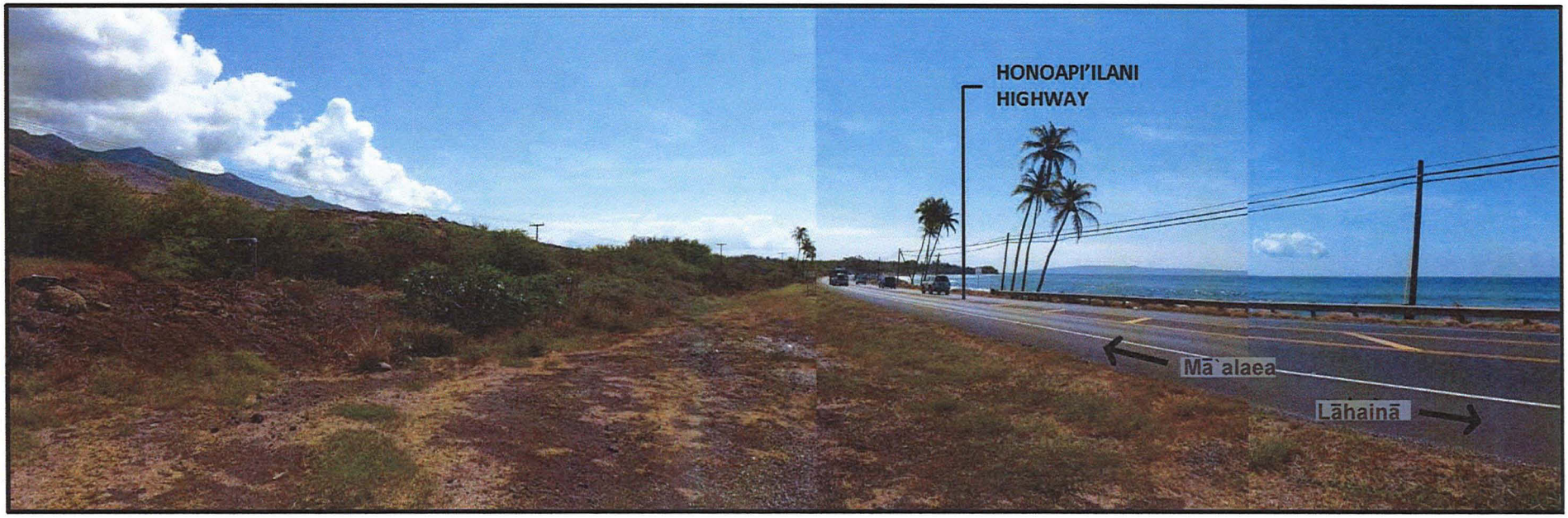
PHOTOGRAPH NO. 6

Facing South-East, between Olowalu Stream and County's Olowalu Solid Waste Transfer Station



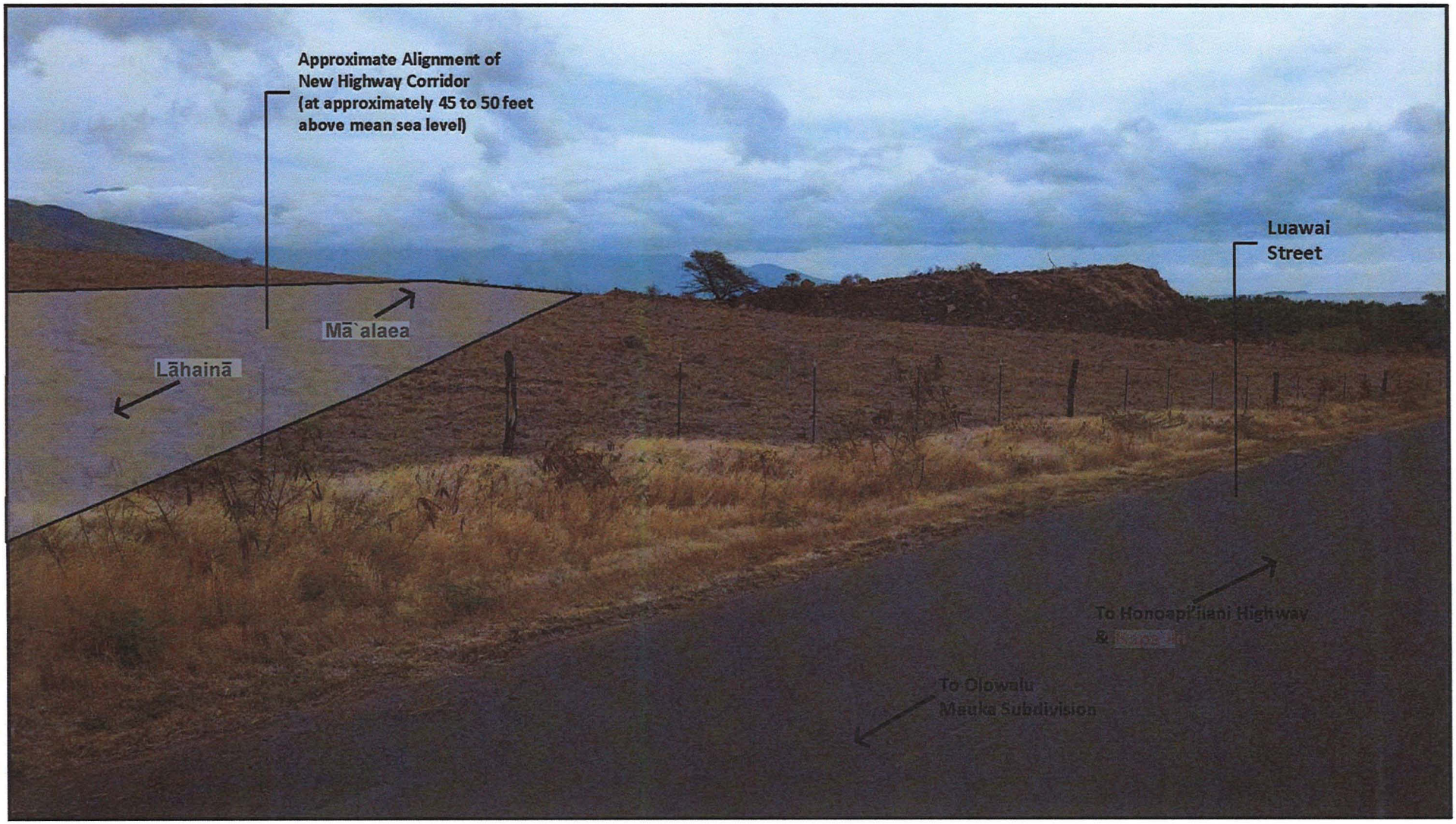
PHOTOGRAPH NO. 7

Facing South-East, near County's Olowalu Solid Waste Transfer Station



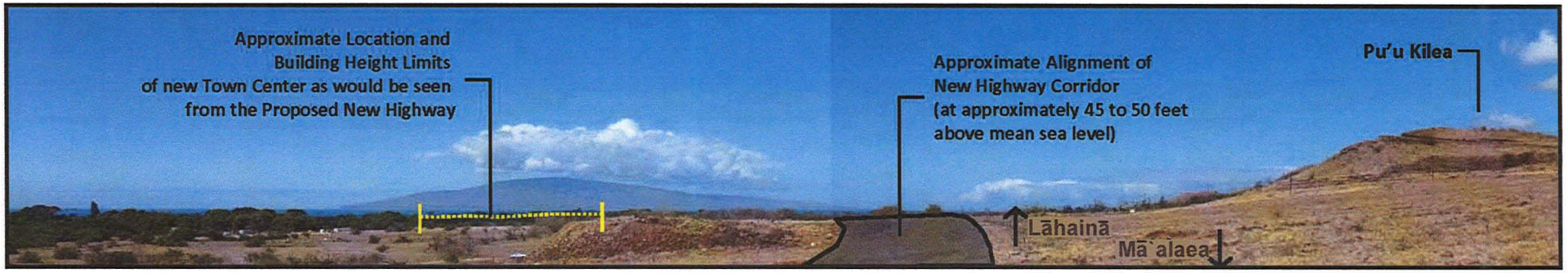
PHOTOGRAPH NO. 8

Facing East, in vicinity of new Mauka Highway corridor and Luawai Street



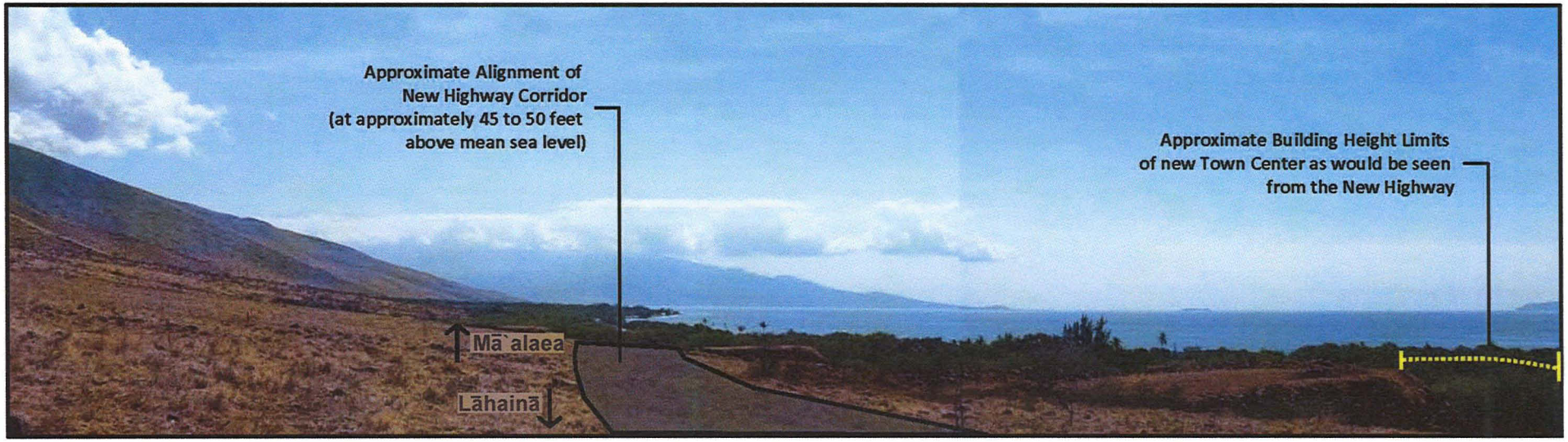
PHOTOGRAPH NO. 9

Facing West, in vicinity of new Mauka Highway corridor



PHOTOGRAPH NO.10

Facing East, in vicinity of new Mauka Highway corridor

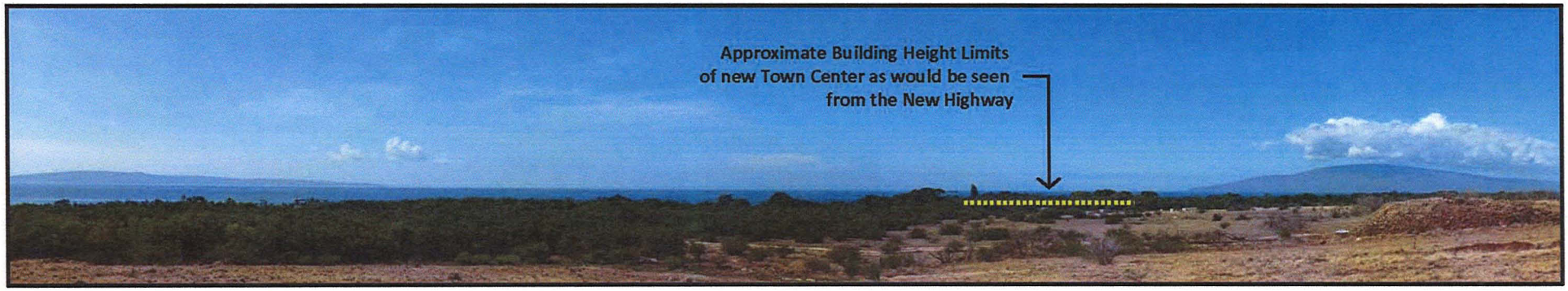


PHOTOGRAPH NO. 11

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.

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

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-to-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. 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

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 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.

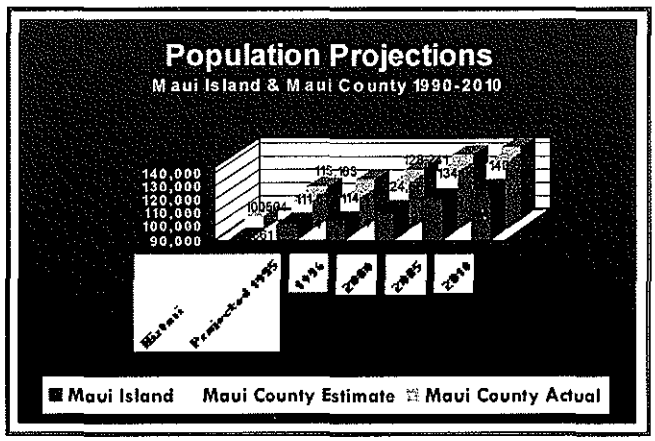
17) Possession of this report, or a copy thereof, does not carry with it the right of publication. It may not be used for any purpose by any person other than the party to whom it is addressed without the written consent of the consultant, and in any event, only with property written qualification and 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.

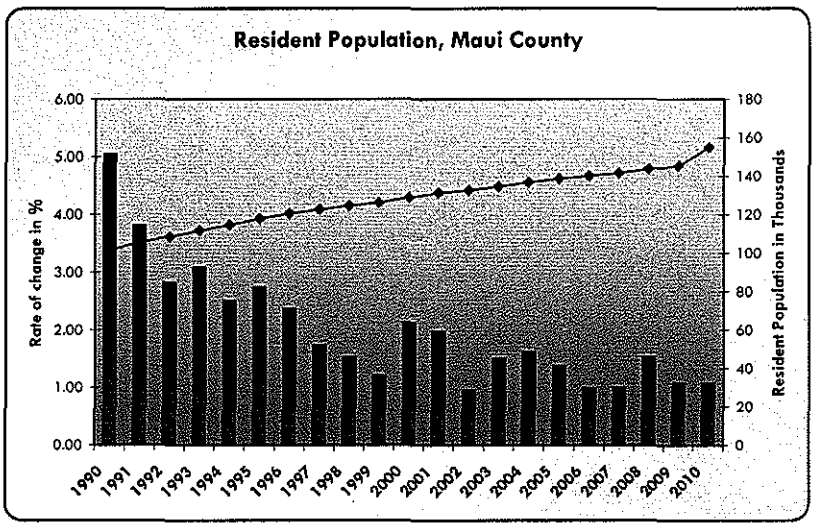
PART II – FACTUAL DATA

A. REGIONAL DATA - MAUI COUNTY

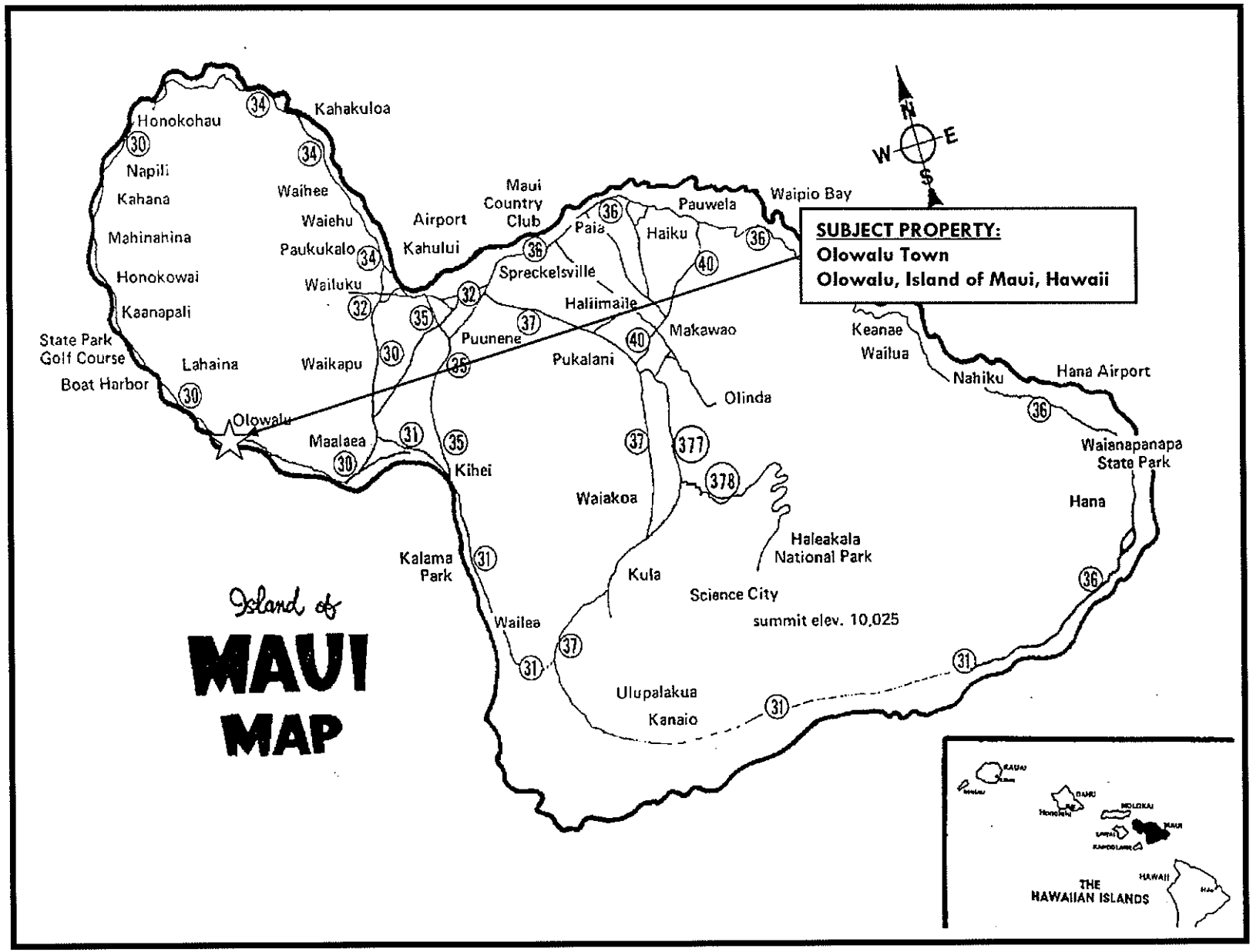
Maui County is the third most populous of the four counties of Hawaii, with a total resident population of 154,834 (2010 Census) and a change of 20.9 percent since 2000. Maui County consists of the islands of Maui, Molokai, Lanai, and Kahoolawe. Ninety percent (90%) of County residents live on Maui; 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


SUBJECT PROPERTY:
Olowalu Town
Olowalu, Island of Maui, Hawaii
Island of
MAUI
MAP
Honokohau
Napili
Kahana
Mahinahina
Honokowai
Kaanapali
State Park
Golf Course
Boat Harbor
Lahaina
Olowalu
Kahakuloa
Waihee
Waiehu
Paukukalo
Wailuku
Waikapu
Maalaea
Kihei
Kalama
Park
Wailea
Airport
Kahului
Maui
Country
Club
Spreckelsville
Paia
Haliimaile
Puunene
Pukalani
Pauwela
Haiku
Waipio Bay
Makawao
Olinda
Keanae
Wailua
Nahiku
Hana Airport
Waianapanapa
State Park
Hana
Haleakala
National Park
Waiakoa
Kula
Science City
summit elev. 10,025
Ulupalakua
Kanaio
N
E
S
W
THE
HAWAIIAN ISLANDS

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.

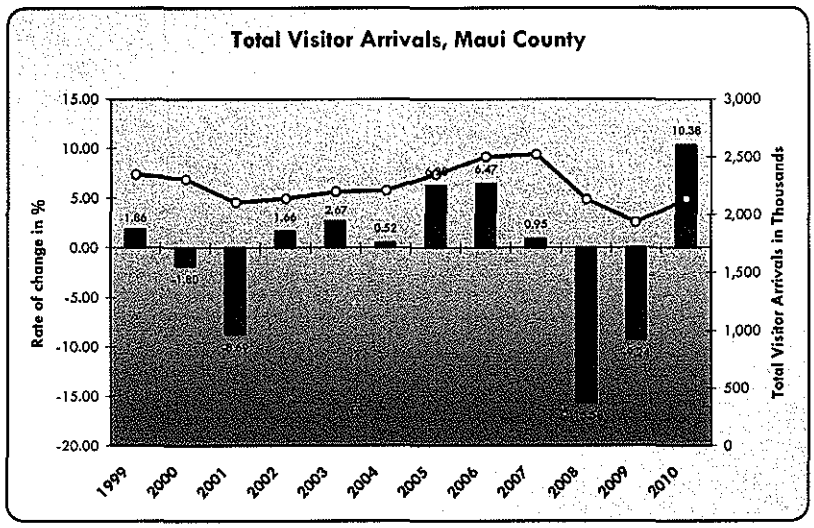
Visitor Industry

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.

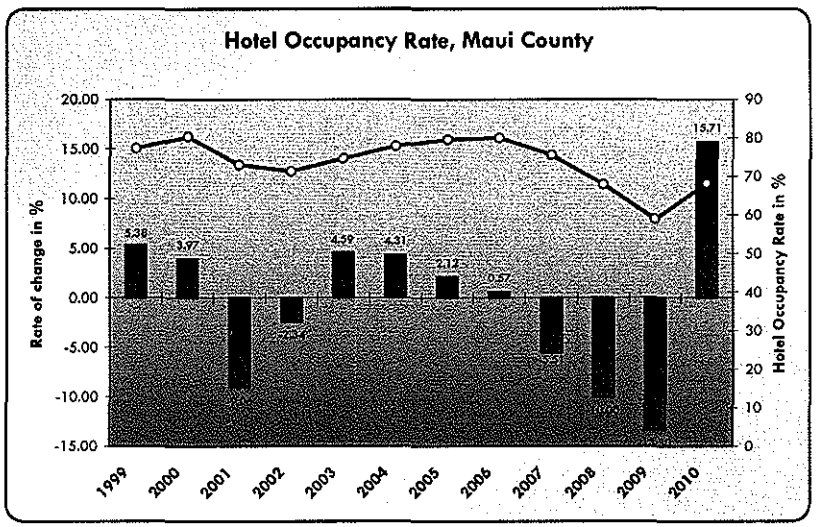
Tracking the tourism counts during this decade begins with the effects of the September 11, 2001 terrorist attacks on this country which had a drastic impact on the tourism industry. The final Maui visitor count for 2001 was 2,104,480. In 2002, the visitor count rebounded slightly to 2,139,427 as the 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.

Hotels 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.

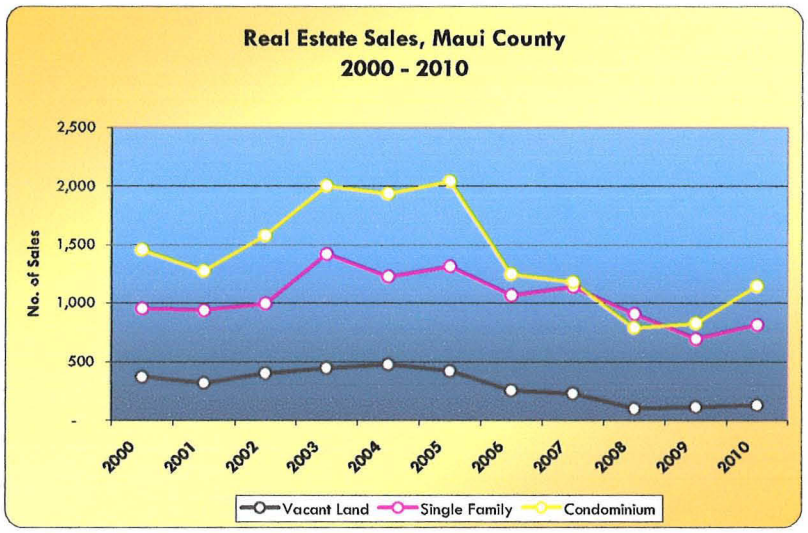
Owner-occupied housing on Maui runs about 56 percent of all occupied housing units. The total housing stock has been growing at a rate of about 1,000 units a year in the 1980's. The total accelerated to 1,500-2,000 new units in the late 1980's, well short of demand. The Maui population has expanded tremendously 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



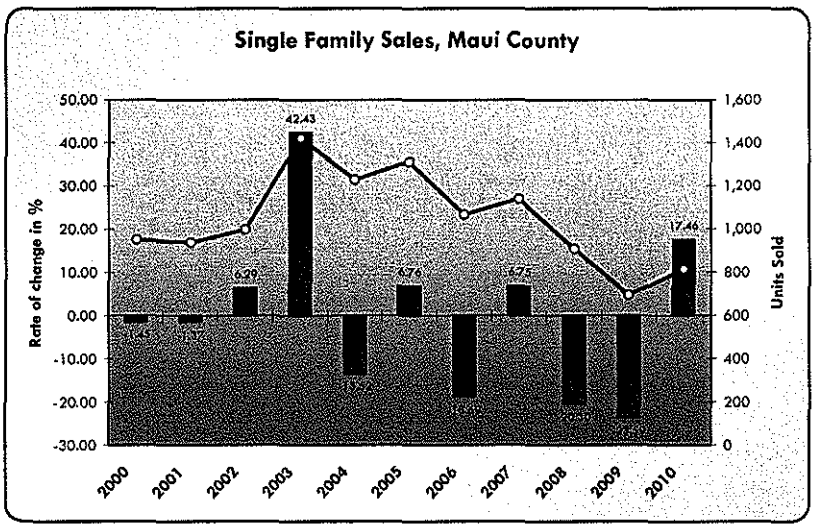
Source: Realtors Association of Maui

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.

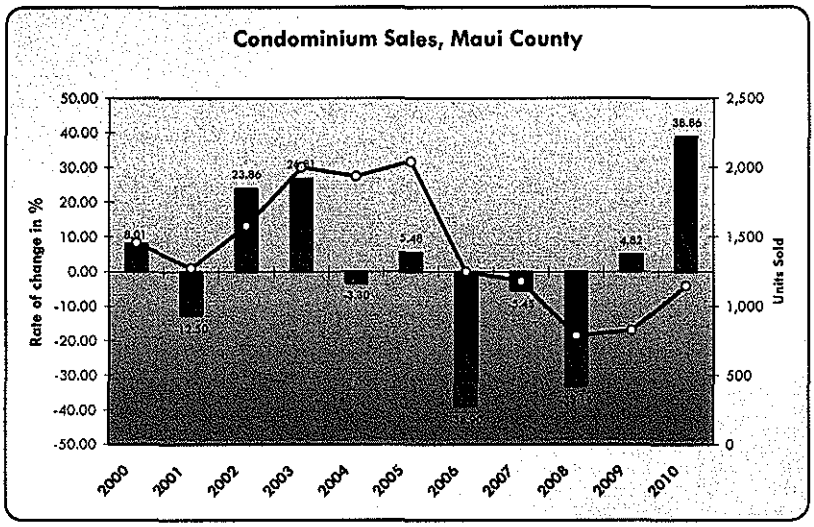


Source: Realtors Association of Maui

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.

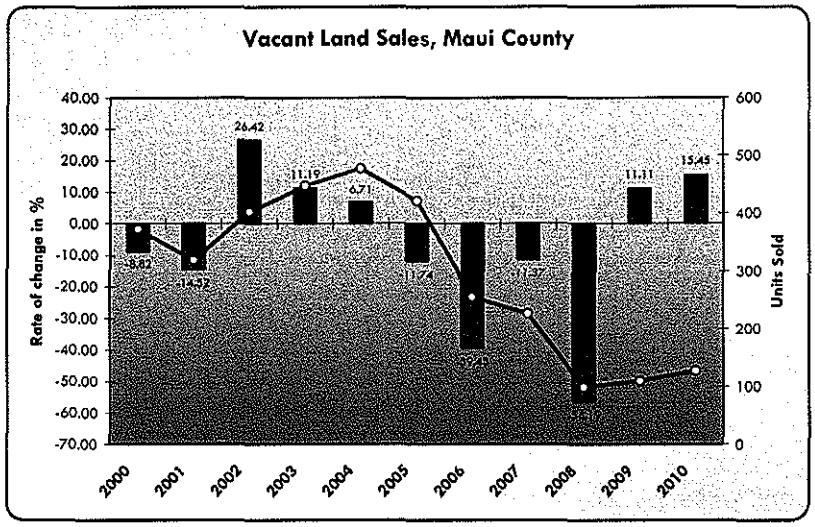
The following graph further illustrates the condominium sales volume history for Maui County from 2000 to 2010.



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

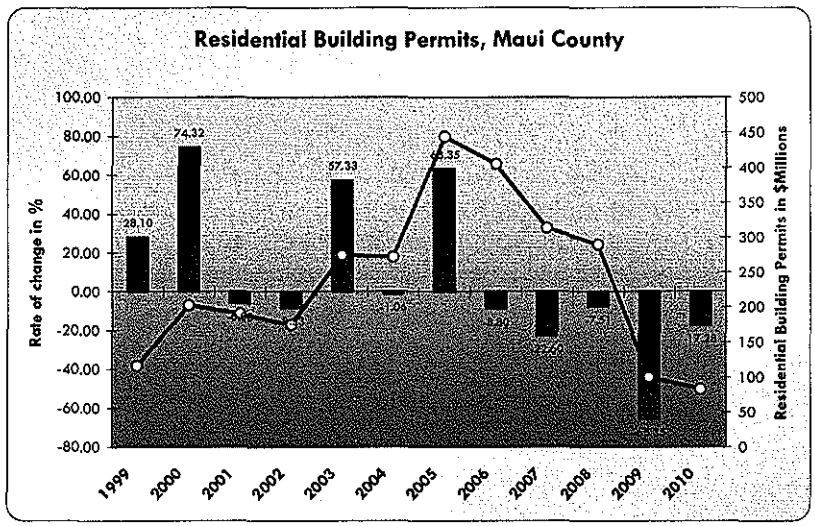
The construction industry, in the mid part of this decade, benefitted from a robust economy and building climate.

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.

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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 over 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 Plaza, 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 Mayor 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 Maui 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 home. Since then, the median single-family price has continued to fall, with an average monthly median sales price of $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 overcrowded on Maui and 41.4 percent of the households pay more than the recommended limit of 30 percent of their income 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 contain 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 community. 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

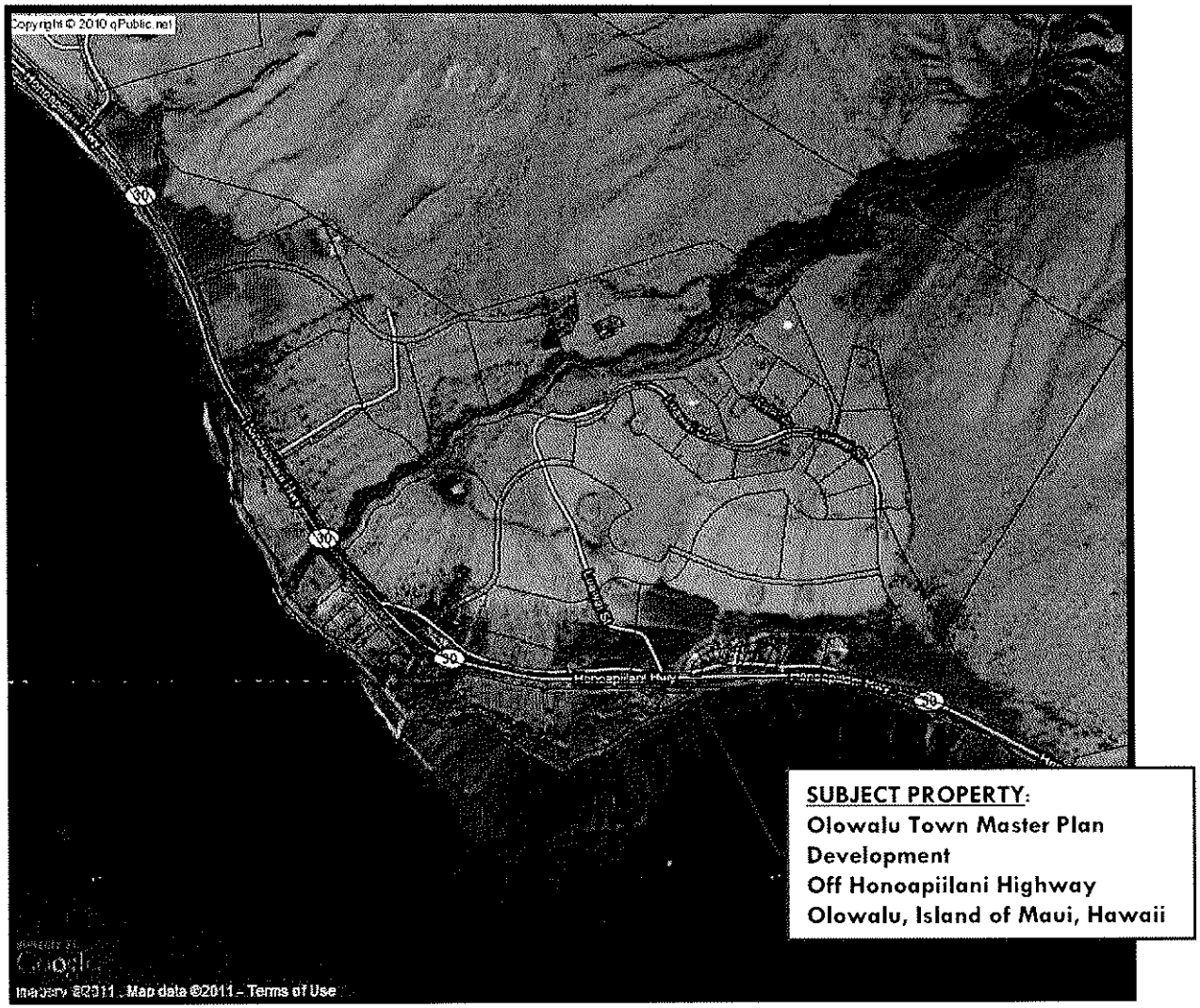
Since real estate is fixed in location, its marketability and rentability are strongly influenced by economic and social trends in its immediate environment. The continuing attractiveness of this neighborhood environment to potential users and tenants, and its competitive relation to those of substitute 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.



