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April 26, 2012

TO: GARY HOOSER, DIRECTOR
OFFICE OF ENVIRONMENTAL QUALITY CONTROL

FROM: GLENN M. OKIMOTO, Ph.D.
DIRECTOR OF TRANSPORTATION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT/FINDING OF NO SIGNIFICANT IMPACT, PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

The State of Hawaii Department of Transportation (HDOT) has reviewed the Draft Environmental Assessment (EA) for the subject project and anticipates a Finding of No Significant Impact (FONSI). Please publish notice in the next available OEQC Environmental Notice.

Enclosed is a completed OEQC Publication Form, one (1) copy of the document in pdf format, one (1) hardcopy of the Draft EA/FONSI and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

If you have any questions, please contact Darell Young, Project Manager at 587-1835.

Enclosures

Draft Environmental Assessment

PROPOSED RELOCATION OF LAHAINA BYPASS SOUTHERN TERMINUS

Prepared for:

State of Hawaii
Department of Transportation

April 2012

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Prepared by:

MUNEKIYO HIRAGA, INC.

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LIST OF ACRONYMS

ALISH	Agricultural Lands of Importance to the State of Hawaii
BMPs	Best Management Practices
CFR	Code of Federal Regulations
CZMA	Coastal Zone Management Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FHWA	Federal Highways Administration
FIRM	Flood Insurance Rate Map
FSEIS	Final Supplemental Environmental Impact Statement
HDOT	State of Hawaii, Department of Transportation
HRS	Hawaii Revised Statutes
HSA	Hawaii Stream Assessment
LSB	Land Study Bureau
MSAT	Mobile Source Air Toxics
NEPA	National Environmental Policy Act (NEPA)
SHPD	State Historic Preservation Division
SMA	Special Management Area

PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

Draft Environmental Assessment/
Anticipated Finding of No Significant Impact

Submitted Pursuant to
Hawaii Revised Statutes, Chapter 343

State of Hawaii, Department of Transportation, Highways Division

The following person may be contacted for additional information concerning this document.

Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813
Contact: Darell Young
Telephone: (808) 587-1835

Applicable Environmental Assessment Review "Trigger": Use of State and Federal funds

Location: Launiupoko, Lahaina, Maui
TMK (2) 4-7-001:026, 027 and 030

Project Summary: The State of Hawaii, Department of Transportation (HDOT), in coordination with the Federal Highway Administration (FHWA), is proposing the relocation of the southern terminus of the Lahaina Bypass Highway from its current terminus point at Launiupoko to the vicinity of the former Olowalu Landfill, a distance of approximately 4,800 lineal feet. Although the terminus is proposed to be moved approximately 4,800 feet to the south as measured along Honoapiilani Highway, the length of the new right-of-way corridor, will be approximately 10,300 lineal feet. The parcels of land affected by the proposed action are identified as Tax Map Key Nos. (2) 4-7-001:026, 027 and 030. The basic configuration of the Lahaina Bypass Project in terms of functional traffic flow will not change; the location of the proposed terminus will simply be shifted further south. The roadway's alignment will still intersect with Kai Hele Ku Street, however, the location of this intersection will be shifted mauka or inland. There will be no additional intersections created as a result of the proposed terminus relocation.

I. PROJECT OVERVIEW

I. PROJECT OVERVIEW

A. INTRODUCTION

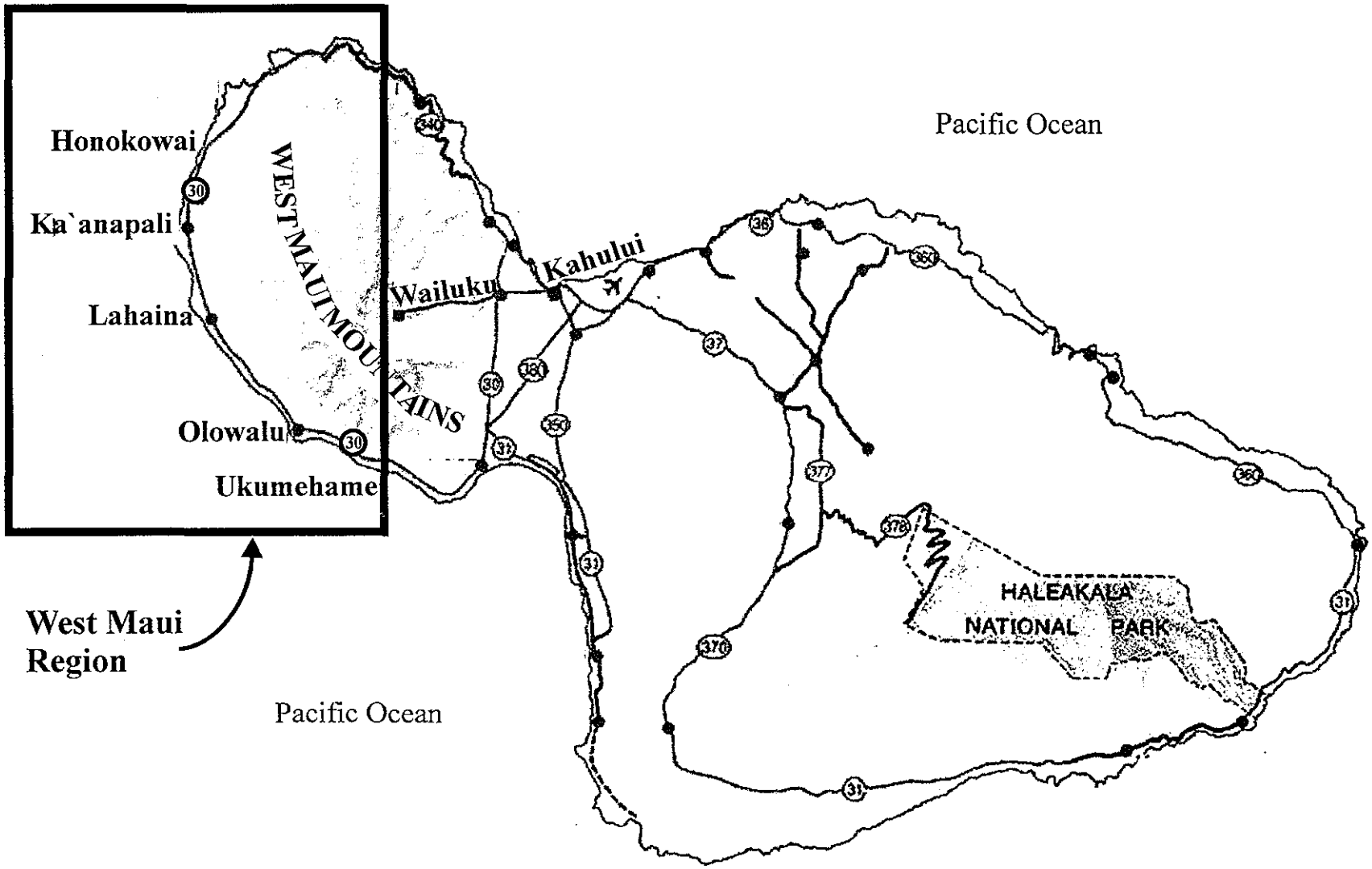
The State of Hawaii, Department of Transportation (HDOT), in coordination with the Federal Highway Administration (FHWA), is proposing the relocation of the southern terminus of the Lahaina Bypass Highway from its current terminus point at Launiupoko to the vicinity of the former Olowalu Landfill, a distance of approximately 4,800 lineal feet. Although the terminus is proposed to be moved approximately 4,800 feet to the south as measured along Honoapiilani Highway, the length of the new right-of-way alignment, will be approximately 10,300 lineal feet. The parcels of land affected by the proposed action are identified as Tax Map Key Nos. (2) 4-7-001:026, 027 and 030. The basic configuration of the Lahaina Bypass Project in terms of functional traffic flow will not change; the location of the proposed terminus will simply be shifted further south. The roadway's alignment will still intersect with Kai Hele Ku Street, however, the location of this intersection will be shifted mauka or inland. There will be no additional intersections created as a result of the proposed terminus relocation.

Inasmuch as the proposed action will involve the use of State and Federal funds, this report has been prepared in accordance with Chapter 343, Hawaii Revised Statutes (HRS) and the National Environmental Policy Act (NEPA).

B. BACKGROUND

The State of Hawaii, Department of Transportation (HDOT), initially proposed the development of a bypass highway (also known as the Lahaina Bypass Project) to mitigate traffic congestion along Honoapiilani Highway through Lahaina Town in West Maui. See **Figure 1**. The initial Lahaina Bypass Project consisted of the development of a bypass route between Puamana Park and Hanakaoo Point near Kaanapali. The widening of Honoapiilani Highway between Kaanapali and Honokowai was also proposed as a part of this action. See **Figure 2**. A Record of Decision for the Environmental Impact Statement (EIS) for the initial scope of the Lahaina Bypass was approved on June 18, 1991 by the FHWA.

Subsequently, the HDOT modified the scope of the project to extend the northern terminus of the Bypass from Kaanapali to Honokowai and to extend the southern terminus from



Source: www.usgs.gov

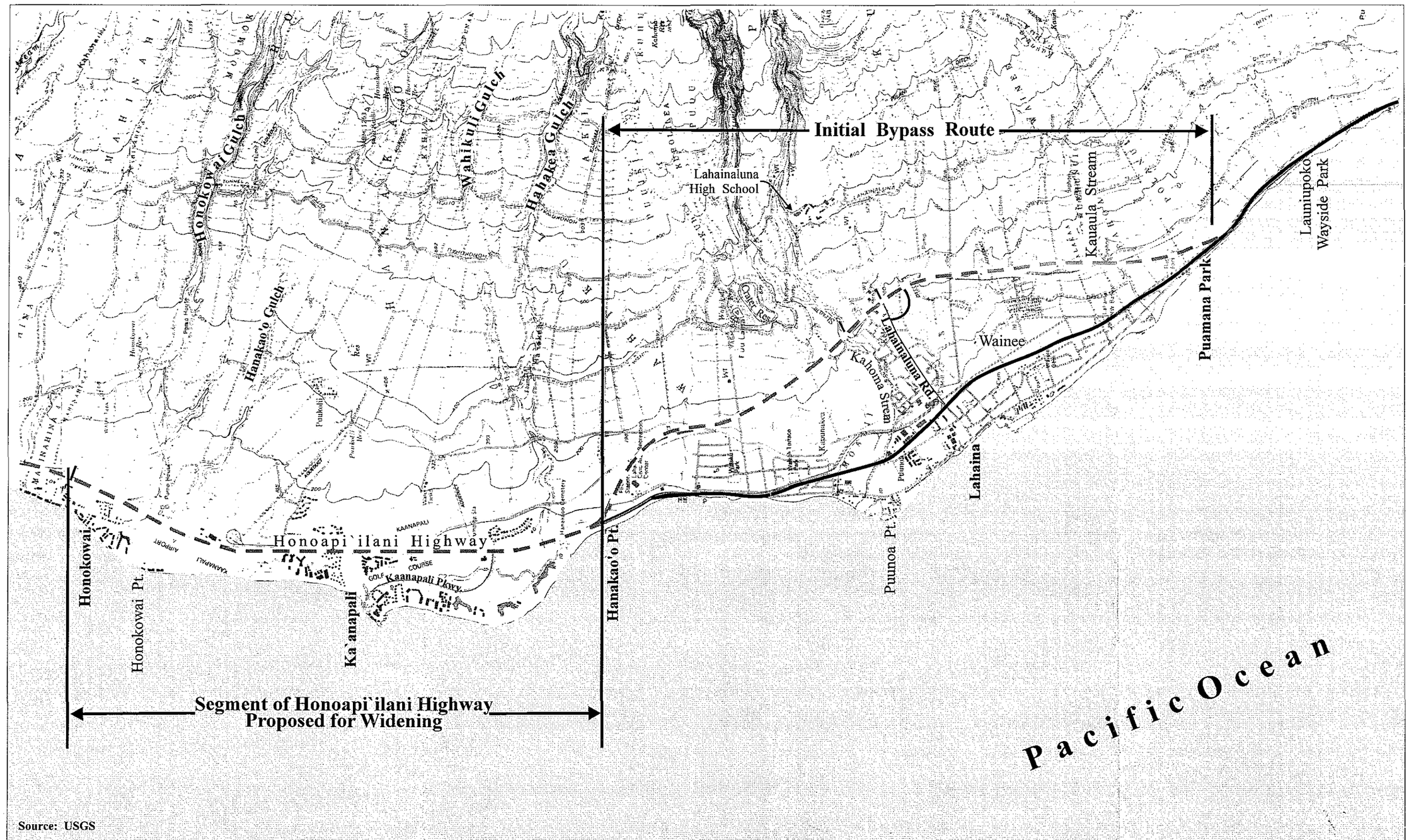
Figure 1 Proposed Lahaina Bypass Southern Terminus Relocation

West Maui Regional Location Map

0 2.0 4.0 8.0 Miles

Prepared for: State of Hawai`i, Department of Transportation

MakilaLand\LahBypassExt\Draft EA\RegLoca



Source: USGS

Figure 2

Proposed Lahaina Bypass Southern Terminus Relocation Project

Initial Lahaina Bypass Project Limits

NOT TO SCALE

Prepared for: State of Hawai`i, Dept. of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LhnBypassExt\ Initial LB Project Limits

Puamana to Launiupoko. Amendments made to the project scope also included the incorporation of several connector and access roads, modifications to roadway profiles and typical sections. Thus, a Supplemental EIS was then prepared to address the scope revisions. The amended project was referred to as the Lahaina Bypass Modified Project in the Supplemental EIS. See **Figure 3**. In October, 2003, the Record of Decision for the Final Supplemental EIS for the Lahaina Bypass Modified Project was approved.

C. IMPLEMENTATION STATUS OF LAHAINA BYPASS

The HDOT is now implementing the Lahaina Bypass in phases. The initial implementation phases for the Bypass are summarized in **Table 1**. See **Figure 4**.

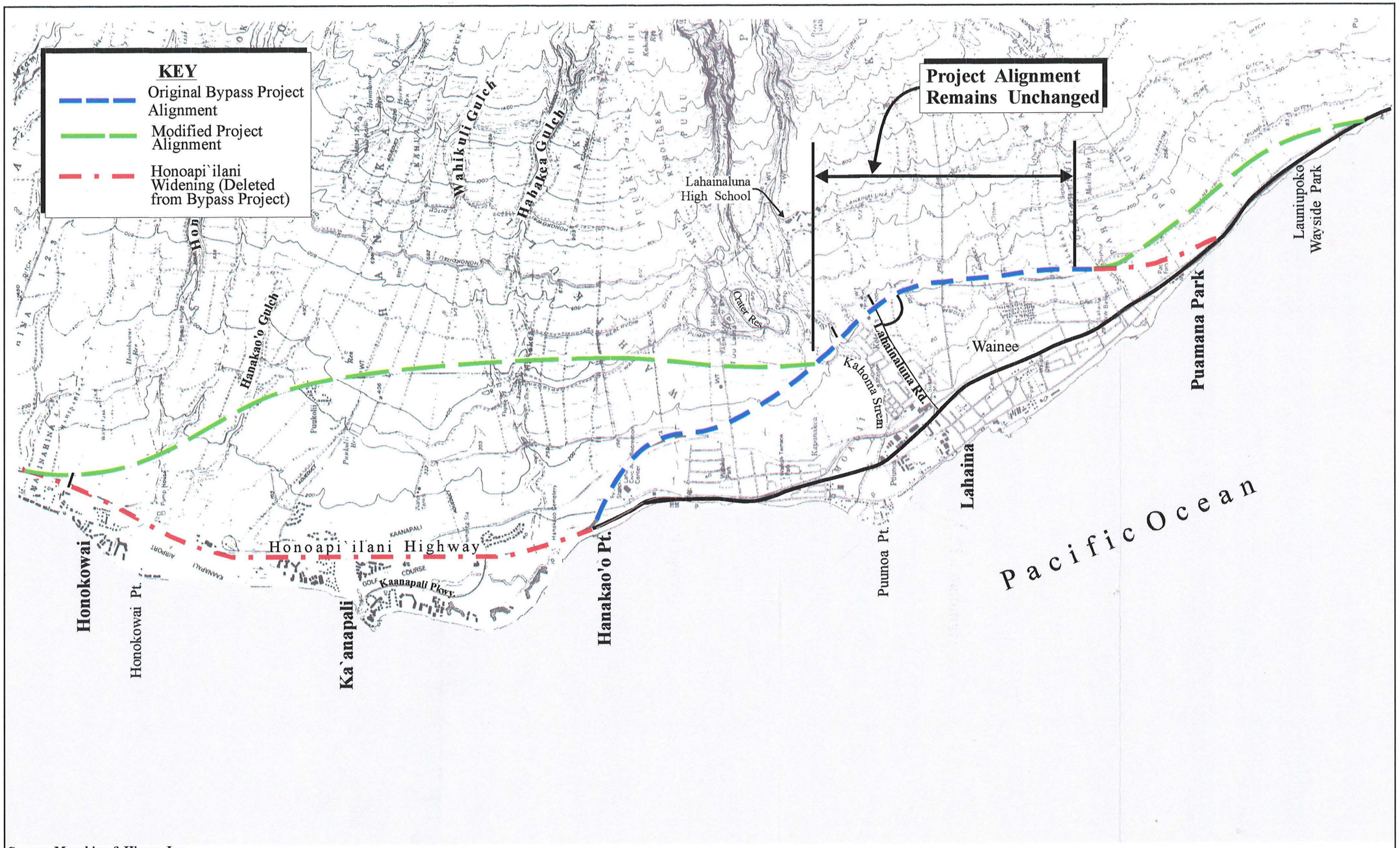
Table 1. Summary of Lahaina Bypass Initial Construction Phases

Construction Phase Designation	Limits of Construction Phase	Comments
Phase 1A	Keawe Street Extension to Lahainaluna Road	Design-build contract awarded in January 2007; construction initiated in mid 2009 and completion estimated by late 2012.
Phase 1B-1	Lahainaluna Road to Hokiokio Place	Design completed December 2009, bidding advertised December 2009, construction contract award in mid 2010, estimated construction completion by late 2012.
Phase 1B-2	Hokiokio Place to Honoapiilani Highway	Design and construction to follow Phase 1B-1; dates to be determined.

The implementation timeframe for phases beyond Phase 1B-2 will be contingent on availability of funding.

D. PROJECT PURPOSE AND NEED

The HDOT, in coordination with the FHWA, is proposing the relocation of the southern terminus of the Lahaina Bypass Highway from its current terminus point at Launiupoko to the vicinity of the former Olowalu Landfill site, a distance of approximately 4,800 lineal feet measured along Honoapiilani Highway. See **Figure 5**. Although the terminus is proposed to be moved approximately 4,800 feet to the south, the length of the new right-of-way will be approximately 10,300 lineal feet, as shown in **Figure 6**.



Source: Munekiyo & Hiraga, Inc.

Figure 3

Proposed Lahaina Bypass Southern Terminus Relocation

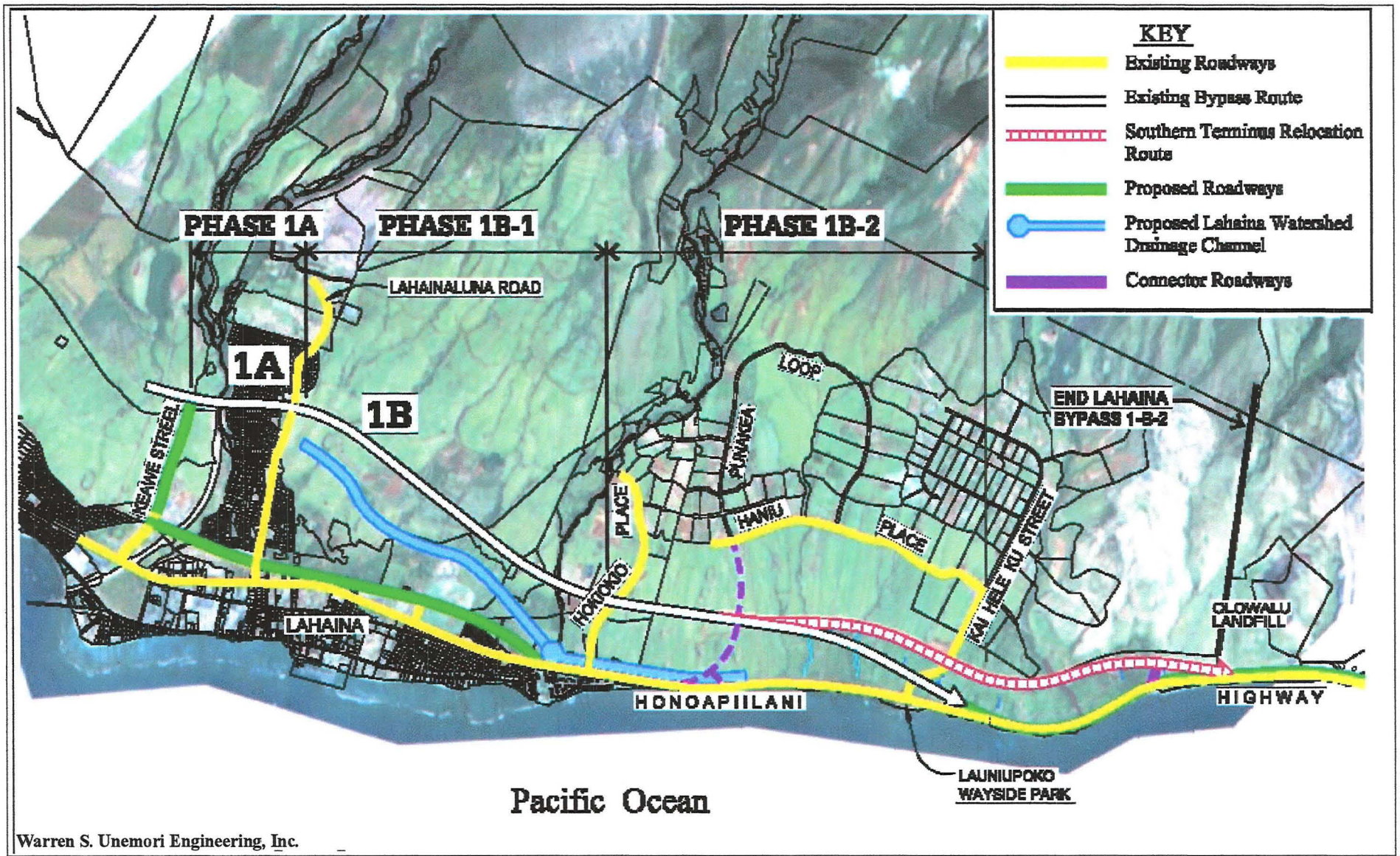
Modified Project Limits

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LhnBypassExt\DraftEA\Modified Project Limits



Warren S. Unemori Engineering, Inc.

Figure 4

Proposed Lahaina Bypass Southern Terminus Relocation

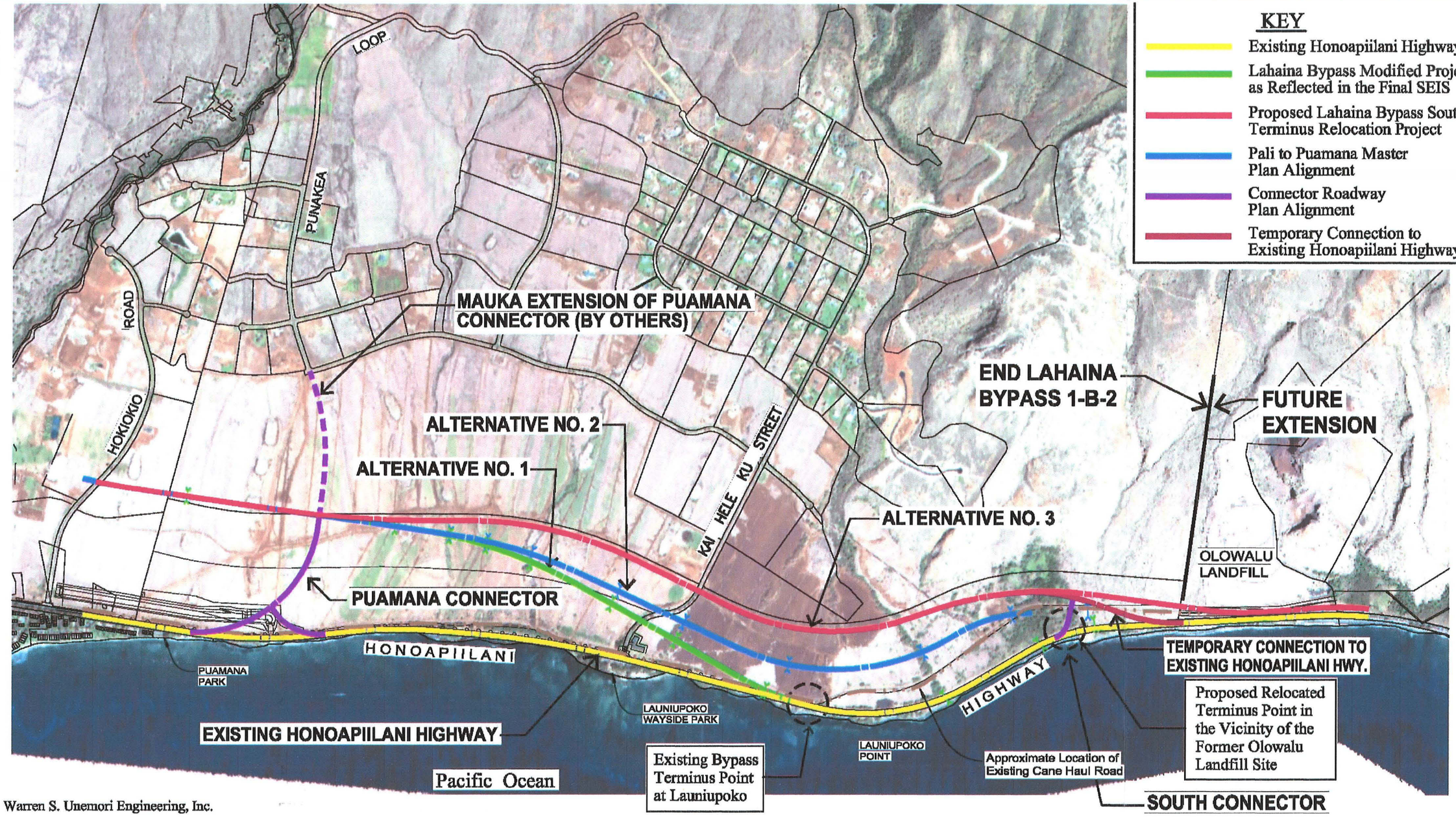
Initial Construction Phases for the Lahaina Bypass

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\DraftEA\InitialConstruction



Source: Warren S. Unemori Engineering, Inc.

Figure 5

Proposed Lahaina Bypass Southern Terminus Relocation
Limits of Proposed Action

NOT TO SCALE

Prepared for: State of Hawaii, Department of Transportation

MUNEKIYO & HIRAGA, INC.

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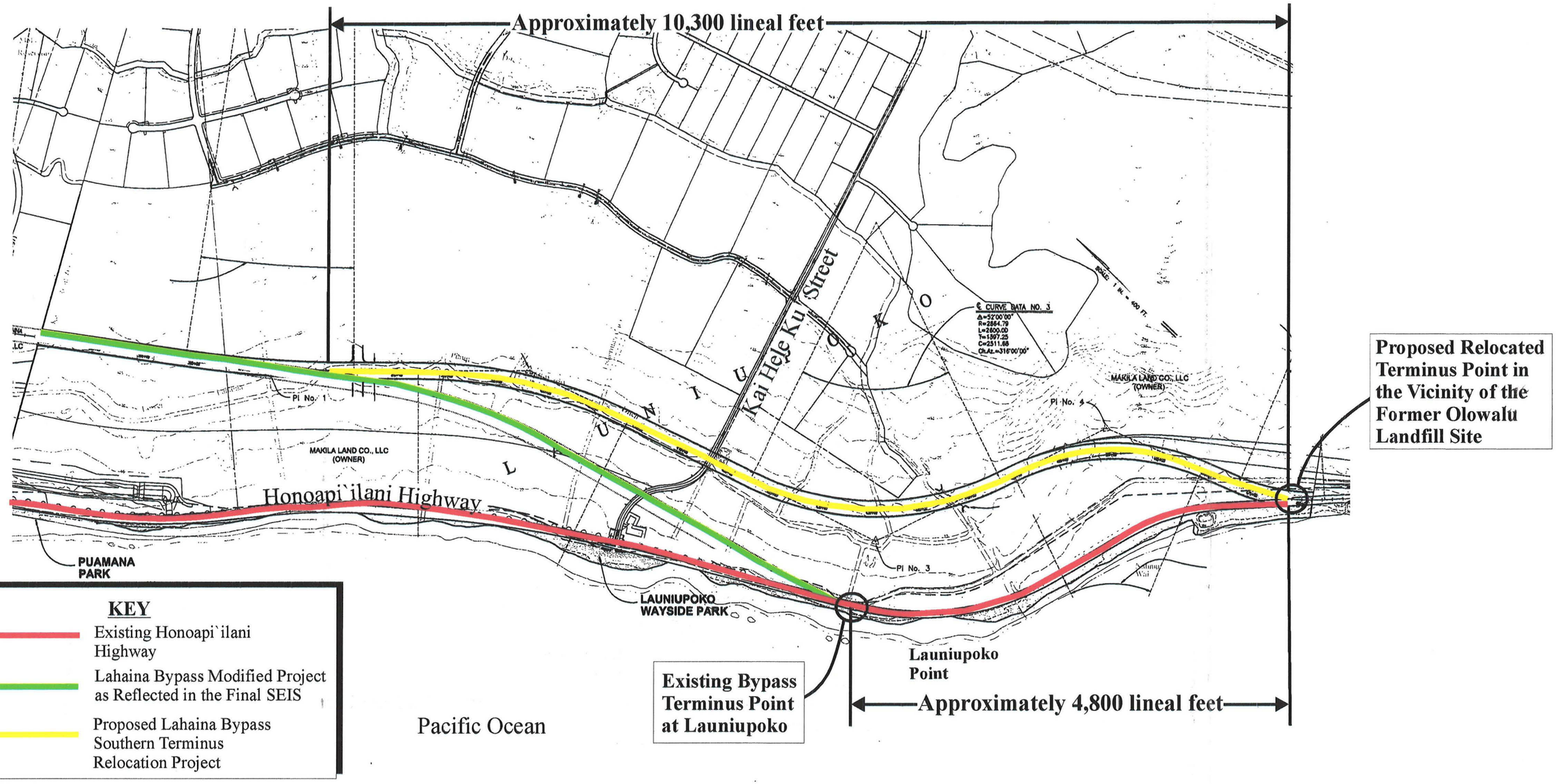


Source: Warren S. Unemori Engineering, Inc.

Figure 6

Proposed Lahaina Bypass Southern Terminus Relocation

Detailed Alignment Map

NOT TO SCALE

Prepared for: State of Hawaii, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LhnBypassExt\Draft EA\DetailedAlignment

This action has been initiated in response to a number of regional and local conditions affecting long-term transportation and land use planning in this region.

1. Shoreline Erosion and Coastal Processes

Honoapiilani Highway is the major access road into the West Maui region from Central and East Maui and is an essential link in the island's transportation system for residents, visitors, and emergency vehicles.

Shoreline areas in vicinity of the project corridor have historically experienced varying degrees of coastal erosion. In the Launiupoko area, the average beach width decreased by about 34% between 1949 and 1997. Damage or loss of this section of the highway would potentially create significant delays and traffic congestion between Central Maui and West Maui. Emergency measures have been undertaken over the past five (5) to seven (7) years to mitigate erosion damage to the highway in this area. In recent years, concrete jersey barriers have been placed along the seaward edge of the highway pavement to mitigate wave overtopping and to prevent closure of the highway during high surf conditions. See **Figure 7**. Portions of the existing Honoapiilani Highway in the Olowalu vicinity have also required pavement widening and restriping on the mauka or inland side of the highway to ensure continued stable roadway conditions along these erosion-prone segments. These kinds of mitigation measures have been determined to be inadequate in addressing the threat of potential collapse of the roadway pavement. According to the Maui Shoreline Atlas, erosion rates in this area range can reach as high as -1.0 foot per year. Wave action and coastal erosion continue to threaten the stability of the roadway pavement, poising a public safety concern for residents and visitors of the West Maui region.

These areas of the coastline have been previously identified in the November 2003 Statewide Highways Shoreline Protection Study. In addition, under the draft Hawaii Statewide Transportation Plan, climate change and sea level rise are identified as an issue that will impact Hawaii's transportation facilities. These areas, already affected by wave action and coastal erosion, will be even more impacted by sea level rise in future years.

The proposed terminus relocation further south will result in an inland alignment of the southerly segment of the Lahaina Bypass. With this adjusted alignment, the area

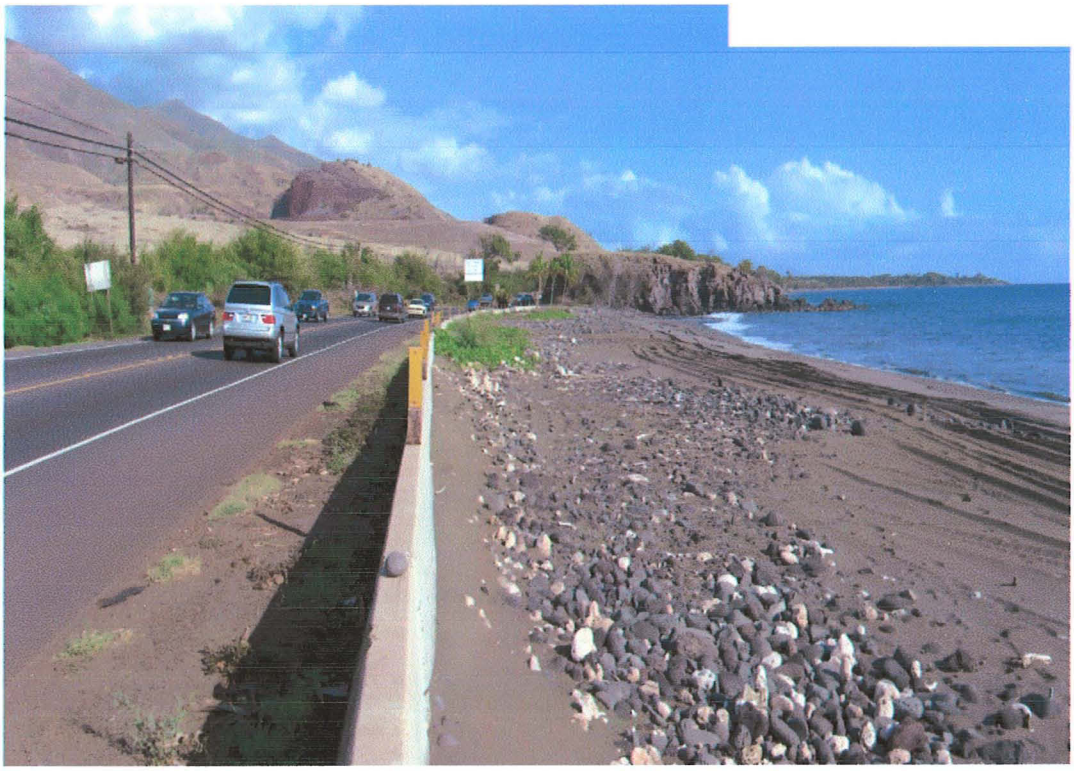


Figure 7

Proposed Lahaina Bypass Southern Terminus Relocation

Shoreline Erosion Conditions in Project Vicinity

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\DraftEA\ShorelineErosion

of shoreline that is currently undergoing erosion and is exposed to high surf which impacts the operational viability of the existing Honoapiilani Highway will be avoided. The proposed terminus relocation project therefore provides an opportunity to provide a long term solution for coastal erosion mitigation.

2. Future Increase of Congestion Within the Project Corridor

Traffic congestion between the current terminus point at Launipoko to the vicinity of the Olowalu Landfill site was forecasted to increase in the Final Supplemental EIS for the Lahaina Bypass Modified Project due to projected growth in the West Maui region. In addition, this forecast did not include the additional traffic that would be generated by recent planned developments in the area that have been proposed since the acceptance of the Final Supplemental EIS. Without capacity enhancement, existing traffic conditions along the project corridor will deteriorate causing longer queues of vehicles and traffic delays for drivers in the West Maui region.

3. Long Range Transportation Planning Considerations

The Lahaina Bypass Project is one of the HDOT's top highway priorities, with new roadway infrastructure needed to address Maui's rapid population growth and is a recommended improvement in the Maui Long Range Land Transportation Plan. Ultimately, the long range goal is to provide additional corridor capacity between Maalaea and Launiupoko. This goal may be achieved via a new inland alignment of the highway between the Pali and the Puamana/Launiupoko vicinity.

a. Honoapiilani Highway Realignment/Widening Maalaea to Launiupoko

The HDOT is currently studying options for providing the needed highway capacity between Maalaea and Launiupoko, either via widening or realignment of the Honoapiilani Highway in order to meet long term travel demands along this corridor. Planning criteria being considered in identifying an appropriate set of alternatives include the functional viability of the roadway given current shoreline erosion patterns, as well as land use opportunities and community benefits which may be derived from the studied alternatives.

The proposed relocation of the southern terminus of the Lahaina Bypass advances the objective of the Honoapiilani Highway Realignment/Widening

study effort by extending the Lahaina Bypass further south, thereby establishing a viable point of connection for the next phase of work which will be identified by the Maalaea to Launiupoko study. The selected terminus location is at a "pinchpoint" created by the former Olowalu Landfill and the shoreline. Extending the highway along an inland alignment to this location is seen as cost effective in the long term, since the existing approved connection location would ultimately require future inland relocation in order to establish an alignment which avoids the section of shoreline exposed to coastal processes.

b. <u>Pali to Puamana Parkway Master Plan</u>

The Pali to Puamana Parkway Master Plan, prepared for the County of Maui, was published in 2005. According to the master plan report:

"The purpose of this Plan is to serve as a foundation for a public policy promoting responsible land preservation and development in the coastal zone. The objectives of the plan are: 1) to recommend a proposed realignment of the Honoapiilani Highway from Papalaua Park to Puamana Park; 2) to recommend a proposed open space preserve and to protect the shoreline environment; 3) to increase roadway capacity; 4) to protect public health and safety by getting the highway out of the tsunami inundation zone; and 5) to recommend methods of accommodating new land uses for the area through the implementation of the West Mau'i Community Plan".

The Master Plan identified a preferred alternative roadway alignment between Ukumehame and Puamana Park which sets forth an inland route for the realigned Honoapiilani Highway. See **Appendix "A"**. Further details regarding the Pali to Puamana Parkway Master Plan are provided in Chapter II (Alternatives Analysis) of this report.

In addition to the proposed action's complementary role in advancing long-range transportation and land use planning efforts, the project reflects the policies set forth in the West Maui Community Plan which advocates realigning portions of the Honoapiilani Highway in order to reduce impacts from coastal processes. These policies are further discussed in Chapter IV of this report.

E. CHAPTER 343, HAWAII REVISED STATUTES (HRS) AND NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) REQUIREMENTS

The HDOT is proposing this action to advance long-range regional transportation planning objectives for West Maui. The limited action is confined to a minimum 150-feet wide corridor, 10,300 feet in length. As this action is being initiated by HDOT, the requirements of Chapter 343, Hawaii Revised Statutes (HRS) are triggered. Furthermore, this HDOT-funded project includes funding support from the FHWA, thereby triggering requirements of the National Environmental Policy Act or NEPA.

This EA has been prepared to address the proposed action and is limited in scope to that portion of the roadway between Launiupoko and the vicinity of the former Olowalu Landfill Site to accommodate the relocation of the south terminus of the Lahaina Bypass Project.

F. ENVIRONMENTAL ASSESSMENT TIME SCHEDULE

The EA schedule will not affect the implementation scheduling of Phase 1A or Phases 1B-1 and 1B-2 of the Lahaina Bypass. Both Phases 1A and 1B-1 (encompassing the segment between Keawe Street and Hokiokio Place) are not affected by the proposed southern terminus relocation project. Phase 1B-2 will be modified with the new terminus location, resulting in an inland realignment. The EA for the southern terminus relocation is in keeping with the overall implementation sequencing for the initial construction phases for the Lahaina Bypass and will not cause delays to these elements of work.

G. COST IMPLICATIONS

State and Federal appropriations for Phase 1B-1 have been allocated $48 million dollars. The HDOT-FHWA match distribution is 20 percent HDOT, 80 percent FHWA. Additional funds will be needed for Phase 1B-2.

The proposed southern terminus relocation will result in an increase in the overall bypass roadway length by approximately 4,800 lineal feet, when compared to the current Launiupoko terminus location. The added length translates to an approximate increase in

cost of $12 million. The expected result of the proposed terminus relocation project is an extended bypass highway that provides additional corridor capacity and continued access along the coastal erosion-prone segments of Honoapiilani Highway.

II. ALTERNATIVES ANALYSIS

II. ALTERNATIVES ANALYSIS

A. SOUTHERN TERMINUS RELOCATION ALTERNATIVES ANALYSIS

1. Background

As reflected in the Final Supplemental Environmental Impact Statement (FSEIS), the preferred alternative involved extending the Lahaina Bypass to Launiupoko. Refer to **Figure 3**. This alternative was deemed appropriate in the context of addressing shoreline erosion threats to Honoapiilani Highway, between Puamana and Launiupoko.

Since the issuance of the Record of Decision for the FSEIS, a number of regional transportation planning initiatives have been developed to examine the larger regional transportation planning context for the West Maui region. These initiatives include the County of Maui's Pali to Puamana Master Plan and the HDOT's Honoapiilani Highway Realignment/Widening, Maalaea to Launiupoko Study. Additionally, landowners in the area have undertaken highway alignment studies as part of their respective master development plans.

2. Environmental Impact Considerations

The proposed southern terminus relocation concept was deemed viable in part, because there were no apparent adverse environmental impacts to sensitive environments such as archaeological and historic sites, endangered or threatened species of flora and fauna, or wildlife/waterbird refuges. In addition there were no established human settlement areas which would be impacted by the terminus relocation. The research and analysis conducted for this environmental assessment (EA) document confirms the foregoing preliminary assessment.

In examining the need for relocating the Lahaina Bypass Southern Terminus further south, various alternatives were evaluated in the process of determining the preferred alternative for review and analysis in this EA document.

3. Alternatives Analysis Evaluative Criteria

In identifying the preferred alternative, the following five (5) evaluative criteria were reviewed. The criteria relate to the programmatic and regulatory considerations of HDOT and FHWA and local planning considerations.

Transportation Objectives:

1. Does the alternative increase the roadway capacity and advance long-term transportation planning objectives?

2. Does the alternative provide for adequate separation between the Bypass and the existing Honoapiilani Highway?

3. Does the alternative provide for an appropriate intersection configuration with Kai Hele Ku Street that minimizes need for significant roadway realignment work.

Environmental Factors:

4. Does the alternative avoid negative impacts to environmental resources (wetlands, streams, sensitive habitats, etc.)?

Historic/Cultural Resources:

5. Does the alternative avoid significant impacts to historic or cultural sites?

Community Planning Efforts:

6. Does the alternative facilitate the planning and provision of additional coastal recreation areas?

4. Alternatives

Three (3) alternatives were reviewed and assessed with respect to the foregoing questions. The results of the alternatives analysis follow.

a. Alternative 1 (No Action)

This option would retain the terminus at its current location at Launiupoko. Refer to **Figure 3**. The "no build" alternative would forego the

implementation of the proposed project and issues relating to shoreline erosion and roadway safety will continue to affect the existing Honoapiilani Highway in the vicinity of Mile Marker 17. The traveling public will be exposed to continuing threats of highway closures and traffic delays during high wave events. As well, the "no action" alternative would likely require ongoing roadway repairs and maintenance and associated traffic delays in order to address coastal wave damage likely to affect the highway.

With this alternative, shoreline erosion mitigation would be undertaken to preserve the long-term structural integrity of the Honoapiilani Highway. Such mitigative measures would include shoreline hardening (e.g., use of revetments) or realigning the roadway within the existing right-of-way. From a long-term perspective these measures, while utilized in the past, are not necessarily deemed environmentally appropriate from a shoreline process standpoint. Moreover, the continued erosion of the shoreline areas may require right-of-way acquisition to secure additional lands for highway alignment relocations away from eroding areas.