Not to Scale!

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, office/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 real 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 and 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 and 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 secondary 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 Kaanapali 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 for 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 through 2010), the short-term market supply would be expected to last approximately 4 years. Of course, a multitude of 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 for 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 who 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 verification of a long-term, reliable supply of water. Written verification by the County shall not constitute an assurance, covenant, or warranty by the County of water source from a private, non-County system.

Many 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*).

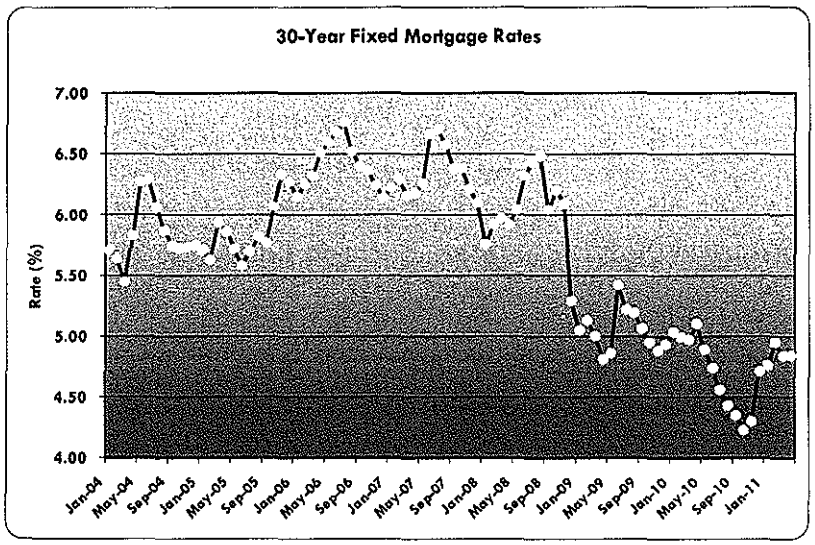
Household income figures have also been increasing. The estimated median annual household income for Maui in 2010 is $76,000 (*Source: U.S. Department of Housing and Urban Development*), a rise of approximately 53 percent over the 1999 median household income of $49,489 (*Source: US Census 2000*) and 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

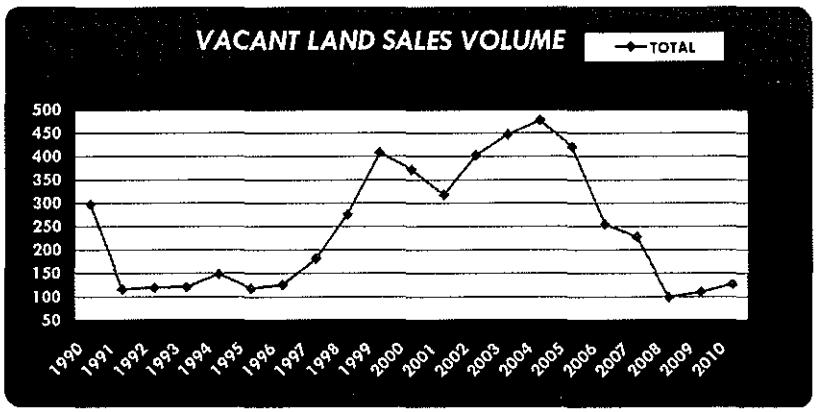
General Residential Sales Activity
Island of Maui

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.

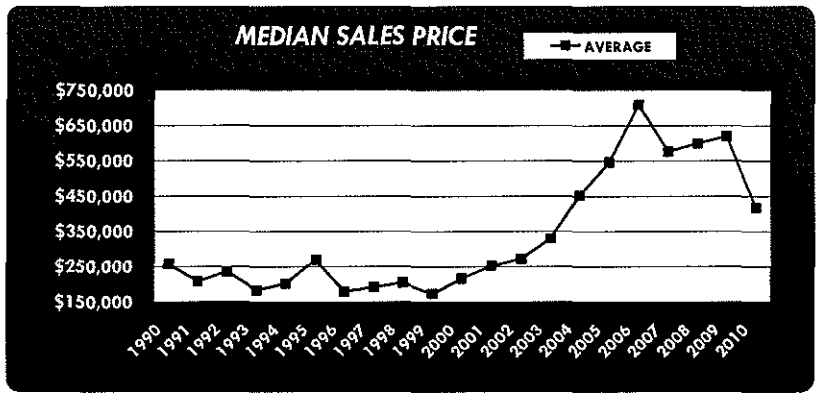
Vacant Land

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.

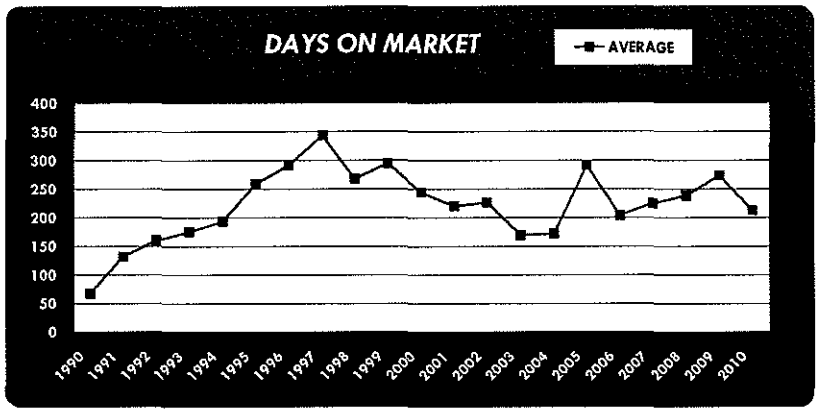


Meanwhile, median prices slowly regained ground from a low of $173,458 in 1999 to $269,691 in 2002, and then sharply increased to $336,690 in 2003, $446,563 in 2004, and $546,081 in 2005. In 2006, the median price jumped approximately 30 percent to $709,000, but retreated by 19 percent in 2007, to $570,438. 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.



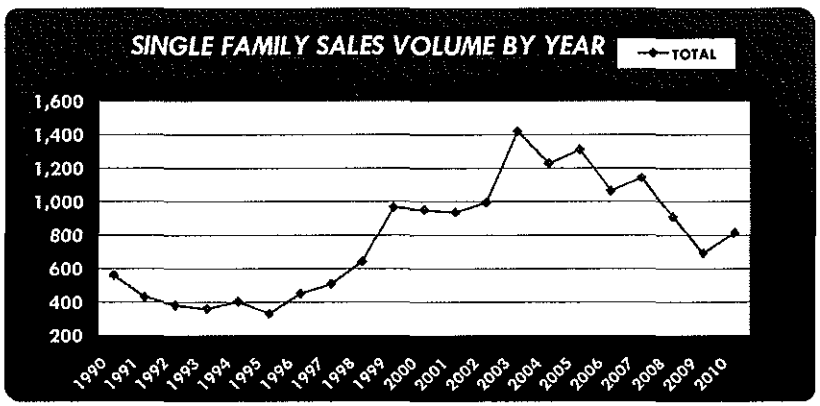
Median monthly days-on-market figures increased steadily from 67 in 1990 to 344 in 1997, but had fallen to 227 in 2002, to 170 days in 2003, increasing slightly to 173 days in 2004. This average escalated in 2005 to 291 days but dropped 29 percent to 204 days in 2006. In 2007, the average marketing time 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.

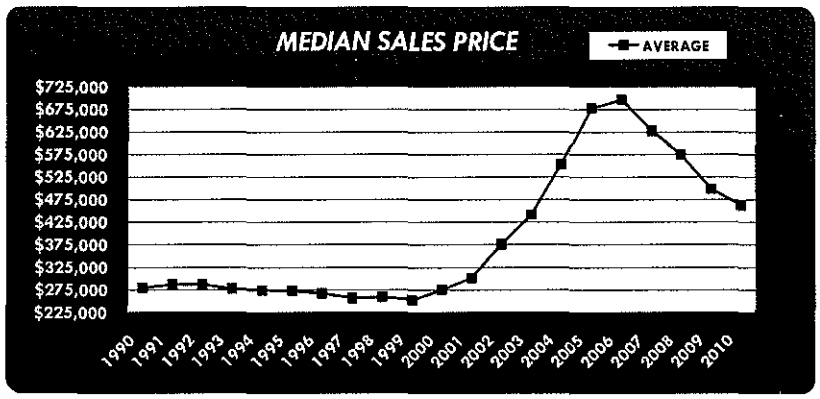


Single-Family

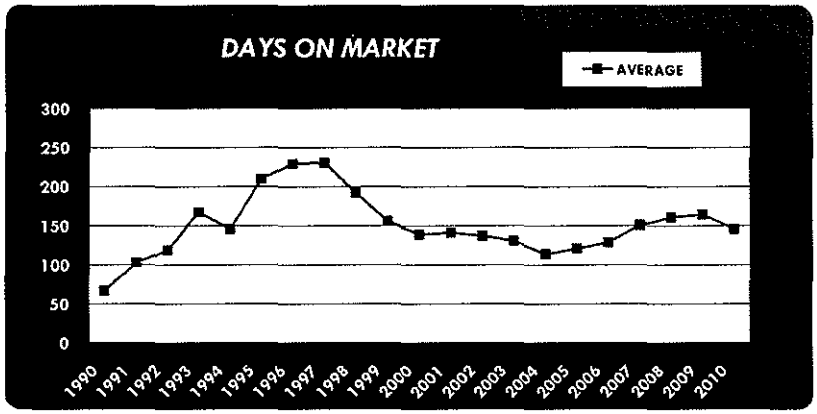
Sales of single-family properties exhibited a decrease after 1990 (560) to a level wavering around 350 to 450 sales for the next 6 years. Weakest sales, in terms of units sold, occurred in 1995 when only 331 properties were sold. In 1997, the number of single-family sales increased to 507 and in 1998, 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.



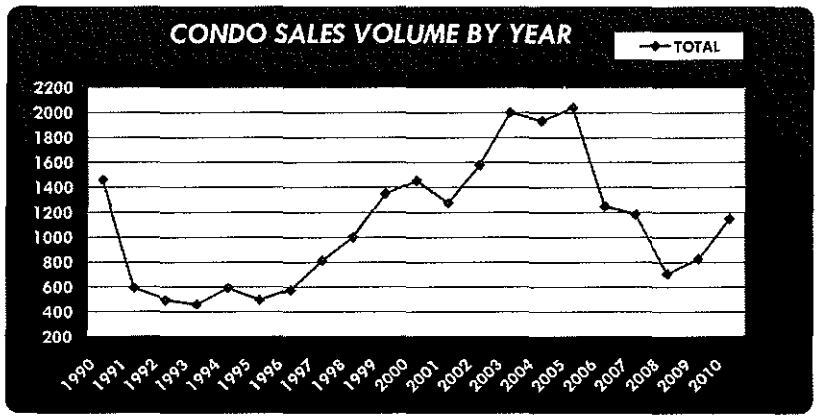
Average monthly days-on-market figures increased steadily from 67 in 1990 to 231 in 1997, but steadily fell to 137 in 2000. It has remained relatively level since that time, except in 2004 when that figure fell to 114 days, before rebounding to 121 days in 2005. The increase continued in 2006 climbing 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.



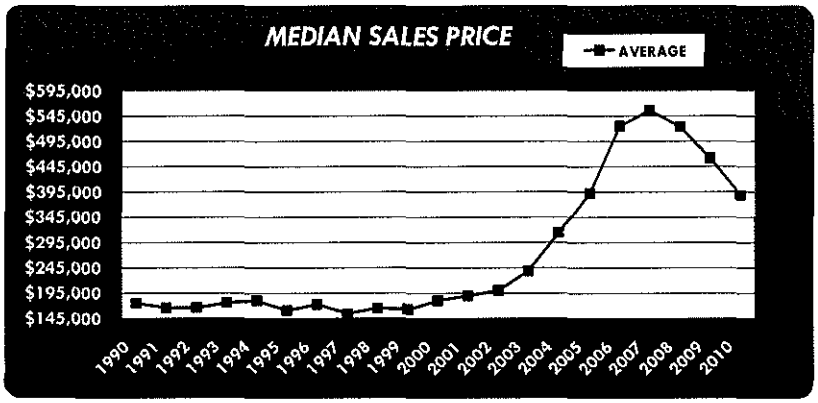
Condominiums

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.

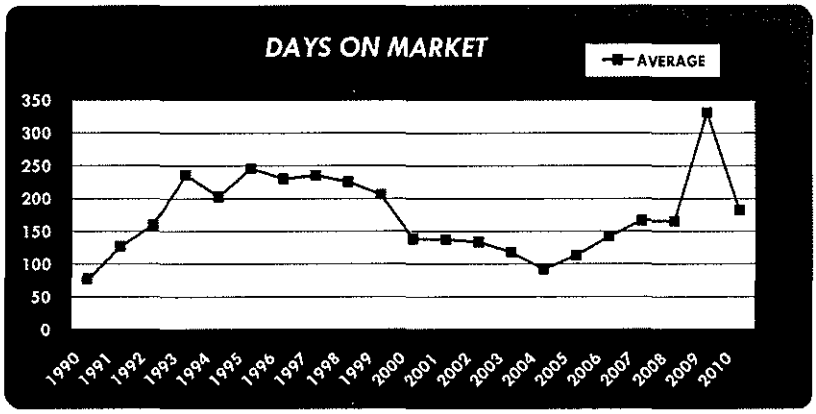
It should be noted that the spike in sales volume between 2003 and 2005 coincides with a flooding of new inventory. During this period, new condominium projects such as Villas at Kenolio and Hale Kanani (Kihei), Villas at Kahana Ridge (Kahana), and Kehalani Gardens and Iliahi (Wailuku) closed on their 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.



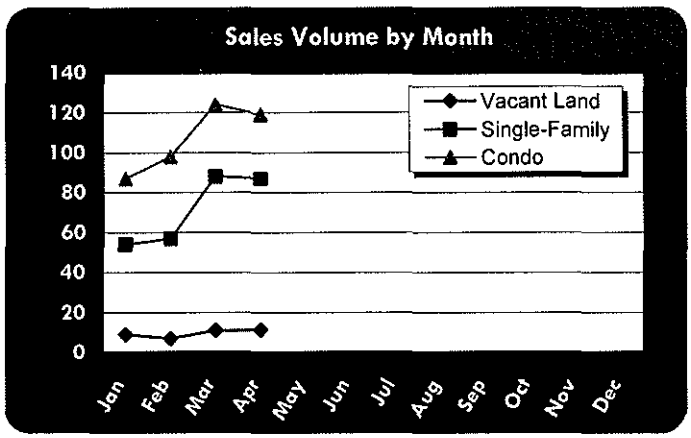
Average monthly days-on-market figures increased steadily from 77 days in 1990 to 230 days in 1996, but had decreased considerably to 133 days by the end of 2002. This figure fell to 118 days in 2003, then to 92 days in 2004, before rebounding to 113 days in 2005. It rose further in 2006, to 142 days, 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.

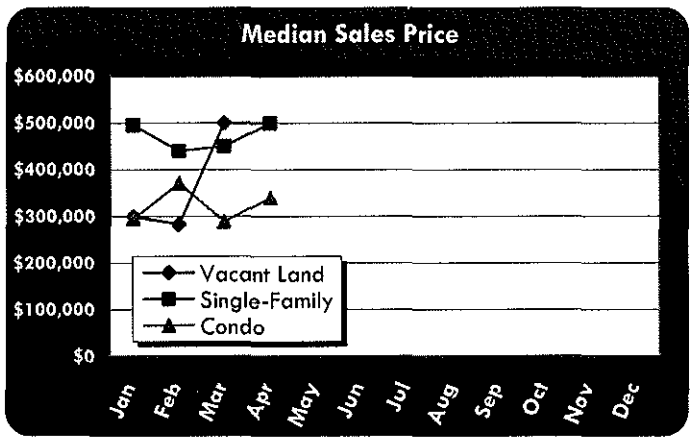
SALES VOLUME BY MONTH

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			



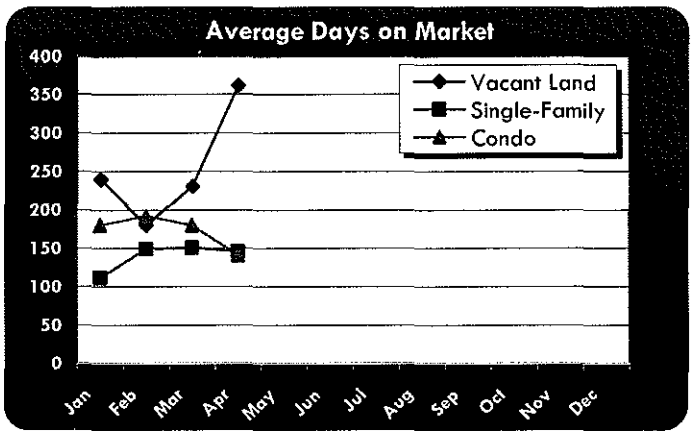
MEDIAN SALES PRICE

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 occasionally 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

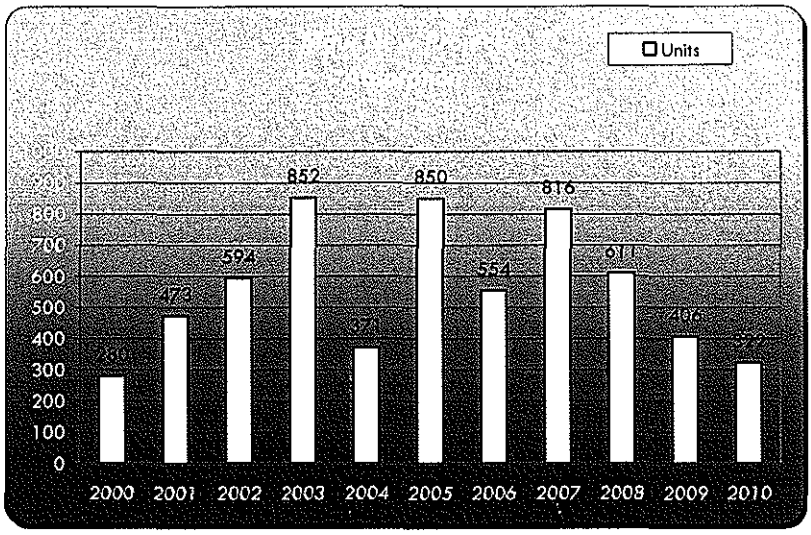
Table 8 – Units Absorbed Per Year (West Maui)

	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

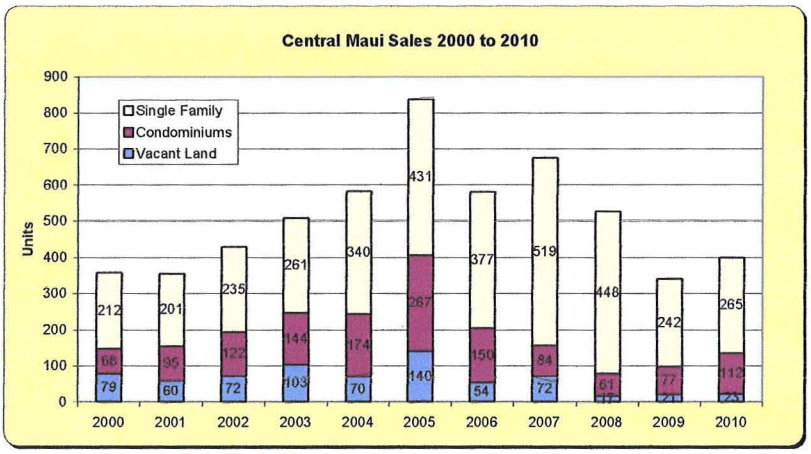
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Vacant Land	79	60	72	103	70	140	54	72	17	21	23	711
Condo	68	95	122	144	174	267	150	84	61	77	112	1,354
Single Family	212	201	235	261	340	431	377	519	448	242	265	3,531
Total	359	356	429	508	584	838	581	675	526	340	400	5,596

West Maui Sales Volume

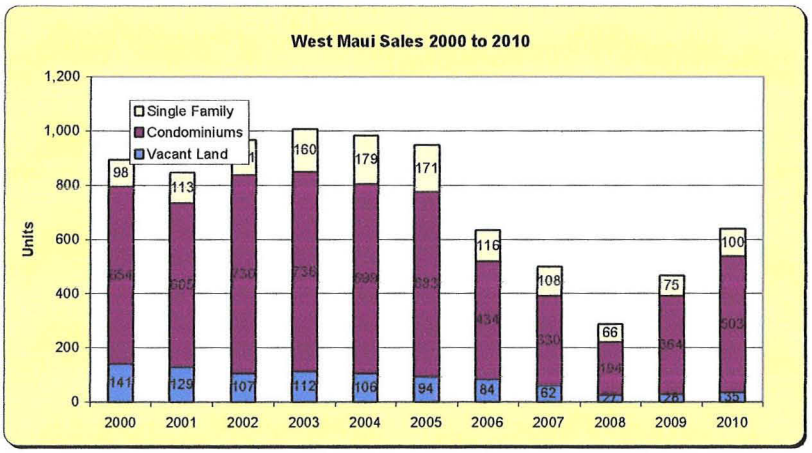
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
Vacant Land	141	129	107	112	106	94	84	62	27	28	35	925
Condo	654	605	730	736	699	683	434	330	194	364	503	5,932
Single Family	98	113	131	160	179	171	116	108	66	75	100	1,317
Total	893	847	968	1008	984	948	634	500	287	467	638	8,174

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

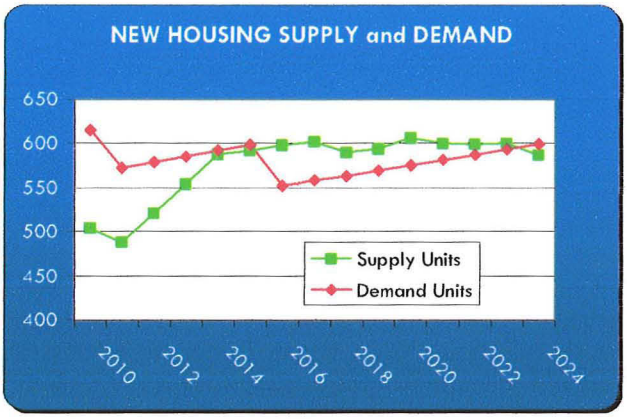


Source: Realtors Association of Maui MLS

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

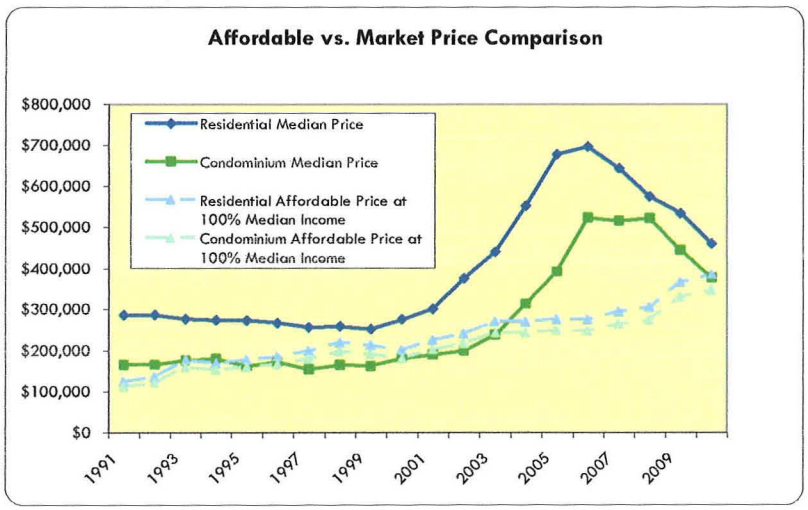
percent of all Maui County households, up from 36 percent from the previous 2003 survey.

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:

<u>Protect the Natural Environment</u>
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

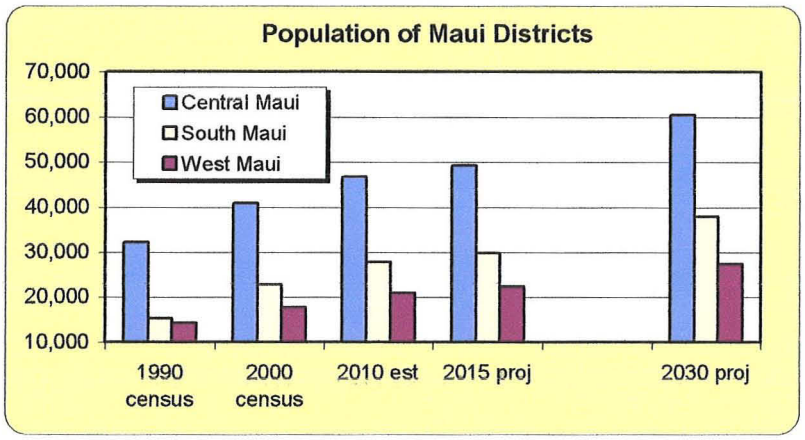
Based on our analysis of the interacting supply and demand factors for commercial and industrial land in Central Maui, the Consultant has analyzed the potential market acceptance of the subject's commercial, industrial and village mixed use areas.

Population Comparison

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.

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.

EXHIBITS

EXHIBIT A

Demographic Reports - Claritas, Inc.

Maui County

West Maui

EXHIBIT B

Olowalu Town Conceptual Community Master Plan

W
E
TOWN CENTER - T8
TOWN CENTER RESIDENCIES - T7
SMALL TOWN LOTS - T6
LARGE TOWN LOTS - T5
PARKS / PUBLIC AMMENITIES - T4
500 0 500 500
URBAN TRANSECTS
TOWN CENTER - T8
TOWN CENTER RESIDENCIES - T7
SMALL TOWN LOTS - T6
LARGE TOWN LOTS - T5
PARKS / PUBLIC AMMENITIES - T4

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 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 basis 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 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 appraiser 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 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 applied 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 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 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
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

<u>The American Society of Farm Managers and Rural Appraisers, Inc.</u>

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

<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

"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

Society of Real Estate Appraisers

Course 101 – "Introduction to Appraising Real Property"
Tempe, Arizona - June, 1991

APPENDIX L.

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 1, 2011**

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

September 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 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 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 1, 2011.

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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EXHIBITS

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

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 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, 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.

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	11,000 residents
Total Households Supported	3,510 units
Total Excise Tax	$38,813,000
At Full Build-Out	
Annual Taxable Property Values	$52,500,000
Annual Property Tax Revenue	$1,614,000
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	$986,000

SUMMARY OF FISCAL IMPACTS, STATE OF HAWAII

Cumulative Net Revenues from Development	$60,339,000
Net Annual Revenues at Full Build-Out	$(377,000)

B. PURPOSE OF THE REPORT

The purpose of this report, as of August 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 August 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.

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 2011 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.

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, 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 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 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.

B. UNIT TYPES

Preliminary plans called for approximately 400 to 800 single-family units and approximately 600 to 900 multi-family units. 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 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
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.

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 441 residents per year, while residents supported by indirect jobs may amount to an average of 452 residents per year.

Oahu residents supported by indirect jobs created by this development were estimated to average 207 residents per year. In

all, approximately 11,000 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 139 units per year, while housing units supported through indirect jobs would average about 143 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 3,510 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 $750,000, while the average **market value** for the multi-family units (450 units) was estimated at $580,000. The average **affordable value** for the single-family units (300 units) was estimated at $470,000, while the average **affordable value** for the multi-family units (450 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 $757,500,000. 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 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.

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 $425,312,000.

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 $425,312,000, 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 $2.00 per $1,000 of assessed value. The tax obligation for the owner-occupied single-family units was calculated at $665,000 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 $189,000 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 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 $346,000 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 $1,645,000 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 $1,614,000 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 4,375 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.

Thus, the net revenue attributed to the project, at full build-out, was estimated to be $986,000 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.

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 $35,378,234, while intermediate sales should be close to $3,434,304. Excise tax attributed to the development totaled approximately $38,812,538.

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 $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 estimated 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 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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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

Tax Foundation of Hawaii, "Taxes in Hawaii", 2010

County of Maui, Office of Economic Development, "Maui County Data Book 2010", May 2011

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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.
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

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.

"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."

"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

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:

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

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;

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;

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

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

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

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 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

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)

EXHIBIT B

Selected Pages from County of Maui
2010 Affordable Sales Price Guidelines

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 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
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

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
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

<u>The American Society of Farm Managers and Rural Appraisers, Inc.</u>

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 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, 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

<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

"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

Society of Real Estate Appraisers

Course 101 – "Introduction to Appraising Real Property"
Tempe, Arizona - June, 1991

APPENDIX L-1.

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 M.

Preliminary Traffic Impact Analysis Report

Olowalu Town
Preliminary Traffic Impact Analysis Report

Prepared for:

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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.

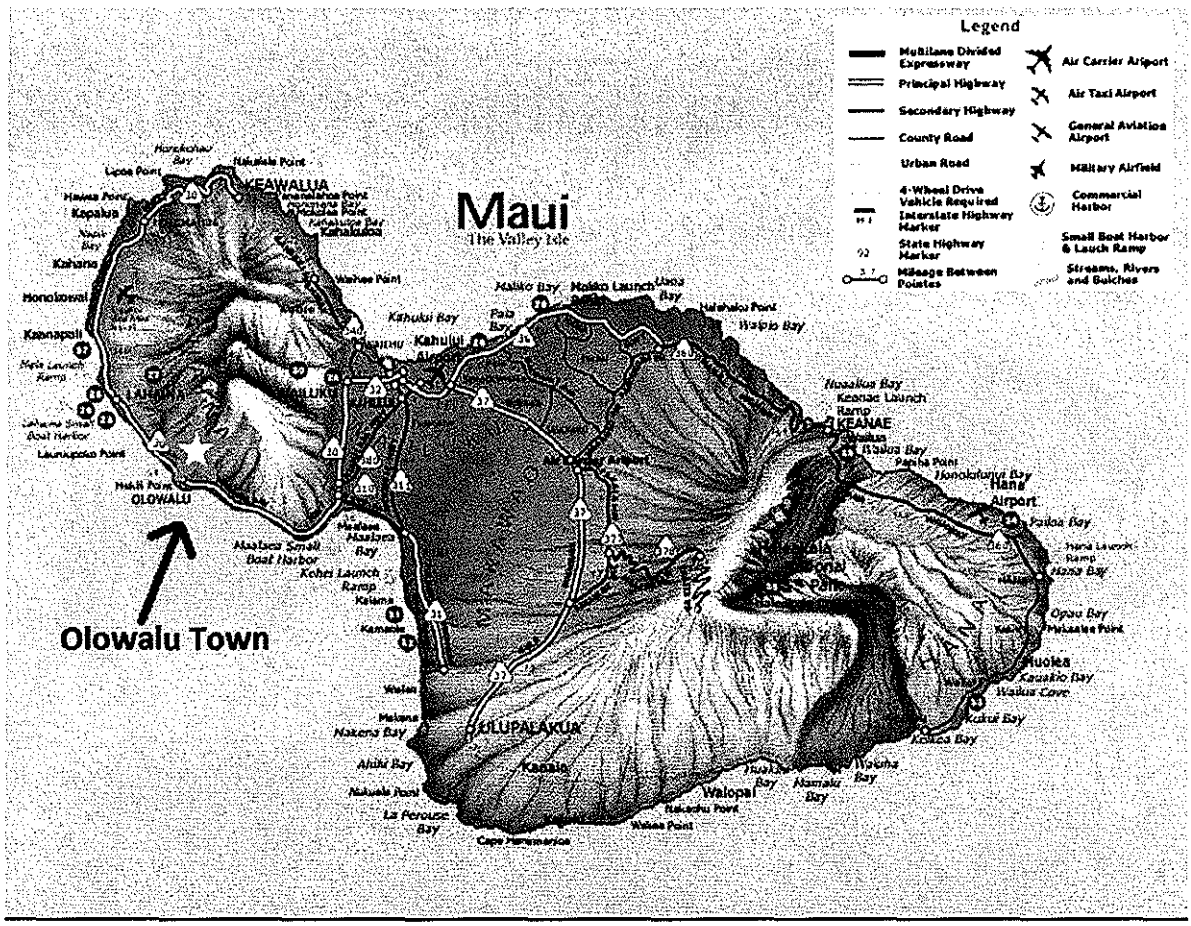
This Preliminary Traffic Impact Analysis Report (TIAR) has been prepared to support the Draft Environmental Impact Statement (EIS). A Final TIAR will be prepared to support the Final EIS. The purpose of this preliminary TIAR is to provide a general assessment of the expected traffic impacts of the proposed 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.

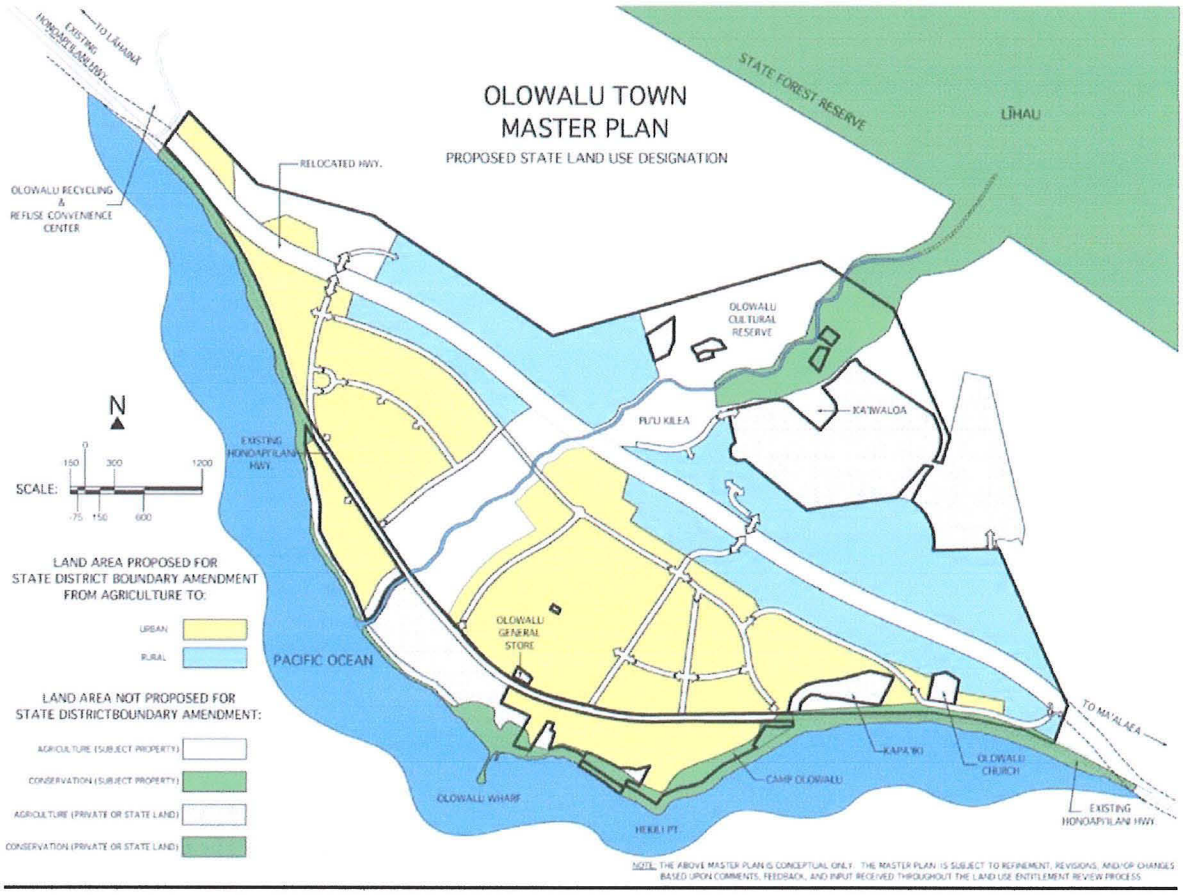
The design of Olowalu Town incorporates smart growth and sustainable land use principles of New Urbanism. As a result, Olowalu Town's spatial layout of land uses, varying density, connective transportation, parks/greenways, civic/social facilities, housing, employment and other land uses are balanced 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.

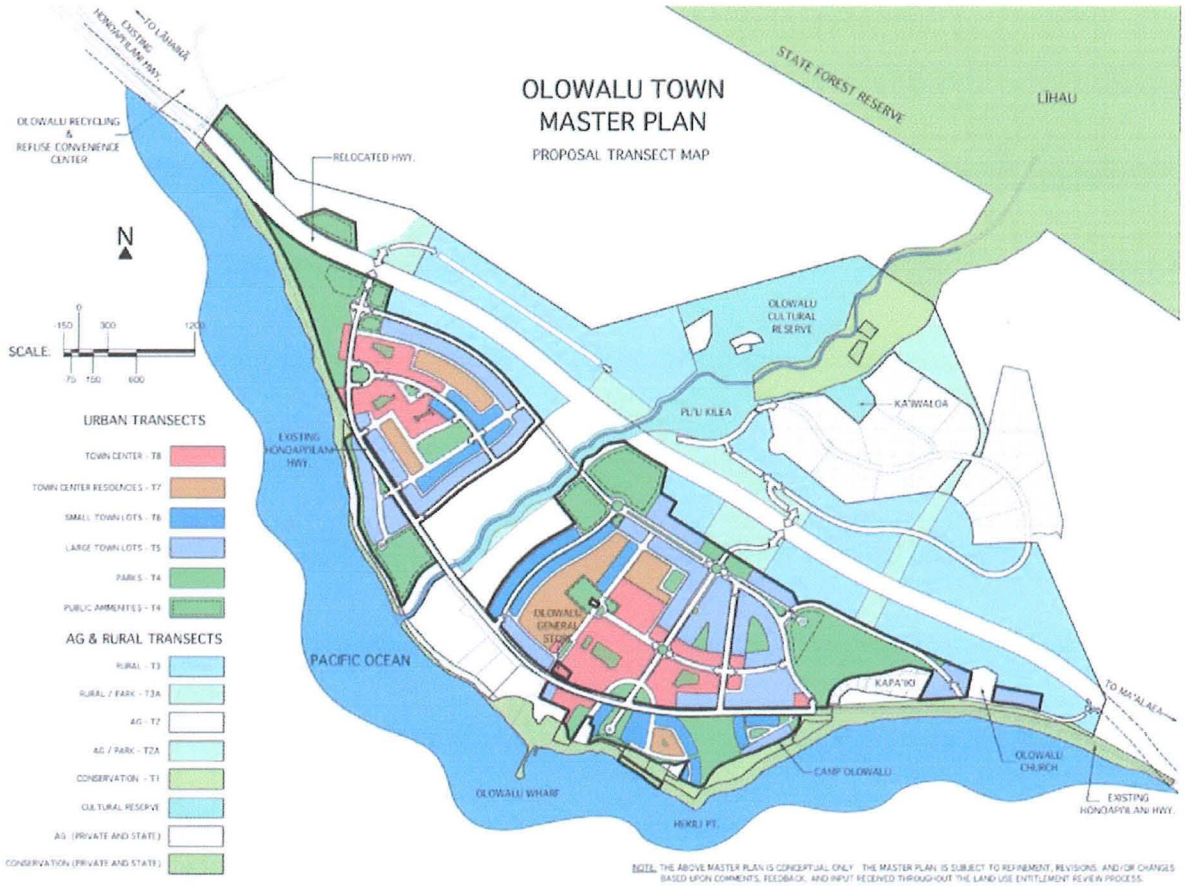
Figure 2 Land Use Categories for Olowalu Town



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

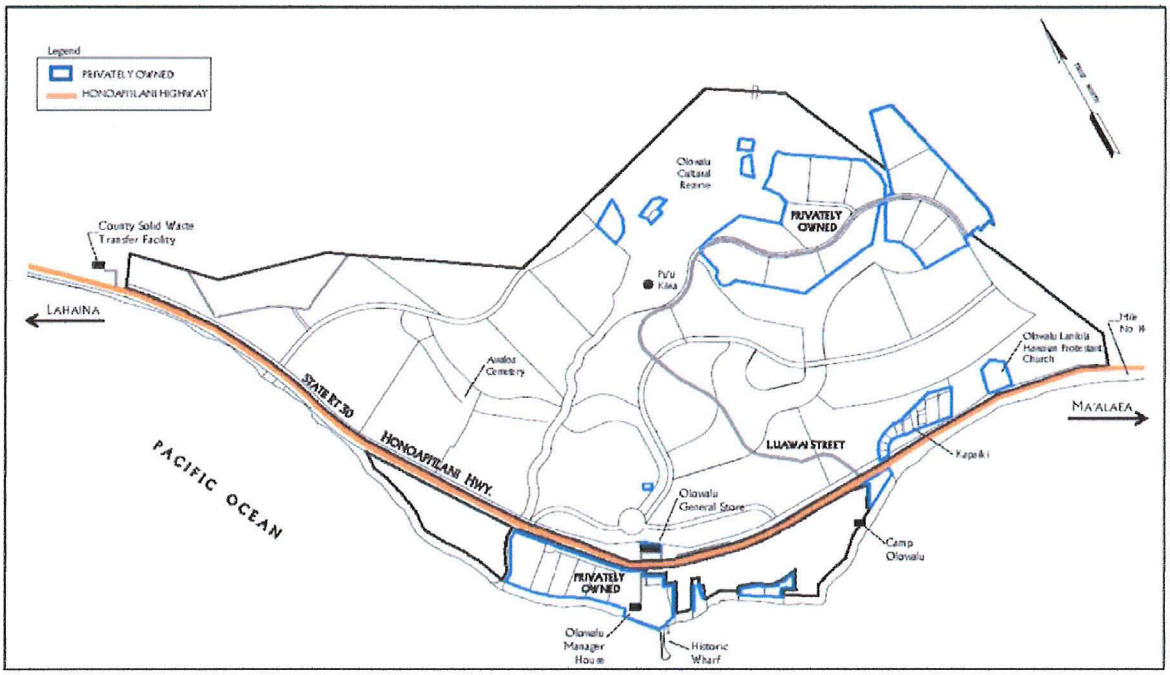


As shown in Figure 3 there are generally two neighborhood town centers on either side of Olowalu Stream, with smaller tracts of rural on the mauka side of Honoapi'ilani Highway. All the tracts on the mauka side of Honoapi'ilani Highway are either rural or agricultural lots ranging from ½ to 2 acres. 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

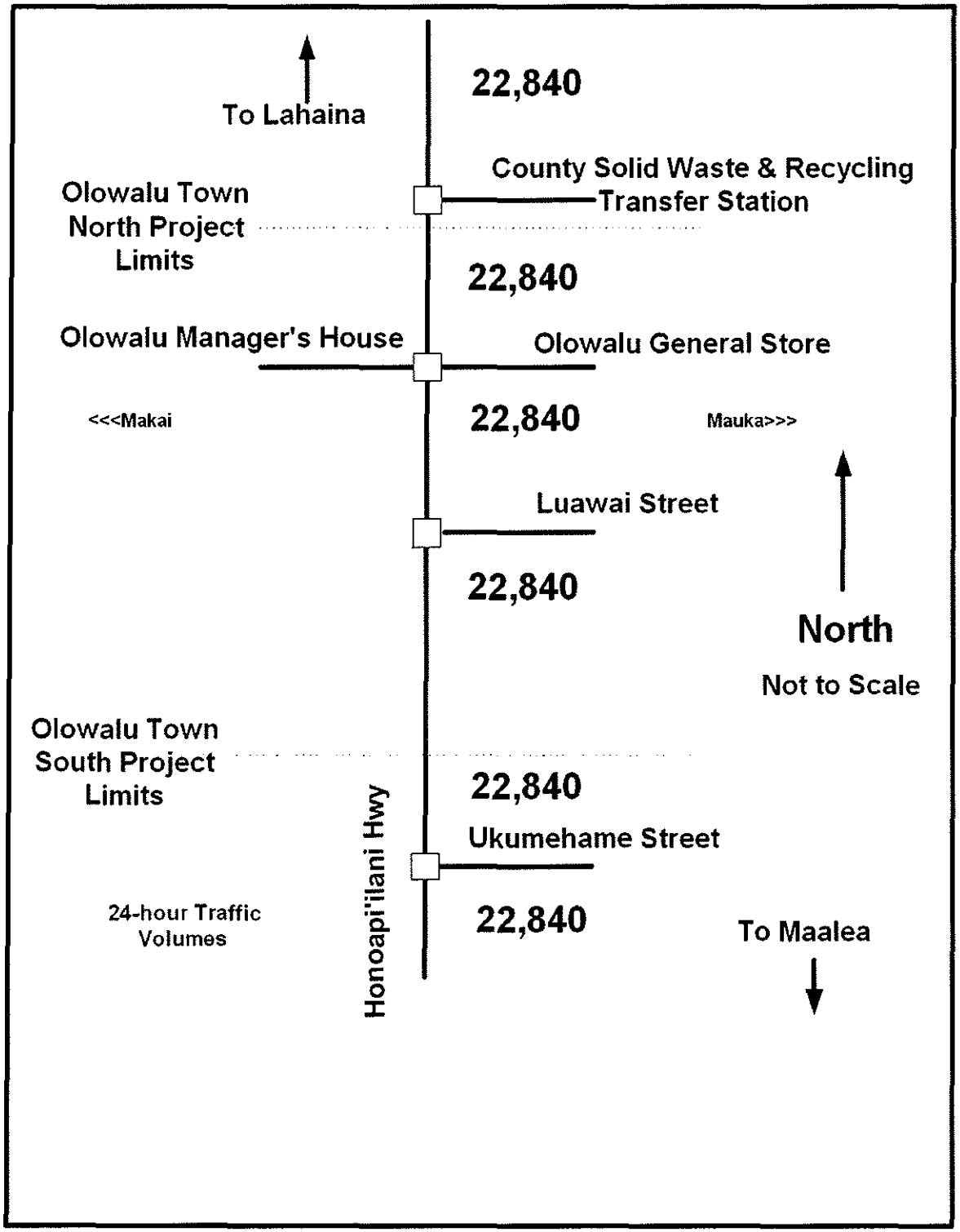


Figure 8 Future Year 2020 Traffic Volumes without Project on Honoapi'ilani Highway

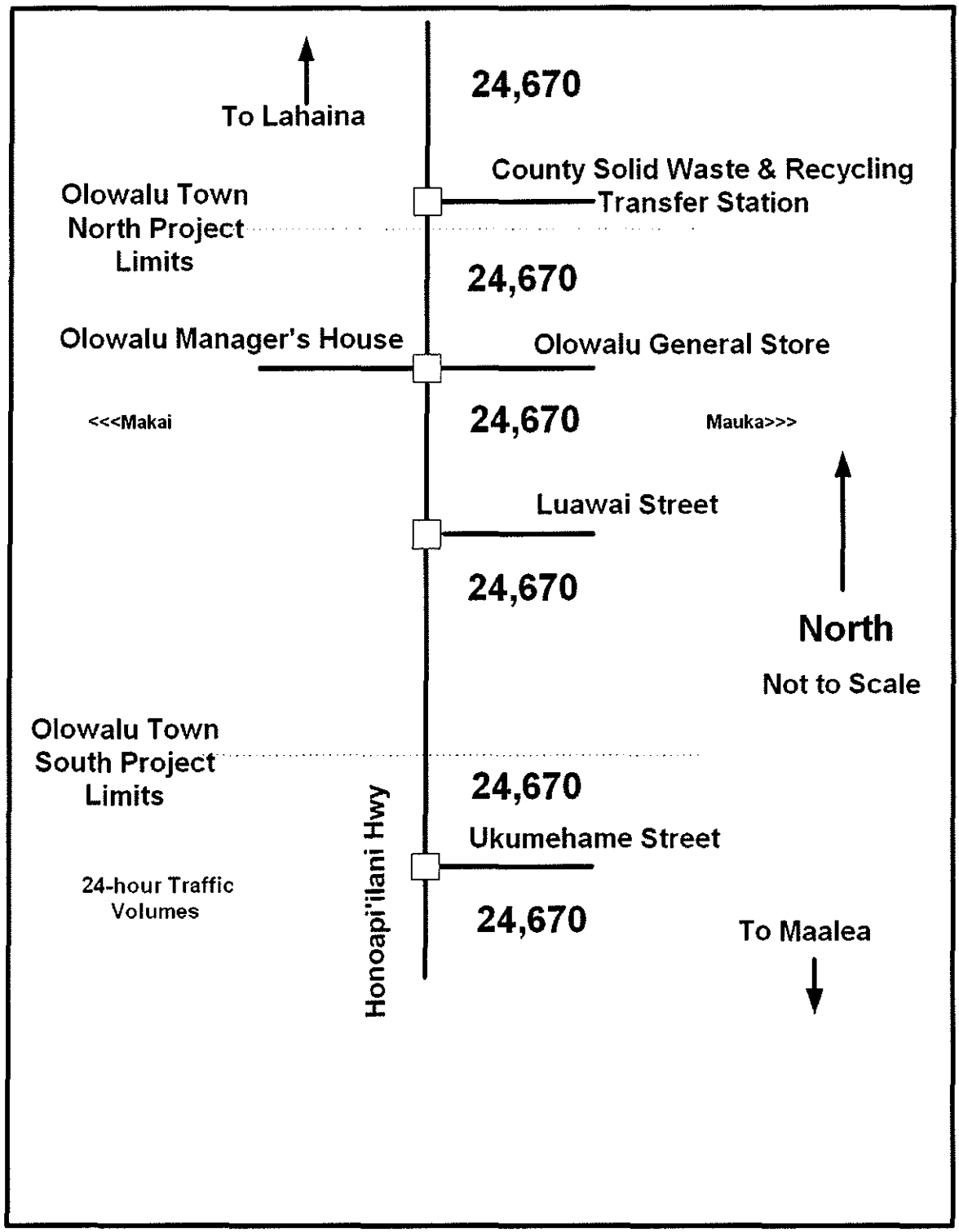


Figure 9 Traffic Added from Olowalu Town Project

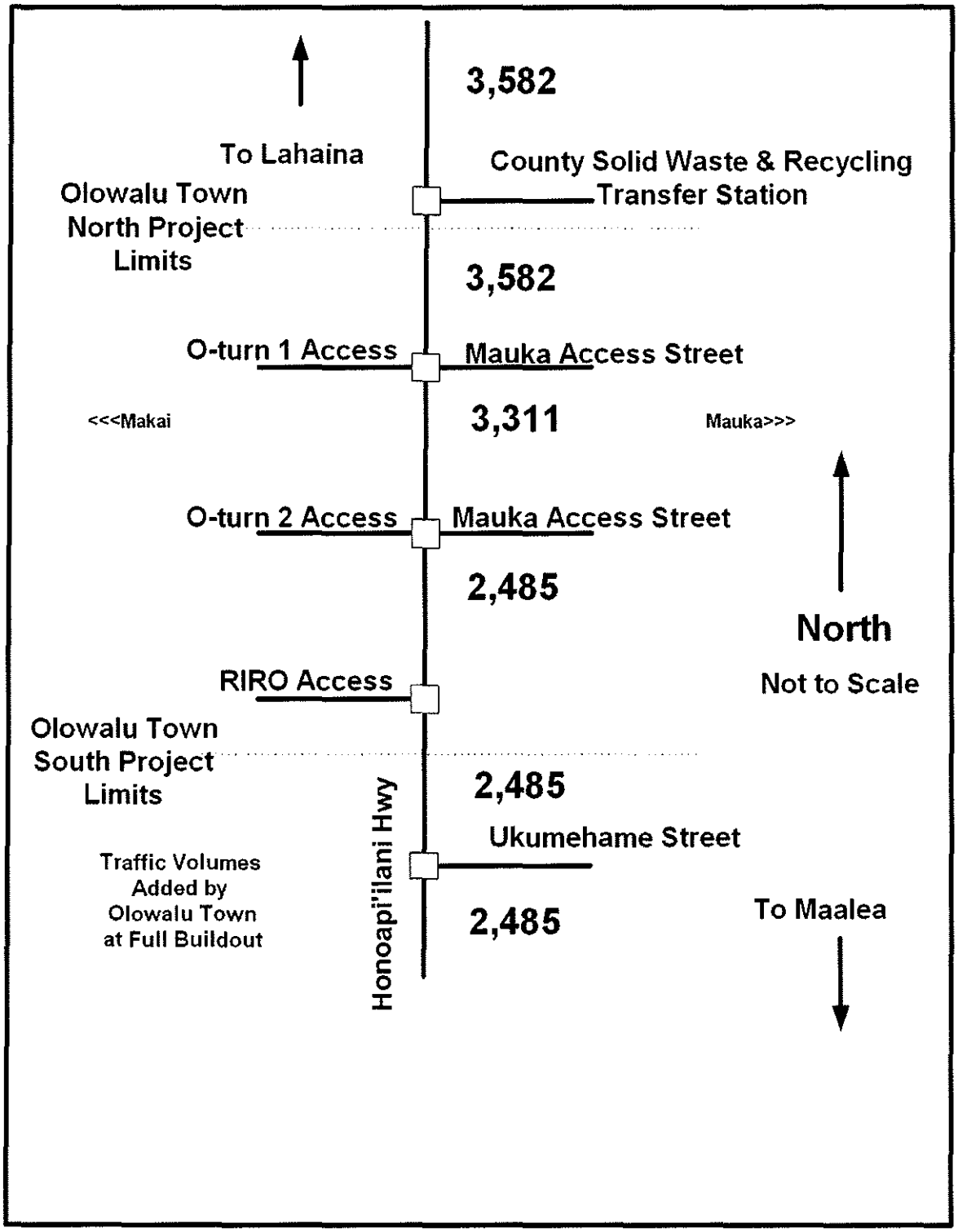
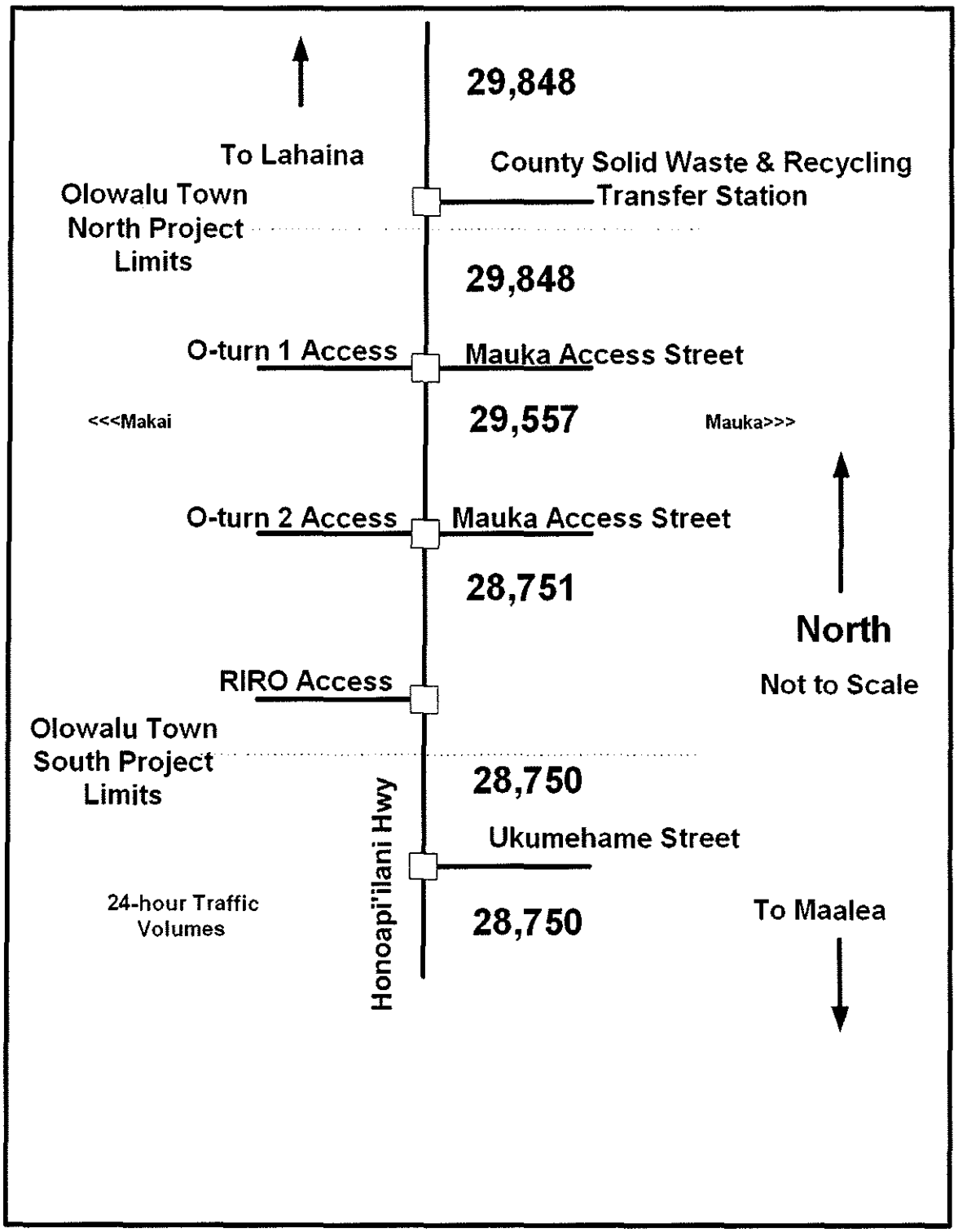


Figure 10 Olowalu Town Study Network Traffic with Full Buildout of Project in Place



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

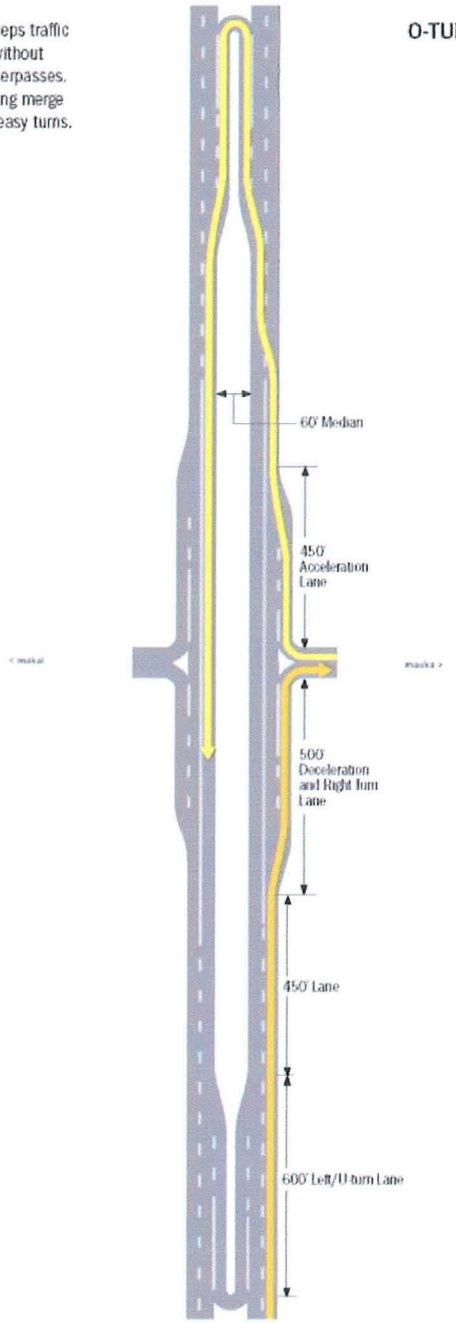
Olowalu Town PRELIMINARY STUDIES FOR POTENTIAL HIGHWAY LOCATIONS

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 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

1

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.)*

2

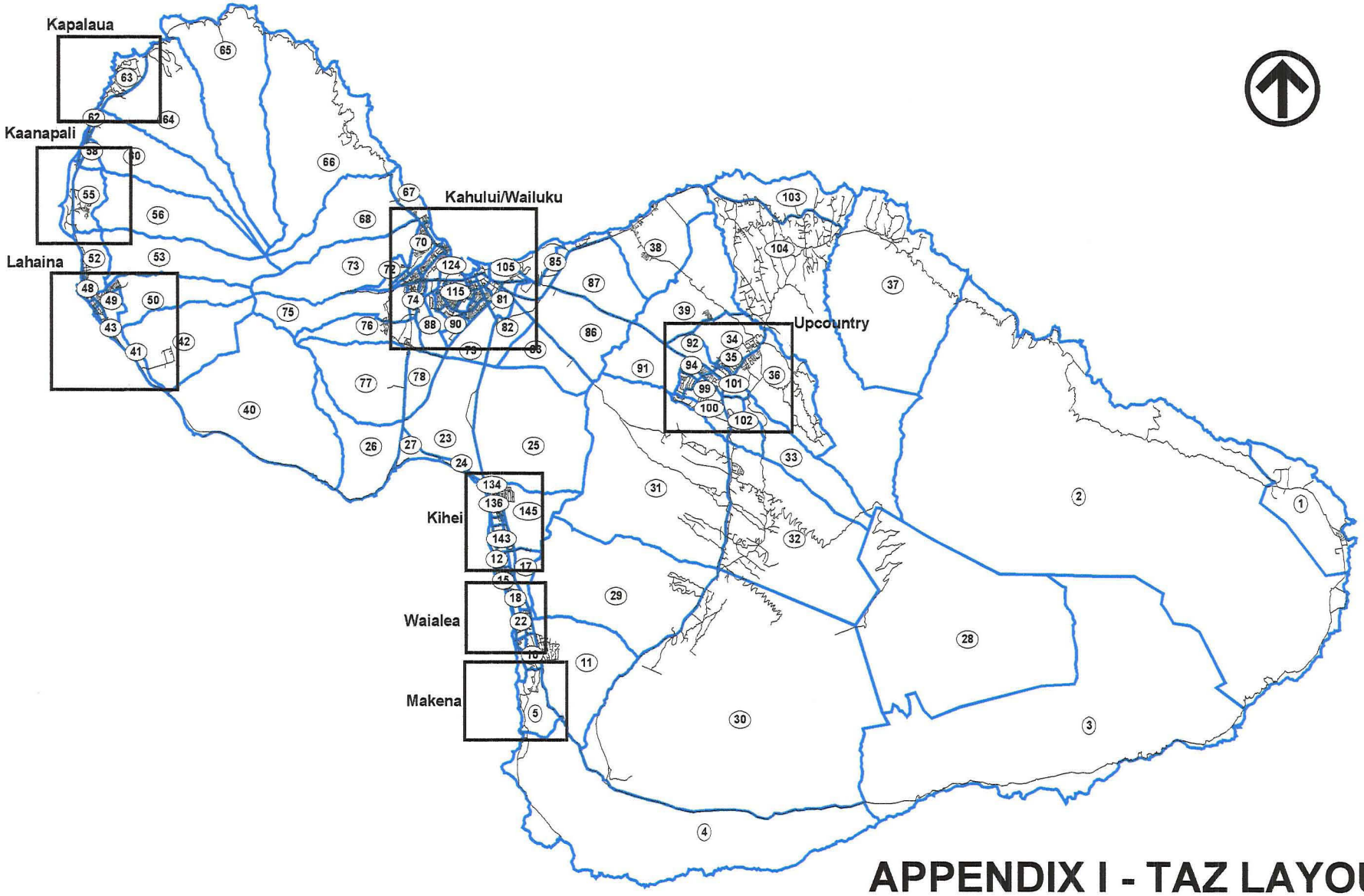
Trip Distribution Calculations Olowalu Town