From a long-term highway capacity standpoint, the "no action" alternative would require additional travel lanes south of Launiupoko to supplement the existing two-lane Honoapiilani Highway typical section. With the terminus remaining at Launiupoko, the options for providing additional capacity would require an examination of a separate highway right-of-way inland of the existing Honoapiilani Highway as reflected in Alternatives 2 & 3, or, widening of the existing highway through acquisition of adjoining mauka lands. Thus, in the context of highway capacity planning, the "no action" alternative is not considered appropriate.

Since the highway would continue to abut the shoreline, this option would eliminate opportunities for coastal recreational area enhancement.

b. <u>Alternative 2 (Pali to Puamana)</u>

In February 2005, the County of Maui completed its Pali to Puamana Parkway Master Plan. The purposes of the plan are as follow:

1. Recommend a proposed realignment of the Honoapiilani Highway from Papalaua Park (near the Pali) to Puamana Park;

2. Recommend a proposed open space preserve and to protect the shoreline environment;

3. Increase roadway capacity;

4. Protect public health and safety by relocating the Honoapiilani Highway out of the tsunami inundation zone; and

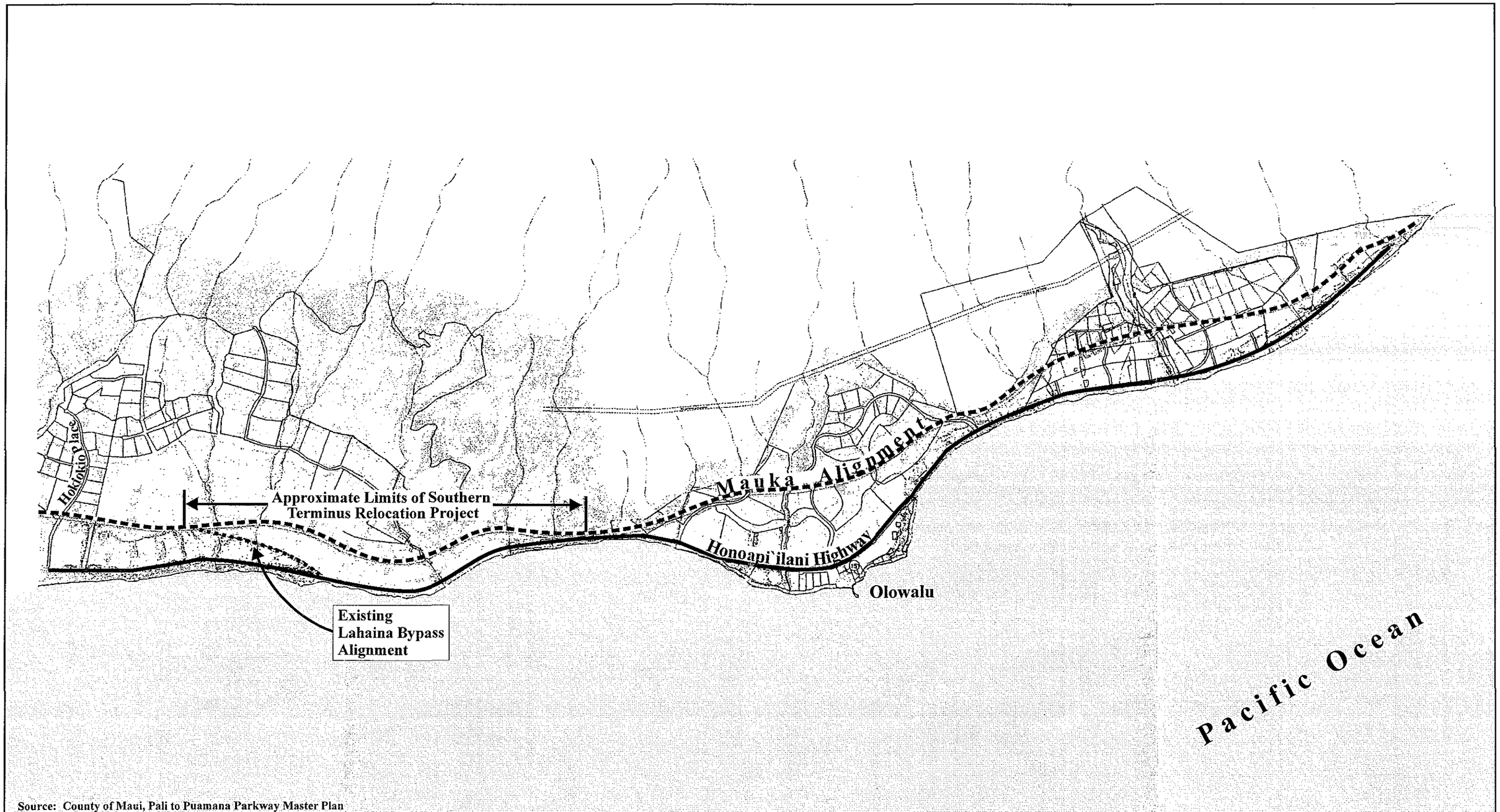
5. Recommend methods of accommodating new land uses for the area through implementation of the West Maui Community Plan.

Through this planning study, three (3) realignment alternatives were identified: (1) a Mauka Alignment (which corresponds to the 'preferred alignment' for the proposed Southern Terminus Relocation project) which creates development parcels makai of the proposed alignment; (2) a Makai Alignment (similar to the 'no action alternative' addressed in this section for the proposed project) which requires minimum land acquisition and avoids natural hazards; and (3) a Mid-Level Alignment (referred to now as the 'Pali to Puamana Master Plan Alignment') that requires moderate land acquisition and avoids natural hazards. See **Figure 8**, **Figure 9** and **Figure 10**.

Master Plan Alignment

Based on an iterative evaluation process, a Master Plan alignment was identified. This alignment corresponds to Alternative 2 in this analysis. See **Figure 11**. This alignment addresses shoreline erosion issues along this segment of Honoapiilani Highway and was developed in the context of a long-range transportation plan. The alignment also provides lands makai of the roadway for added coastal recreation areas which advances the objectives and policies of the West Maui Community Plan.

Because of the need to maintain the existing coastal Highway, the Master Plan alignment would establish two parallel roadways in close proximity to



Source: County of Maui, Pali to Puamana Parkway Master Plan

Figure 8

Proposed Lahaina Bypass Southern Terminus Relocation

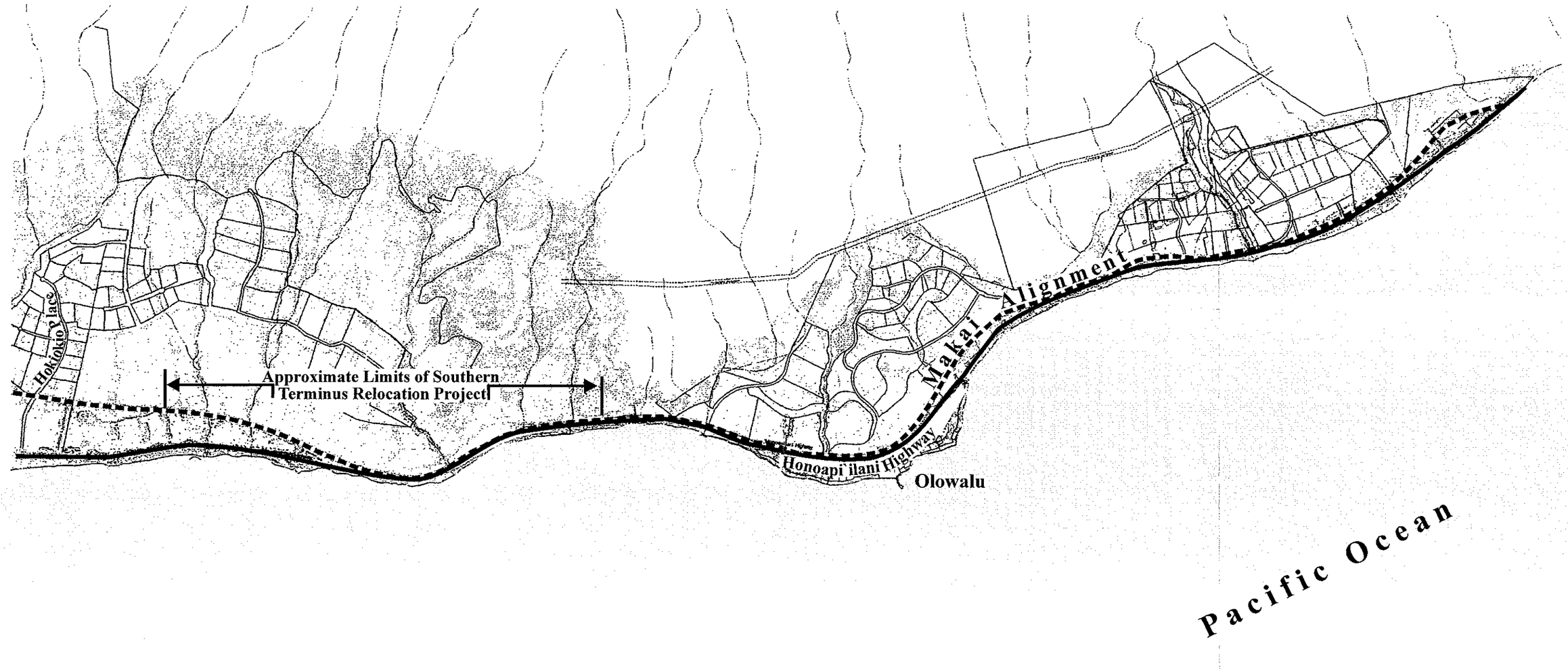
Pali to Puamana Parkway Mauka Alignment

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\DraftEA\Alternative1



Source: County of Maui, Pali to Puamana Parkway Master Plan

Figure 9

Proposed Lahaina Bypass Southern Terminus Relocation

Pali to Puamana Parkway Makai Alignment

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

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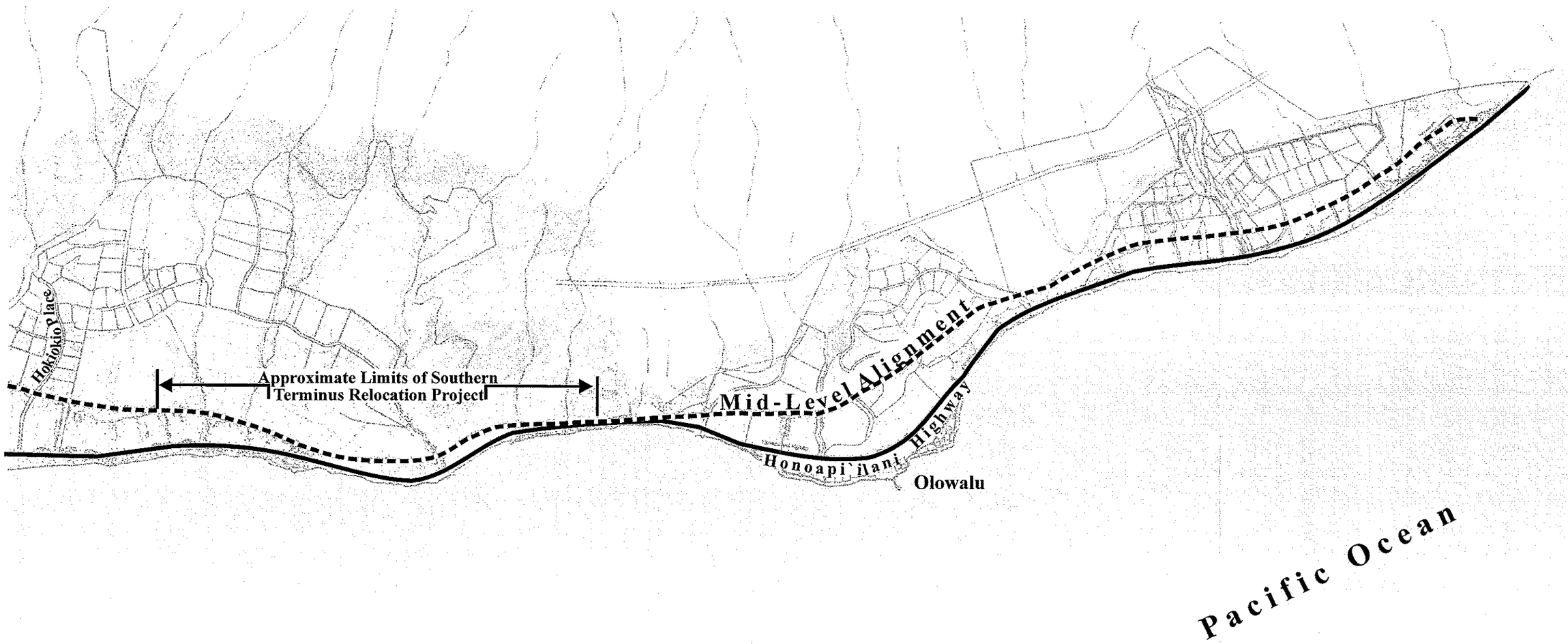

Source: County of Maui, Pali to Puamana Parkway Master Plan

Figure 10

Proposed Lahaina Bypass Southern Terminus Relocation

Pali to Puamana Parkway Mid-Level Alignment

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

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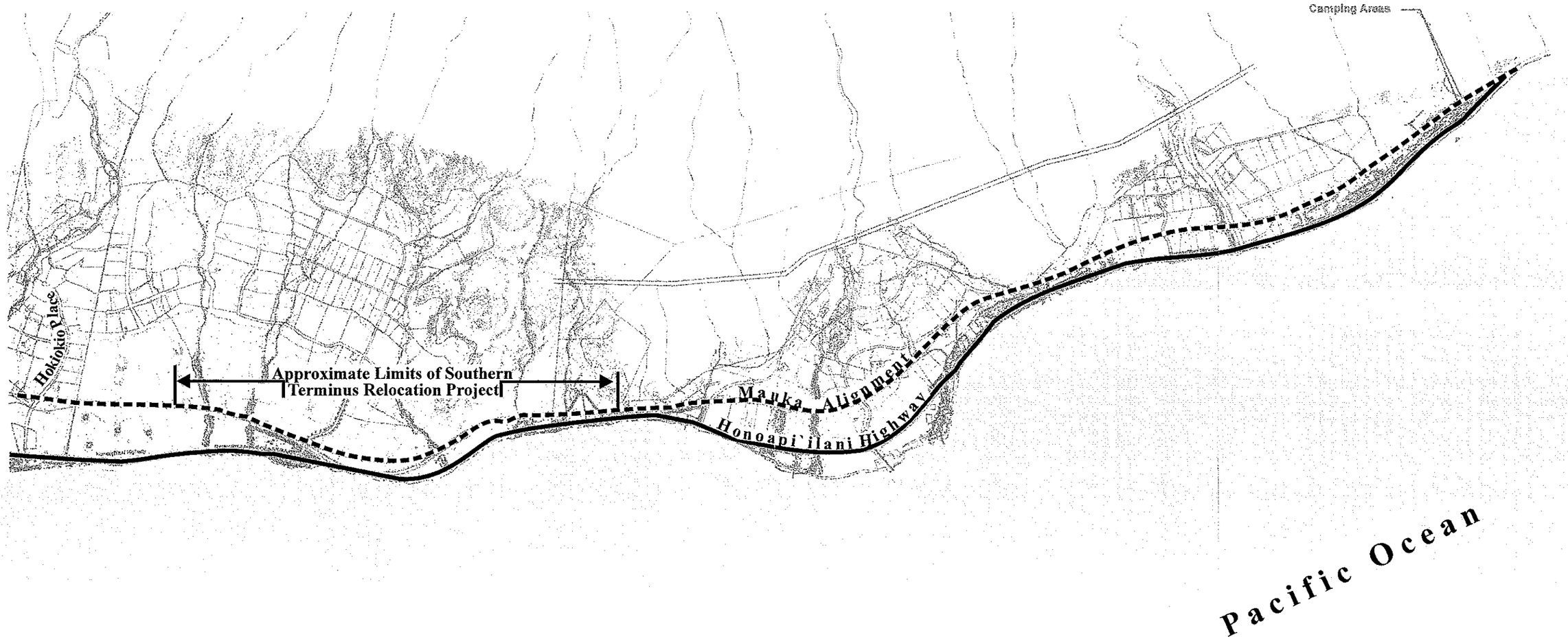


Source: Warren S. Unemori Engineering, Inc.

Figure 11

Proposed Lahaina Bypass Southern Terminus Relocation

Pali to Puamana Parkway Master Plan Alignment

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand/LhnBypassExt/DraftEA/Alternative4

each other which is less desirable from a Highway network planning perspective.

The Master Plan alignment also intersects Kai Hele Ku Street in the middle of a curved portion of the roadway. Optimal intersection alignments would have the roadways intersect at a ninety (90) degree angle. The Master Plan alignment does not provide for this optimal angle and, thus, would require a significant realignment of Kai Hele Ku Street in order to establish an appropriate intersection configuration. Refer to **Figure 5**.

c. <u>Alternative 3 (Preferred)</u>

The Preferred Alternative, as described in Chapter I of this report, establishes an inland route which terminates in the vicinity of the former Olowalu Landfill site. Refer to **Figure 5**. The alignment addresses shoreline erosion issues by establishing an inland route away from shoreline areas. From a long-term transportation planning standpoint, the Preferred Alternative provides a separate right-of-way which can accommodate a 160-ft. wide corridor for the provision of added highway capacity. As proposed, the Preferred Alternative would provide for the best intersection configuration with Kai Hele Ku Street eliminating the need for significant realignment work.

Additionally, the Preferred Alternative would provide for greater separation between the Lahaina Bypass and the Honoapiilani Highway, which is more desirable from a highway network planning perspective.

From a coastal recreation standpoint, the Preferred Alternative provides opportunities for expansion of coastal recreation areas. In this regard, the preferred action advances the objectives and policies of the West Maui Community Plan.

d. Summary

A summary of the foregoing alternative analysis is presented in **Table 2**.

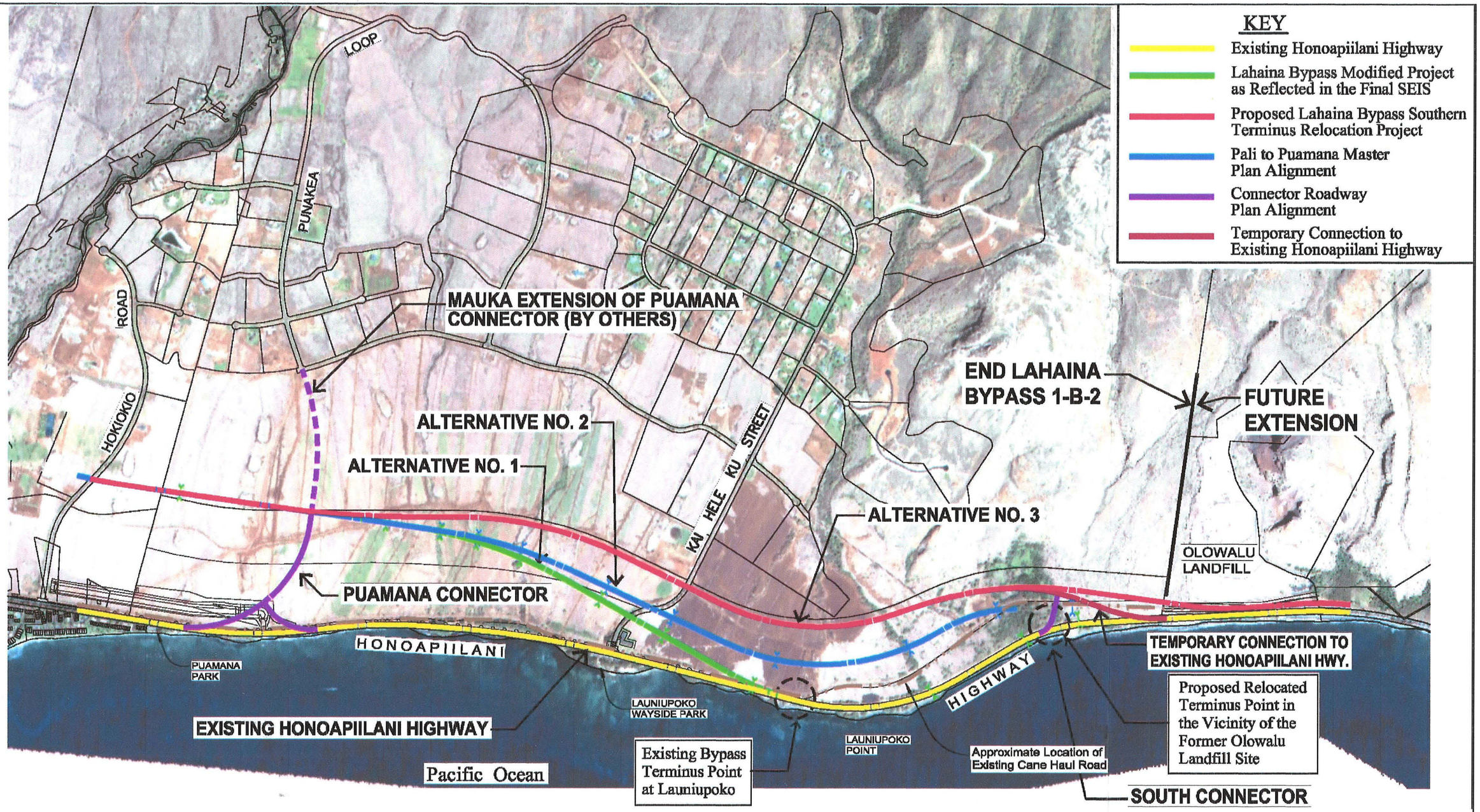
Table 2. Summary of Alternatives Assessment

	Evaluation Criteria	Alternative 1 (No Action)	Alternative 2 (Pali to Puamana)	Alternative 3 (Preferred)
1	Increases Roadway Capacity and Advances Long-Term Transportation Planning Objectives	No	Yes	Yes
2	Provides for Adequate Separation Between Lahaina Bypass and Honoapiilani Highway	N/A	No	Yes
3	Provides for Adequate Intersection Configuration with Kai Hele Ku Street	N/A	No	Yes
4	Avoids Negative Impacts to Environmental Resources	N/A	Yes	Yes
5	Avoids Significant Impacts to Historic or Cultural Sites	N/A	Yes	Yes
6	Facilitates Planning and Provision of Additional Coastal Recreation Areas	No	Yes	Yes

It is noted that with respect to Alternative 2 (Pali to Puamana Master Plan), the preceding assessment is limited to that roadway section between Launiuipoko and the vicinity of the former Olowalu Landfill Site. It does not apply to segments between the Olowalu Landfill Site to Ukumehame, which encompasses the remaining limits of the Pali to Puamana Master Plan Study.

As reflected in **Table 2**, Alternative 3 (Preferred Alternative) meets all six (6) of the evaluative criteria listed above whereas Alternative 2 (Pali to Puamana Master Plan) meets four (4) of the six (6) evaluative criteria.

As depicted in **Figure 12**, both alignments are comparable in location. However, the Preferred Alternative accounts for the better intersection design with Kai Hele Ku Street. Given the foregoing analysis, the Preferred Alternative is considered to be the most appropriate planning solution.



Source: Warren S. Unemori Engineering, Inc.

Figure 12

Proposed Lahaina Bypass Southern Terminus Relocation

Alignment Comparison: Pali to Puamana Master Plan vs. Proposed Action

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LhnBypassExt\Draft EA\AlignmentComparison

B. PUAMANA CONNECTOR ALTERNATIVES ANALYSIS

This section presents an analysis of connector roadway alignments that are being considered by HDOT for implementation as part of the proposed Lahaina Bypass Southern Terminus Relocation Project. As previously noted, the Lahaina Bypass Modified Project planned for the Puamana Connector to be located in the vicinity of Puamana Beach Park. The Puamana Connector is identified as a new mauka-makai roadway which would provide access between the Lahaina Bypass Highway and the portion of the Honoapiilani Highway entering Lahaina Town from the south terminus of the bypass. Two (2) alternative locations have been assessed which (for the purposes of this analysis) are being referred as the Hokiokio and Punakea alternatives. The alignments of these two connector roadways are shown on **Figure 12**. A description and analysis of each of these connector alternatives is presented below:

1. Hokiokio Alternative

Hokiokio Place is an existing two-lane local roadway that provides exclusive access to the Honoapiilani Highway for residents living within the Puunoa subdivision. The Puunoa subdivision is located on the foothills of the West Maui Mountains mauka of the existing Honoapiilani Highway. Hokiokio Place does not act as a circulatory roadway as there is currently no direct road connection between the Puunoa subdivision and the neighboring Makila Plantation and Mahanalua Nui subdivisions located to the southeast. Refer to **Figure 12**. An access gate is located approximately 2,000 feet mauka of the intersection of Hokiokio Place with Honoapiilani Highway limiting ingress/egress opportunities to only those residents living within the subdivision.

Under this alternative, the proposed relocation of the southern terminus for the Lahaina Bypass would result in the creation of an intersection (with the Lahaina Bypass) mid-way along the current alignment of Hokiokio Place. This road would then serve as a connector roadway for residents living mauka of the realigned highway as well as providing a route for traffic to access the Honoapiilani Highway along the coast.

The following considerations were reviewed as part of the analysis of this roadway connector alternative:

- A connector roadway at this location would only serve a limited population residing mauka of the newly aligned highway in the Puunoa subdivision,

access to which is currently restricted by a gated entrance. Due to proximity to other intersections, this alternative would necessitate an underpass in order to provide Punakea Loop with access to the roadway network via Honoapiilani Highway.

- Hokiokio Place is a two-lane roadway with a landscaped median along a portion of its alignment. Substantial engineering upgrades would, therefore, need to be undertaken along Hokiokio Place to facilitate its functionality as a connector roadway to the Lahaina Bypass.

Given the foregoing considerations, a second alternative alignment for a connector roadway along the newly aligned extension of the Lahaina Bypass has been evaluated as part of this analysis.

2. Punakea Alternative

A second alternative alignment for a connector roadway to serve the newly aligned Lahaina Bypass extension between Puamana Beach Park and Launiupoko Wayside Park has been identified. This alternative is being referred to as the Punakea Road Extension for the purposes of this analysis.

The Punakea Connector roadway would be constructed across lands owned by Makila Land Company, LLC and would provide an east-west connection between the realigned bypass extension and Punakea Loop, a local subdivision roadway located within the Makila Plantation subdivision. Punakea Loop connects with Haniu Street which eventually intersects with Kai Hele Ku Street. Access from the Honoapiilani Highway to the Makila Plantation subdivision and neighboring Mahanalua Nui subdivision is currently provided by Kai Hele Ku Street, which forms an intersection with the highway at Launiupoko Wayside Park. Construction of the Punakea alternative would, therefore, provide a second intersection along the newly aligned Lahaina Bypass extension approximately 2,400 feet to the south of Hokiokio Place and approximately 5,200 feet north of Kai Hele Ku Street. Refer to **Figure 12**. Under a post-development scenario, this road would then serve as a connector roadway for residents living in the Makila Plantation and Mahanalua Nui subdivisions as well as providing a route for traffic using the bypass to access the Honoapiilani Highway along the coast. Due to intersection spacing requirements, construction of a connector at this location may require the current alignment of Hokiokio Place to be dead-ended at its intersection with the newly aligned Lahaina

Bypass extension. A local roadway connection from Hokiokio Place would, therefore, need to be provided to enable residents within the Puunoa subdivision to gain access to and from the Lahaina Bypass.

The following considerations were reviewed as part of the analysis of this roadway connector alternative:

- A connector roadway at this location would provide a circulatory system that would service the growing number of residences located mauka of the highway in the Puunoa and Makila Plantation subdivisions. This roadway would also serve as secondary form of ingress/egress for residents and emergency services in times of wild fire incidents and other natural disasters.

- There is no existing roadway at this particular location. As such, implementation of this alternative would require the planning, design and construction of a new connector roadway.

- Access from the bypass to the less populated Puunoa subdivision could be provided via a local roadway connection from Hokiokio Place which would run parallel to the newly aligned highway extension and connect to the Punakea connector intersection.

3. Summary

Given the foregoing considerations and the current design configuration of Hokiokio Place, the Punakea alternative is considered a more beneficial alternative for the Lahaina Bypass Southern Terminus Project. The Punakea connector alternative would provide a circulatory network to an expanding residential community located mauka of the newly aligned highway extension. It would also provide a future secondary access point to the bypass that could be utilized in the event that emergency situations, such as wildfires or traffic accidents, close-down operations along Kai Hele Ku Street.

The following chapter provides an analysis of existing conditions, potential impacts and mitigation measures for the preferred alternative and related improvements.

III. DESCRIPTION OF THE EXISTING ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

III. DESCRIPTION OF THE EXISTING ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

A. PHYSICAL SETTING

1. Existing and Planned Land Uses

a. Existing Conditions

The project area is located in West Maui approximately 17.5 miles from Wailuku and 2.5 miles from Lahaina Town. This area was utilized for sugarcane production for decades and have stood fallow with the cessation of sugar production by Pioneer Mill Company since 1999. Vacant lands extend along the mountain and ocean sides on this stretch of Honoapiilani Highway.

The proposed new highway route resulting from the proposed southern terminus relocation is a 160 foot wide strip of land almost 2 miles in length stretching from the northern Launiupoko boundary towards the vicinity of the County's former Olowalu Landfill site. The alignment crosses between the elevations of 30 feet and 100 feet above sea level. The alignment lies within former agricultural lands which are now open grassland.

The proposed Bypass terminus relocation corridor traverses lands which are located west of agricultural subdivisions. To the east of the corridor is the Mahanalua Nui Agricultural Subdivision, while lands to the northeast encompass the Puunoa Agricultural Subdivision. The roadway route itself is located within the proposed two (2) agricultural subdivisions. The east-west roadways serving this area include Kai Hele Ku Street (serving the Mahanalua Nui Subdivision) and Hokiokio Street (serving the Puunoa Subdivision). Makai of the Kai Hele Ku Street-Honoapiilani Highway intersection is the County of Maui's Launiupoko Beach Park.

Planned uses in the vicinity of the corridor include the master planned Makila Rural Residential Community east (mauka) of the alignment and agricultural lots west (makai) of the alignment. See **Figure 13**.

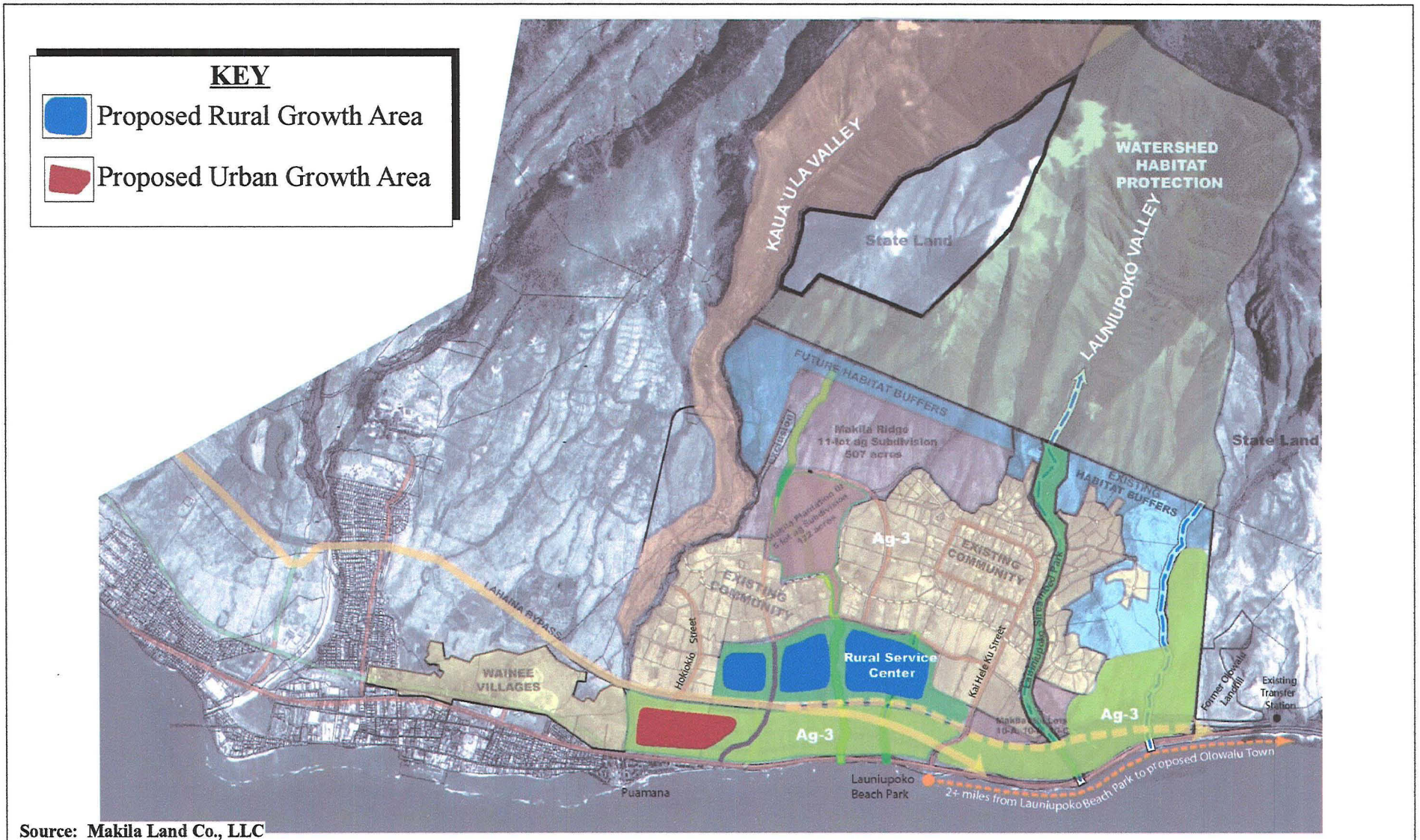
Other future uses could include expanded shoreline recreational opportunities, which would require relocating portions of the existing Honoapiilani Highway. At present, the existing highway location precludes the opportunity to expand areas for safe access to shoreline areas. Under the Pali to Puamana Master Plan, an expansion to Launiupoko Park is recommended. In addition, there is the potential to expand the existing Puamana Park and to create a new coastal park at Waianukole, near the surf spot commonly referred to as "guardrails".

Other potential coastal dependant uses include an inland small boat harbor and/or boat launching facility; and, an ocean orientated camping facility just north of the former landfill site and south of Launiupoko Stream. A privately commissioned study identified that this area of coastline could accommodate an inland small boat harbor (Moffatt and Nichols, November, 2005).

The existing Honoapiilani Highway is a two-lane highway with paved shoulders on both sides located to the west of the project corridor. The highway right-of-way averages 80 feet. Posted speed limits range from 35 to 55 miles per hour at various turns and points along the highway. Coastal erosion is evident along portions of the highway. There are jersey barriers along segments of the highway in the project vicinity to deter the ocean waves from impacting traffic flow.

b. <u>Potential Impacts and Mitigation Measures</u>

The proposed terminus relocation of the Lahaina Bypass from the vicinity of Launiupoko to the vicinity of the former Olowalu Landfill site will traverse or run adjacent to lands, which in the long term, will include agricultural lots and a master-planned rural residential community. The new alignment of the Bypass extension has been incorporated in these planned uses.



Source: Makila Land Co., LLC

Figure 13 Proposed Lahaina Bypass Southern Terminus Relocation

Existing and Planned Uses in the Project Vicinity

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MakilaLand\LahBypassExt\Draft EA\Existing and Planned Uses in the Project Vicinity

Moreover, the preferred mauka alignment maximizes opportunities for long-term planning for coastal development uses, such as a harbor or small boat related recreational uses. The terminus relocation then, facilitates the achievement of near-term and long-term objectives of shoreline erosion mitigation, expansion of coastal recreation resources, and provision of a more inland highway alignment to meet regional planning needs as described in Chapter I. Moreover, the proposed right-of-way traverses lands which are currently fallow which facilitates land acquisition without implications for resident or business displacement. The engineering designs for the terminus extension will provide for appropriate integration of Kai Hele Ku Street as well as the connection at Honoapiilani Highway.

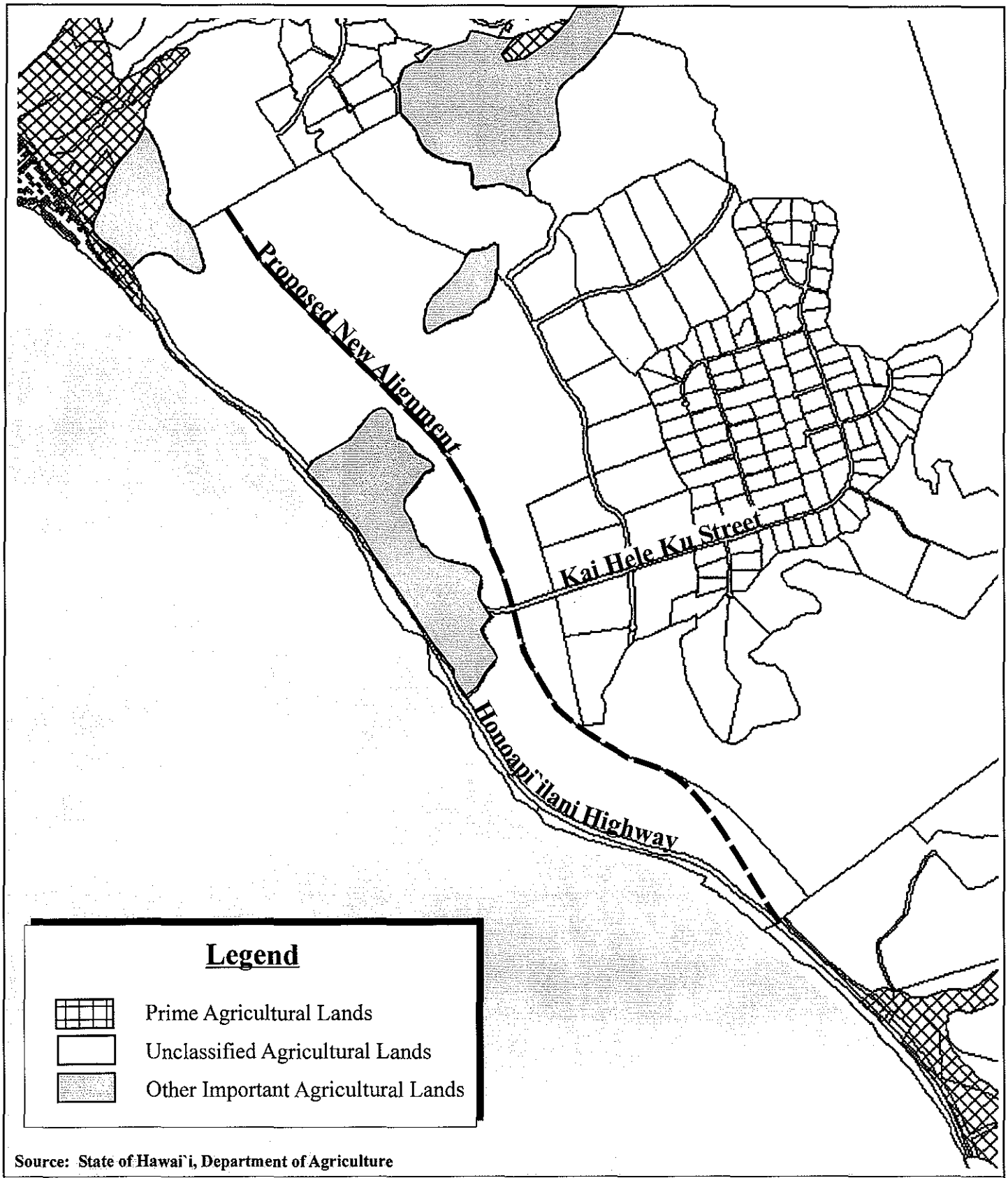
2. Agricultural Productivity Considerations

a. Existing Conditions

In 1977, the State Department of Agriculture developed a classification system to identify Agricultural Lands of Importance to the State of Hawai'i (ALISH), based primarily, though not exclusively, on their soil characteristics. The three (3) classes of ALISH lands are "Prime", "Unique", and "Other Important" agricultural land, with the remaining non-classified lands termed "Unclassified". When utilized with modern farming methods, "Prime" agricultural lands have a soil quality, growing season, and moisture supply needed to produce sustained crop yields economically; while "Unique" agricultural lands possess a combination of soil quality, growing season, and moisture supply to produce sustained high yields of a specific crop. "Other Important" agricultural lands include those important agricultural lands that have not been rated as "Prime" or "Unique".

As reflected by the ALISH map for the West Maui region, the proposed project is comprised of lands that have been defined as "Unclassified" agricultural lands. See **Figure 14**.

The University of Hawaii, Land Study Bureau (LSB) developed the Overall Productivity Rating, which classified soils according to five (5) levels, with "A" representing the class of highest productivity soils and "E" representing the lowest. These letters are followed by numbers which further classify the



Source: State of Hawai`i, Department of Agriculture

Figure 14

Proposed Lahaina Bypass Southern Terminus Relocation

Agricultural Lands of Importance to the State of Hawaii (ALISH)

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\Draft EA\ALISH

soil types by conveying such information as texture, drainage and stoniness. The LSB classifications for the terminus relocation corridor include "B87i" and "E73". See **Figure 15**.

The "B87i" classification reflects soils which are stony to very stony. The soil depth is deep and slope percentages range from 0 to 10 with inclusions of steeper slopes. The texture is fine and well-drained with an elevation of 10 to 1,000 feet with a mean annual rainfall of 10 to 20 inches. The color of the soils is dark reddish brown and is part of the Wainee soil series.

The "E73" classification characterizes soils which are rocky, with variable depths and slope percentages of 0 to 35, with an average of 4 to 9 percent. The soil composition is fine to moderately fine texture, well-drained with an elevation of 0 to 750 feet with a mean annual rainfall of 10 to 30 inches. The color of the soils is dark brown to dark reddish brown and is part of the Pulehu, Puunene, Lanai, Molokai, Waiakoa, and Wainee series.

b. Potential Impacts and Mitigation Measures

The proposed terminus extension will encompass approximately 39 acres of agricultural lands. The removal of these lands is not expected to adversely impact agricultural productivity in the region. Lands underlying the new right-of-way alignment are presently fallow and not expected to affect the inventory of land for diversified or large-scale single crop agricultural use. The proposed southern terminus relocation is deemed to have beneficial results in terms of long-range planning considerations as well as benefits arising from shoreline erosion mitigation and provision of new coastal recreation opportunities.