	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 Daily	Total Single Use Trips Daily	Directional Distribution		Trip Generation		Town Only		External of Town		External Passby Estimate	External New Only Added		External Passby Only		Internal Total	External Total	External New	External Passby	External New		External Passby	
2					(Town)		(ITE)		In	Out	In	Out	In	Out	In	Out	Tot %	In	Out	In	Out					In	Out	In	Out
3											C/(F*G*)	C/(F*G*)	K*E	L*E	E-M	L-N		(1-Q)*O	(1-Q)*P	O-R	O-R								
4	230	Government Office Building	15,000	sq. feet gross floor area	85%	1000	11.9	179	50%	50%	89	89	76	76	13	13	50%	7	7	7	7	152	27	13	13	7	7	7	7
5	110	General Light Industrial	26,000	sq. feet gross floor area	30%	1000	7.0	181	50%	50%	91	91	27	27	63	63	20%	51	51	13	13	54	127	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	20%	11	11	3	3	243	27	22	5	11	11	3	3
7	417	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	310	Hotel	58	rooms	20%	1	8.2	474	50%	50%	237	237	47	47	190	190	20%	152	152	38	38	95	379	303	76	152	152	38	38
9	732	United States Post Office	5,000	sq. feet gross floor area	95%	1000	108.2	541	50%	50%	271	271	257	257	14	14	80%	3	3	11	11	514	27	5	22	3	3	11	11
10	230	Residential Condominium/Townhouse	174	dwelling units	40%	1	5.9	874	50%	50%	437	437	149	149	288	288	20%	231	231	58	58	350	524	419	105	210	210	52	52
11	220	Apartments	260	dwelling units	40%	1	6.7	1,485	50%	50%	742	742	297	297	445	445	20%	356	356	89	89	594	891	713	178	356	356	89	89
12	944	Gasoline/Service Station	20	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	303	17	17	152	152
13	220	Apartments	594	dwelling units	40%	1	6.3	3,162	50%	50%	1,581	1,581	632	632	949	949	20%	759	759	190	190	1,265	1,897	1,518	379	759	759	190	190
14	210	Single-Family Detached Housing	262	dwelling units	40%	1	9.1	2,027	50%	50%	1,013	1,013	405	405	608	608	20%	486	486	122	122	811	1,216	973	243	486	486	122	122
15	210	Single-Family Detached Housing	261	dwelling units	40%	1	9.1	2,021	50%	50%	1,010	1,010	404	404	606	606	20%	485	485	121	121	808	1,212	970	242	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	942	3,768	471	471	1,884	1,884
17	820	Shopping Center (Retail)	187,000	sq. feet gross leasable area	50%	1000	50.1	9,362	50%	50%	4,681	4,681	2,340	2,340	2,340	2,340	80%	468	468	1,872	1,872	4,681	4,681	936	3,745	468	468	1,872	1,872
18								33,717			16,858	16,858	8,664	8,664	8,195	8,195		3,608	3,608	4,586	4,586	17,380	16,337	7,175	9,162	3,587	3,587	4,581	4,581
19																													
20																							33,717		16,337	7,175	9,162		
21																													
22																													
23	Column	Description and Meaning								Trips		Formula			% Trips	Amt.	% Increase												
24	A	ITE land use code								Total for site	33,717	H16			100%														
25	B	Land use description				Distribution				Internal to site	17,380	M16 + n16			52%														
26	C	Units (provided by F&W)				Maalea	40%			External	16,337	K22 - K23			48%											33,717			
27	D	Variable for calculations				Lahaina	60%			External new	7,175	R16 + S16			21%											32,673			
28	E	Internal capture rate for each use (estimated)								External passby	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	Spare	%	Yrs at 1%							
32	I	Percentage of trips into the land use				Internal Capture %		52%	K25/K24	Lahaina Side	27,205	K28 + (K29*G25)				4,305	19%		31,700	4,495	20%	16							
33	J	Percentage of trips out of the land use				12.73581 New Lahaina Side %		13%		Maalea Side	25,770	K26 + (K29*G24)				2,870	13%		31,700	5,930	26%	22							
34	K	Trips generated into each land use (C * G * I)				18.31965 Passby Lahaina Side %		19%		Total ADT						7,175	31%												
35	L	Trips generated out of each land use (C * G * J)				8.490543 New Maalea Side %		8%																					
36	M	Trips to/from the town itself (K * E) inbound				10.87972 Passby Maalea Side %		11%																					
37	N	Trips to/from the town itself (L * E) outbound						100%																					

Island Trip Distribution From Urban Model

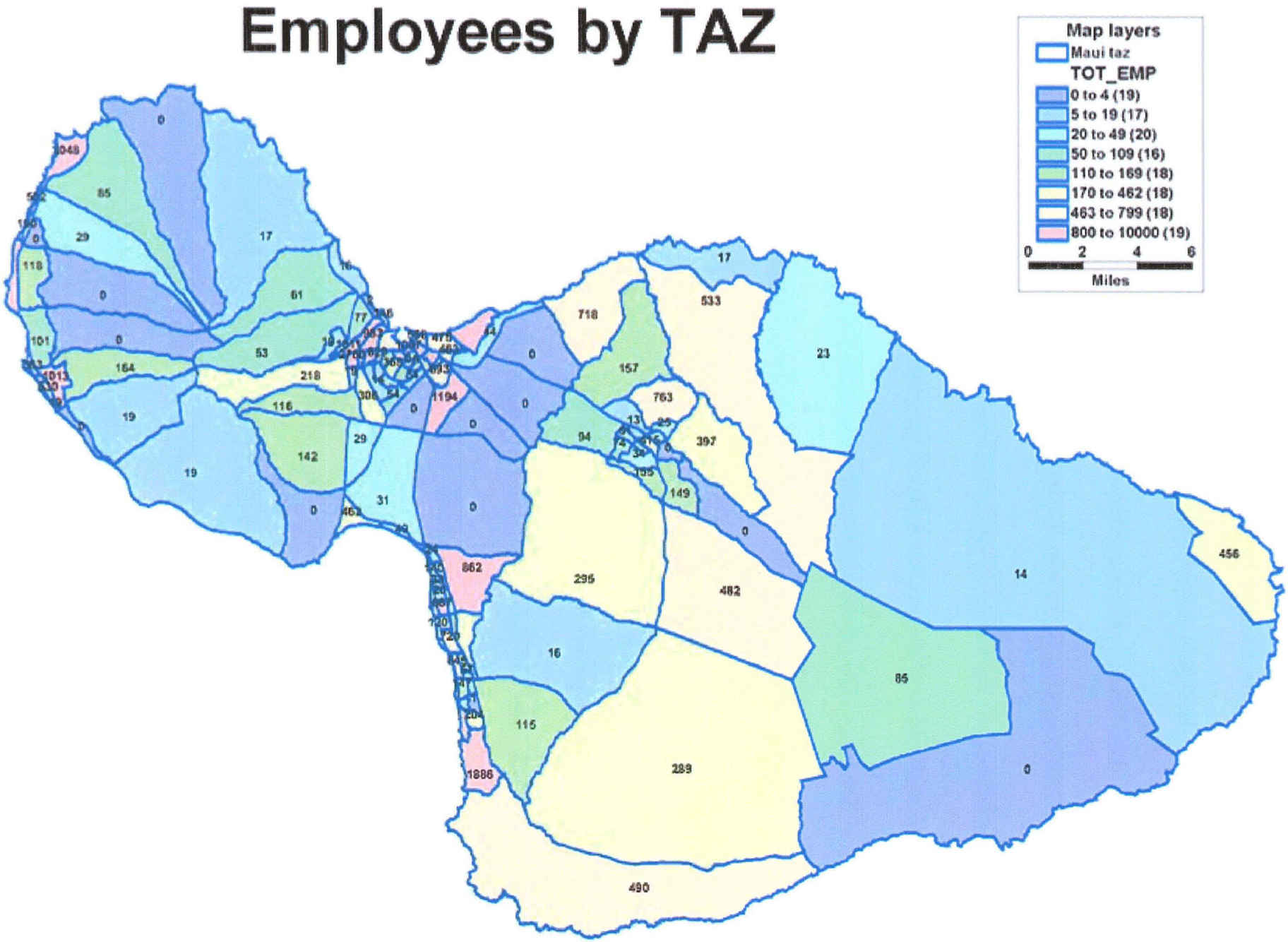
	A	B	C	D	E	F	G
2	Section	Lahaina	Kaanapali	Honokowai Napili	Kahana	Kapalua	Total
3	West Maui	17%	28%	3%	5%	7%	60%
4	Kahului	4%	6%	0%	0%	1%	11%
5	Wailuku	5%	8%	1%	0%	1%	15%
6	Kihei	3%	4%	0%	0%	1%	8%
7	Up Country	2%	3%	0%	0%	1%	6%
8	Other	0%	0%	0%	0%	0%	0%
9	Total	31%	49%	4%	5%	11%	100%

3

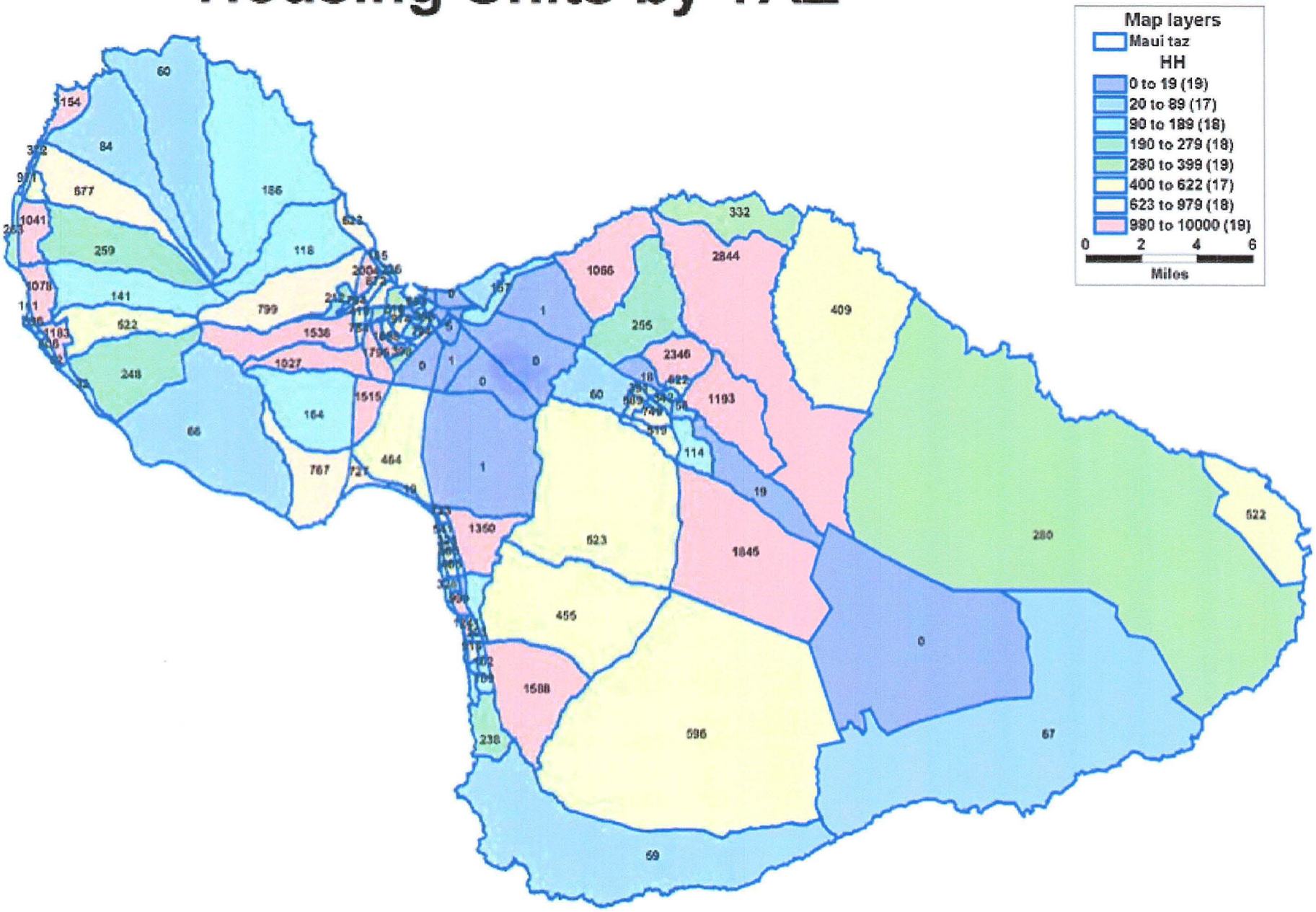


APPENDIX I - TAZ LAYOUT

Employees by TAZ



Housing Units by TAZ



Trips in 1990 and 2020 By Community Name and By Purpose

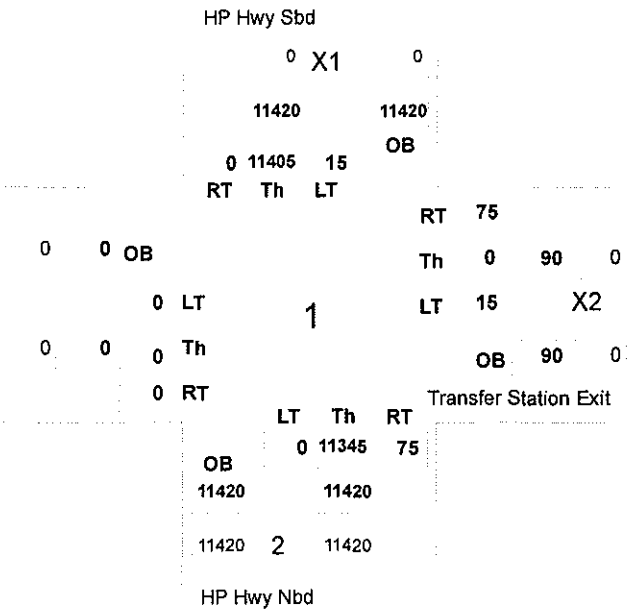
	A	B	C	D	E	F	G	H	I	J	K	L
1												
2												
3				1990						2020		
4			Home Based Work	Home Based Other	Non-Home Based	Visitors	Total	Home Based Work	Home Based Other	Non-Home Based	Visitors	Total
5	**Community Name**	**aka 1997 LRTP**										
6	West Maui	Lahaina										
7	Kihei-Makena	Kihei-Makena										
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								

Intersection Turning Movements

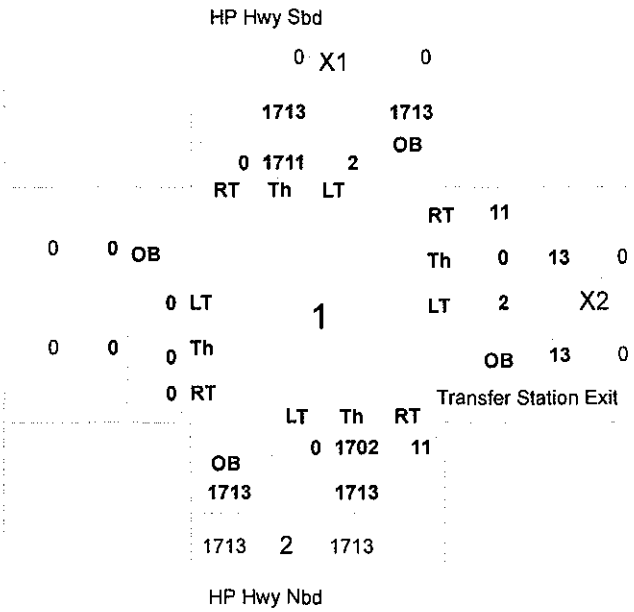
Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

Intersection Name: HP Hwy at Transfer Station
Intersection ID: 1

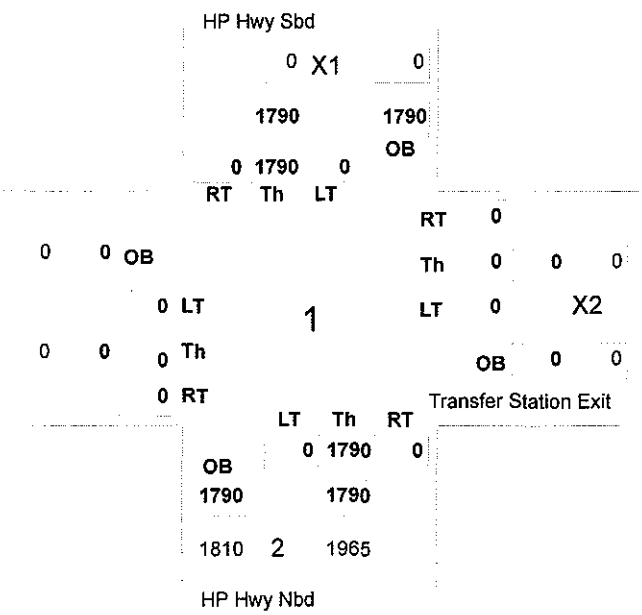
Existing



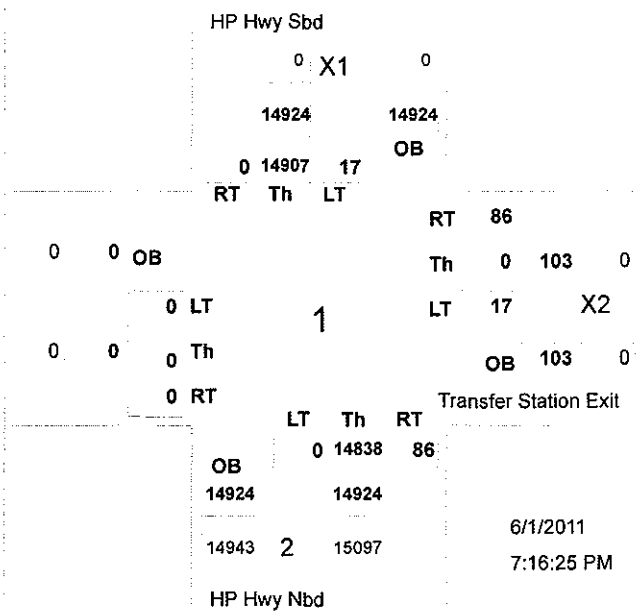
Growth



Site



Future



6/1/2011
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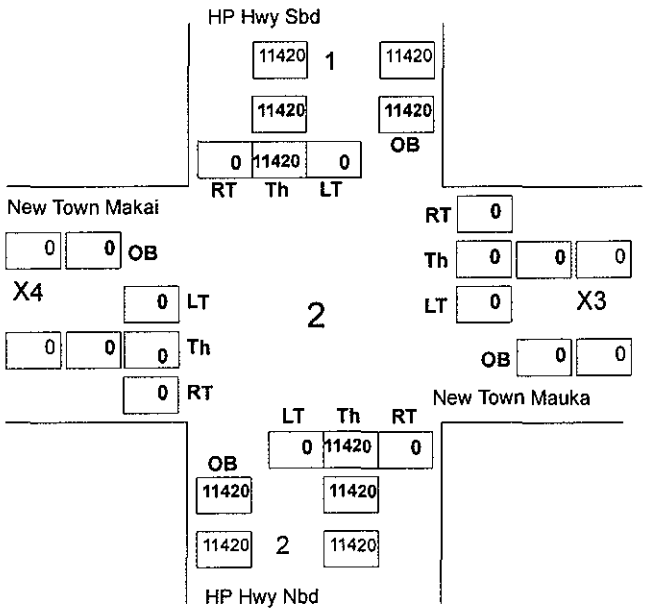
Intersection Turning Movements

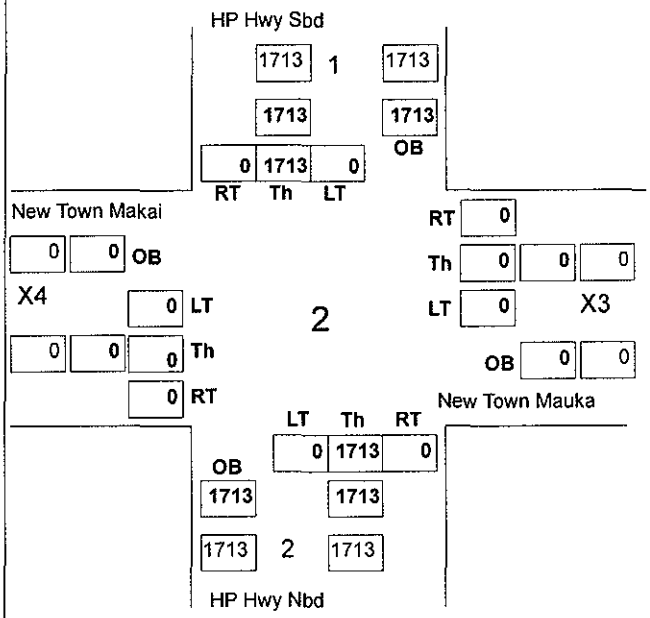
Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

Intersection Name: HP Hwy at New Town Access 1
Intersection ID: 2

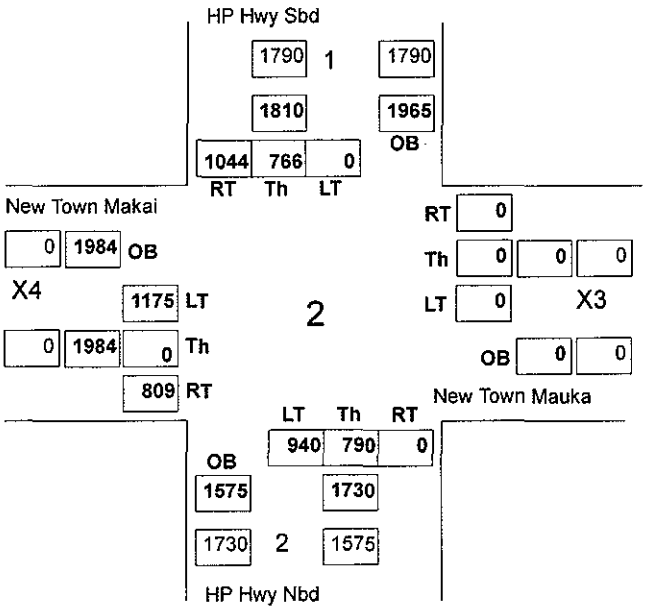
Existing



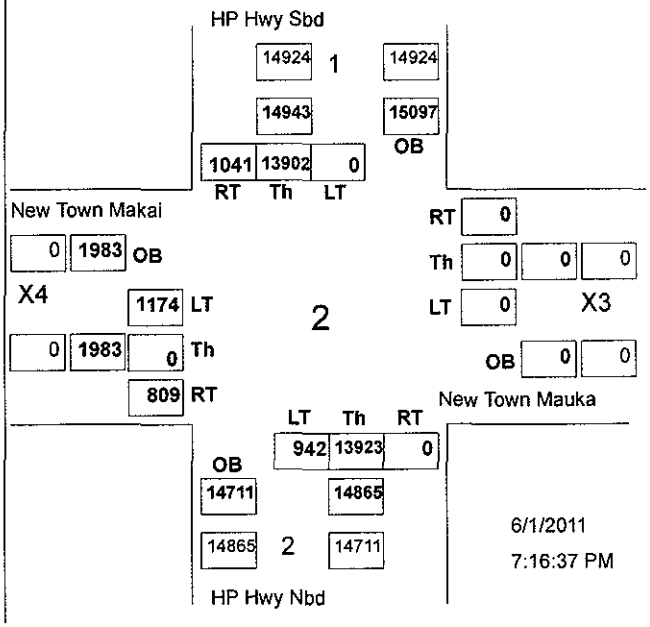
Growth



Site



Future



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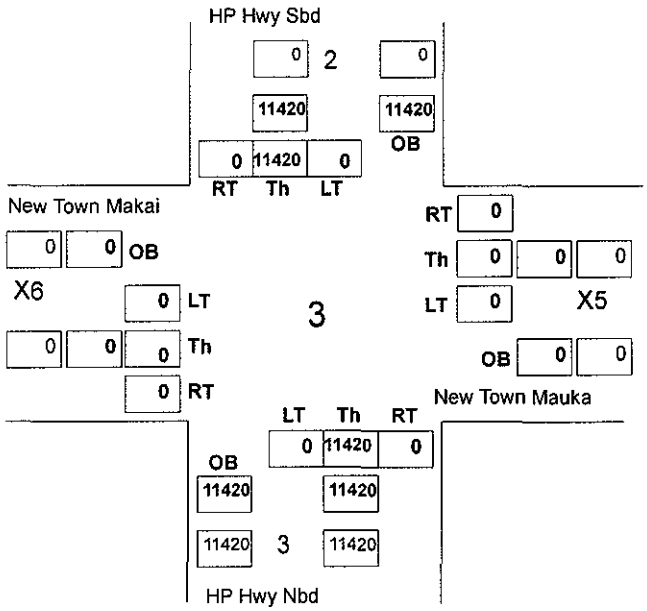
Intersection Turning Movements

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

Existing



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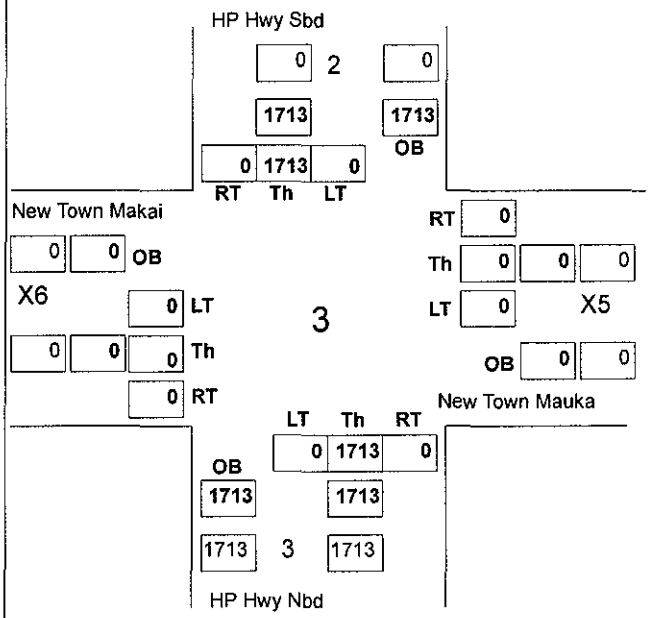

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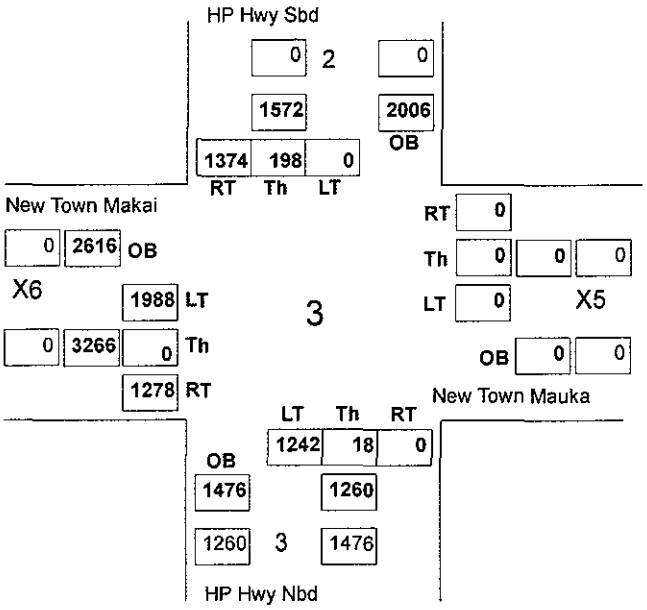

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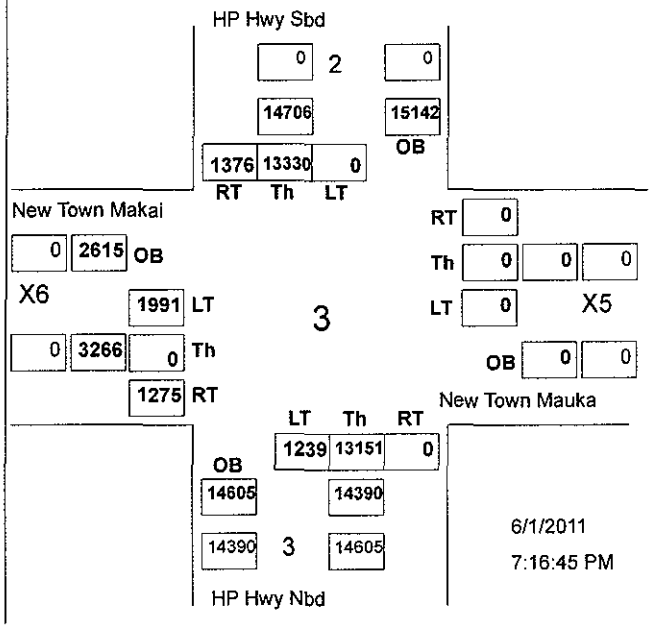

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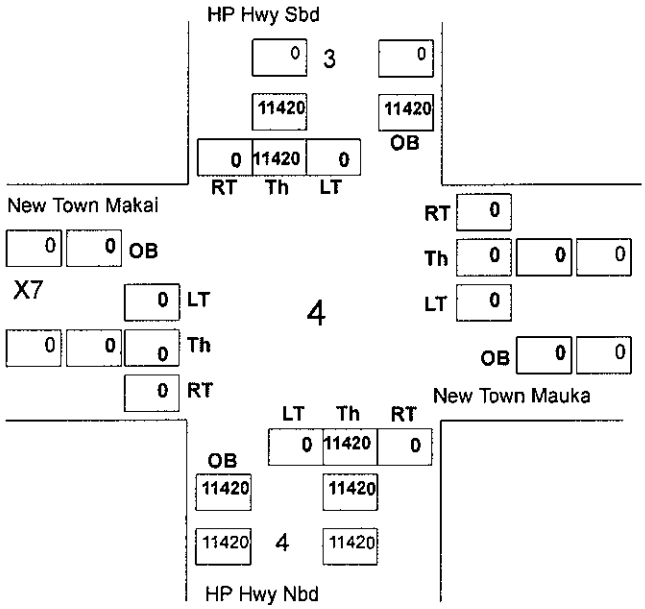
Intersection Turning Movements

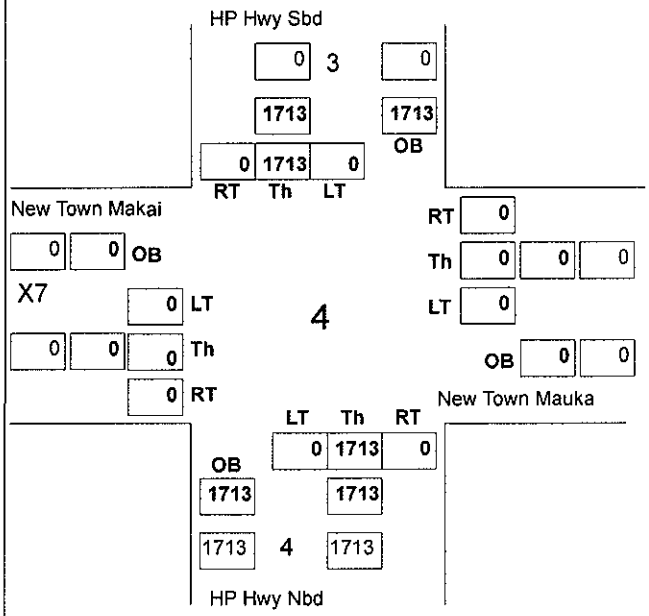
Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

Intersection Name: HP Hwy at New Town Access RIRO
Intersection ID: 4

Existing



Growth



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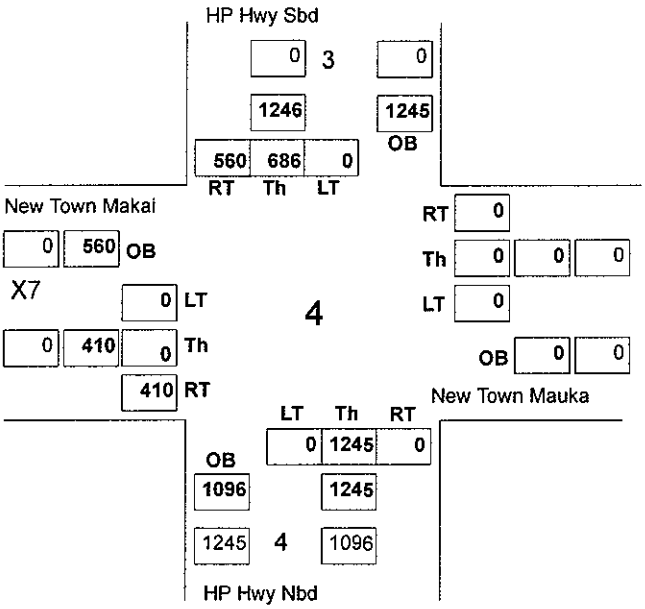