3. Topography and Soil Characteristics

a. Existing Conditions

Most of the area surrounding the project site was formerly utilized for sugar cultivation and is currently fallow. The topography of this area reflects the general topographical patterns of the West Maui region. Near the shoreline, the topography is generally flat to slightly sloping. Proceeding upland, the

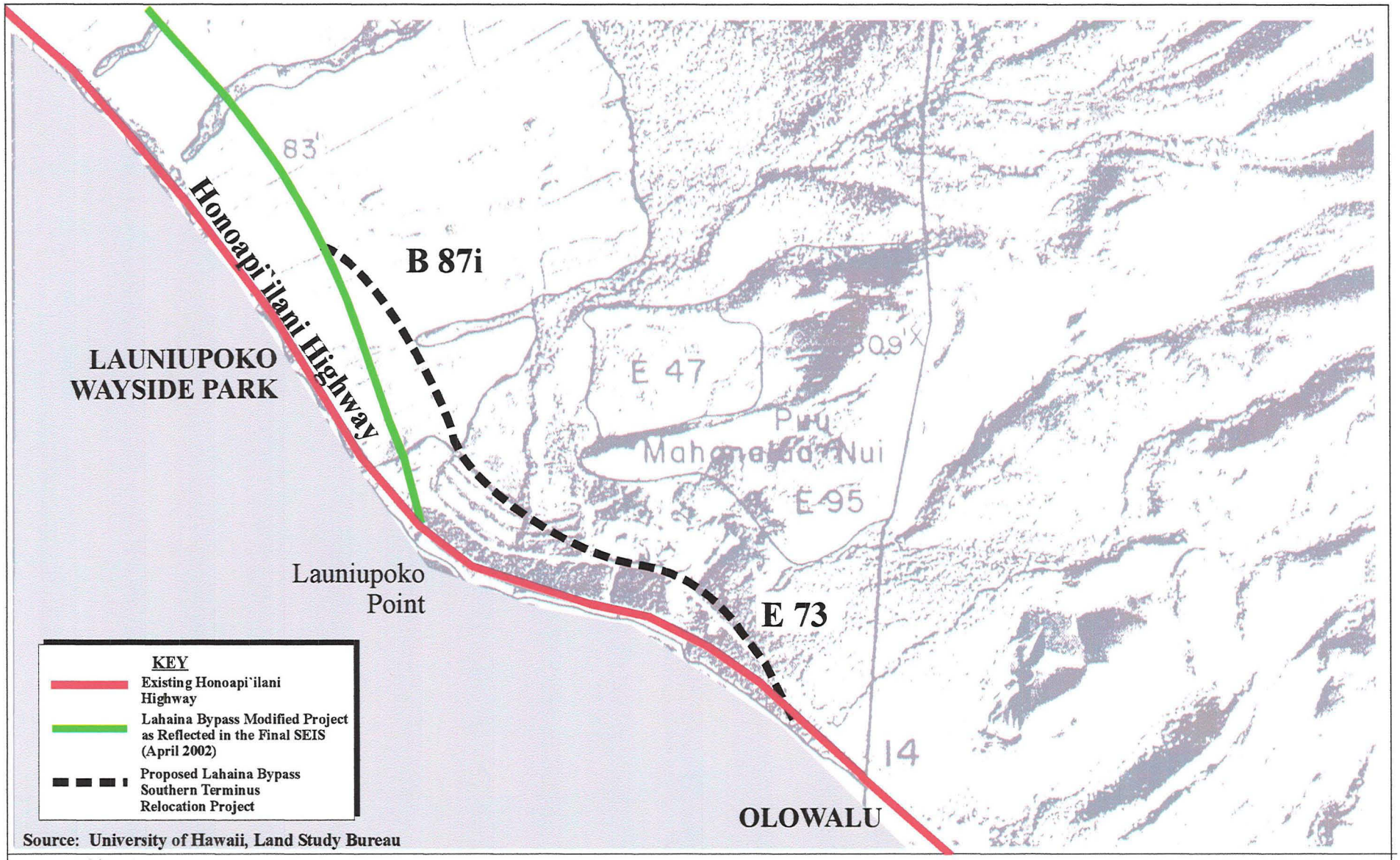


Figure 15 Proposed Lahaina Bypass Southern Terminus Relocation

Soil Productivity Classification Map

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypass\DraftEA\SoilProductivityClassification

land slopes gently higher to the foothills of the West Maui mountains. Elevations in this area generally range from sea level to approximately 400 feet above sea level. The topography of the project site is generally flat to slightly sloping towards the ocean. Grades along the profiles for the new roadway alignment are estimated to range between 0.5 percent and 3.0 percent.

Underlying the project site are soils of the Pulehu-Ewa-Jaucas association. See **Figure 16**. This series consist of well-drained soils on alluvial fans and stream terraces and in basins. These soils were developed in alluvium washed from basic igneous rock.

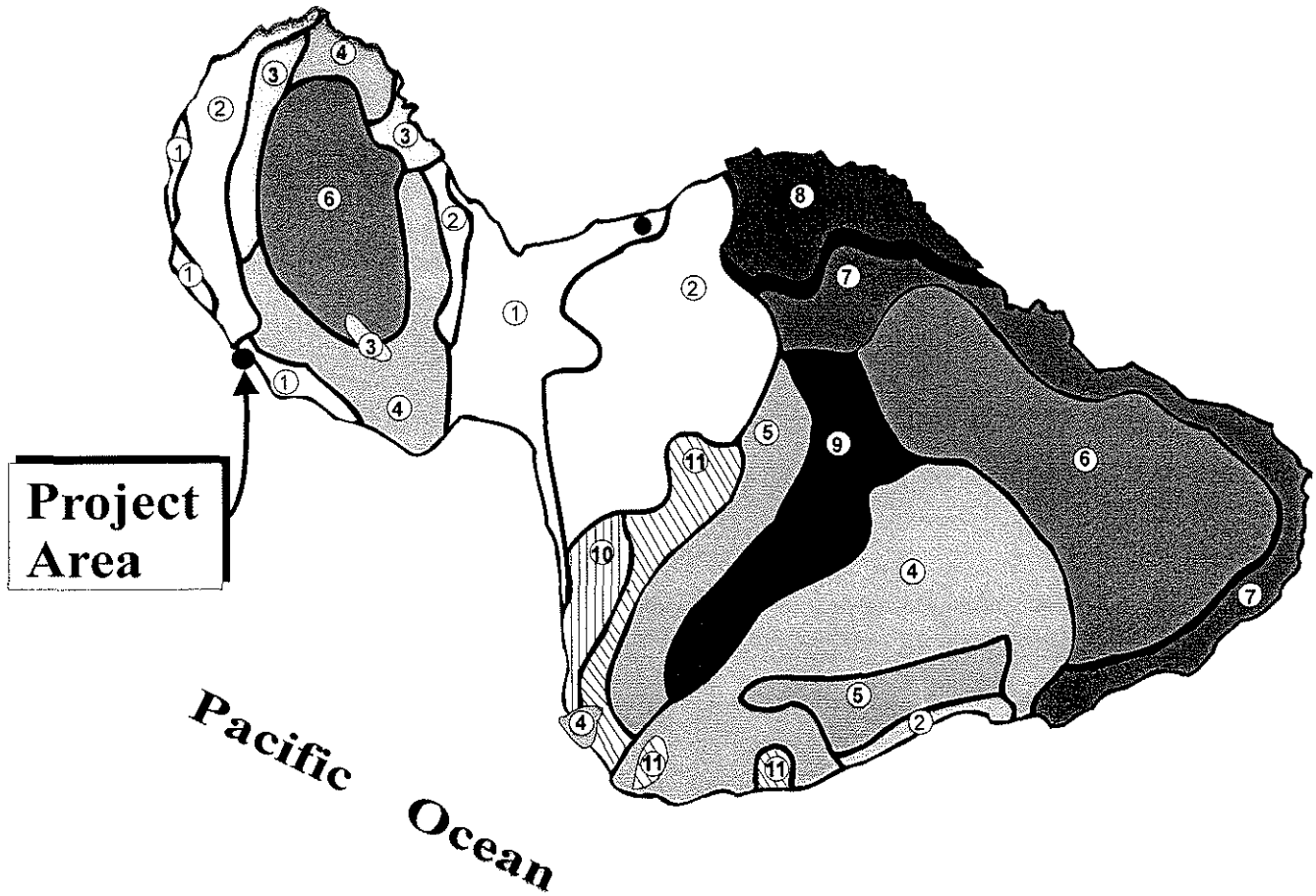
The soil types specific to the project site consist of Wainee extremely stony silty clay (WyC and WyB) and stony alluvial land (rSM). See **Figure 17**. Wainee extremely stony silty clay (WyC) has 7 to 15 percent slopes. This soil is moderately sloping and occurs on smooth, alluvial fans. In a representative profile, the surface layer is dark reddish-brown silty clay about 12 inches thick. Stones make up 10 to 15 percent of the volume. The subsoil, 24 inches thick, consists of dark reddish-brown silty clay that has subangular blocky structure. Gravel, cobblestones, and stones make up 30 to 80 percent of the volume. The substratum is dark-brown silty clay. As much as 80 to 90 percent of this layer is gravel, cobblestones, and stones. This soil is neutral in the surface layer and subsoil. Permeability is moderately rapid. Runoff is slow to medium, and the erosion hazard is slight to moderate. The available water capacity is about 0.6 inch per foot of soil. Stones cover 3 to 15 percent of the surface. Roots penetrate to a depth of 5 feet or more.

Wainee extremely stony silty clay (WyB) has 3 to 7 percent slopes. Runoff is slow and the erosion hazard is slight. This soil is used for sugarcane.

Stony alluvial land (rSM) consists of stones, boulders, and soil deposited by streams along the bottoms of gulches and on alluvial fans. In most places the slope is 3 to 15 percent. Elevations range from nearly sea level to 1,000 feet. The annual rainfall amounts to 15 to 200 inches. This land type is suited to pasture in the dry areas and to pasture and woodland in the wet areas. The natural vegetation consists of kiawe, klu, ilima, piligrass, and lantana in the

LEGEND

1. Pulehu-Ewa-Jaucas association
2. Waiakoa-Keahua-Molokai association
3. Honolua-Olelo association
4. Rock land-Rough mountainous land association
5. Puu Pa-Kula-Pane association
6. Hydrandepts-Tropaquods association
7. Hana-Makaalae-Kailua association
8. Pauwela-Haiku association
9. Laumaia-Kaipoipoi-Olinda association
10. Keawakapu-Makena association
11. Kamaole-Oanapuka association



Source: USDA Soil Conservation Service

Figure 16

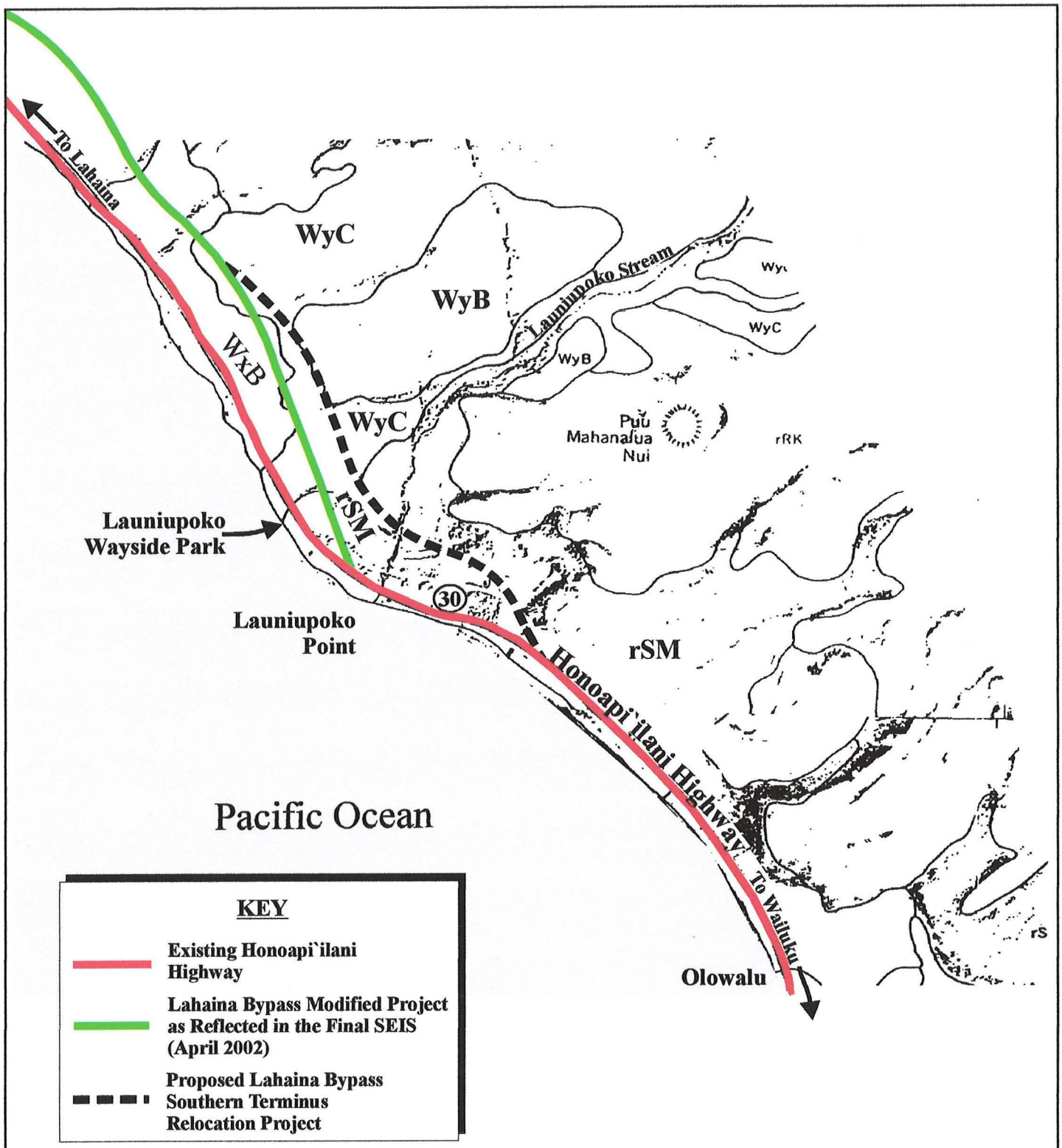
Proposed Lahaina Bypass
Southern Terminus Relocation
Soil Association Map

NOT TO SCALE

Prepared for: State of Hawai'i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LhnBypassExt\Draft EA\SoilAssociation



Source: U.S. Department of Agriculture, Soil Conservation Service

NOT TO SCALE

Figure 17

Proposed Lahaina Bypass Southern Terminus Relocation

Soil Classification Map

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\DraftEA\SoilClassificationMap

dry areas and guava, kukui, hilograss, and Christmas berry in the wet areas. Improvement of this land is difficult because of the stones and boulders.

b. Potential Impacts and Mitigation Measures

Vertical roadway profile cuts and fills will not alter local topographic and soil conditions significantly. The underlying soil conditions are not anticipated to limit pavement designs nor require extraordinary geotechnical mitigation measures for pavement stability.

4. Climate

a. Existing Conditions

Like most areas of Hawaii, the climate in this area, between Launiupoko and Olowalu, is relatively uniform year round. This stability is attributed to its tropical latitude, its position relative to storm tracts and the Pacific anticyclone, and the surrounding ocean. Variations in climate among different regions, then, are largely left to local terrain.

In Lahaina, August is historically the warmest month with an average high temperature of approximately 88 degrees Fahrenheit and average low temperature of 69 degrees Fahrenheit. February is normally the coolest month of the year with an average high temperature of 81 degrees Fahrenheit and an average low temperature of approximately 63 degrees Fahrenheit (Maui County Data Book, 2008).

Rainfall in West Maui, as measured at Kapalua-West Maui Airport, is highly seasonal, with most precipitation occurring from October to March when winter storms hit the area. Precipitation data for West Maui in 2007 shows that on average, December was the wettest month, with 11.97 inches of rainfall. Total precipitation for the year was 38.05 inches (Maui County Data Book, 2008).

The winds in the region are also seasonal. Wind patterns also vary on a daily basis, with tradewinds generally being stronger in the afternoon. During the

day, winds blow onshore toward the warmer land mass. In the evening, the reverse occurs, as breezes blow toward the relatively warm ocean.

b. Potential Impacts and Mitigation Measures

The proposed project will not have an adverse effect on micro-climates in the vicinity of the proposed project corridor.

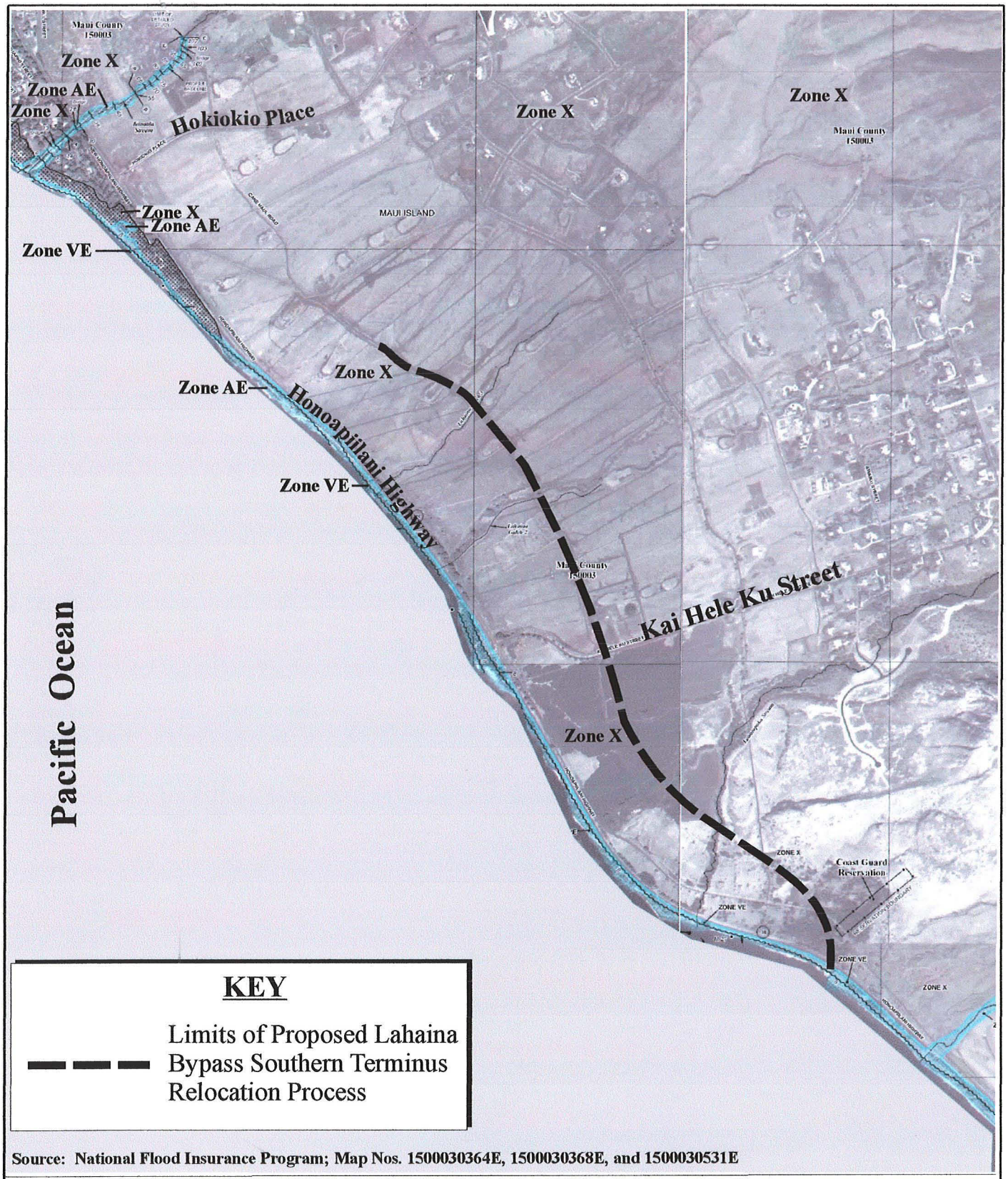
5. Flood and Tsunami Hazards

a. Existing Conditions

The Flood Insurance Rate Map (FIRM) indicates that the project site is located within Zone X, an area of minimal flooding. See **Figure 18**. The alignment resulting from the proposed southern terminus relocation traverses an east to west slope. Stormwater runoff from upland areas flows towards the coastline via local drainage gullies and gulches. After moderate storms, runoff occurs on the highways and has caused road hazards. During severe storm events, the highway can be shut down and closed to traffic due to high wave action.

As shown on **Figure 18**, there is an area subject to the 100-year coastal flood with velocity (wave action) running along the coastline identified as zones AE and VE. The base flood elevation and coastal flood zone with wave action within these areas has been determined at eight (8) feet. The inland boundary of this flood zone does not extend past the existing Honoapiilani Highway.

As discussed above, there are no regulatory flood zones established by the Federal Emergency Management Agency (FEMA) for administration of the National Flood Insurance program within the project limits. There are, however, eight (8) contributory drainage areas located above, or upstream, of the proposed realignment project. Three (3) of these drainage areas (two (2) unnamed gulches and Launiupoko Stream) are greater than one (1) square mile and will be bifurcated by the proposed project. Since the proposed action traverses these three (3) floodways, the provisions of Code of Federal



Source: National Flood Insurance Program; Map Nos. 1500030364E, 1500030368E, and 1500030531E

Figure 18

Proposed Lahaina Bypass Southern Terminus Relocation

Flood Insurance Rate Map

NOT TO SCALE

Prepared for: State of Hawaii, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\Draft EA\FIRM

Regulations (CFR) 650 (Bridges, Structures, and Hydraulics) will be applicable to the proposed project.

b. Potential Impacts and Mitigation Measures

A Drainage (Hydraulic) Study has been completed to examine the existing drainage conditions and any improvements that may be required to comply with CFR 650. See **Appendix "B"**.

As noted above, three (3) floodways identified within the project limits will be affected by the project. These three (3) drainageways generally flow from the mountain slopes to the ocean along natural contours and highway corridors. As such, there is no practical alternative to avoid encroachment by the project. These encroachments are not significant and can be mitigated by sizing and designing the drainage structures to maintain the status quo. The design of the Bypass will provide for culvert crossings which will accommodate stormwaters generated from the mauka side of the proposed roadway route.

Although Section 650.115 of CFR and HDOT's design standards allow the use of 50-year storms to size the drainage structures for smaller drainage basins, these structures will be sized to handle 100-year storms to minimize the probability of overtopping.

Desilting and retention basins will also be installed to capture the additional runoff generated by the impermeable pavement structures on the new highway to maintain the current peak runoff during a 100-year storm. Energy dissipators will also be installed at outlets of drainage structures where necessary to maintain the existing velocities in the drainageways.

The Drainage (Hydraulic) Study concludes that the encroachment across the three (3) above-noted floodways can be mitigated readily during the design phase to maintain the status quo in compliance with the provisions of CFR 650. Refer to **Appendix "B"**.

As such, no adverse effects from flood and tsunami hazards are expected as a result of the proposed action. By providing a more inland transportation

route, the proposed action will address traffic flow disruption attributed to coastal wave action and will facilitate evacuations to mauka areas.

6. Flora and Fauna

a. Existing Conditions

A Biological Resources Survey conducted in December 2006 by Robert Hobdy encompassed both a botanical survey and a fauna survey. See **Appendix "C"**.

A walk-through botanical survey method was used following both sides of the proposed right-of-way to ensure maximum coverage of the area. Areas most likely to harbor native or rare plants were more intensively examined. About 80 percent of this proposed right-of-way consists primarily of grass species with a mixture of agricultural and pasture weeds. The remaining 20 percent is made up of mixed dryland forest and shrub land. A total of 65 plant species were recorded during the survey. Of these, 3 species were indigenous to Hawaii as well as other Pacific islands. They were ilima (*Sida fallax*), aalii (*Dodonaea viscose*), and uhaloa. Each of these is extremely widespread and common throughout Hawaii. The remaining 62 species are all common non-native agricultural or pasture plants.

The fauna survey was conducted in conjunction with the botanical survey work. Four (4) species of mammals were observed within the project area during three (3) site visits to the property: mongoose, cattle, horse, and dog. Significant populations of cat, mice, and rats would also be expected in this area. A number of species of birds were observed, including barred dove, common myna, gray francolin, house finch, northern cardinal, and Japanese white-eye. The survey also took note of insect species found in the area. There was no evidence of the Blackburn's Sphinx Moth or their larvae, nor was there any finding of its host plants, the aiea or tree tobacco plant.

b. Potential Impacts and Mitigation Measures

No Federally listed endangered or threatened plant species were found in the project area, nor were any species found that are candidate for such status.

Populations of two (2) Endangered species, *Gouania hillebrandii* and *Spermolepis hawaiiensis*, are known to occur about 1.5 miles upslope of the project area in the foothills of the West Maui Mountains, but these populations lie far beyond the influence of any disturbances that might be associated with the proposed action.

Based on the findings of the Botanical Survey, it has been determined that the anticipated disturbances associated with the development of a highway are not expected to have a significant impact on the botanical resources in this part of Maui.

With respect to fauna species, only common, non-native mammals, birds, and insects were observed on the property during the course of the survey. No Federally listed endangered or threatened fauna were found.

7. Streams and Wetlands

a. Existing Conditions

The proposed action crosses two (2) unnamed drainage gulches which accommodate stormwater runoff during high rainfall events. The proposed alignment will also traverse the Launiupoko Stream. According to the Hawaii Stream Assessment (HSA), Launiupoko Stream is not perennial, flowing during storm events only. There are no outstanding aquatic resources identified at Launiupoko Stream, nor are there significant riparian resources identified. Photos of the Launiupoko Stream in the vicinity of the proposed action are presented in **Figure 19**. There are no designated wild and scenic rivers (pursuant to the 1968 National Wild and Scenic Rivers Act) in the project vicinity.

Based on the Botanical Survey conducted by Robert Hobdy, there are no wetlands found in the vicinity of the project corridor. There is no water body and wildlife refuge within or around the vicinity of the project.

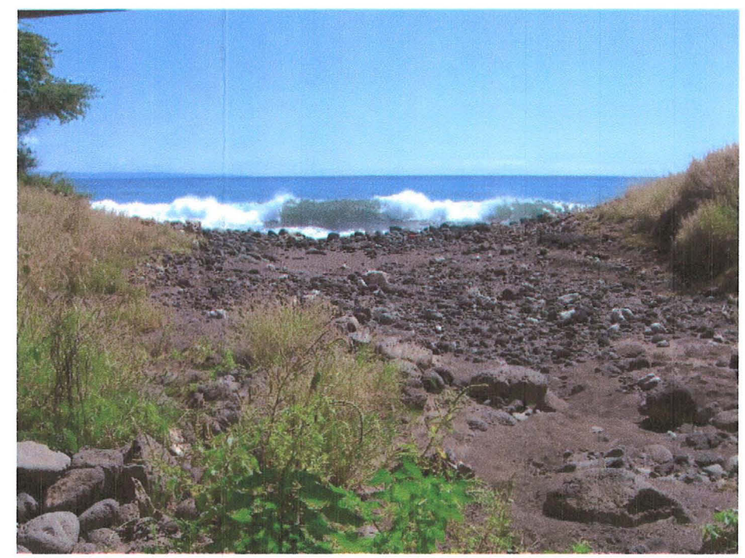
View of Stream From Mauka Crossing
Looking West (Makai)

View of Steam From Cane Haul Road Crossing,
Bridge Looking East (Mauka)

View of Honoapi`ilani Highway Bridge
Looking East (Mauka) From Shoreline

View of Stream From Mauka Crossing
Looking East (Mauka)

View Across Cane Haul Road
Crossing Looking North



View of Shoreline Looking West (Makai) From
Honoapi`ilani Highway Bridge

Source: Makila Land Co., LLC

Figure 19

Proposed Lahaina Bypass Southern Terminus Relocation

Photos of Launiupoko Stream

NOT TO SCALE

Prepared for: State of Hawai`i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\DraftEA\PhotosofLauniupokoStream

b. Potential Impacts and Mitigation Measures

The natural drainage characteristics of the Launiupoko Stream and other drainage gulches will not be altered. A preliminary drainage report has been prepared to describe the proposed drainage system for the project. See **Chapter II. Section D**. Mitigation measures, such as Best Management Practices (BMPs) for erosion and sedimentation control, are addressed in the preliminary drainage report.

8. Air Quality

a. Existing Conditions

The West Maui region in general does not experience adverse air quality conditions due to its low humidity and dry temperatures. There are no point sources of airborne emissions within close proximity of the project site. There is occasional fugitive dust generated from home construction and small farming activities within the agricultural subdivisions located upland of the proposed roadway route. However, these activities are considered intermittent with no significant adverse impacts to regional air quality parameters.

b. Potential Impacts and Mitigation Measures

The implementation of the Lahaina Bypass' southern terminus relocation project will result in construction-related air impacts. Airborne particulates, including dust, may be generated as a result of construction-related activities.

Dust control measures, such as regular watering and sprinkling, will be implemented to minimize wind-blown emissions. Other appropriate BMPs will be employed to ensure that fugitive dust from the project site is minimized.

The potential for major highway projects to impact air quality via Mobile Source Air Toxics (MSAT) has been an emerging area of environmental concern. MSATs are a subset of the 188 air toxins defined by the Clean Air

Act. The MSATs for the proposed projects are compounds emitted from highway vehicles and non-road equipment.

The purpose of the proposed project is to relocate the southern terminus of the Lahaina Bypass from its currently approved location at Launiupoko to the vicinity of the former Olowalu Landfill, approximately 4,800 feet to the south. There would be no additional intersections or connector roads with the proposed relocation, and no changes in terms of functional traffic flow. Thus, the proposed project has been determined to generate minimal air quality impacts for criteria pollutants and has not been linked with any special MSAT concerns.

Additionally, the traffic analysis for the project concluded that all three alternatives would have very similar traffic forecasts. In essence, there would be no meaningful difference between the no-build alternative and the two alternative alignments in terms of traffic volumes, vehicle mix, basic project location, or any other factors that would cause an increase in MSAT impacts from the project.

Moreover, Environmental Protection Agency (EPA) regulations for vehicle engines and fuels will cause overall MSAT emissions to decline significantly over the next several decades. Based on regulations now in effect, an analysis of national trends with EPA's MOBILE6.2 model forecasts a combined reduction of 72 percent in the total annual emission rate for the priority MSAT from 1999 to 2050 while vehicle-miles of travel are projected to increase by 145 percent. This will both reduce the background level of MSAT as well as the possibility of even minor MSAT emissions from this project.

9. Noise

a. Existing Conditions

Vehicular noise from traffic traveling along Honoapiilani Highway is the primary source of intermittent noise at the project site. Ambient noise conditions are generally associated with natural conditions such as ocean waves, wind, and rain.

b. Potential Impacts and Mitigation Measures

The implementation of the Lahaina Bypass Southern Terminus Relocation project will result in construction-related noise impacts. Heavy construction equipment, such as bulldozers, front-end loaders, and material transport vehicles, will likely be the dominant source of noise during the construction period.

In order to mitigate noise impacts, construction work will be limited to daylight hours. Construction noise will be minimized through use of applicable BMPs as well.

The proposed southern terminus relocation project is being planned in the context of future uses which will be sufficiently set back from the roadway. There are no noise sensitive receptors in the vicinity of the proposed realigned right-of-way. In summation, the proposed project is not expected to adversely impact local or regional ambient noise conditions.

10. Scenic and Open Space Resources

a. Existing Conditions

The project site offers excellent views and vistas of the Pacific Ocean, as well as the islands of Lanai and Kahoolawe. The location of the proposed action is not part of a significant view corridor. Open space resources in the region are also characterized by the West Maui Mountains, as well as the vast expanse of former agricultural lands that lie between the mountains and the proposed realigned right-of-way. From different locations along the proposed right-of-way, the views are panoramic with a portion of the islands of Kahoolawe, Lanai and Molokai in sight.

b. Potential Impacts and Mitigation Measures

No major effect on scenic and open space resources is anticipated in connection with the proposed project. The result of the more inland alignment would include the loss of immediate roadway adjacency to the ocean and the associated scenic attribute of the coastal drive. However, this

scenic route can be utilized should drivers decide to take the older and "slower" Honoapiilani route, once the Bypass segment is completed.

A Massing and Viewplane Simulation Study has been prepared in conjunction with proposed agricultural subdivisions in the project vicinity by Makila Land Co., LLC. See **Appendix "D"**. The visual study has been developed for the purpose of providing an elevation-correct simulation of the coastal views from the proposed action and to provide a scale-accurate simulation of potential residential structures which could be constructed in the proposed agricultural subdivisions. It is noted that the preferred alignment for the Southern Terminus Relocation Project is identified as Highway Alignment No. 3 in the Massing and Viewplane Simulation Study. Refer to **Appendix "D"**.

The Massing and Viewplane Simulation Study illustrates that views of the ocean will not be significantly impacted by the proposed highway alignment. Given the large size of the respective agricultural lots and the distance of the structures from the future highway, the potential impacts from the proposed farms dwellings would be minimal.

11. Historical, Archaeological, and Cultural Resources

a. Existing Conditions

An Archaeological Inventory Survey (Paraso and Dega, 2006) was performed on the larger parcels which encompasses the proposed roadway right-of-way for the Southern Terminus Relocation Project. See **Appendix "E"**. In general, the project area has been significantly altered by sugar cultivation activities. Subsurface testing conducted in connection with the previous archaeological inventory survey yielded negative results. The State Historic Preservation Division (SHPD) review and acceptance letter for this study is provided in **Appendix "E-1"**.

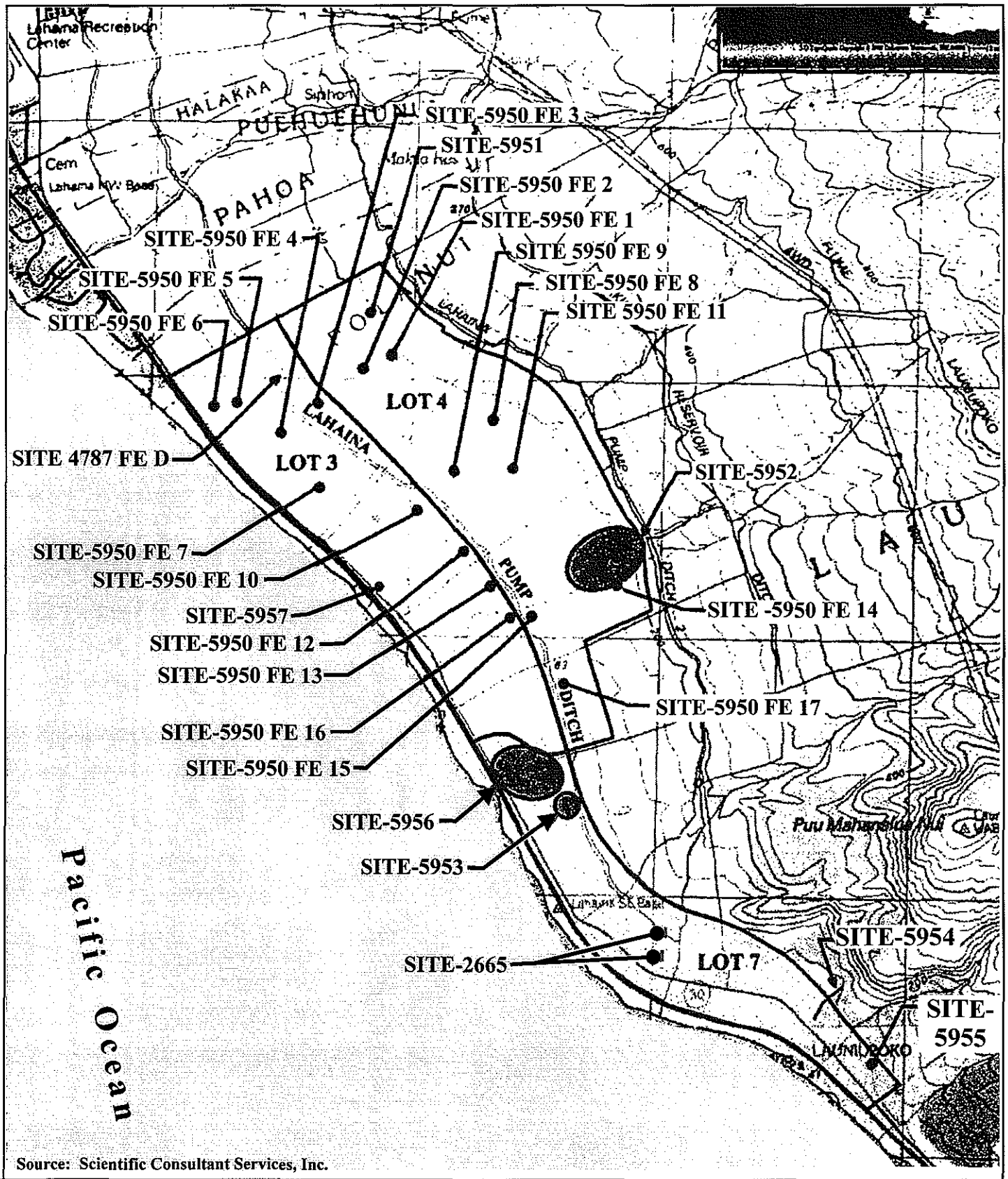
An archaeological field inspection was undertaken on October 31, 2006 and November 1, 2006, specifically for the corridor of the proposed southern terminus relocation project. See **Appendix "F"**.

Three (3) sites documented in the previous archaeological inventory survey are contained within the vicinity of the preferred roadway alignment, (Alternative 3). See **Figure 20**. These are Site 5954 (rock wall), Site 5955 (activity area), and Site 5950 (consisting of 17 rock clearing mounds). Of the 17 rock clearing mounds (Site 5950), five were determined to fall within the project area for the extension (Site 5950 FE 3, FE 12, FE 13, FE 15 and FE 16). Three (3) other identified sites in the vicinity could be affected if Alternative 2 were to be pursued. These are Site 5953 (slag scatter), Site 5956 (activity area), and Site 2665 (rock wall).

b. <u>Potential Impacts and Mitigation Measures</u>

No new archaeological sites were documented during the October 31, 2006 and November 1, 2006 field inspections. Site 5954 (rock wall), Site 5955 (activity area), Site 5953 (slag scatter), Site 5956 (activity area), and Site 2665 (rock wall) have been fully documented and no further work is required for these sites, allowing for the removal of these sites. Site 5950 (rock mounds) consists of pushpiles of large rocks that are the result of rock removal programs during former plantation use of the land. Large boulders that characterized the geology of the southern slopes of the West Maui Mountains were piled into large mounds across the lower and upper plains. Similar features of this type can be found across the West Maui region from Ukumehame to Honokowai. The five (5) mounds within Site 5950 affected by the proposed project will be monitored prior to roadway construction. A monitoring plan will be prepared and submitted to the State Historic Preservation Division for review and approval.

The construction of the proposed highway bypass along the southern terminus relocation route is not expected to have an adverse effect on cultural beliefs, practices, resources, or gathering rights along the project corridor. Act 50 of the Hawaii State Legislature (2000) requires that Environmental Assessment (EA) and Environmental Impact Statement (EIS) documents include an assessment of cultural practices, and further mandates that the planning process takes said practices into account. Consequently, a Cultural Impact Assessment (CIA) report was also prepared by Scientific Consulting Services, Inc. for the project in February 2007. See **Appendix "G"**. The CIA report



Source: Scientific Consultant Services, Inc.

Figure 20

Proposed Lahaina Bypass Southern Terminus Relocation

Location of Archaeological Sites Along Project Corridor

NOT TO SCALE

Prepared for: State of Hawaii, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\Draft EA\Location of Archaeological Sites

was based on consultation sought from various agencies, civic groups and individuals such as the Maui and Honolulu Offices of Hawaiian Affairs (OHA), the State Historic Preservation Division (SHPD), the Maui Planning Department, Na Kapuna O Maui, and Clifford Naeole (Cultural Advisor for the Ritz Carlton Kapalua). Archival research was also conducted and historical source materials were consulted.

Based on these consultations and research, the report found no evidence that the project area had been used for traditional cultural practices in recent times, and concluded that Hawaiian rights related to gathering, access, and other customary activities would not be affected by the proposed project. Consulted community members did recognize that the adjacent coastal areas contain resources which are critical for the continuance of traditional and customary native Hawaiian practices (pole fishing, diving, collecting limu, camping, etc.). The consulted community members recognized that the proposed extension could lessen highway associated impacts to coastal access and could eventually lead to an expansion of coastal activity areas. However, they also recognized that the Bypass has the potential to inhibit opportunities for mauka/makai access and suggested that the Bypass be designed to allow for safe mauka/makai access. Lastly, the consulted community members expressed the importance of preserving a lateral coastal road, in addition to the Bypass, in order to preserve ocean views and continuous coastal access. In particular, it was noted that the following comments and suggestions offered by the Lahaina Chapter of the Hawaiian Civic Club should be considered during the planning and design phase for the project:

- Incorporate pedestrian underpasses at major drainage crossings and streams, since those areas would have been used as traditional mauka/makai access by native Hawaiians.

- The current road provides continuous access and is also very scenic. The visual plain is a cultural resource often overlooked and needs to be preserved. Design plans should continue to allow vehicle access to this section of the shoreline.

- It is important to preserve a continuous coastal road (in addition to the Bypass) as an alternative route in case of emergencies.

- There are concerns about private control of new coastal accesses or roadways. Legal mechanisms should be in place which allows for public use in perpetuity.

B. SOCIO-ECONOMIC ENVIRONMENT

1. Land Use and Community Character

a. Existing Conditions

The vast majority of lands in West Maui are either State designated "Conservation" or "Agricultural". Generally, "Conservation" lands occupy the higher elevations, while the "Agricultural" district spans the middle ground. "Urban" designated lands, then, are left to occupy the lower elevations along the coast. The proposed project corridor traverses lands that are designated "Agricultural".

The region contains a diverse range of physical and socio-economic environments. With its dry and mild climate and proximity to recreation-oriented shoreline resources, the visitor-based economy has grown steadily over the years.

West Maui's attraction can be attributed to its year-round dry and warm climate, complemented by many white-sand beaches and scenic landscapes. Visitor accommodations are located in Lahaina and the resort communities of Kaanapali, Napili, and Kapalua. A number of internationally recognized luxury hotels and golf courses are located along the coastline at Kaanapali. The Kapalua-West Maui airport links this region to Oahu and other neighbor islands.

Diversified agriculture and pineapple fields occupy much of the land in the West Maui region. Maui Land & Pineapple Company's fields span along the slopes of the West Maui Mountains in the Kahana to Honolua region.

Lahaina, meanwhile, encompasses a diverse mix of land uses, including residential, business, light industrial, recreational, and agricultural uses. The town of Lahaina, located approximately three (3) miles north of the proposed

project site, is the commercial center of West Maui. The town contains several shopping centers and retail business areas, and serves as a hub for the region's residential housing.

The southern terminus relocation route of the Lahaina Bypass is within the Launiupoko area that has been historically used for sugarcane cultivation. Since the termination of sugar cultivation by Pioneer Mill Company in 1999, the area has transitioned to smaller agricultural lots.

Launiupoko Beach Park is a Maui county park approximately 6.7 acres and located just west of the project corridor. There are swimming, picnic areas, public restrooms, showers, and onsite parking. There are other County parks located along Honoapiilani Highway north and south of the proposed project as well.

Puamana Beach Park is located to the northwest of the proposed project site, while Papalaua and Ukumehame Beach Parks are located to the south.

b. Potential Impacts and Mitigation Measures

The proposed southern terminus relocation is a minor component of the overall approved Lahaina Bypass project and is not anticipated to adversely impact the land use and community character of the West Maui or its sub-region of Launiupoko. The roadway alignment has been incorporated in subdivision planning and longer-range master planning for the area. Residences and businesses will not be affected by the new alignment and the implementation of the southern terminus extension can be accomplished without adversely affecting agricultural operations.

2. Population

a. Existing Conditions

The island of Maui has the fastest growing population in the State of Hawaii. According to the latest census figures, there are an average of 50,000 residents and visitors in West Maui daily. The resident population of the West Maui Community Plan region has demonstrated a substantial increase

over the last two decades. Population gains were especially evident in the 1970's as the rapidly developing visitor industry served as a catalyst for attracting new jobs and new residents. The population in West Maui increased from 14,574 in 1990 to 17,967 in 2000. Projections of the resident population for West Maui for the years 2020 and 2030 are 25,096 and 28,903, respectively (County of Maui, June 2006).

Growth at the County level exhibits a similar pattern. The County's resident population increased from 101,709 in 1990 to 128,968 in 2000. Projections for the resident County population in 2020 and 2030 are 174,450 and 199,550, respectively (County of Maui, June 2006).

The island's defacto (residents and visitors) population is projected at 246,532 in 2030 if increases continue at historic rates. West Maui currently attracts the majority of Maui's visitors.

b. Potential Impacts and Mitigation Measures

The proposed relocation of the southern terminus to the vicinity of the former Olowalu Landfill site is a minor component of the overall approved Lahaina Bypass project and will not impact population parameters. As a fundamental infrastructure improvement needed to improve existing and long-term transportation needs of West Maui, the proposed action is not deemed a direct population generator.

3. Economy

a. Existing Conditions

The economy of Maui is heavily dependent upon the visitor industry. The dependency on the visitor industry is especially evident in West Maui, which is one of the State's major resort destination areas. The Kaanapali district includes a number of hotels, including the Maui Marriott Resort, Hyatt Regency Maui, the Westin Maui, the Sheraton Maui, and Ritz-Carlton Kapalua. The foundation for the region's visitor strength lies in the availability of vacation rentals, world-class resorts, and recreational facilities throughout West Maui.

In addition, West Maui's visitor orientation is reflected in the character of Lahaina Town, which serves as a center for visitor-related retail outlets, as well as visitor-related activities.