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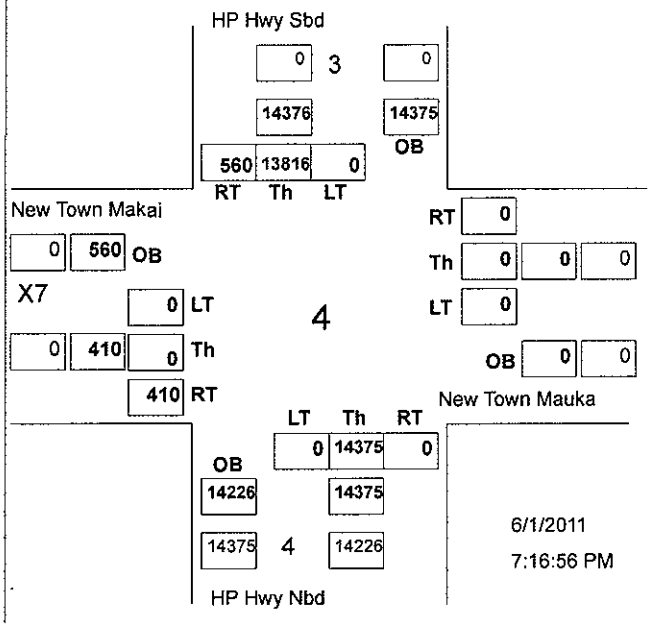

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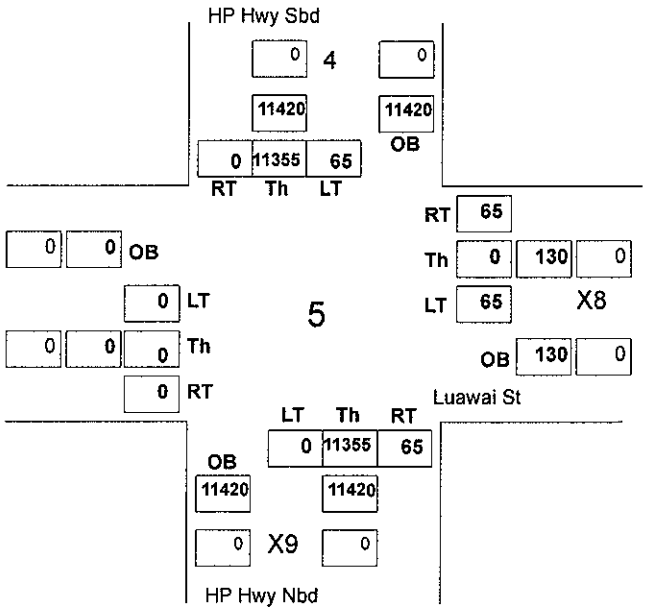
Intersection Turning Movements

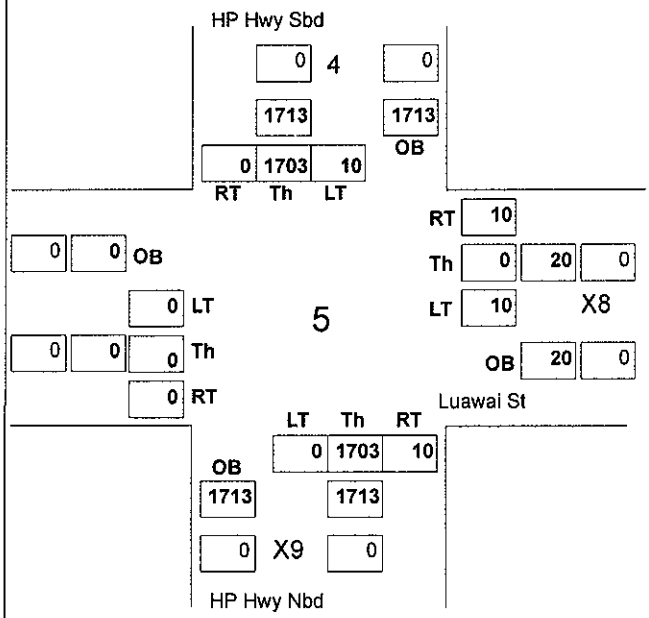
Project: Olowalu New Town
Scenario: Preliminary Traffic Report Full Buildout + 15% Growth
Time Period: Daily

Intersection Name: HP Hwy at Luawai
Intersection ID: 5

Existing



Growth



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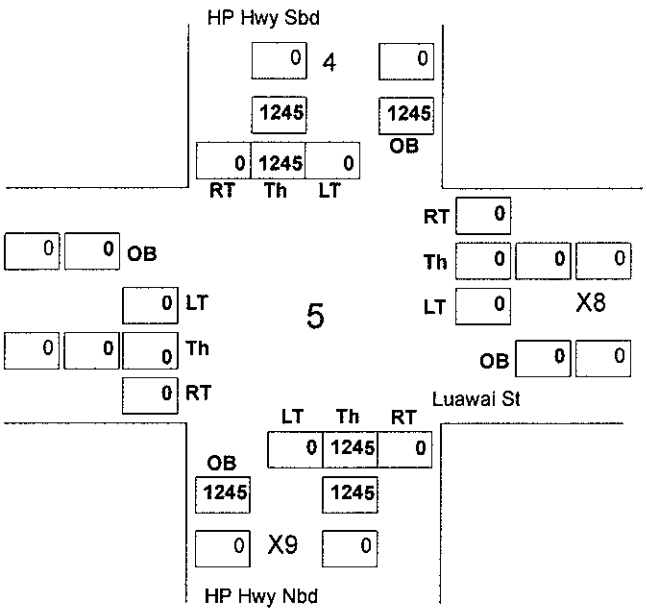
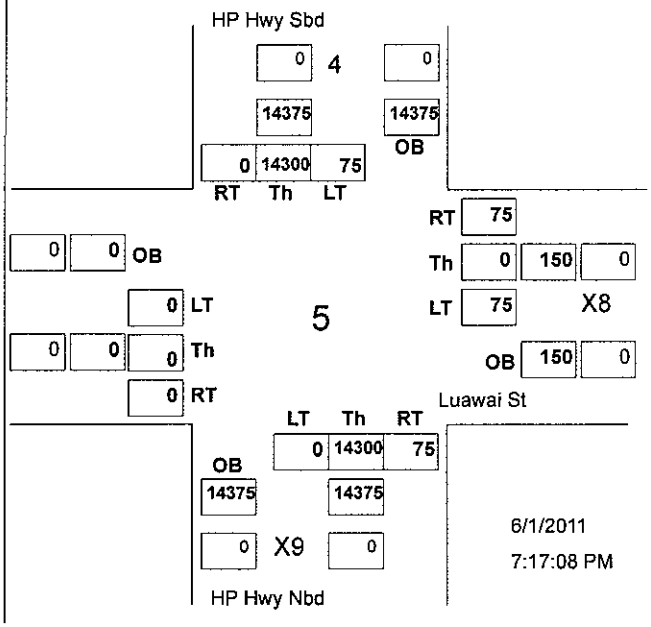


Future



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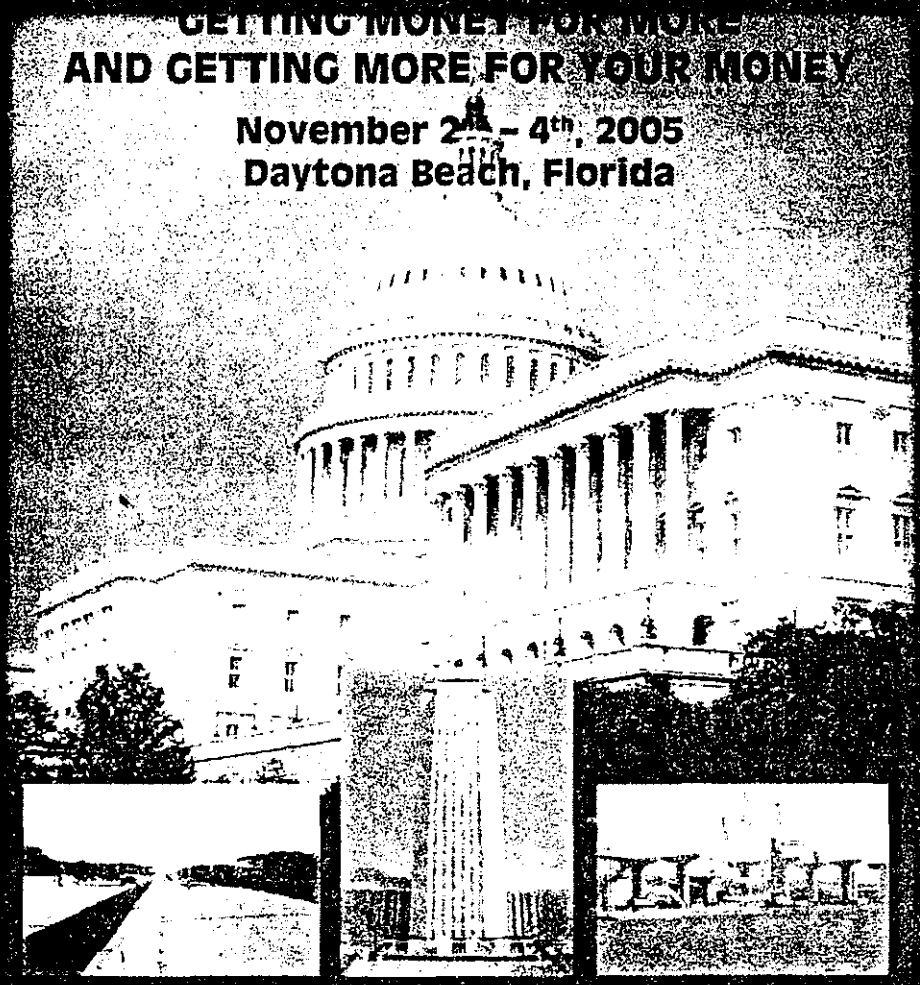

INSIDE

- PREDICTING FUTURE TRAVEL PATTERNS IN FLORIDA MPO AREAS
- TRADITIONAL DEVELOPMENT TRIP GENERATION CHARACTERISTICS
- FSITE STRATEGIC PLAN
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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

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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]

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.

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.

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

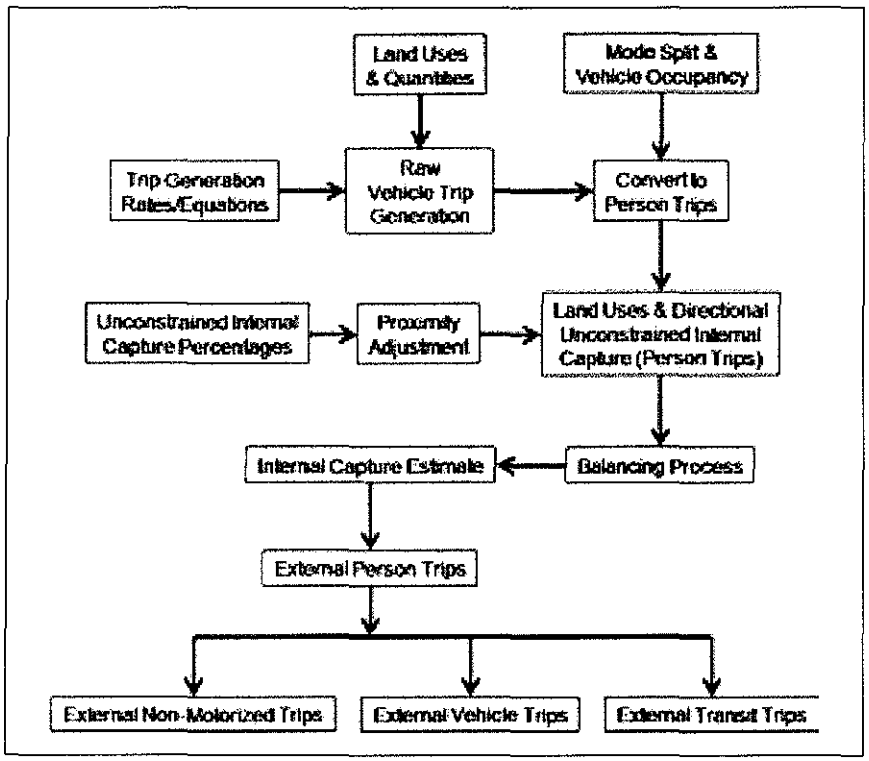

Figure 1. Generalized NCHRP 8-51 internal capture estimation method.

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.

2. *Trip Generation Handbook*, 2nd Edition, Institute of Transportation Engineers, Washington, DC, June 2004.

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.

6. Ibid.

7. ITE, 2004.

8. Ibid.

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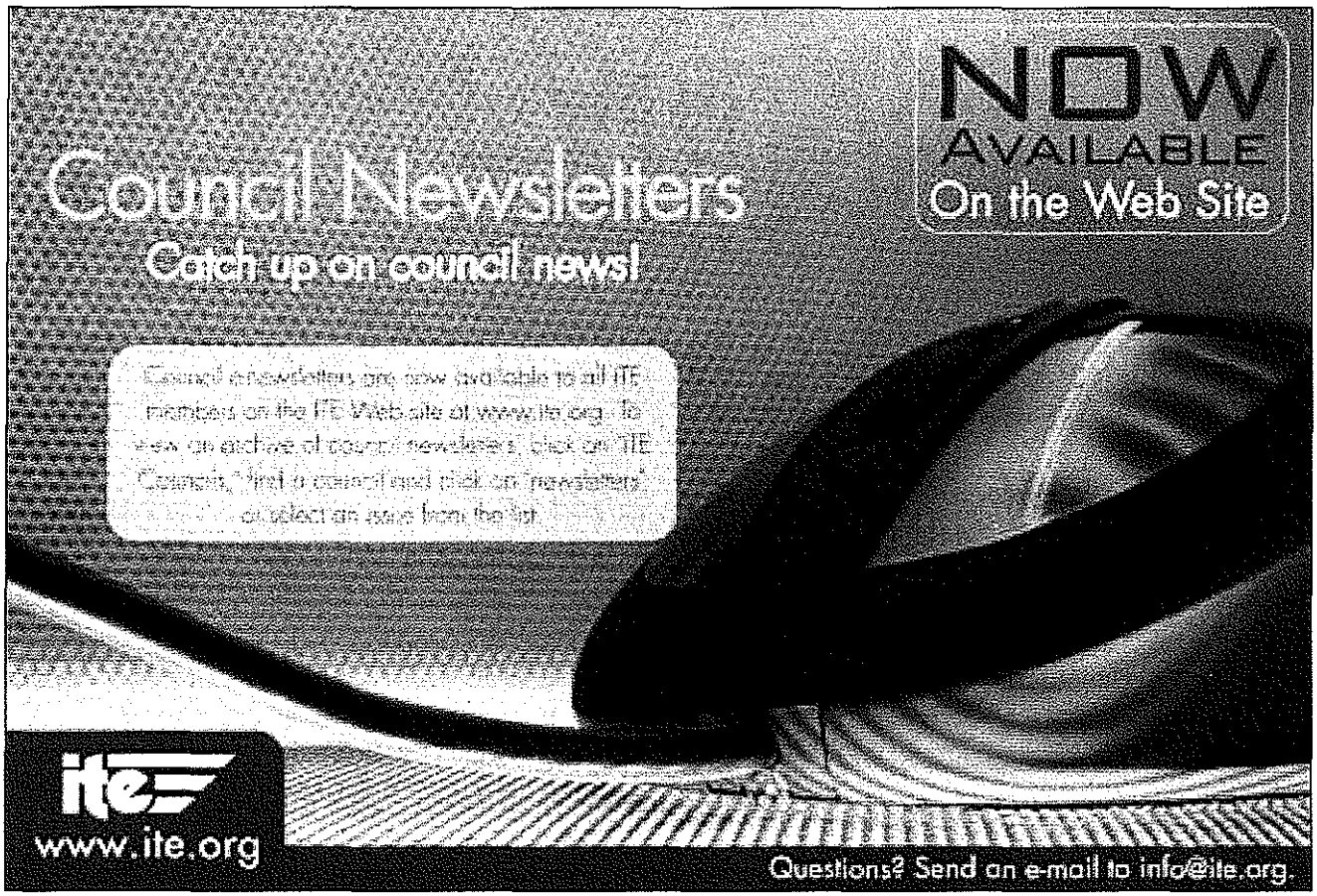

Table 411-7 TND Trip Reductions for Traffic Studies

% 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.

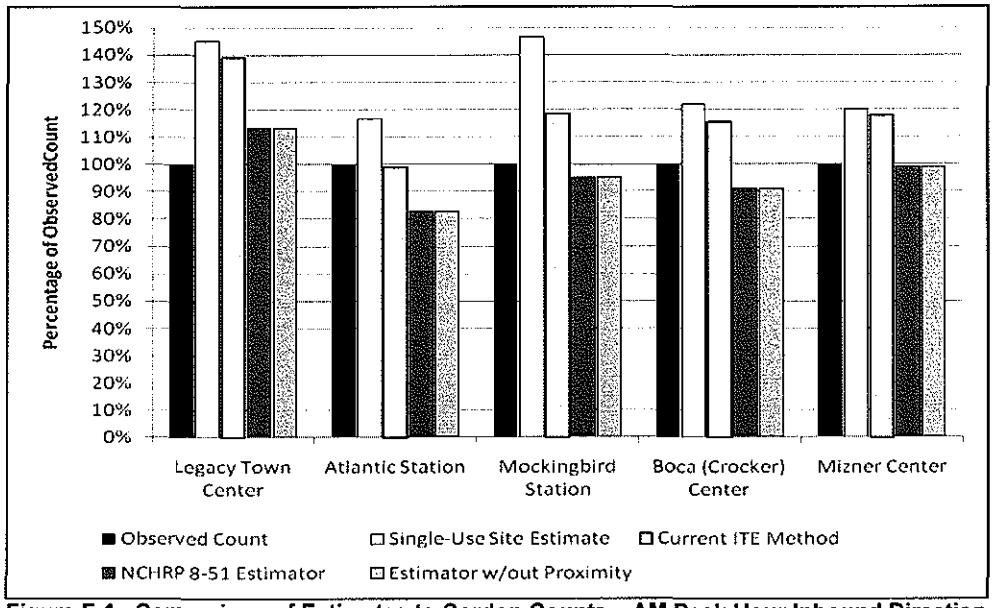

Figure F-1. Comparison of Estimates to Cordon Counts – AM Peak Hour Inbound Direction

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.

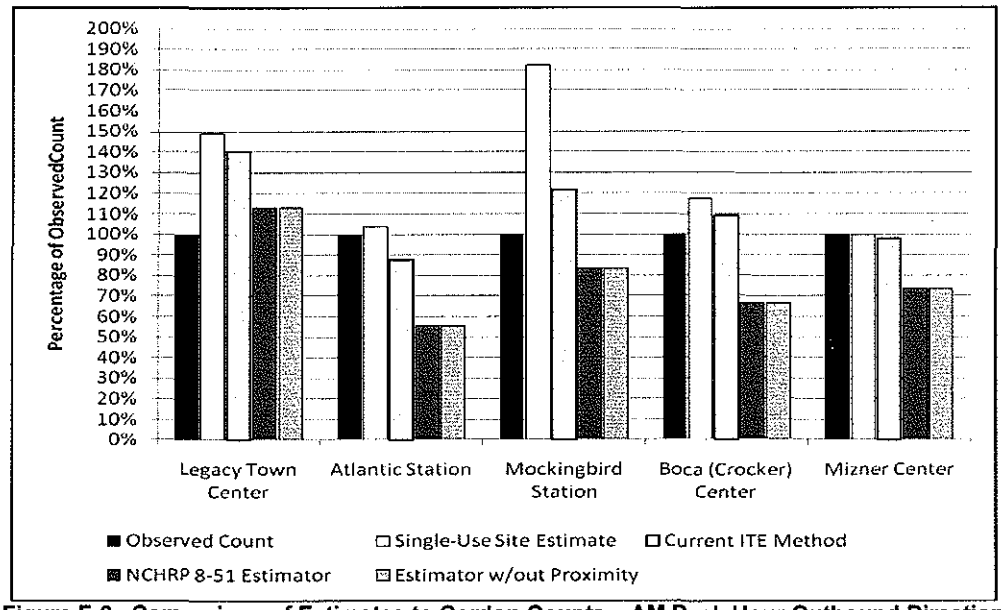

Figure F-2. Comparison of Estimates to Cordon Counts – AM Peak Hour Outbound Direction

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.

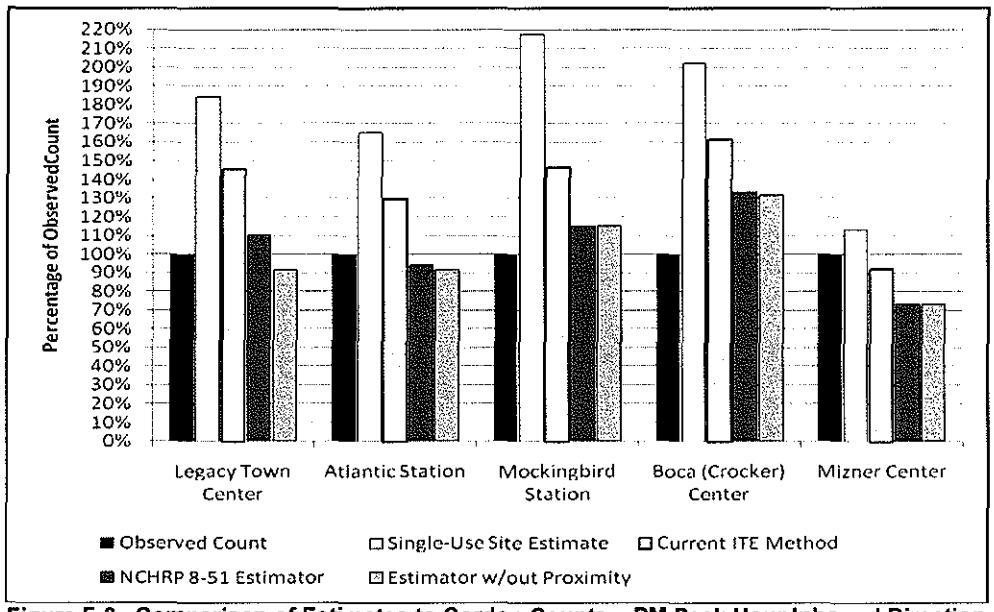

Figure F-3. Comparison of Estimates to Cordon Counts – PM Peak Hour Inbound Direction

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.

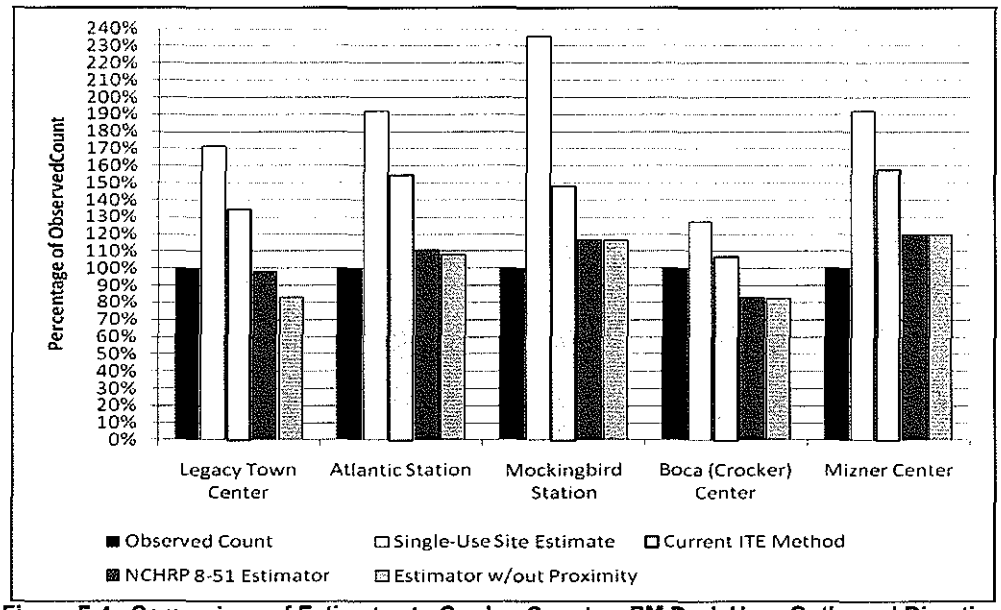

Figure F-4. Comparison of Estimates to Cordon Counts – PM Peak Hour Outbound Direction

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)

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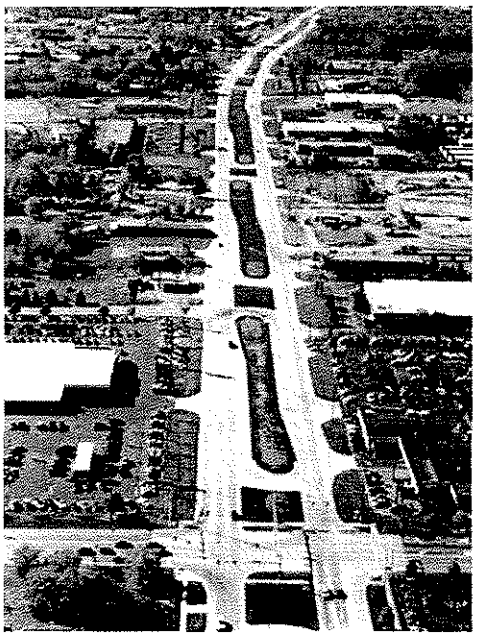
Objective

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.

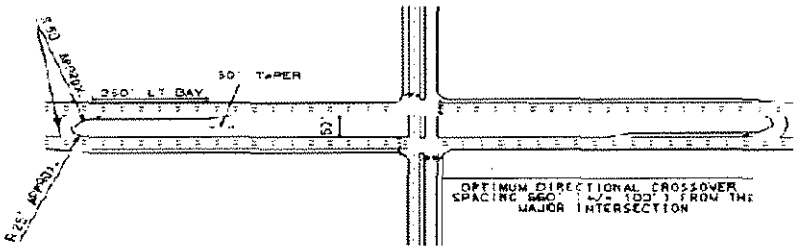
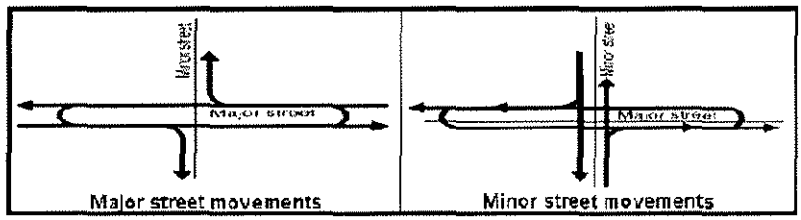


Figure 3. Vehicular movements at a MUTIT
(Source: Signalized Intersections Information Guide, FHWA-HRT-04-091, pg. 243).



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.

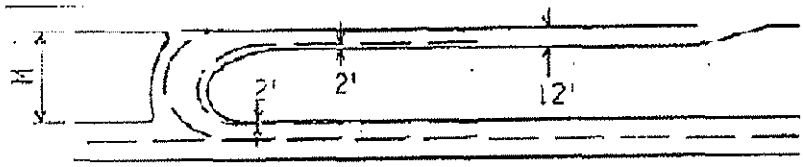


Figure 4b. Left lane to second lane maneuver.

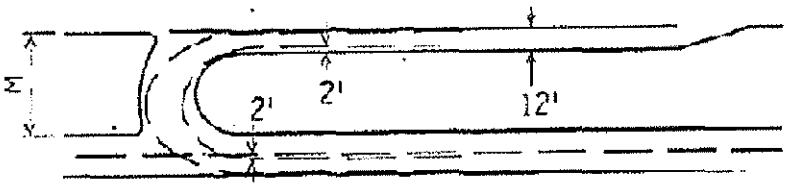


Figure 4c. Left lane to third lane maneuver.

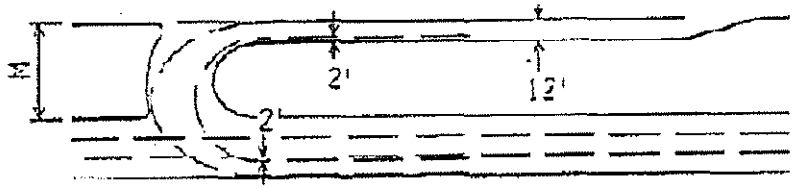


Table 1. Minimum median widths M for U-turn maneuvers suggested by MDOT.

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

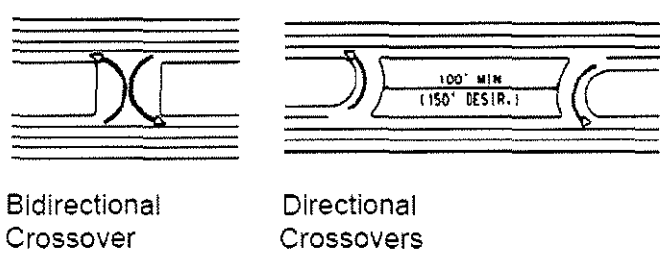
Location and Design of Median Crossovers

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.)

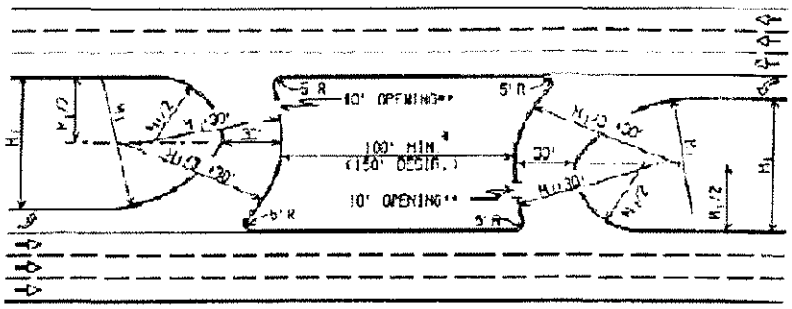
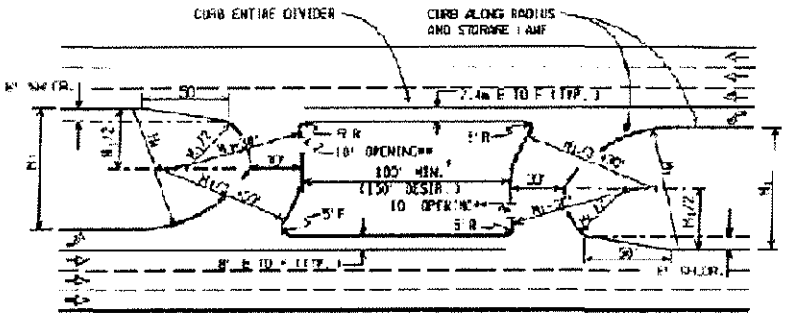


Figure 6b. Uncured section of directional median crossovers (Source: MDOT Geometric Design Guide 670).



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.

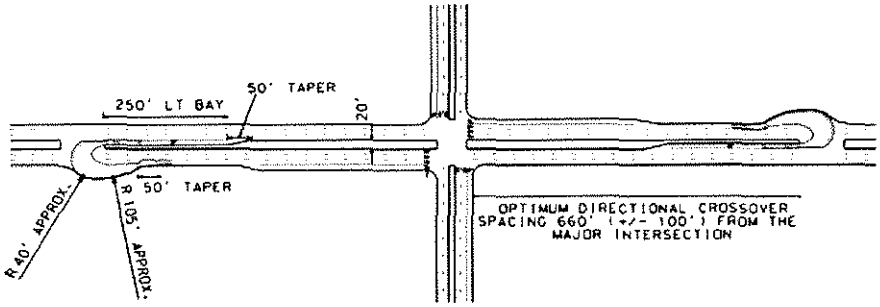


Figure 8. Example of loon implementation for a Michigan MUTIT.