In terms of the agriculture industry, Pioneer Mill Company, Inc. ceased sugarcane cultivation on its lands in 1999. Of its 6,700 acres, approximately 500 acres are now currently utilized for the growing of coffee.

Maui Land & Pineapple Company's (MLP) fields remain an important component of the region's agricultural base. MLP currently leases portions of its land to Haliimaile Pineapple Company, which allows for the continuation of pineapple agriculture in West Maui.

The State's seasonally unadjusted unemployment rate was 6.4 percent for the month of February 2012. Maui County's seasonally unadjusted unemployment rate for the same period was 6.8 percent (State Department of Labor and Industrial Relations, March 2012).

b. <u>Potential Impacts and Mitigation Measures</u>

During the construction phase of the proposed project, benefits will accrue to the local economy as a direct result of construction expenditures. These beneficial impacts include contributions made in the form of wages and salaries. In the long term, the proposed action will improve existing roadway system operations for Maui residents, visitors, and businesses by providing a more efficient travel route and facilitating traffic movement.

There are no adverse economic impacts associated with the proposed action. The roadway right-of-way has been planned in the context of proposed subdivisions and master planned land uses and, therefore, does not involve the displacement of residences and business, including the displacement of existing agricultural operations.

C. PUBLIC SERVICES

1. Police and Fire Protection

a. Existing Conditions

The project site is within the Lahaina Police Station service area, which services all of the Lahaina district. The Lahaina Station is located in the Lahaina Civic Center complex at Wahikuli, approximately 7.5 miles from the project site.

Fire prevention, suppression, and protection services for the Lahaina District are provided by the Lahaina Fire Station, also located in the Lahaina Civic Center and the Napili Fire Station, located in Napili. The Lahaina Fire Station includes an engine and a ladder company, and is staffed by 30 full-time personnel. The Napili Fire Station consists of an engine company including fifteen (15) full-time fire fighting personnel.

b. Potential Impacts and Mitigation Measures

The proposed project will not affect the service area limits or requirements for police and fire protection. The provisions of a more efficient roadway, not subject to closure or disruption from coastal wave action and related erosion incidents will benefit emergency response conditions for both the Department of Fire and Public Safety and the Police Department.

2. Medical Facilities

a. Existing Conditions

The only major medical facility on the Island is Maui Memorial Medical Center, located approximately 18 miles from the project site, midway between Wailuku and Kahului. The 201-bed facility provides general, acute, and emergency care services.

Regular hours are offered by private medical practices in Lahaina, which include the Maui Medical Group, Lahaina Physicians, West Maui Healthcare Center, and Kaiser Permanente Lahaina Clinic.

b. Potential Impacts and Mitigation Measures

The proposed project will not affect the service area limits or requirements for medical services. As with fire and police services, the new roadway alignment to the vicinity of the former Olowalu Landfill site will provide for improved travel conditions for medical emergency response. As previously noted, the proposed action will benefit residents and visitors with a more efficient roadway to accommodate a higher capacity of traffic and a roadway less subject to road closure due to high surf.

3. Recreational Facilities

a. Existing Conditions

West Maui is served by numerous recreational facilities offering diverse opportunities for the region's residents. There are seventeen (17) County parks and three (3) State beach parks in West Maui. Approximately one-third of the County parks are situated along the shoreline and provide excellent swimming, diving, and snorkeling opportunities.

In addition, Kaanapali and Kapalua Resorts operate world-class golf courses which are available for public use.

County park facilities in the vicinity of the proposed southern terminus relocation project include the Puamana Beach Park and the Launiupoko Beach Park. The Puamana Beach Park is located approximately 1.5 miles to the northwest of the proposed project vicinity. This 1.4-acre park includes picnic tables, portable toilets, an outdoor shower and parking for approximately 32 vehicles.

The Launiupoko Beach Park is located to the west of the proposed project route, seaward of the intersection of Honoapiilani Highway and Kai Hele Ku

Street. Launiupoko Beach Park is 6.7 acres in size and offers picnic tables, comfort station, an outdoor shower, and paved parking.

Additionally, the coastline at various locations is used by residents and visitors alike for coastal recreation uses. These beaches are busy with a wide variety of ocean activities, including fishing, surfing, snorkeling, and sun bathing.

b. Potential Impacts and Mitigation Measures

The proposed southern terminus relocation will not impact existing public recreational facilities which are located along the coastline. Once completed, opportunities for increasing coastal recreation areas in the area can be further explored.

4. Schools

a. Existing Conditions

The West Maui area is served by four public schools operated by the State of Hawaii, Department of Education as shown in **Table 3**.

Table 3. Department of Education (DOE) Schools Located in West Maui

School	Enrollment (2009-2010)
Kamehameha III Elementary School	713
Princess Nahienaena Elementary School	610
Lahaina Intermediate School	693
Lahainaluna High School	969
Source: State of Hawaii, Department of Education.	

All of the public schools are located within the Lahaina Town area.

University of Hawaii-Maui Campus is located in Kahului and is a branch of the University of Hawaii system. This is the primary higher education

institution serving the County of Maui. Private schools in the West Maui region include Sacred Hearts School and Maui Preparatory Academy.

b. Potential Impacts and Mitigation Measures

Inasmuch as the proposed southern terminus relocation of the Lahaina Bypass corridor to the vicinity of the former Olowalu Landfill site is not a direct population generator, the proposed action will not affect school enrollments and facility requirements.

5. Solid Waste

a. Existing Conditions

Single-family residential solid waste collection service is provided by the County of Maui on a once-a-week basis. Residential solid waste collected by County crews is disposed at the County's Central Maui Landfill, located four (4) miles southeast of the Kahului Airport. In addition to County-collected refuse, the Central Maui Landfill accepts commercial waste from private collection companies.

To facilitate solid waste collection services for the West Maui region, a refuse transfer station has been established at the former County landfill site at Olowalu which is located near the proposed new southern terminus.

b. Potential Impacts and Mitigation Measures

Cleared and grubbed materials from the roadway right-of-way will be disposed for composting use, as applicable. Construction waste which may be generated from the building of the roadway (e.g., wood used for casting and forming) will be either recycled or disposed of at an approved construction waste site. With these solid waste management provisions, the contribution of construction waste to the County's Central Maui Landfill will be minimized. Thus, the proposed action will not affect collection or capacity parameters of the County's solid waste disposal system.

D. INFRASTRUCTURE

1. Roadways

a. Existing Conditions

A Traffic Impact Analysis Report (February 2009) was prepared by SSFM International, Inc. to analyze the impact of the proposed relocation of the Lahaina Bypass southern terminus on future traffic operations of the approved Lahaina Bypass Highway. See **Appendix "H"**. The study area used in the TIAR extends from Hokiokio Place to the proposed new location for the intersection of the southern terminus with the Honoapiilani Highway.

To provide context, a summary of the roadway network (including existing and planned facilities) within the study area is provided below:

- **Honoapiilani Highway (Existing)**

  Honoapiilani Highway is an existing state-owned and maintained regional highway facility. It is currently the only major roadway facility providing vehicular access between West Maui with the central valley of the island. The highway in the vicinity of the Olowalu and Launiupoko area primarily serves as access for vehicles traveling to and from the Lahaina, Kaanapali, and Kapalua resort areas. The highway in the project area is a two-lane rural highway generally aligned in an east to west direction following the coastline. The highway has a posted speed limit of 35 miles per hour (mph) in the Olowalu area, increasing to 45 mph outside of this area toward Lahaina Town. In the project area, the highway has 12-foot-wide lanes with paved shoulders varying in widths from about 6 to 10 feet wide.

- **Lahaina Bypass Highway (Planned)**

  The Lahaina Bypass Highway will initially be constructed in three phases as a two-lane highway between the northern terminus located in Honokowai and the southern terminus by the year 2020. The

roadway network created as a result of the proposed relocation of the southern terminus would fall under Phase 1B-2 of the Lahaina Bypass project. An additional makai-mauka roadway, referred to as the Puamana Connector, between the Honoapiilani Highway and the Lahaina Bypass would also be constructed in the vicinity of Puamana Beach Park. Refer to **Figure 5**. Upon completion of construction of the two-lane Lahaina Bypass project, the highway will then be widened by the State from two (2) to four (4) lanes by 2035 in order to accommodate projected traffic growth in the West Maui region. As is the case with the original approved bypass alignment, the roadway network between Hokiokio Place and the relocated southern terminus would consist of five (5) intersections. Refer to **Figure 5** and **Table 4**, as follows:

Table 4: Study Area Intersections

Intersection	Location
A	Lahaina Bypass Highway and Honoapiilani Highway (Proposed Southern Terminus)
B	Lahaina Bypass Highway and Kai Hele Ku Street
C	Lahaina Bypass Highway and Puamana Connector
D	Honoapiilani Highway and Puamana Connector
E	Honoapiilani Highway and Kai Hele Ku Street

- **Puamana Connector (Planned)**

As noted above, the Puamana Connector is planned as a new mauka-makai roadway which would provide access between the Lahaina Bypass Highway and the portion of the Honoapiilani Highway entering Lahaina Town from the south terminus of the bypass. Refer to **Figure 5**. This intersection would be located in the general vicinity of Puamana Beach Park. Two (2) alternative alignments for the Puamana Connector are currently being evaluated for implementation by HDOT. A discussion of these alternatives is presented in Section II of this document. This connector roadway is eventually planned to extend mauka of the Lahaina Bypass to provide

access to both existing and proposed mauka residential areas. The mauka portion of the Puamana Connector will be completed by others. The section of Honoapiilani Highway falling between the intersection of this connector and proposed southern terminus of the Bypass is intended to be converted by HDOT and the County of Maui into a local roadway in order to facilitate local access to Lahaina Town and promote coastal recreational opportunities along this section of coastline.

- **Kai Hele Ku Street (Existing)**

  Kai Hele Ku Street is an existing roadway which intersects Honoapiilani Highway as a signalized intersection across from Launiupoko Wayside Beach Park. The roadway provides access to existing residential areas located mauka of the Honoapiilani Highway. The proposed bypass would require construction of an additional intersection along the mauka segment of this roadway. The amended Lahaina Bypass alignment resulting from the proposed relocation of the southern terminus would provide for a more appropriate intersection connection with Kai Hele Ku Street than was previously planned under the original approved alignment. Refer to **Figure 5**.

b. <u>Potential Impacts and Mitigation Measures</u>

The TIAR analyzed the traffic impacts of the proposed southern terminus relocation project during both the morning and afternoon peak hour periods in the 2020 and 2035 planning time horizons. A subsequent analysis showed that the traffic forecasts would be similar for all three (3) alignments being considered for the Lahaina Bypass Southern Terminus Relocation Project. The first study year (2020) is the expected completion of the entire bypass highway as a two-lane highway and the second study year (2035) is its completion as a four (4) lane highway. The study also developed conceptual recommendations for the design of the five (5) intersections that would fall along the proposed amended alignment. In addition to the construction and widening of the Lahaina Bypass, the study assumed that the portion of the Honoapiilani Highway immediately south of the proposed location for the

southern terminus would also be widened to four (4) lanes by 2020 to accommodate projected traffic volumes.

The study developed morning and afternoon peak hour traffic projections (for 2020 and 2035) for the five (5) intersections that would be developed within the study area by using baseline traffic data prepared for both the modified Lahaina Bypass Highway and the Honoapiilani Highway Widening/Realignment (Maalaea to Launiupoko) project. The baseline data was updated to reflect recent and future residential development on either side of the bypass highway alignment.

A Level of Service (LOS) analysis was then prepared for those five (5) intersections using the traffic projections to identify potential traffic impacts and propose mitigation strategies and intersection design solutions, as applicable. LOS ratings are commonly utilized in traffic studies to measure the quality of traffic flow on roadway facilities, particularly at signalized intersections. LOS designations range from the best, most efficient rating of "A" (average delays of less than 10 seconds) to the least efficient rating of "F" (average delays longer than 80 seconds). Service level ratings between "A" and "D" are generally considered acceptable for major roadway facilities. LOS ratings "E" and "F" are, however, indicative of the need for the formulation and application of mitigation measures. Notwithstanding the foregoing service assessment criteria, intersections are often designed with the priority of facilitating a higher level of service for approaches along major streets. Lower levels of service along minor street approaches to intersections can, therefore, be tolerated if they allow major roadways with higher volumes of traffic to operate at acceptable levels of service. A discussion of the findings of the LOS analysis is provided in the TIAR. Refer to **Exhibit "H"**.

Following completion of the traffic projections and LOS analysis components of the traffic study, a series of conceptual design recommendations for the five (5) intersections were presented based upon an assessment of potential alternatives. The recommended intersection designs were selected based upon projected improvements in service ratings relative to the level of mitigation necessitated by the traffic forecasts.

In considering alternative intersection designs, roundabouts were not considered feasible since they do not conform to several guidelines set forth in the HDOT's memo on Modern Roundabouts Policy Guideline dated December 19, 2008. These non-conforming items include:

- The capacity of a single lane roundabout of 1,100 vehicles per hour is insufficient to handle the forecast volumes for the project.

- Operating speeds through roundabouts should not exceed 35 miles per hour while the design speed of the roadway is 55 miles per hour.

- Roundabouts need not be considered when less than 10% of the traffic enters the intersection from a minor street, which is the case for several intersections in the project area.

- Roundabouts are best suited for level terrain while the bypass highway alignment is located across a rolling terrain.

2020 Study Year

Due to continued increases in roadway usage in West Maui, the proposed section of roadway generated by the relocated southern terminus will operate over recommended capacity limits by the year 2020. The two-lane bypass highway would, therefore, not be adequate toward meeting the 2020 travel element between the southern terminus and the Puamana Connector. To meet 2020 traffic demand projections, the existing section of the Honoapiilani Highway will need to be maintained as a regional roadway until the widening of the Lahaina Bypass to four (4) lanes in 2035. Furthermore, Honoapiilani Highway will need to be widened to four (4) lanes south of the relocated southern terminus by 2020.

All of the five (5) intersections would require signalization by 2020. A summary of the recommended design concept for each of the five (5) study intersections in 2020 is presented in **Table 5** below. Graphic illustrations for each of these recommended intersection designs are provided in the TIAR. Refer to **Appendix "H"**.

Table 5. Recommended Intersection Designs for Study Area

Intersection Description		2020 Recommended Design	TIAR Date/Figure Reference No.
A	Lahaina Bypass Highway and Honoapiilani Highway (Proposed Southern Terminus)	Signalized T-Intersection	Page 30 (Figure D-1)
B	Lahaina Bypass Highway and Kai Hele Ku Street	Traditional Signalized Intersection	Page 35 (Figure D-4)
C	Lahaina Bypass Highway and Puamana Connector	Traditional Signalized Intersection	Page 40 (Figure D-7)
D	Honoapiilani Highway and Puamana Connector	Signalized T-Intersection	Page 45 (Figure D-10)
E	Honoapiilani Highway and Kai Hele Ku Street	Existing Signalized Intersection	Page 48 (Figure D-12)

2035 Study Year

As discussed previously, the Lahaina Bypass is expected to be operating as a four (4) lane highway by the study year 2035. The TIAR concludes that the four (4) lane highway network will provide adequate capacity to accommodate all north-south traffic flows in the year 2035. Two scenarios for utilizing the existing Honoapiilani Highway would then be available. First, the Honoapiilani Highway would have the ability to be converted into a local recreational roadway from 2035 onwards. Under this scenario (Scenario A), the intersections at either end of this portion of the Honoapiilani Highway would not require signalization and would not permit cross-traffic movements onto the Lahaina Bypass.

Alternatively, Honoapiilani Highway could be retained as a two-lane highway between the southern terminus and the Puamana Connector (Scenario B). This scenario would further improve traffic operations along the Lahaina Bypass corridor by providing diversion opportunities for traffic using the facility. Under this scenario, the intersections at either end of this section of the Honoapiilani Highway would require signalization to facilitate cross traffic movements onto the Lahaina Bypass.

To ensure acceptable LOS, the TIAR presents the following recommendations for the design of the five (5) intersections along the realigned Lahaina Bypass Highway under the two (2) above-noted scenarios, which are summarized in **Table 6**. Again, Scenario A represents the case where Honoapiilani Highway would be made into a local roadway whereas Scenario B illustrates the situation where Honoapiilani Highway would continue to operate as a two-lane highway.

Table 6. Recommended Intersection Design for 2035 Study Year

Intersection Description		SCENARIO A 2035 Recommended Design (No Diversion)	TIAR Page/Figure Reference	SCENARIO B 2035 Recommended Design (With Diversion)	TIAR Page (Figure) Reference
A	Lahaina Bypass Highway and Honoapiilani Highway	T-Intersection	Page 31 (Figure D-2)	Signalized T-Intersection	Page 32 (Figure D-3)
B	Lahaina Bypass Highway and Kai Hele Ku Street	Michigan U-Turn	Page 37 (Figure D-6)	Same	Same
C	Lahaina Bypass Highway and Puamana Connector	Partial Interchange	Page 42 (Figure D-9)	Same	Same
D	Honoapiilani Highway and Puamana Connector	T-Intersection	Page 46 (Figure D-11)	Signalized T-Intersection	Page 45 (Figure D-10)
E	Honoapiilani Highway and Kai Hele Ku Street	Signalized Intersection (Existing)	Page 48 (Figure D-12)	Same	Same

The TIAR concludes that with implementation of the recommended intersection designs and maintenance of the Honoapiilani Highway as a through road until the year 2035, the amended alignment of the Lahaina Bypass Project is expected to operate at acceptable levels of service in both the 2020 and 2035 planning time horizons. Based on the findings of the TIAR, the relocation of the southern terminus will not adversely impact the

future traffic operating conditions of the Lahaina Bypass Highway project. Refer to **Appendix "H"**.

2. Water

a. Existing Conditions

A Preliminary Engineering Report has been completed for the proposed project by Warren S. Unemori Engineering, Inc. in January 2008. See **Appendix "I"**. The water systems in Launiupoko area are privately owned and regulated by the Public Utilities Commission (PUC) Company. There is no water system within the proposed project corridor except for a line along Kai Hele Ku Street which is being used primarily for irrigation. Since the new Kai Hele Ku Street intersection will be at grade, the existing waterline will not be affected.

The existing, source, storage, and water distribution systems are located mauka and east of the proposed highway corridor. Therefore, the HDOT proposes to install new pipeline sleeves or lines across the right-of-way to service lands on the makai side of the highway. Refer to **Appendix "I"**.

b. Potential Impacts and Mitigation Measures

The proposed project is not anticipated to impact water demand or affect water infrastructure requirements. Refer to **Appendix "I"**.

3. Wastewater

a. Existing Conditions

There are no County operated wastewater disposal facilities in the Olowalu area, including the project site. Individual wastewater disposal needs in the Launiupoko area are currently addressed either by septic or equivalent individual treatment systems.

b. Potential Impacts and Mitigation Measures

The proposed project is not anticipated to create an additional demand for wastewater services.

4. Drainage

a. Existing Conditions

As previously discussed in Chapter II, Section A(5) of this report, a Preliminary Drainage (Hydraulic) Study was completed for the Southern Terminus Relocation Project to examine existing drainage improvements and any improvements that will be required to comply with Code of Federal Regulations - CRF 650 (Bridges, Structures and Hydraulics). Refer to **Appendix "B"**.

There are eight (8) upland drainage or watershed areas which contribute to drainage flows across the project area. These drainage areas are located on the westerly slopes of the West Maui Mountains, and consist of both steep slopes and flatter lands, the latter of which was previously utilized for cultivation of sugar cane prior to the closure of Pioneer Mill in 1999. Portions of these flatter slopes have been subdivided in recent years and are now characterized by single-family residential housing.

The proposed drainage systems for the realigned highway, summarized below in **Table 7**, along with estimated drainage rates, have been sized in accordance with CFR 650 to maintain surface run-off for the 100-year, 24-hour storm from mauka lands at pre-development rates and volumes. A graphic depiction of these improvements for the proposed realignment is presented in **Exhibit "C"** of the Preliminary Drainage (Hydraulic) Study (Refer to **Appendix "B"** in this document).

Table 7: Proposed Project-Related Drainage Improvements

Drainage Basin	Drainage Area (acres)	Estimated Run-off Rate (cfs)	Size of Proposed Drainage Structure
1	866	1768[1]	Single 9' x 20' Box Culvert
2	785	1646[1]	Single 8' x 20' Box Culvert
3	1581	3067[1]	Twin 8' x 18' Box Culvert
4	261	333[1]	84" C.M. Pipe
5a	115	117[1]	54" C.M. Pipe
5b	212	216[1]	72" C.M. Pipe
6a	76	80[1]	48" C.M. Pipe
6b	231	27[1]	72" C.M. Pipe
6c	26	34[1]	36" C.M. Pipe
7a	82	94[1]	54" C.M. Pipe
7b	78	91[1]	54" C.M. Pipe
8	81	79[1]	48" C.M. Pipe.

cfs - cubic feet per second

[1] - 100-year, 24-hour storm

In summary, the drainage system along the realigned highway within the project area is proposed to consist of three (3) box culverts and nine (9) C.M. Pipe structures.

Desilting and retention basins will also be installed to capture the additional runoff generated by the impermeable pavement structures on the new highway to maintain the current peak runoff during a 100-year storm. Energy dissipaters will also be installed at outlets of drainage structures where necessary to maintain the existing velocities in the drainageways. Refer to **Appendix "B"**.

b. <u>Potential Impacts and Mitigation Measures</u>

With implementation of the proposed drainage improvements along the amended alignment, the proposed project is not anticipated to impact downstream properties or coastal resources.

5. Electrical, Telephone, and CATV Systems

a. Existing Conditions

Electrical power and telephone service are provided to the Launiupoko area by Maui Electric Company, Ltd. (MECO) and Hawaiian Telcom, via overhead distribution lines situated along Honoapiilani Highway. MECO's main high voltage transmission line connecting the Lahaina and Central Maui areas, runs along the foothills of the West Maui Mountains approximately one mile east (mauka) of the proposed project corridor. An overhead distribution system providing electrical service to residential areas mauka of the proposed project corridor also exists along Kai Hele Ku Street.

b. Potential Impacts and Mitigation Measures

The proposed project will not impact the regional transmission line, nor will it require infrastructural improvements to the existing distribution lines along Honoapiilani Highway. The overhead distribution system along Kai Hele Ku Street will be placed underground across the proposed project corridor during construction.