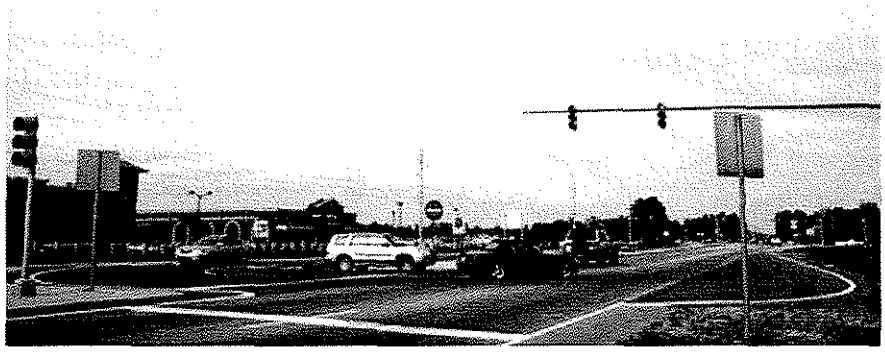
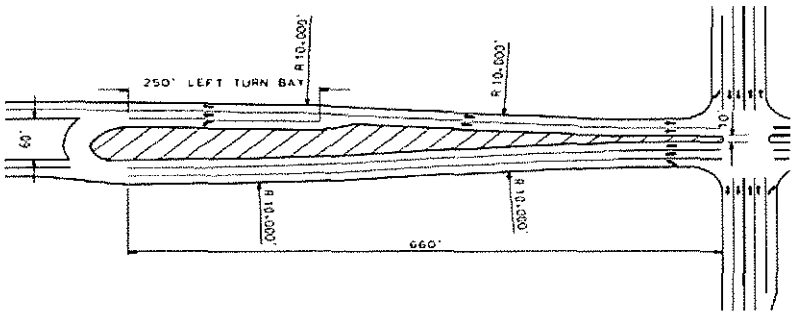


Figure 9. Example of a transition from a wide median section to a narrow median section on MUTIT corridors.



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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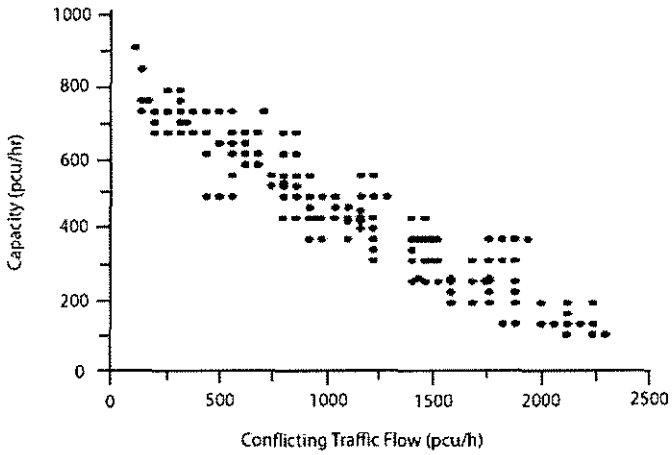


Traffic Operational Performance

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.

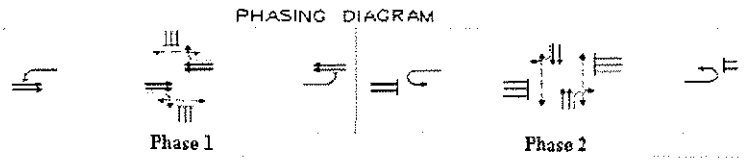


Figure 12. Example of typical signing plan for the MUTIT in Michigan.

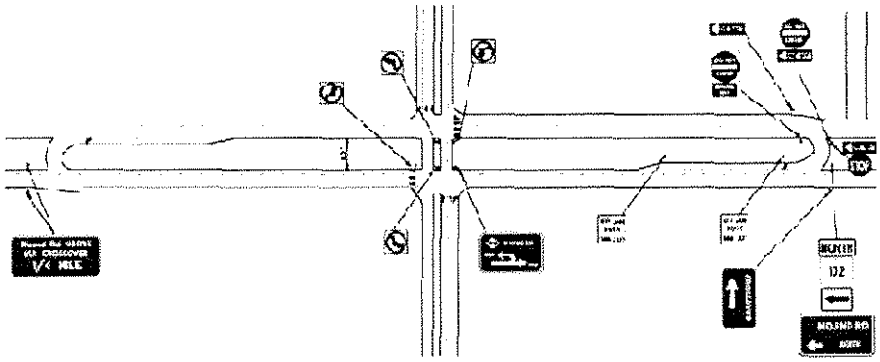


FIGURE 13. EXAMPLES OF "INNOVATIVE" SIGNING PLANS FOR THE MUTIT IN MICHIGAN.

Figure 13a. Example 1 of innovative signing. (Credit: Lee Rodegerdts)

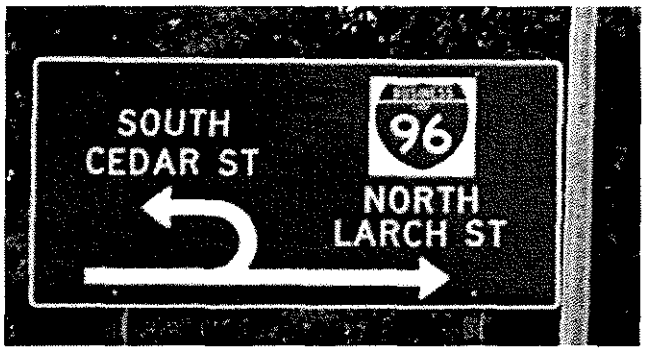


Figure 13b. Example 2 of innovative signing.
(Credit: Chris J. Bessert, www.michiganhighways.org)

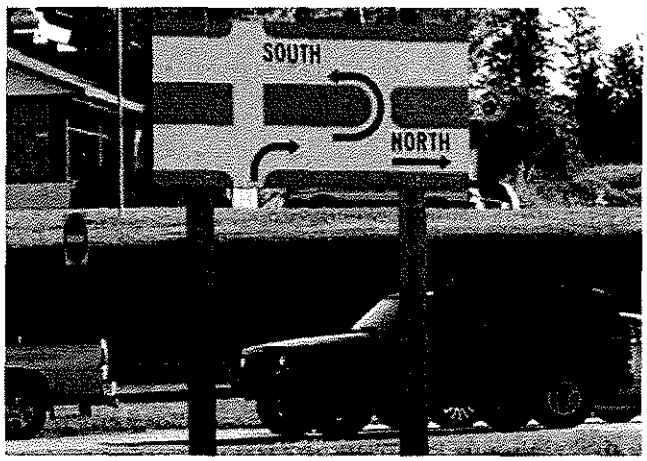


Figure 13c. Example 3 of innovative signing.
(Credit: Warren Hughes)

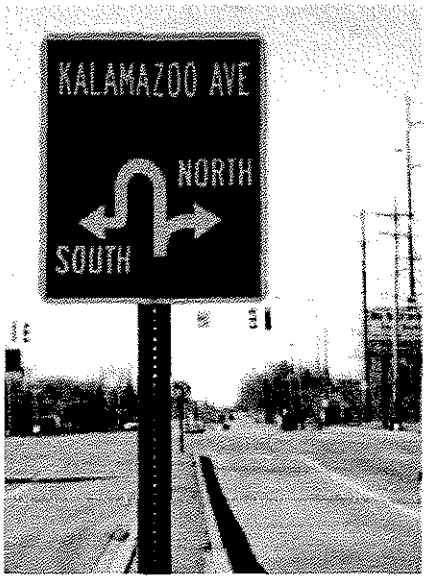


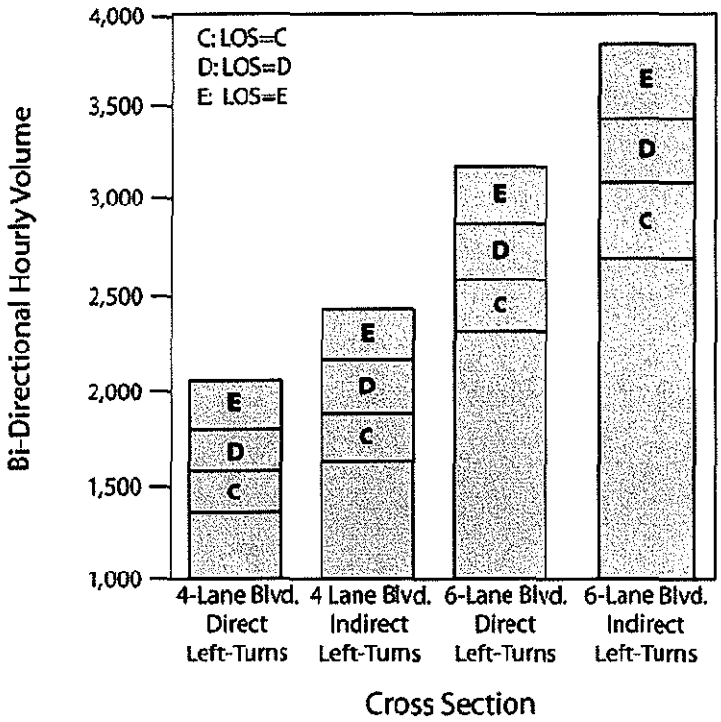
Figure 13d. Example 4 of innovative signing.
(Credit: Shawn Glynn)

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.

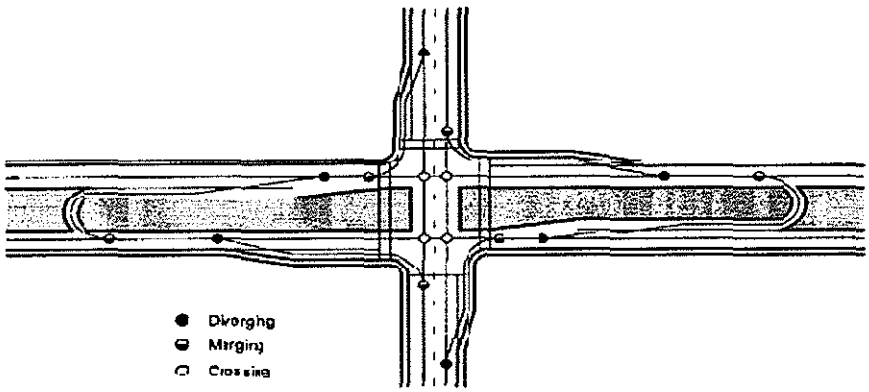
Overall, the literature shows that reducing signal phases and redirecting the left-turning movement at the intersection for the MUTIT provided significant benefits in terms of increased roadway capacity and reductions in travel time and vehicular delay when compared to conventional intersections.

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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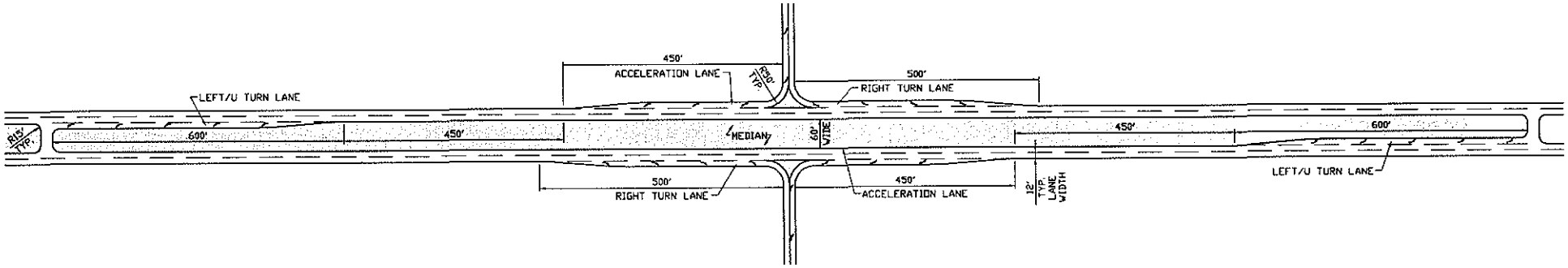
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RIGHT TURN LANE
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600'
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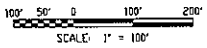
600'
500'
RIGHT TURN LANE
450'
ACCELERATION LANE
12' TYP. LANE WIDTH
LEFT/U TURN LANE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SCALE: 1" = 100'

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

6

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

END

APPENDIX N.

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

April 30, 2012

Signature | 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

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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.

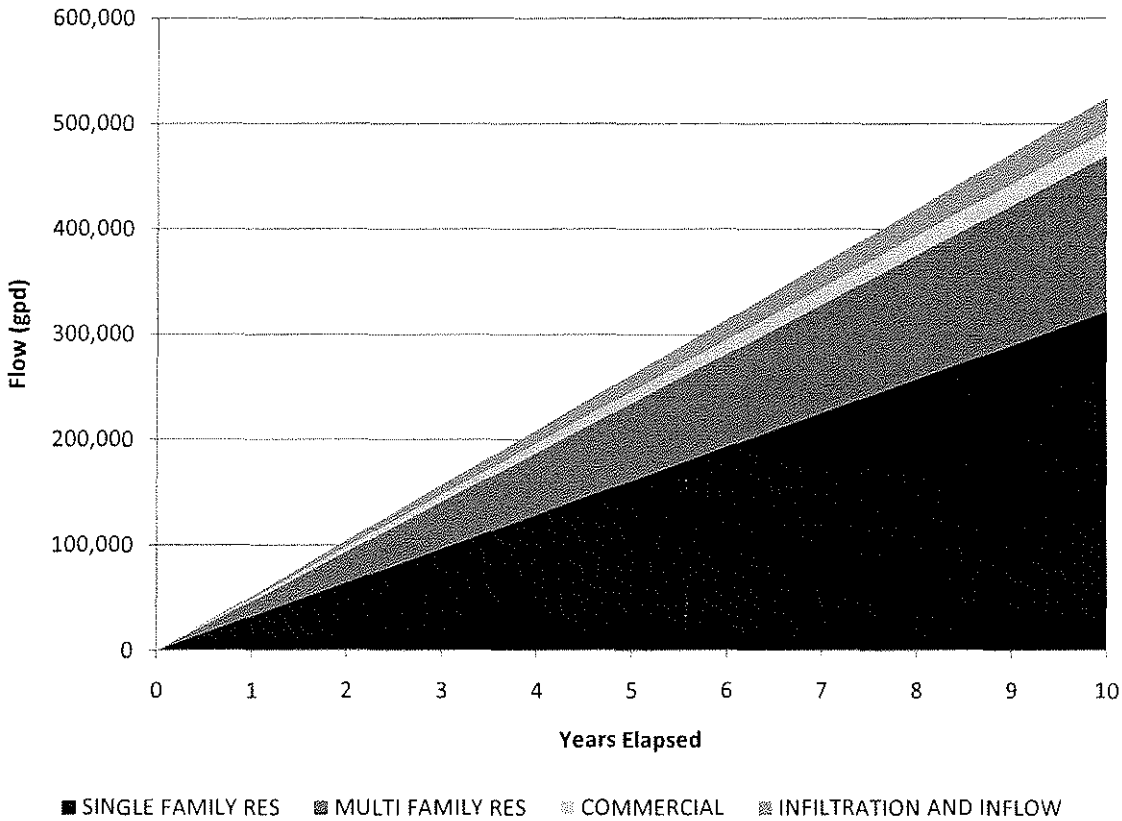

Figure 2-1. Olowalu Town Projected Average Dry Weather Wastewater Flow

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).

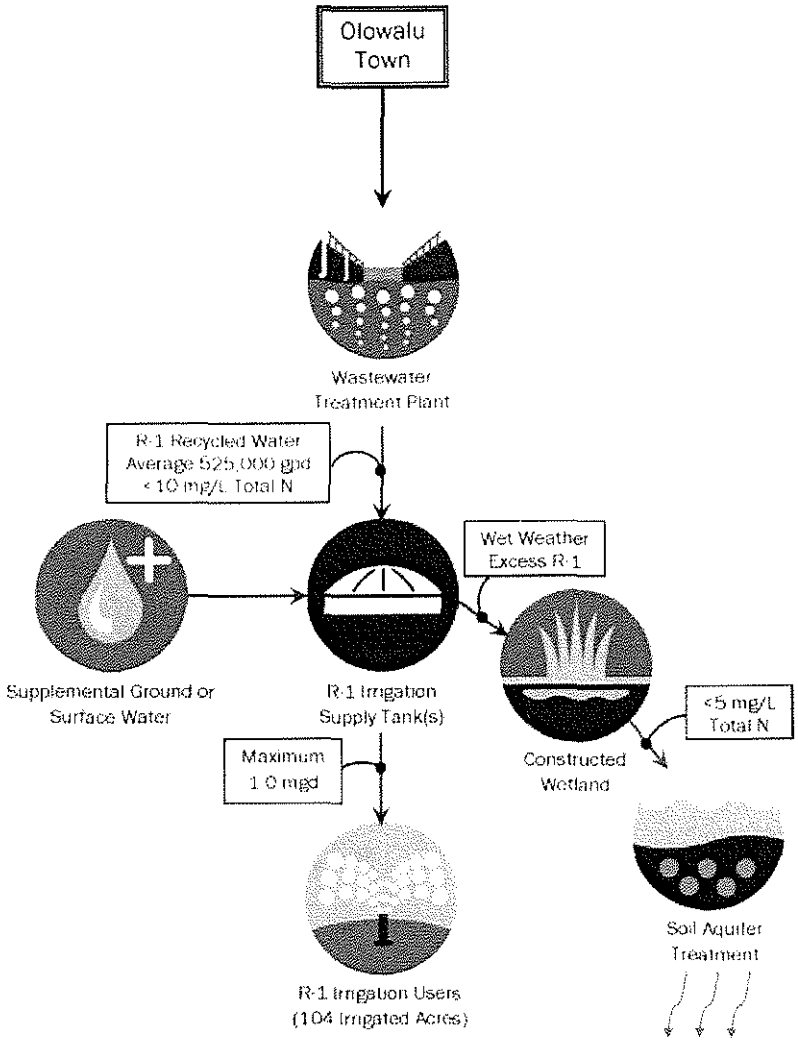

Figure 3-1. Schematic of Olowalu Town Wastewater Management System

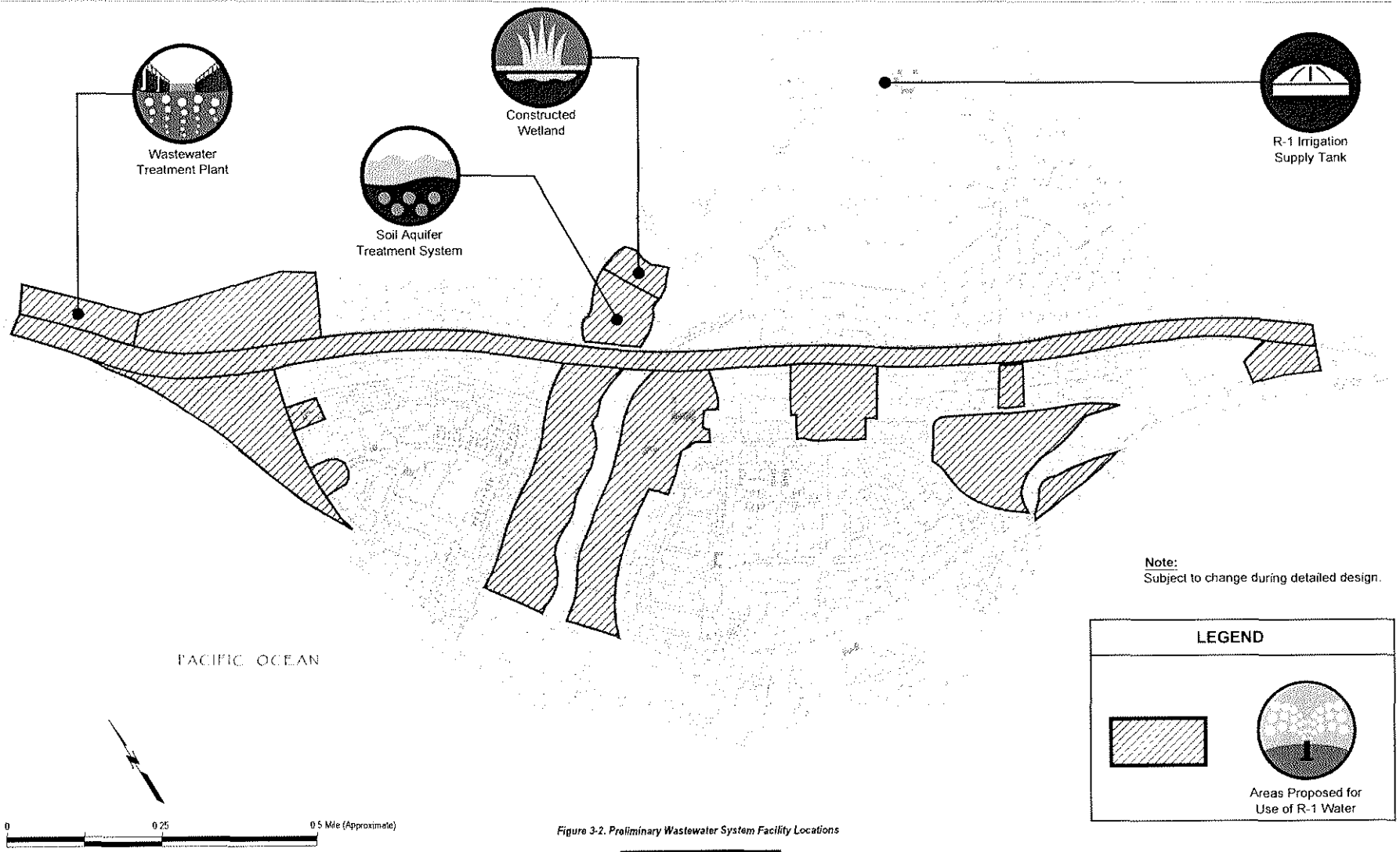

Figure 3-2. Preliminary Wastewater System Facility Locations

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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

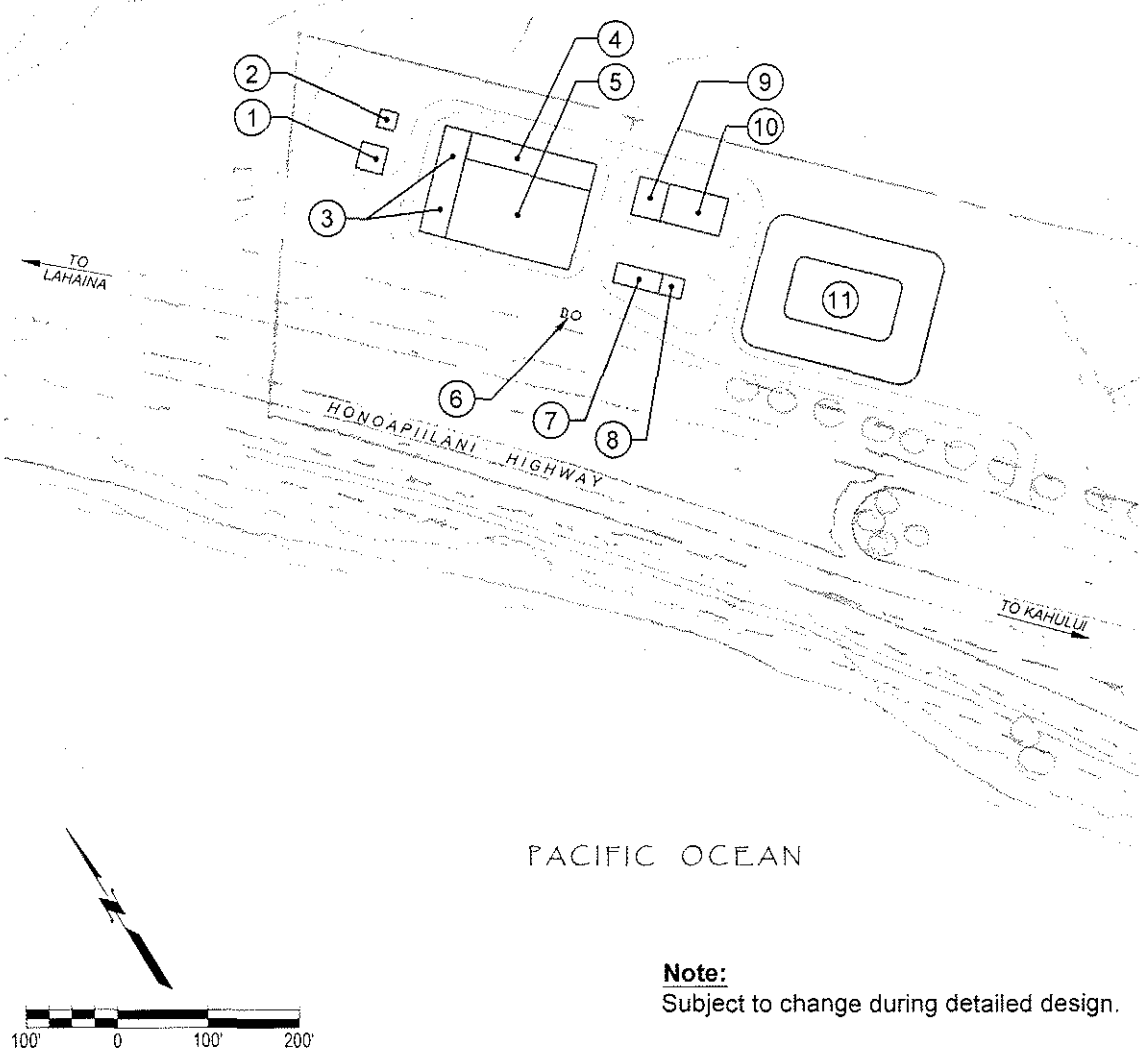
A number of wastewater treatment processes were considered for Olowalu Town, including:

- 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.

KEY

1. HEADWORKS
2. BIOFILTER
3. EQUALIZATION BASINS
4. AEROBIC SLUDGE DIGESTER
5. MEMBRANE BIOREACTOR
6. PLANT DRAIN PUMP STATION
7. UV DISINFECTION
8. EFFLUENT PUMP STATION
9. SLUDGE DEWATERING
10. OPERATIONS BUILDING
11. EMERGENCY STORAGE BASIN



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.

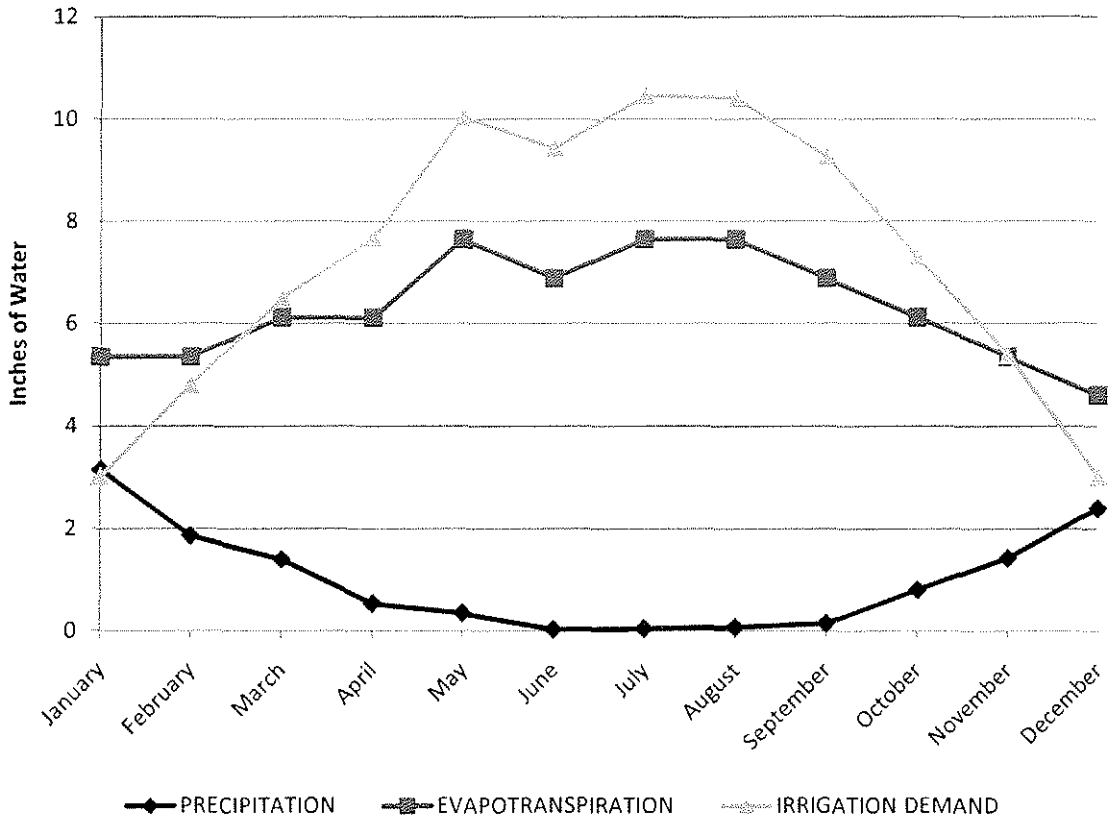

Figure 6-1. Average Year Irrigation Demand

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**	**84.15**	**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.

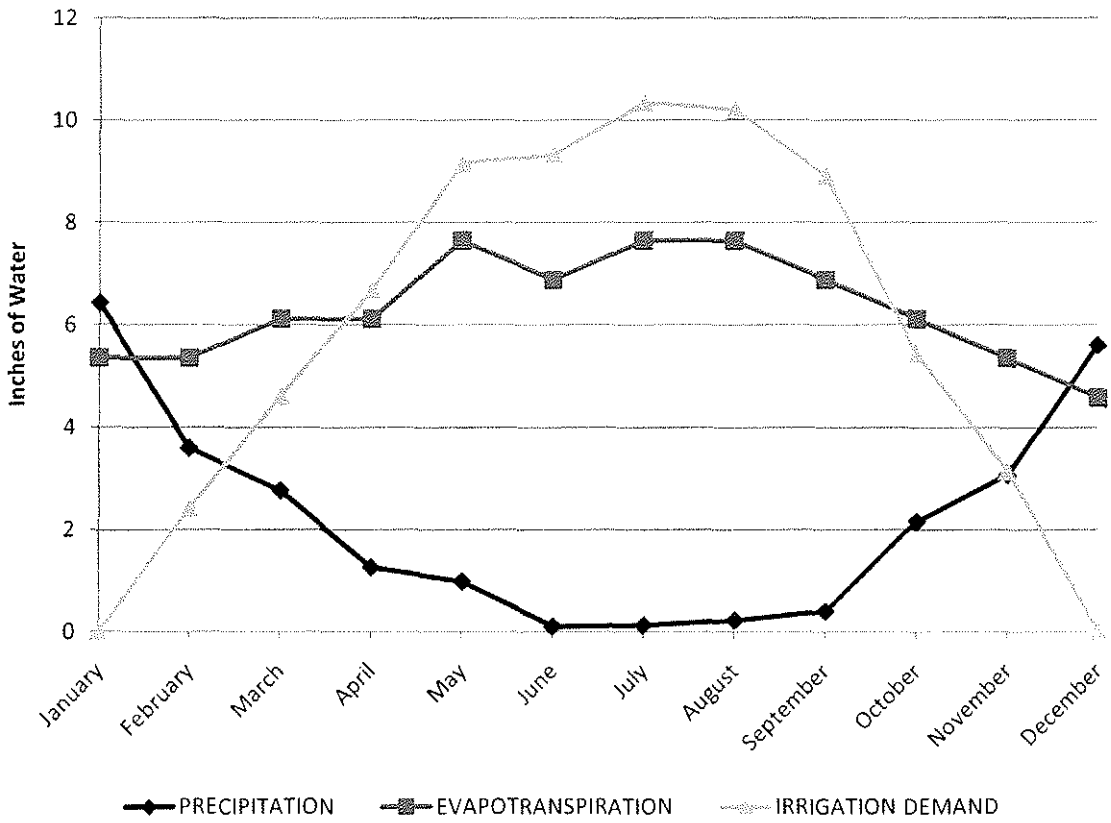

Figure 6-2. Wet Year (1 in 20) Irrigation Needs

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

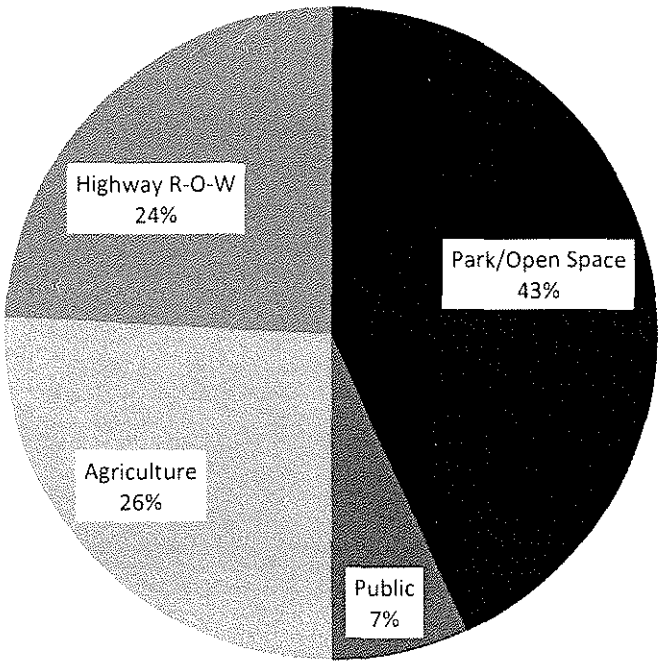

Figure 6-3. Recycled Water Use Areas

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.

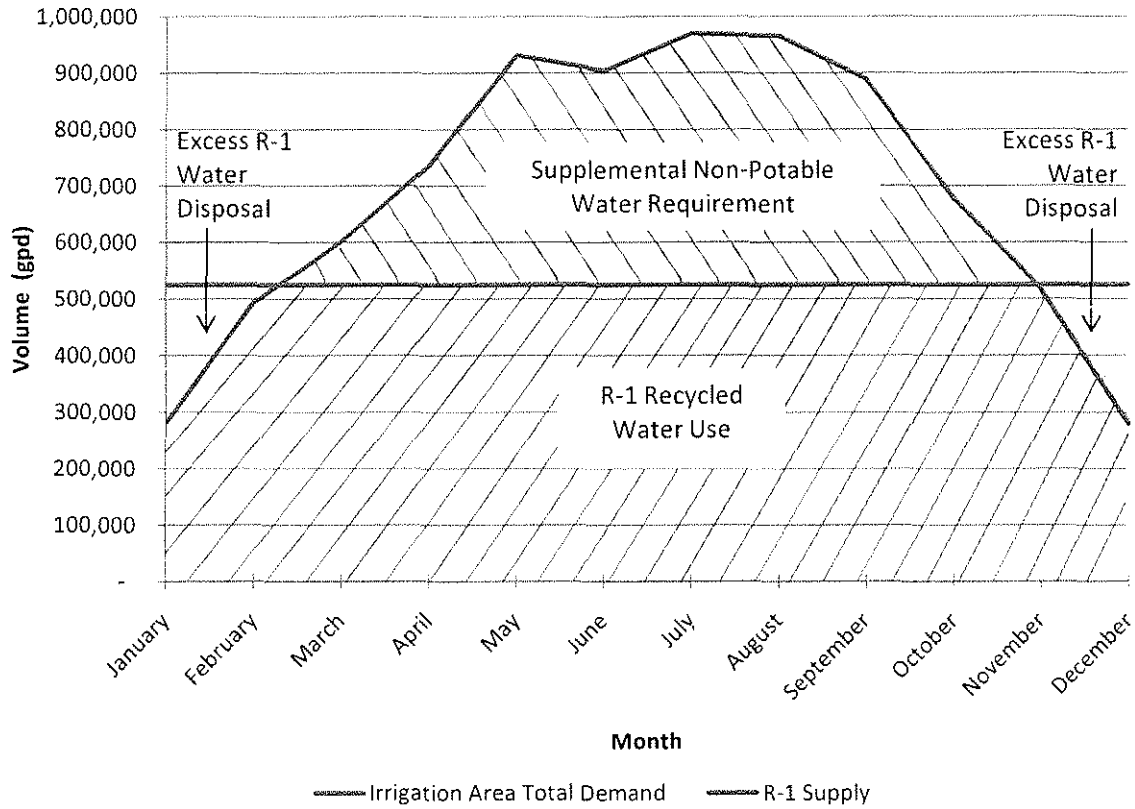

Figure 6-4. Recycled Water Supply and Demand Analysis for Average Precipitation Year

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.

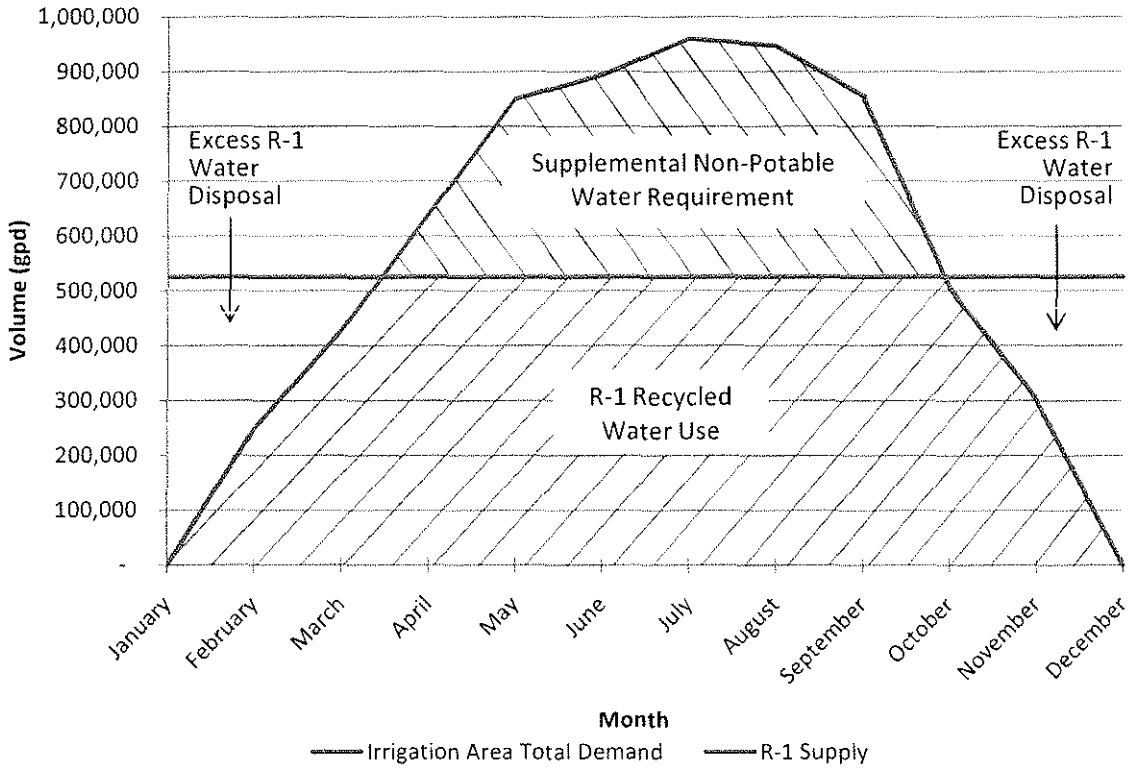

Figure 6-5. Recycled Water Supply and Demand Analysis for Wet Precipitation Year

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.

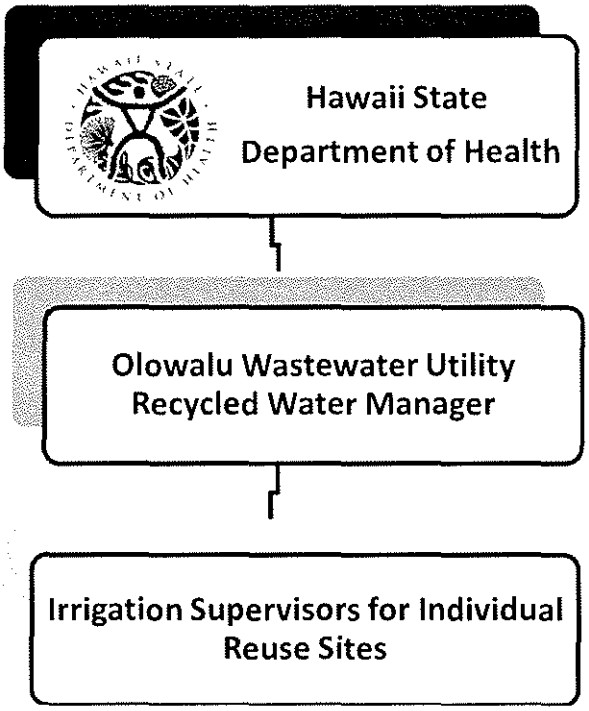

Figure 7-1. Olowalu Town Irrigation Management Program Organization Chart

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).

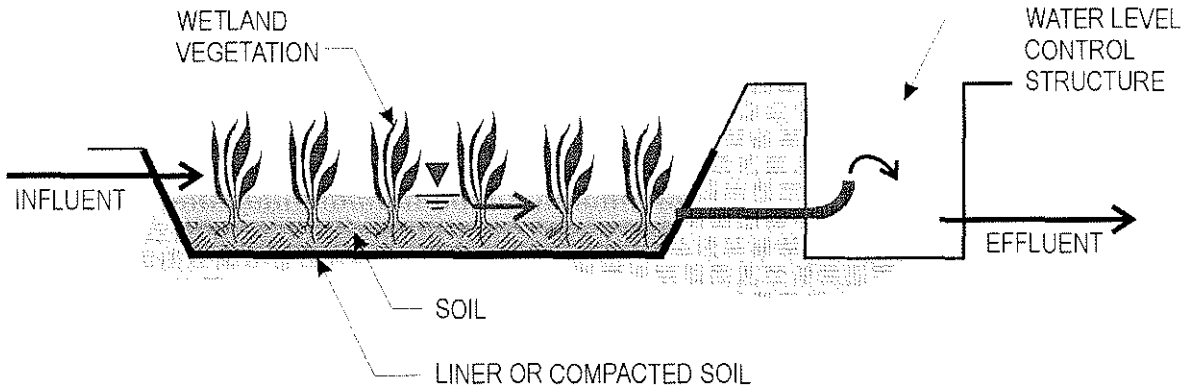

Figure 8-1. Schematic of Free Water Surface Wetland

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.

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APPENDIX O.

Maui Island Plan Directed Growth Maps

GPAC Directed Growth Map

Olowalu

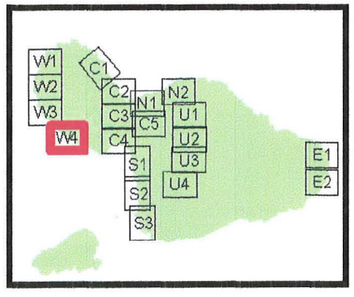
W4

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



Feet

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1 inch = 2,000 feet

Product Code: MSET-JK0_20090327-a

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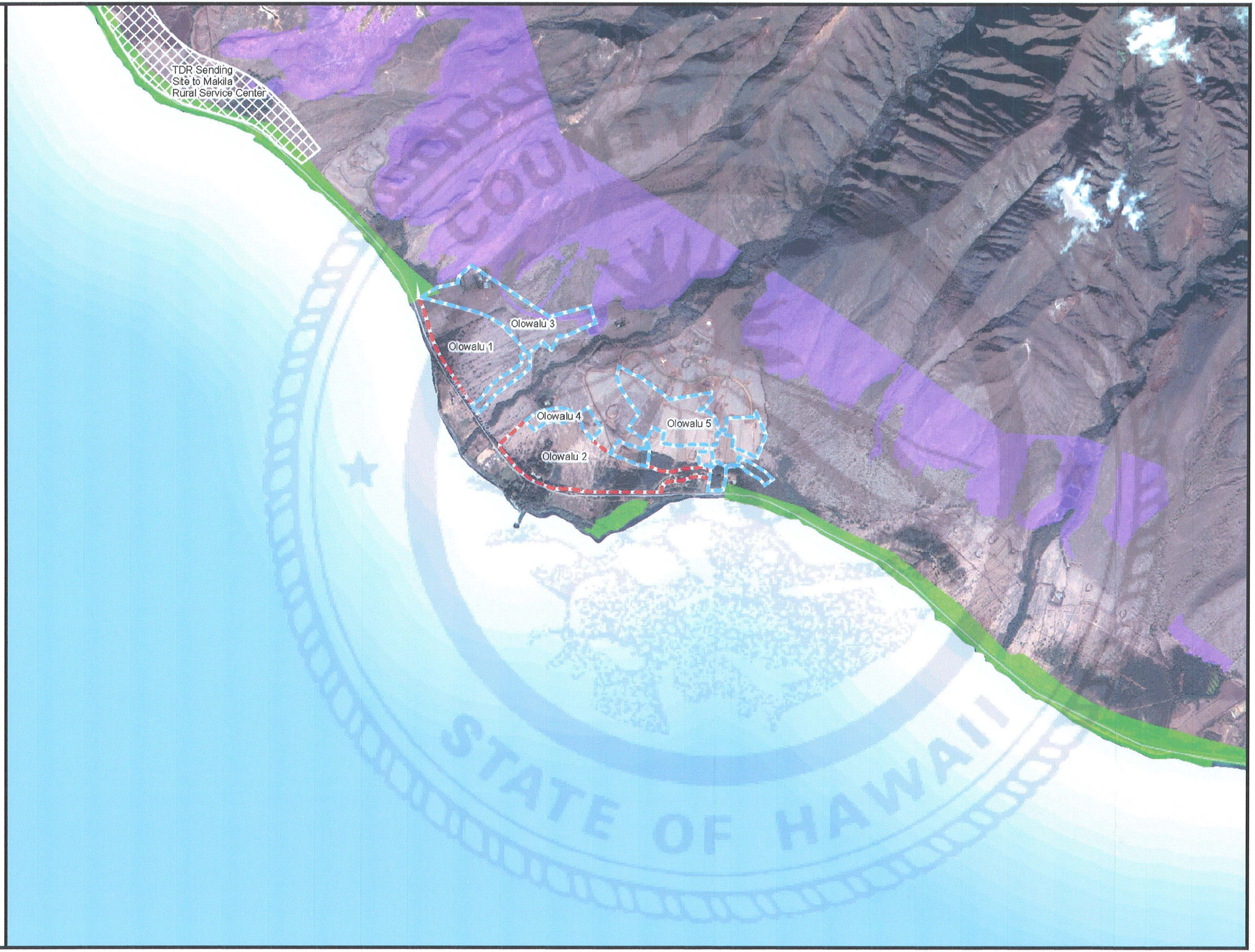
This is not a zoning map. Please contact the Planning Department for Zoning confirmation.

PREPARED BY:
Long Range Planning Division
Department of Planning
County of Maui
250 South High Street
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

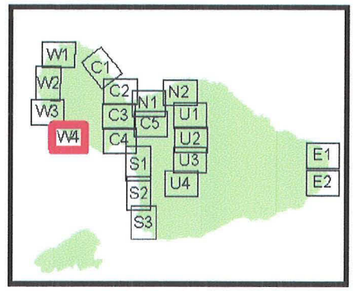
Olowalu

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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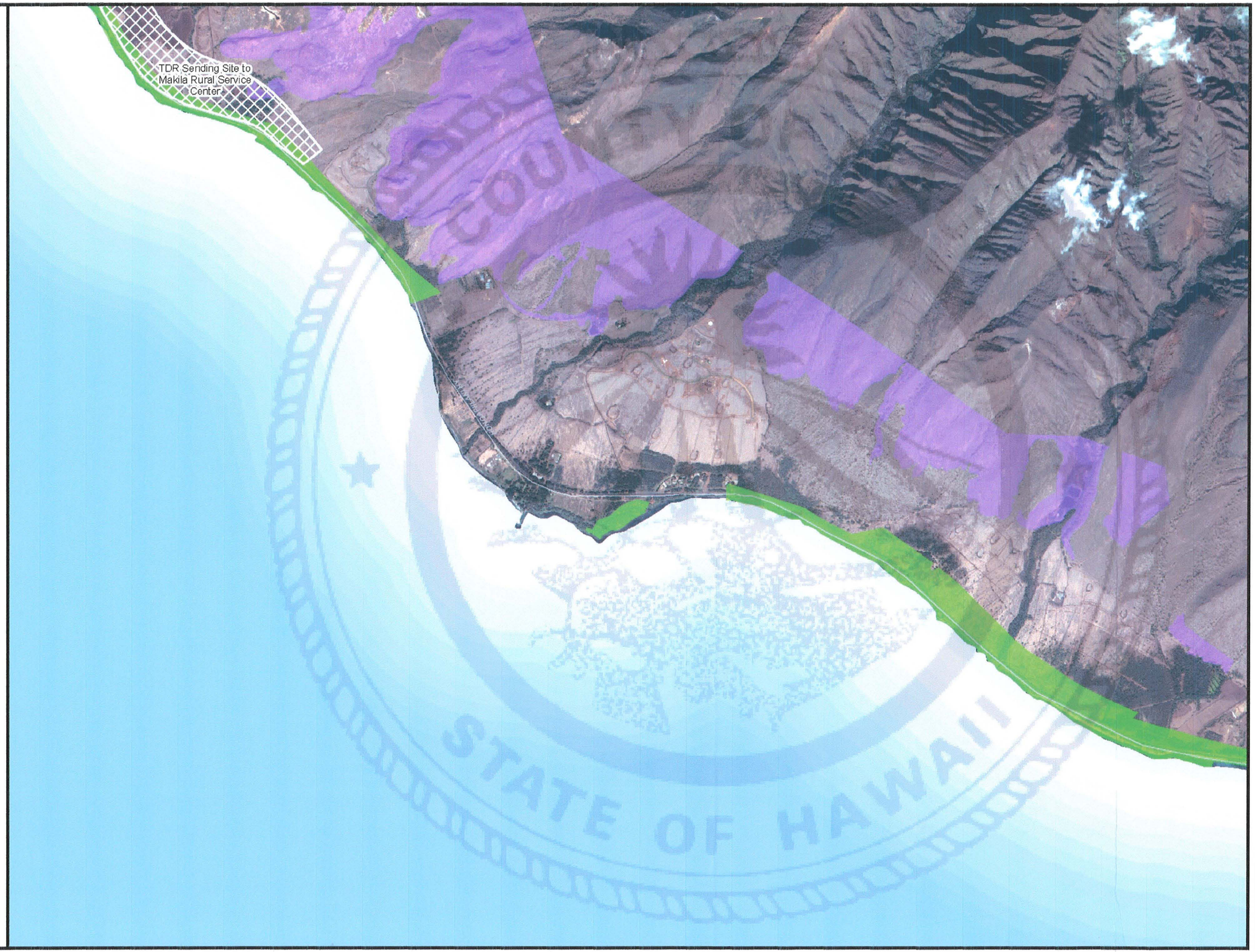
PREPARED BY:
Long Range Planning Division
Department of Planning
County of Maui
250 South High Street
Wailuku, Hawaii 96793

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

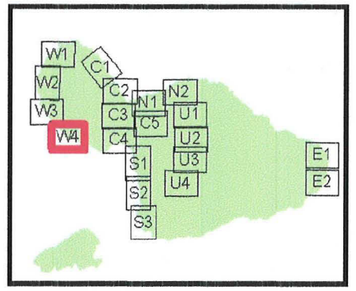
Legend

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



Feet

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1 inch = 2,000 feet

Product Code: MSET-JK6_20001002-b

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PREPARED BY:

Long Range Planning Division
Department of Planning
County of Maui
250 South High Street
Wailuku, Hawaii 96793

APPENDIX P.

Special Management Area Permit No. SM1 990021

JAMES "KIMO" APANA
Mayor

JOHN E. MIN
Director

CLAYTON I. YOSHIDA
Deputy Director

RECEIVED
BY ___ DATE 9/21/00

COUNTY OF MAUI
DEPARTMENT OF PLANNING

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 clarified 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

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 A0 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.

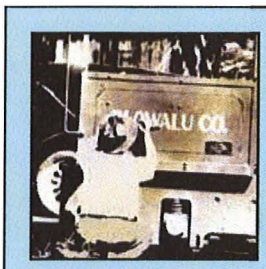
Very truly yours,

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)

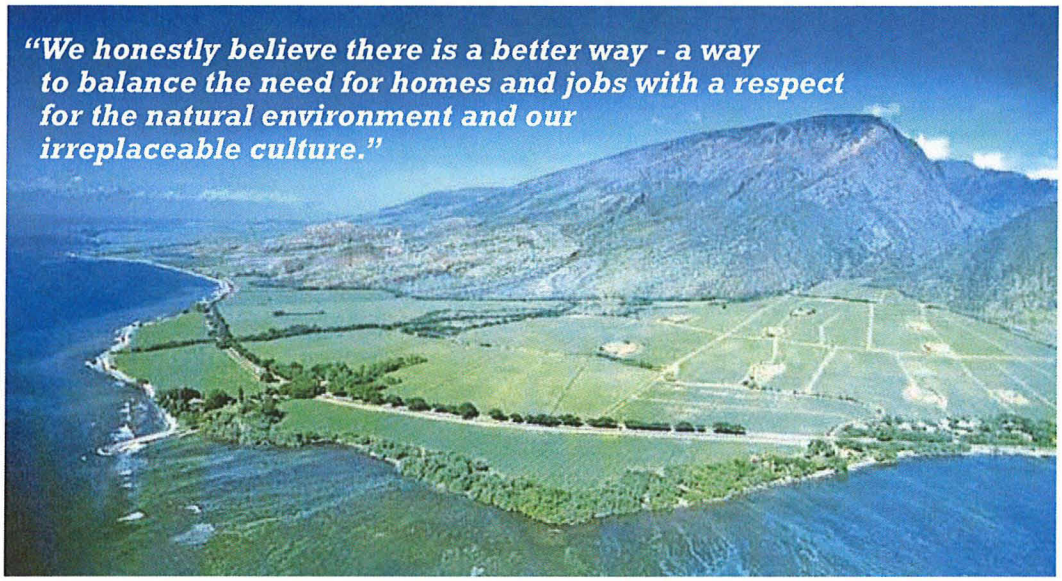
APPENDIX Q.

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.

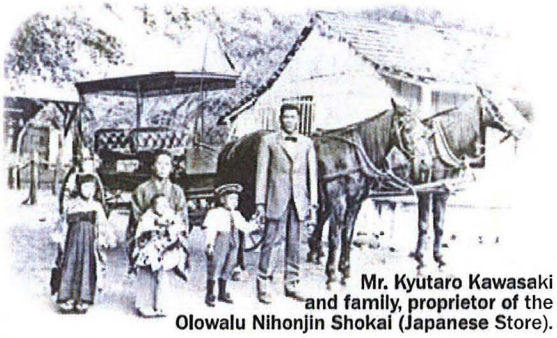
MAHALO

FROM AHUPUA'A TO PLANTATION:

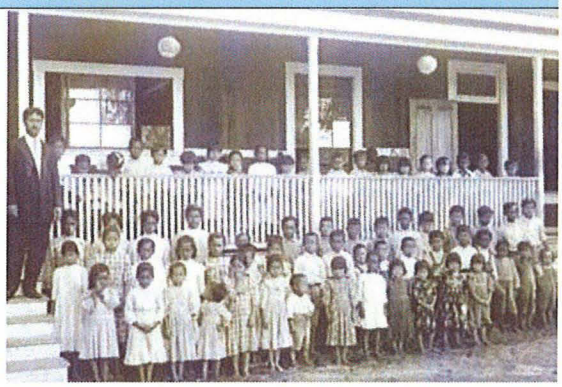
A HISTORY OF OLOWALU

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 — H.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.

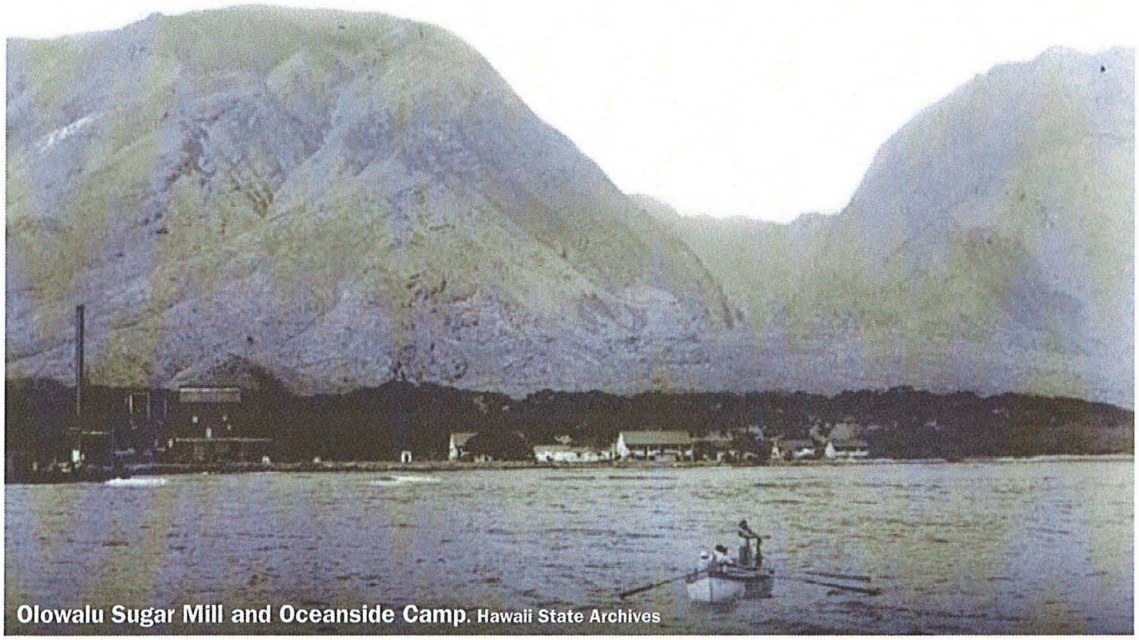
The sea provided the primary contact with the outside world. For decades, the Inter-Island Steamship Company picked up and delivered mail, freight and passengers at Olowalu Landing. The world also entered the Olowalu community through regular showings at the Olowalu Theater.

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

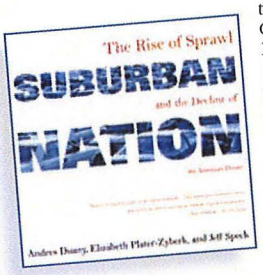
DUANY PLATER-ZYBERK & CO.

Mr. Andres Duany

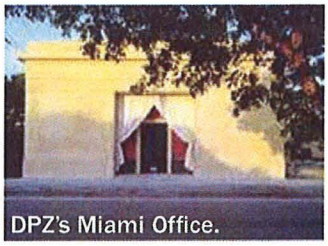
Celebrating its 25th year in 2005, Duany Plater-Zyberk & Company (DPZ) is a major leader in the practice and direction of urban planning, having designed over 300 new and existing communities in the United States and overseas.

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

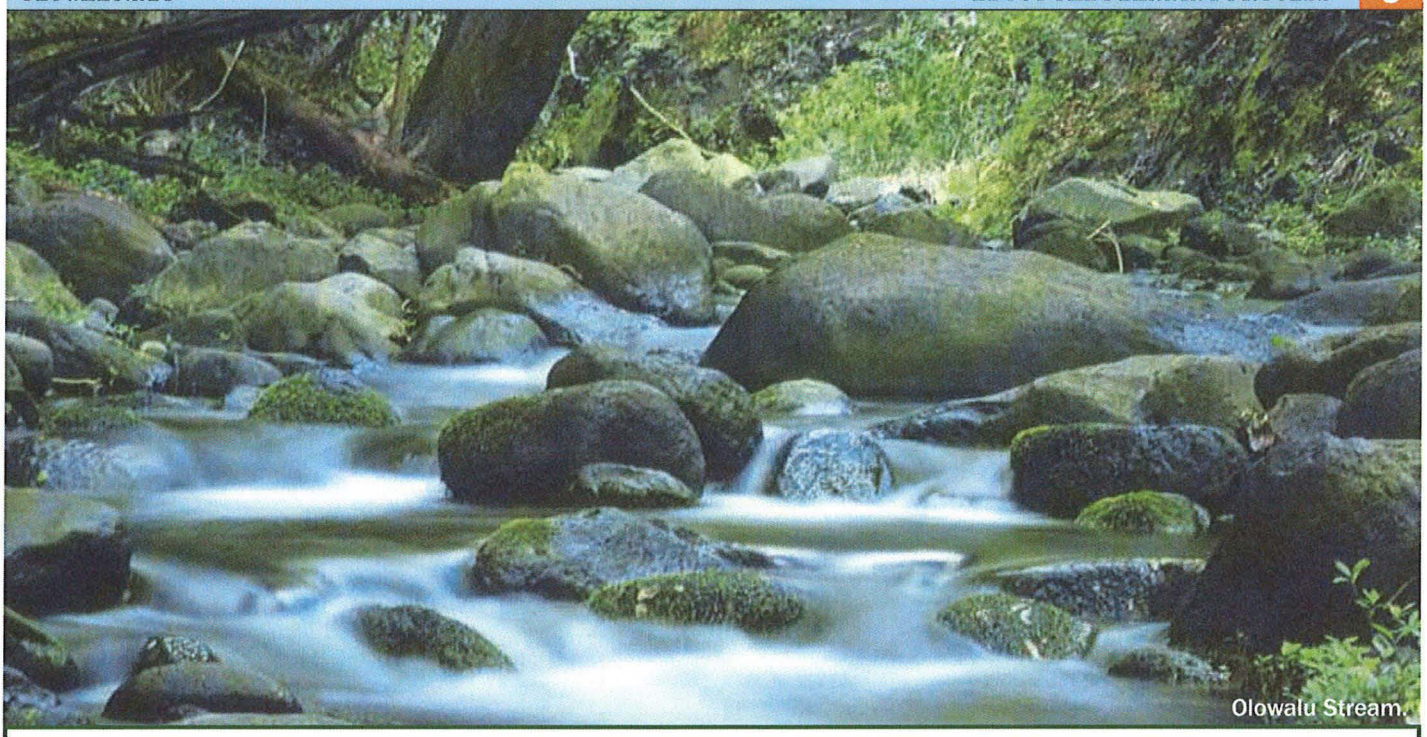
This Planning Workshop is an intensive one-week planning session where Maui citizens, public agencies, world-class town designers, and other interested groups collaborate to create a vision for re-establishing a sustainable community at Olowalu. Everyone on Maui is invited and encouraged to participate 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.

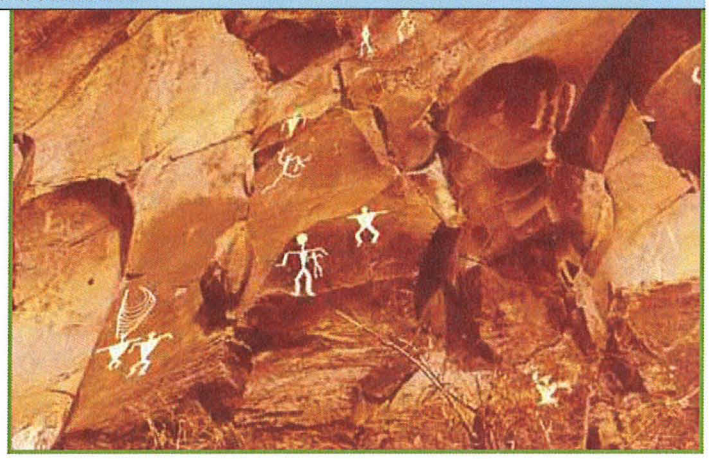
Traditional Neighborhood Development in the Hawaiian context, via a strong focus on traditional neighborhood development and the public engagement process, offers unique opportunities for capitalizing upon and reinforcing the innate sense and feeling of community. This is achieved by focusing on the 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.

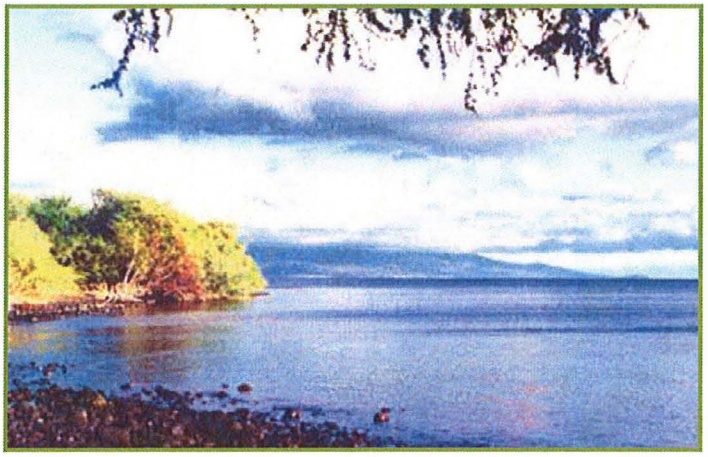
Aside from these activities, the team gathered a bunch of books and even a Rap Reiplinger DVD to share with other designers in preparation for the November Community-based Planning Workshop.

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

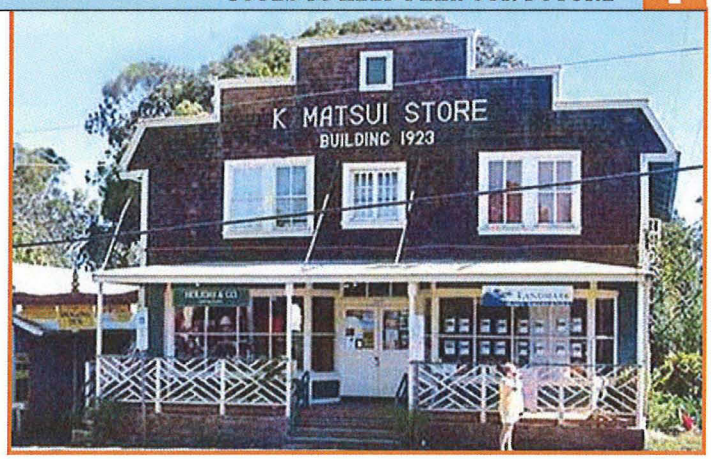
The DPZ team is looking forward to working with the Maui community to ensure that Maui's special qualities are incorporated into a plan for Olowalu.

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
Wailuku, HI 96793

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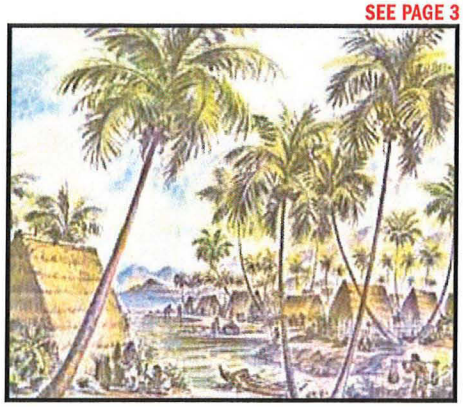

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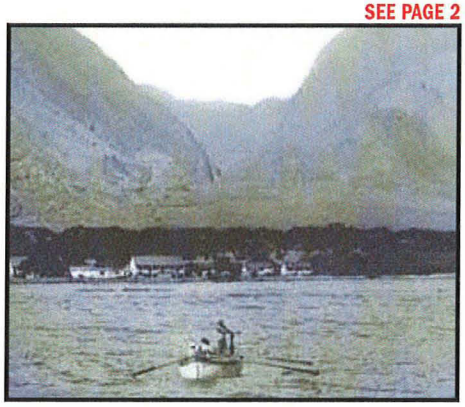

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NOVEMBER

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.

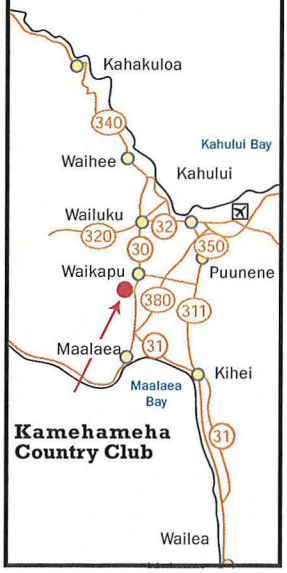
Residential
4:30 p.m. - 6:30 p.m.
Public discussion of residential needs, affordable, senior, market, rental, multi-family and single-family. Light food/snacks & refreshments.

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

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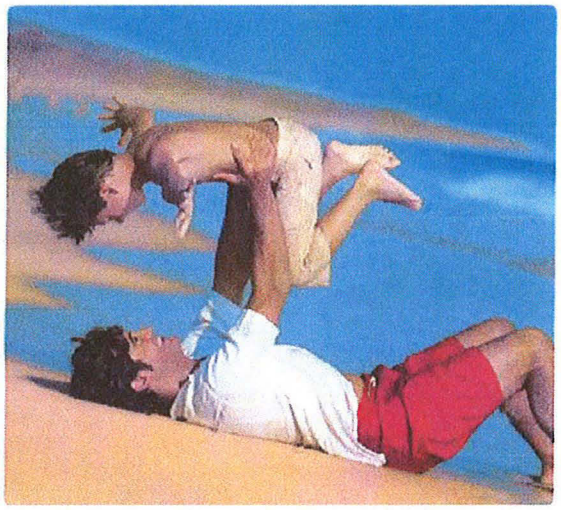
A Community for Maui's Families



Aloha

In November 2005, we invited the residents of Maui to attend Olowalu Talk Story, a week-long 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.

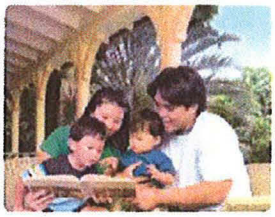
Stopping Sprawl

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.

Olowalu Town
BY MAUI, FOR MAUI
Olowalu Town, LLC
2073 Wells Street, Suite 101
Wailuku, Hawai'i 96793

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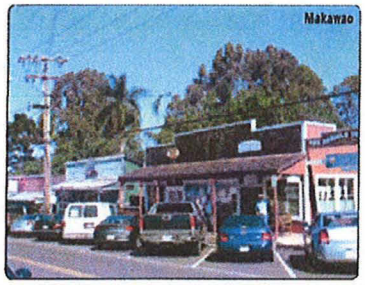
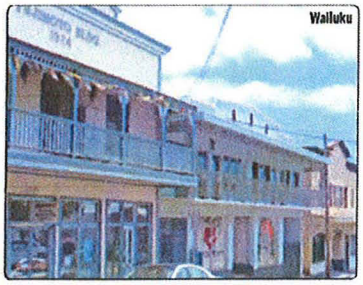




Makawao, Wailuku, and Paia are good examples of sustainable communities that provide residents with daily needs and services, while maintaining their small-town character.

Sustainable Communities are Not New to Maui

Maui is an island of small towns and communities, each separate and distinct.

Paia, 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.

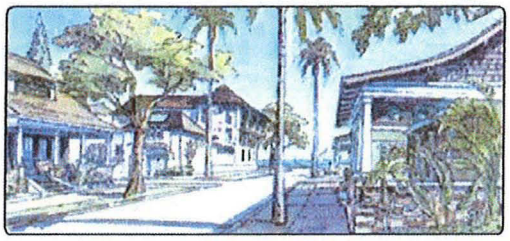
County of Maui Benchmark Study (2002): A household survey of residents countywide which arrived at seven top concerns for the county and local families.

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 knew 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.

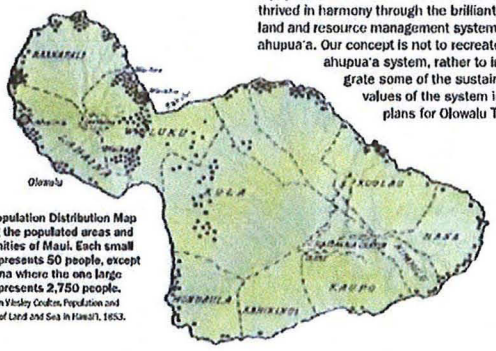
– JON SANTOS
Raised in Haiku

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.

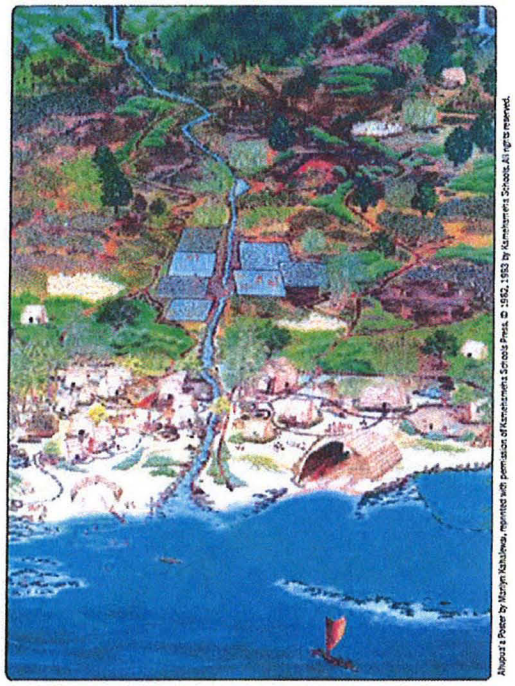
From historic times through the plantations days (see below), Olowalu has been a traditional location for a community. Only in recent times - because of the closure of the sugar mill - did Olowalu see its historic importance as a traditional population center decline. For more information about Olowalu's history please visit our website at www.olowalu.net



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 Hawaii, 1853.

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.



Ahupua'a Pioneer by Marilyn Kahokiwai, 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/czm/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.

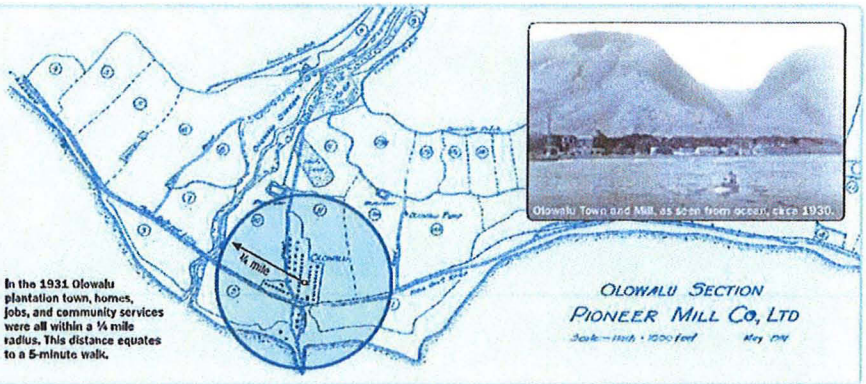
KALEWALANI
Respect elements that float in the sky including the sky, moon, clouds, stars, wind, and rain which guide the planting and fishing seasons, provide water, and create the tides and directions for ocean navigation.

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 over 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 (Kawailoa) heiau, Awalua Cemetery, historic burials, Pu'u Kilea, 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.

OLOWALU TALK STORY

A COMMUNITY-BASED PLANNING WORKSHOP

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.

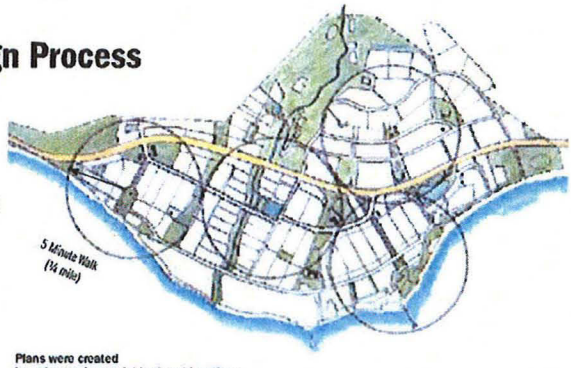
Residential
A wide variety of housing types, including affordable, senior, market, single-family, multi-family, and rental.

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

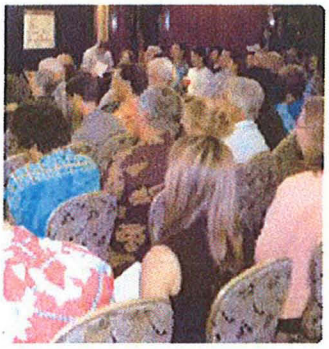
The ideal size or scale of a walkable neighborhood is measured by a **5-Minute Walk*** with only a ¼ mile from center to edge. The neighborhood center is a gathering place, such as a town square, a park, town center, or green space.

*Defined as a Pedestrian Shed

"The planning and growth of a small town community is just like that of a family."

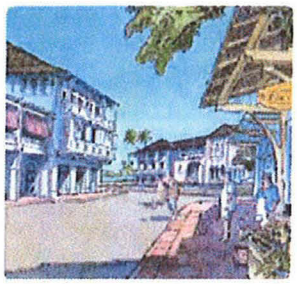
"The planning and growth of a small town community is just like that of a family. What you nurture from the very beginning of its conception and continue to nurture has a direct result on its presence to the world. People and things that are close to the family and hold it dear to their heart will inevitably 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.

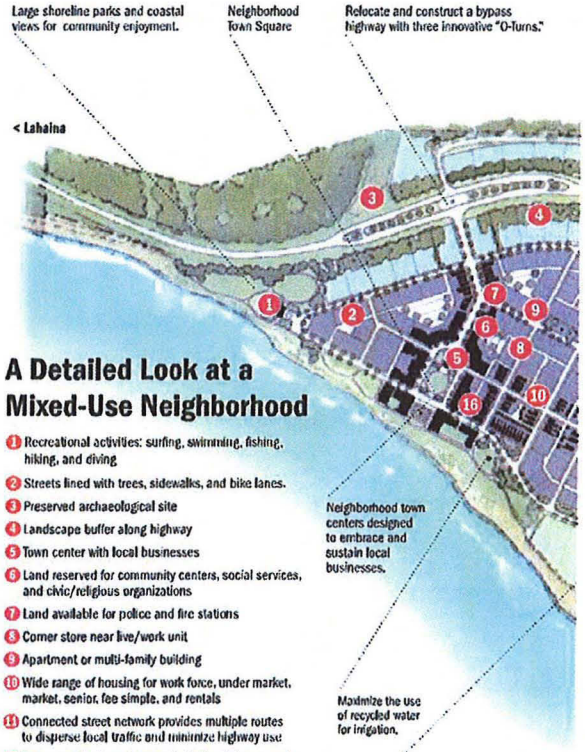
The conceptual drawings and charts provide more detail about living in this community. We look forward to finalizing these plans based upon continued dialogue with the public.

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

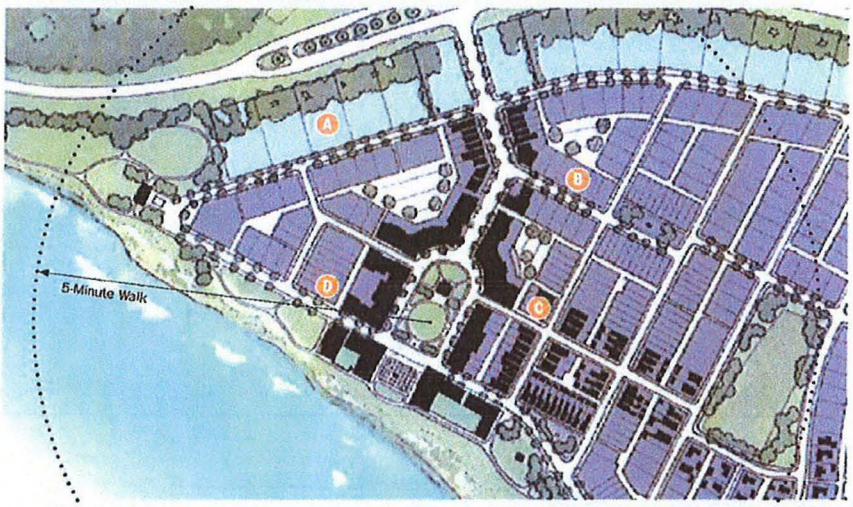
Olowalu will offer a wide range of housing for all ages and income levels — young singles, families, service workers, working farmers, entrepreneurs, and retirees. From single-family lots to live/work units, Olowalu homes will be dignified and close to the town center, parks, and beaches.

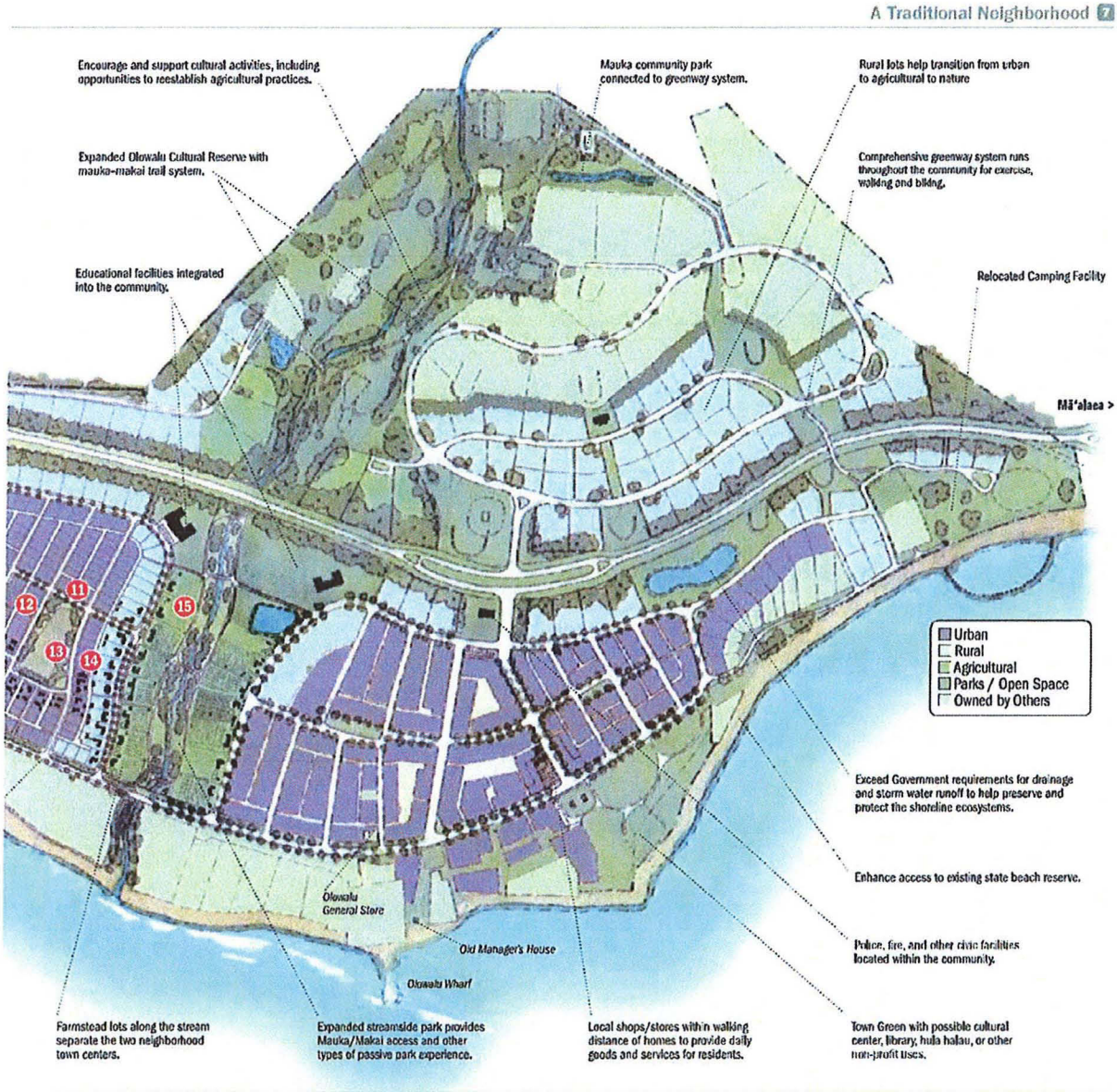
A. Rural Residential
Single-family homes on minimum one-half acre lot with rural character.

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.

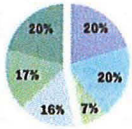




Olowalu Town Land Use Breakdown

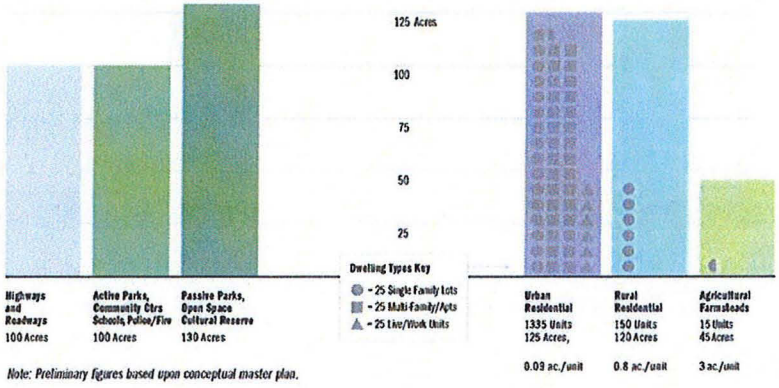
Parks, Open Space & Community Space: 53%

- 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

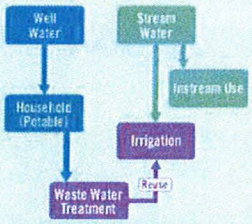
Olowalu Town will be supported by privately funded, independent infrastructure. The water, wastewater, and drainage systems will be sized appropriately to support the town's needs. In many cases, these infrastructure systems will be decentralized which allows for less impact on the environment. Olowalu 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).

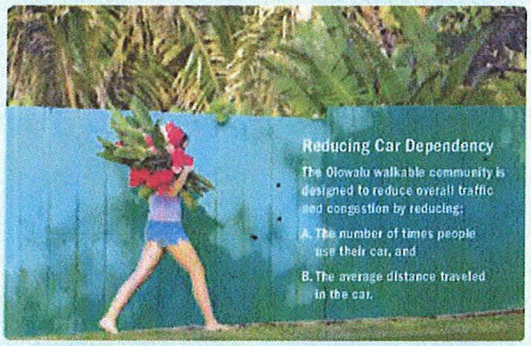
Connectivity

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.

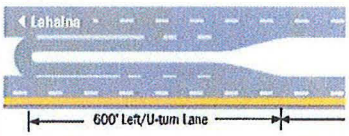


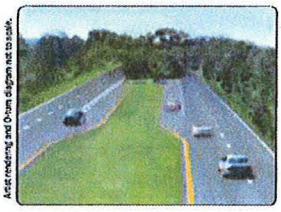
Regional Transportation

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.





Artist rendering and Drawn diagram not to scale.

Access to beaches, surfing, parks, and play areas.

Neighborhood parks provide "back yards" for children.

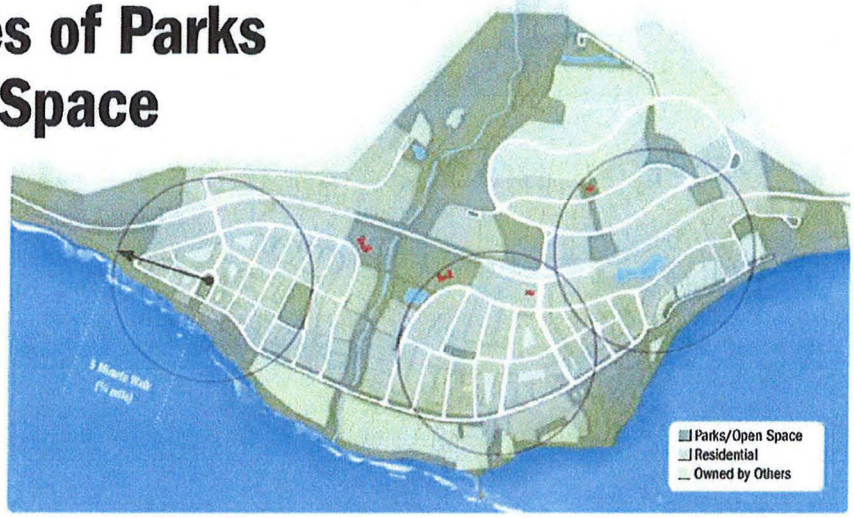
Series of interconnected greenways/ bikeways for walking or biking.

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.



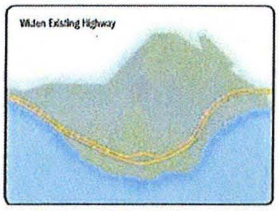
Homes are situated within easy walking distance to recreational facilities.

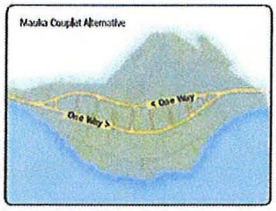
Easy access to civic, religious, and non-profit facilities.

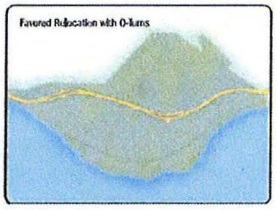
Preserve and enhance public access to shoreline resources.

Camping facilities.

Relocation Process and The Innovative Olowalu O-Turn

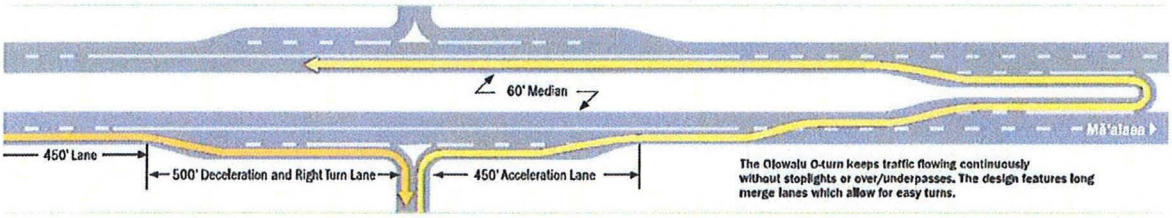






Relocation Highlights

- 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

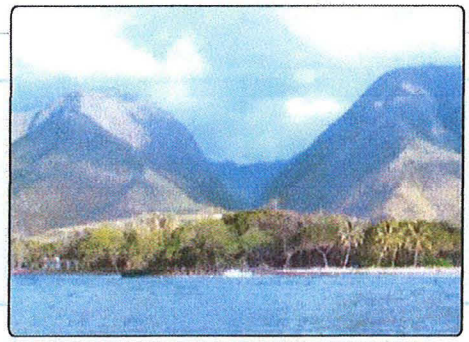
One of the problems with the existing flow of traffic through Olowalu is that cars making turns off the highway – especially left-turns – invariably slow the overall flow of the traffic. Our mainland and local traffic engineers at the workshop introduced a new approach to Maui which we call the "O-Turn." 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."

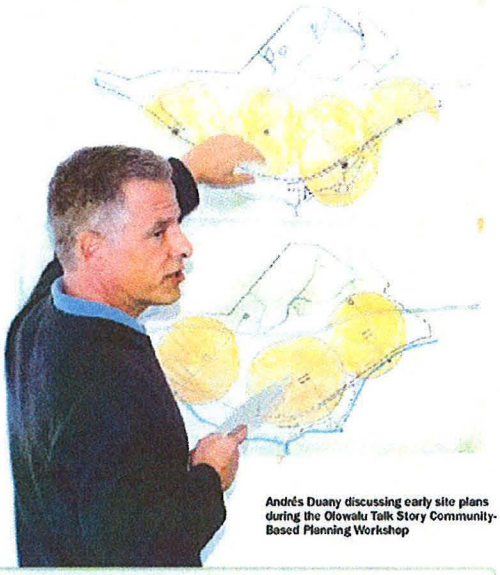
ANDRÉS DUANY Lead Architect of Olowalu Town



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.

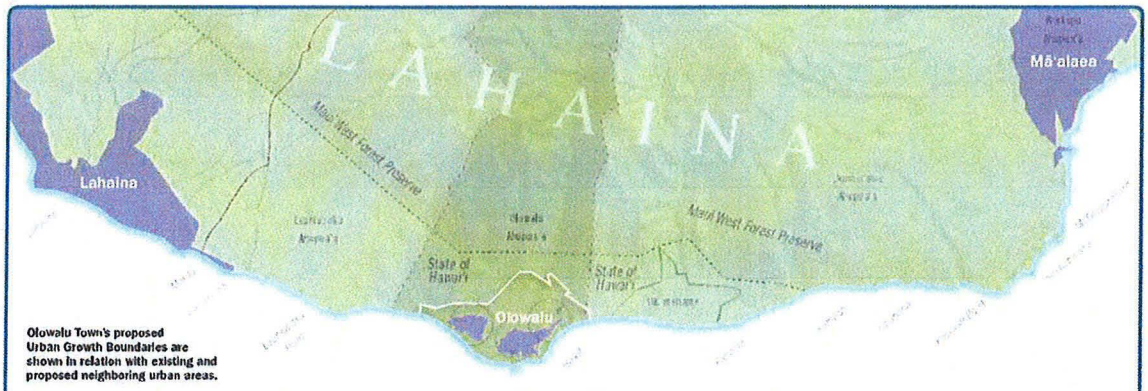
Participate Now

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	Traditional Neighborhood Design
General Characteristics	
• Segregated land uses	• Mixed-use communities
• Congested roadways	• Pedestrian-friendly
• Continuous outward growth of communities	• Wide range of housing for all income levels
• Inefficient use of resources	• Environmentally sustainable
Traffic & Roadways	
• Designed for cars and unsafe for pedestrians	• Designed for people, not cars
• Congested connector roads	• Multiple connected and parallel roadways
• High-speed streets, wide and open	• Low-speed streets, lined with trees and sidewalks
• Dead end, cul-de-sacs	
Community	
• Sprawling sub-urban developments	• Multi-generational communities
• Require car to get to services and schools	• Walking distance to schools and parks
• Social and civic facilities an afterthought	• Social and civic facilities planned within town
Land Use	
• Sprawling suburbs and isolated land use	• Smaller neighborhoods and efficient land use
• No sense of community	• Distinct sense of place
• Reduced open-space and uncontainable growth	• Open-space and urban boundaries
Infrastructure	
• Large, expensive infrastructure systems	• Efficient, small-scale infrastructure systems
• Extensive transmission lines	• Fewer transmission lines
Environmental Resources	
• Low-density developments pave over open-space	• Clustered, higher-density communities
• Large development footprint	• Small urban footprint on environment
• Many car trips required per day	• 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.

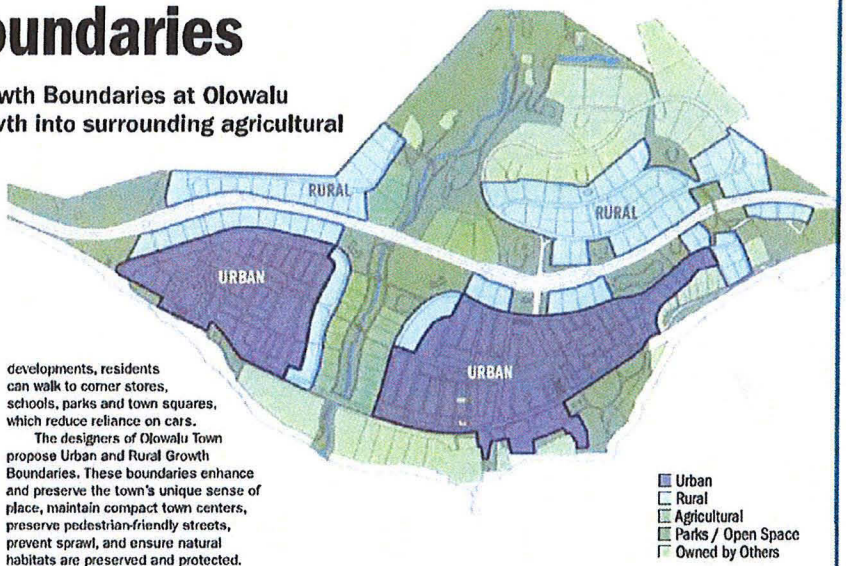
Once established, these growth boundaries will maintain Olowalu's small town scale, ensuring its continued sense of place.

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.

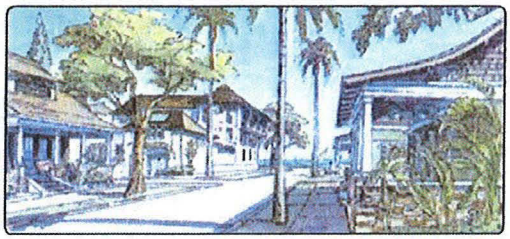
The Value of Boundaries as a Design Tool

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

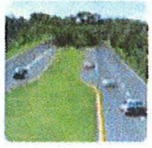
Early Consultation and Notice of Environmental Impact Statement

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 knew 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	State Department of Transportation - Highways Division	Honolulu, Oahu
December 2005	same as above (2nd meeting)	Honolulu, Oahu
September 2006	same as above (3rd meeting)	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	Maui Coastal Land Trust	Wailuku, Maui
March 2006	same as above (2nd meeting)	Olowalu, Maui
• September 2005	Maui County Council Member, Charmaine Tavares	Wailuku, Maui
• September 2005	Maui County Planning Department, Director, Deputy, and Staff	Wailuku, Maui
February 2007	same as above (2nd meeting)	Wailuku, Maui
April 2007	same as above (3rd meeting)	Wailuku, Maui
February 2008	same as above (4th meeting)	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	Former Maui County Mayor, Alan Arakawa	Wailuku, Maui
November 2005	same as above (2nd meeting)	Kahului, Maui
February 2006	same as above (3rd meeting)	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	Former Mayor, Alan Arakawa	Kahului, Maui
February 2006	same as above (2nd meeting)	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	State Senator Roz Baker	Kihei, Maui
August 2007	same as above (2nd meeting)	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	Maui County Council Member, Joanne Johnson	Wailuku, Maui
July 2007	same as above (2nd meeting)	Wailuku, Maui
• February 2006	Kahului Rotary Club	Kahului, Maui
• February 2006	West Maui Taxpayer's Association, Annual Meeting	Lahaina, Maui
February 2007	same as above (2nd meeting)	Lahaina, Maui
January 2008	same as above (3rd meeting)	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	Maui County Council Member, Gladys Baisa	Wailuku, Maui
July 2007	same as above (2nd meeting)	Wailuku, Maui
• January 2007	Maui County Council Member, William Medeiros	Wailuku, Maui
• January 2007	Lahaina-Honolua Senior Citizens Club	Lahaina, Maui
March 2008	same as above (2nd meeting)	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	Maui Native Hawaiian Chamber of Commerce	Wailea, Maui
November 2008	same as above (2nd meeting)	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	Maui Nui Marine Resource Council, Representatives	Olowalu, Maui
January 2009	same as above (2nd meeting)	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