E. CUMULATIVE AND SECONDARY IMPACTS

The proposed relocation of the Lahaina Bypass terminus from Launiupoko to the vicinity of the former Olowalu Landfill site is part of the larger Lahaina Bypass project which will extend to Honokowai to the north. As previously stated in Chapter I, the Supplemental Final EIS for the Lahaina Bypass was concluded in April 2002. The action covered under this environmental assessment does not alter the scope of the Lahaina Bypass project as previously described in the Supplemental Final EIS, with the exception that the southern terminus would be extended by approximately 4,800 feet to the south.

The realignment of the Lahaina Bypass right-of-way upland does provide for associated benefits as described in Chapter I. In particular, by moving the major high speed transportation corridor inland, there would be opportunities to expand coastal recreational areas by modifying the alignment of the existing Honoapiilani Highway to create a local coastal access roadway. If this coastal recreational concept is realized, public benefits will include improved access to shoreline areas, and safer access to coastal areas as the high-

speed Honoapiilani Highway may be functionally reclassified to a lower class of roadway serving local shoreline areas only. Additionally, the need to artificially armor the shoreline to mitigate shoreline erosion will be minimized, thus providing for natural beach processes to continue without intervention.

In light of the preceding discussion, there are no adverse cumulative or secondary impacts anticipated from the proposed southern terminus relocation project.

IV. RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS

IV. RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS

A. STATE LAND USE DISTRICTS

Chapter 205, Hawaii Revised Statutes, relating to the Land Use Commission, establishes four (4) major land use districts in which all lands in the State are placed. These districts are designated "Urban", "Rural", "Agricultural", and "Conservation". The subject property encompasses lands classified as "Agricultural". See **Figure 21**. Roadways are a permitted use in the Agricultural district.

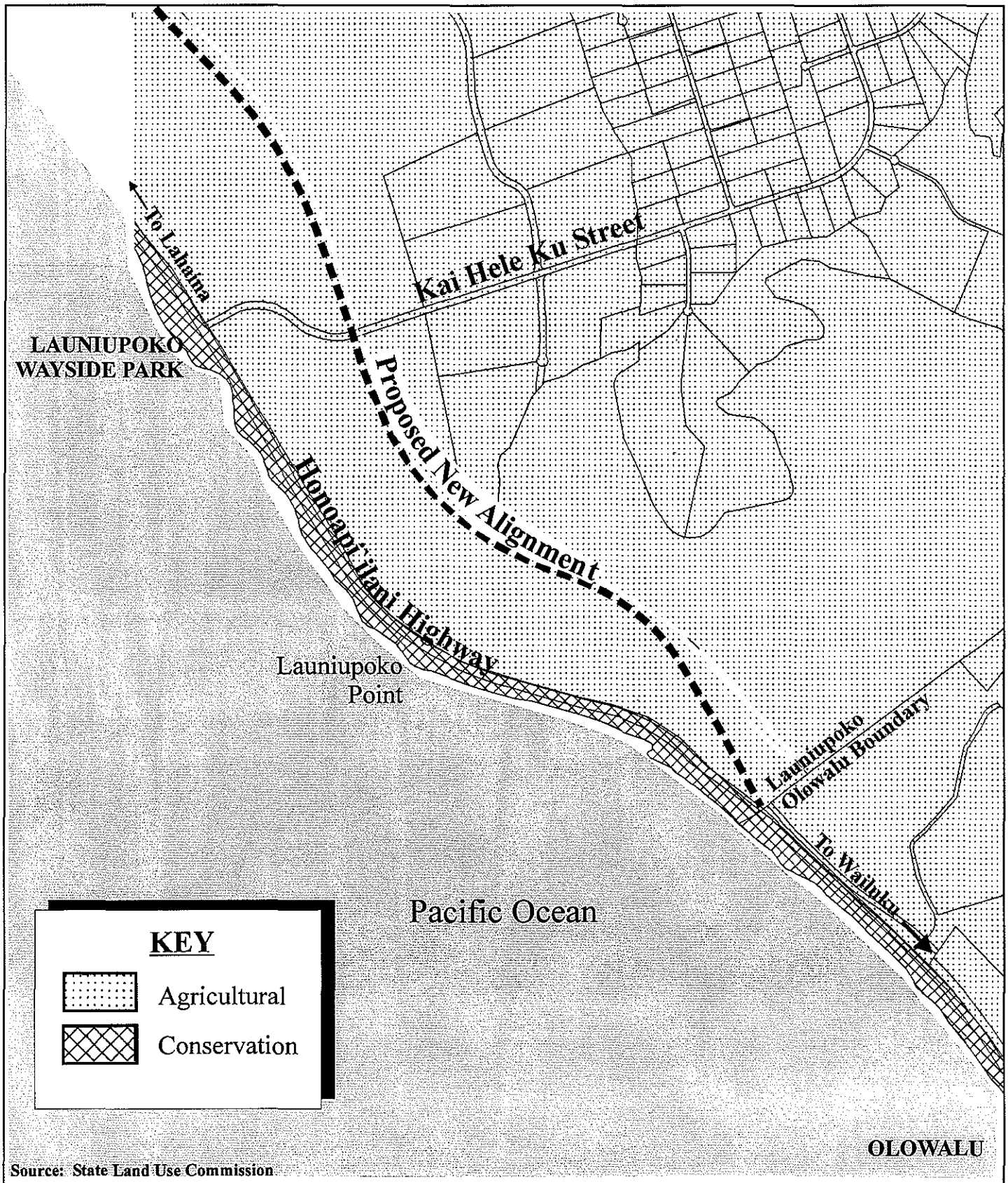
B. MAUI COUNTY GENERAL PLAN

As indicated by the Maui County Charter, the purpose of the general plan shall be to:

> *... indicate desired population and physical development patterns for each island and region within the county; shall address the unique problems and needs of each island and region; shall explain opportunities and the social, economic, and environmental consequences related to potential developments; and shall set forth the desired sequence, patterns and characteristics of future developments. The general plan shall identify objectives to be achieved, and priorities, policies, and implementing actions to be pursued with respect to population density; land use maps, land use regulations, transportation systems, public and community facility locations, water and sewage systems, visitor destinations, urban design, and other matters related to development.*

Chapter 2.80B of the Maui County Code, relating to the General Plan and Community Plans, implements the foregoing Charter provision through enabling legislation which calls for a Countywide Policy Plan and a Maui Island Plan. The Countywide Policy Plan was adopted as Ordinance No. 3732 on March 24, 2010. The Maui Island Plan is currently in the process of review and formulation by the Maui County Council.

With regard to the Countywide Policy Plan, Section 2.80B.030 of the Maui County Code states the following.



Source: State Land Use Commission

Figure 21

Proposed Lahaina Bypass
Southern Terminus Relocation
State Land Use Designations

0 0.06 0.12 0.24 Miles

Prepared for: State of Hawai'i, Department of Transportation

MUNEKIYO & HIRAGA, INC.

MakilaLand\LahBypassExt\Draft EA\SLUD

The countywide policy plan shall provide broad policies and objectives which portray the desired direction of the County's future. The countywide policy plan shall include:

1. *A vision for the County;*
2. *A statement of core themes or principles for the County; and*
3. *A list of countywide objectives and policies for population, land use, the environment, the economy, and housing.*

Core principles set forth in the Countywide Policy Plan are listed as follows:

1. Excellence in the stewardship of the natural environment and cultural resources;
2. Compassion for and understanding of others;
3. Respect for diversity;
4. Engagement and empowerment of Maui County residents;
5. Honor for all cultural traditions and histories;
6. Consideration of the contributions of past generations as well as the needs of future generations;
7. Commitment to self-sufficiency;
8. Wisdom and balance in decision making;
9. Thoughtful, island appropriate innovation; and
10. Nurturance of the health and well-being of our families and our communities.

Congruent with these core principles, the Countywide Policy Plan identifies goals objectives, policies and implementing actions for pertinent functional planning categories, which are identified as follows:

1. Natural environment
2. Local cultures and traditions
3. Education

4. Social and healthcare services

5. Housing opportunities for residents

6. Local economy

7. Parks and public facilities

8. Transportation options

9. Physical infrastructure

10. Sustainable land use and growth management

11. Good governance

With respect to the proposed relocation of the Lahaina Bypass Southern Terminus from Launiupoko to the vicinity of the former Olowalu Landfill site, the following goals, objectives, policies and implementing actions are illustrative of the project's compliance with the Countywide Policy Plan:

H. DIVERSIFY TRANSPORTATION OPTIONS

Goal: Maui County will have an efficient, economical, and environmentally sensitive means of moving people and goods.

Objective:

- Provide an effective, affordable, and convenient ground-transportation system that is environmentally sustainable.

Policies:

- Execute planning strategies to reduce traffic congestion.
- Plan for the efficient relocation of roadways for the public benefit.
- Ensure that roadway systems are safe, efficient, and maintained in good condition.
- Evaluate all alternatives to preserve quality of life before widening roads.

I. IMPROVE PHYSICAL INFRASTRUCTURE

Goal: Maui County's physical infrastructure will be maintained in optimum condition and will provide for and effectively serve the needs of the County through clean and sustainable technologies.

Objective:

- Improve the planning and management of infrastructure systems.

Policies:

- Discourage the development of critical infrastructure systems within hazard zones and the tsunami-inundation zone to the extent practical.
- Ensure that basic infrastructure needs can be met during a disaster.

In summary, the proposed relocation of the Lahaina Bypass Southern Terminus from Launiupoko to the vicinity of the former Olowalu Landfill site, is consistent with the themes and principles of the Countywide Policy Plan.

C. WEST MAUI COMMUNITY PLAN

The project site is located in the West Maui Community Plan region. This region is one (1) of nine (9) Community Plan regions established in the County of Maui. The Community Plans establish regional planning guidelines. The West Maui Community Plan Land Use Map designates the project area as "Agricultural".

The proposed project implements the following goals, objectives, and policies of the West Maui Community Plan.

LAND USE

Goal

An attractive, well-planned community with a mixture of compatible land uses in appropriate areas to accommodate the future needs of residents and visitors in a manner that provides for the stable social and economic well-being of residents and the preservation and enhancement of the region's open space areas and natural environmental resources.

Objectives and Policies

- Preserve and enhance the mountain and coastal scenic vistas and the open space areas of the region.

- Where possible, relocate the Honoapiilani Highway south of Puamana in order to reduce potential inundation and disruption of service due to storm-generated wave action. Where the highway is relocated for the purpose stated, lands makai of the new alignment shall be designated Open Space (OS) or Park (PK) to provide for ocean-related recreational use. Notwithstanding the foregoing, continued agriculture use shall be allowed within these areas.

ENVIRONMENT

Goal

A clean and attractive physical, natural and marine environment in which man-made developments on or alterations to the natural and marine environment are based on sound environmental and ecological practices, and important scenic and open space resources are preserved and protected for public use and enjoyment.

Objectives and Policies

- Prohibit the construction of vertical seawalls and revetments except as may be permitted by rules adopted by the Maui Planning Commission governing the issuance of Shoreline Management Area (SMA) emergency permits, and encourage beach nourishment by building dunes and adding sand as a sustainable alternative.

- Protect the shoreline and beaches by preserving waterfront land as open space wherever possible. This protection shall be based on a study and analysis of the rate of shoreline retreat plus a coastal hazard buffer zone. Where new major waterfront structures or developments are to be approved, preservation should be assured for 50-100 years by employing a shoreline setback based on the rate established by the appropriate study.

INFRASTRUCTURE

Goal

Timely and environmentally sound planning, development, and maintenance of infrastructure systems which serve to protect and preserve the safety and health of the region's residents,

commuters, and visitors through the provision of clean water, effective waste disposal and efficient transportation systems which meets the needs of the community.

Transportation

Objectives and Policies

- Support construction of the planned Lahaina Bypass Road in such a way as to promote safe, efficient travel across the region without encouraging further urbanization or impeding agricultural operations.

- Support the provision of an alternative route between West Maui and Central Maui.

Implementing Actions

- Widen the existing highway to four lanes from the pali to Lahaina town and from Kaanapali Parkway to Office Road.

- Discourage at-grade intersections along the planned Lahaina Bypass Road, in order to maintain safe and efficient traffic flow without traffic signals. When and where appropriate, provide for the safe under passage of agricultural equipment and vehicles, such as via stream crossings.

SOCIAL INFRASTRUCTURE

Goal

Develop and maintain an efficient and responsive system of public services which promotes a safe, healthy, and enjoyable lifestyle, and offers opportunities for self improvement and community well being.

Recreation and Open Space

Objective and Policy

- Provide resource-oriented regional park facilities and public access along the shoreline for picnicking, camping, informal play, swimming, sunbathing, and other coastal-related activities along coastal lands makai of the existing or future realigned

coastal highways from Honokahua Bay to the district's north boundary and from Puamana to the district's south boundary, except for the agriculture designated lands makai of the highway at Olowalu.

GOVERNMENT

Goal

Government that demonstrates the highest standards of fairness, responsiveness to the needs of the community, fiscal integrity, effectiveness in planning and implementing programs and projects to accommodate a stable social and economic well-being for residents, a fair and equitable approach to taxation, and efficient and results-oriented management.

Objective and Policy

- Coordinate and direct future public and private development, including capital improvement projects, consistent with the Community Plan and the island-wide directed and managed growth plan required by the General Plan.

D. MAUI COUNTY ZONING

The project site is zoned "Agricultural" " by the County of Maui. The proposed southern terminus relocation project is allowable under the current zoning designation for the property.

E. HAWAII COASTAL ZONE MANAGEMENT PROGRAM

The Hawaii Coastal Zone Management Program (HCZMP), as formalized in Chapter 205A, HRS, establishes objectives and policies for the preservation, protection, and restoration of natural resources within Hawaii's coastal zone.

It is noted that the new southern terminus point where the Lahaina Bypass connects to Honoapiilani Highway may involve work within the County of Maui's Special Management Area or SMA. The specific details of the connection point will be better defined following completion of more detailed engineering work. Should construction work fall within the SMA, a SMA Permit will be required. Depending on the scope and cost of improvements falling within the SMA, the permit may be issued as a "Minor Permit" which is issued

administratively, or a "SMA Use Permit" which requires the approval of the Maui Planning Commission. The analysis which follows is provided to address overall requirements of Chapter 205A, HRS, as well as SMA permitting needs, should a SMA permit be needed.

(1) Recreational Resources

Objective: Provide coastal recreational opportunities accessible to the public.

Policies:

(A) Improve coordination and funding of coastal recreational planning and management; and

(B) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:

(i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;

(ii) Requiring replacement of coastal resources having significant recreational value including, but not limited to, surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the state for recreation when replacement is not feasible or desirable;

(iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;

(iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;

(v) Ensuring public recreational uses of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;

(vi) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, and county authorities; and crediting such dedication against the requirements of Section 46-6, HRS.

Response: The proposed southern terminus relocation project will not affect existing coastal recreation areas such as Launiupoko Beach Park or Puamana Beach Park. The inland alignment of the Bypass resulting from the terminus relocation to the south will provide opportunity for enhancing coastal recreation areas.

(2) Historic Resources

Objective: Protect, preserve and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies:

(A) Identify and analyze significant archeological resources;

(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and

(C) Support state goals for protection, restoration, interpretation, and display of historic resources.

Response: A field inspection of the proposed project area was conducted by Scientific Consultant Services (SCS), Inc. on October 31 and November 1, 2006. The area surveyed covered a 2.5 mile, 160 ft. wide corridor that extends toward Lahaina from the former Olowalu Landfill northwest to Puamana. There were three (3) sites documented by Paraso and Dega (2006) that are contained within the proposed Bypass alignment. Two (2) of the three (3) sites have been fully documented as Criterion D sites (Paraso and Dega 2006) and no further work has been recommended. The five (5) rock mounds located within the project limits will be subject to archaeological monitoring. In the event archaeological resources are uncovered during construction of the roadway, appropriate "stop work", review and mitigation protocols will be implemented by the contractor and the HDOT.

(3) Scenic and Open Space Resources

Objective: Protect, preserve and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies:

(A) Identify valued scenic resources in the coastal zone management area;

(B) Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;

(C) Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and

(D) Encourage those developments that are not coastal dependent to locate in inland areas.

Response: The proposed project will maintain public view corridors and scenic resources from the highway. While above-ground structures associated with roadway construction may include utility poles and railings, these ancillary design elements are not considered significant in terms of view obstruction. Adverse impacts to coastal scenic and open space resources or adverse effects on public views to and along the shoreline resulting from the proposed action are not anticipated.

(4) Coastal Ecosystems

Objective: Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

Policies:

(A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;

(B) Improve the technical basis for natural resource management;

(C) Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;

(D) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and

(E) Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and

enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.

Response: The proposed project is not anticipated to adversely impact coastal ecosystems. Best Management Practices will be utilized during construction activities to ensure that coastal ecosystems are not impacted. Drainage systems associated with roadway construction will be designed to mitigate discharges to marine waters.

(5) Economic Uses

Objective: Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies:

(A) Concentrate coastal dependent development in appropriate areas;

(B) Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:

(i) Use of presently designated locations is not feasible;

(ii) Adverse environmental effects are minimized; and

(iii) The development is important to the State's economy.

Response: Construction of the proposed southern terminus relocation project will have a beneficial short-term impact on the economy through increased expenditures and generation of construction-related employment opportunities. In the long term, the completed project will enhance the movement of goods and services, contributing to the general health of the economy.

(6) Coastal Hazards

Objective: Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence and pollution.

Policies:

(A) Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;

(B) Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint pollution hazards;

(C) Ensure that developments comply with requirements of the Federal Flood Insurance Program; and

(D) Prevent coastal flooding from inland projects.

Response: The new right-of-way resulting from the southern terminus relocation falls within Zone X, an area of minimal flooding. Appropriate soil erosion control measures will be incorporated during the construction period to minimize soil loss and erosion. Temporary drainage improvements will be utilized during construction activities. Interim and long-term drainage improvements will be coordinated with applicable regulatory agencies and landowners. These improvements will be designed to applicable government standards to ensure that there are no adverse drainage impacts to adjoining and downstream properties. The resulting inland route will facilitate evacuations during high waves and storm events, alleviate traffic congestion, and reduce the traffic flow on the existing Honoapiilani Highway.

(7) Managing Development

Objective: Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

Policies:

(A) Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;

(B) Facilitate timely processing of applications for development permits and resolve overlapping of conflicting permit requirements; and

(C) Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the public to facilitate public participation in the planning and review process.

Response: In compliance with requirements of Chapter 343, Hawaii Revised Statutes, this Environmental Assessment has been prepared to facilitate public understanding and input for the project.

Applicable Federal, State and County requirements will be adhered to in the design and construction of the terminus segment of the Lahaina Bypass. Agency reviews and public notices of the filing of an Environmental Assessment (EA), which are required elements of the EA review process, will advance the objectives and policies for managing development.

(8) Public Participation

Objective: Stimulate public awareness, education, and participation in coastal management.

Policies:

(A) Promote public involvement in coastal zone management processes;

(B) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal issues, developments, and government activities; and

(C) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.

Response: A public scoping meeting was held on April 26, 2007. The purpose of the meeting was to solicit input on the proposed southern terminus relocation project. A summary of the meeting comments is included in **Appendix "J"** of this report.

(9) Beach Protection

Objective: Protect beaches for public use and recreation.

Policies:

(A) Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;

(B) Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and

(C) Minimize the construction of public erosion-protection structures seaward of the shoreline.

Response: The alignment of the existing Honoapiilani Highway, between Launiupoko and the vicinity of the former Olowalu Landfill site, is in close proximity to the shoreline. Areas along the existing highway have experienced ocean waves washing over the highway during storm events. These same areas are subject to shoreline erosion which can be mitigated with revetment type solutions. However, given the opportunity to have a more inland road alignment associated with the southern terminus relocation, such less-than-optimum mitigative measures can be avoided. In this regard, the proposed action is considered to be in keeping with the objective and policies for Beach Protection.

(10) Marine Resources

Objective: Promote the protection, use, and development of marine and coastal resources to assure their sustainability.

Policies:

(A) Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;

(B) Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;

(C) Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;

(D) Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and

(E) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.

Response: During construction of the segment of the Lahaina Bypass, between Launiupoko and the vicinity of the former Olowalu Landfill site, appropriate Best Management Practices will be implemented to ensure that construction runoff is properly contained. A National Pollutant Discharge Elimination System Permit will be required in this connection. From a long-term perspective, the new alignment is considered preferable to the existing Honoapiilani Highway location as the inland route provides physical separation from the ocean, which is considered beneficial in managing direct runoff from the road into the ocean.

F. BIKE PLAN HAWAII

Bike Plan Hawaii 2003 is a modal master plan prepared by the State Department of Transportation. The plan establishes a long-term strategy for bicycle facility improvements statewide. The plan is conceptual in nature. Implementation of the *Bike Plan Hawaii* is dependent on available funds. Approval of the plan by HDOT does not guarantee adequate financial resources to carry out the projects, nor can HDOT commit the financial resources of other public agencies or organizations.

Bike Plan Hawaii identifies three (3) potential facilities in the vicinity of the project. The Lahaina Bypass is proposed to be a "signed shared roadway", which means that the bikeway will utilize the shoulder of the paved facility. HDOT intends on incorporating this recommendation as part of the implementation of the Lahaina Bypass.

The other two (2) recommended facilities are envisioned to occur as bike paths, defined as a bikeway physically separated from motorized vehicular travel by an open space or barrier, and either within the highway right-of-way or an independent right-of-way. The West Maui Greenway would occur along the cane haul road parallel to and just inland from Honoapiilani Highway. The other path is identified as the Honoapiilani Highway Greenway which would run along the makai side of Honoapiilani Highway along the shoreline. These greenways are defined as a pathway for various modes of transportation, including bicycles, that contains elements of a linear park. These two (2) facility recommendations will not be developed in conjunction with the proposed project.

V. COMPLIANCE WITH FEDERAL ENVIRONMENTAL REQUIREMENTS

V. COMPLIANCE WITH FEDERAL ENVIRONMENTAL REQUIREMENTS

A. SECTION 4(F), U.S. DEPARTMENT OF TRANSPORTATION ACT OF 1966

Section 4(f) refers to the original section within the Department of Transportation (DOT) Act of 1966 which set the requirement for consideration of park and recreational lands, wildlife and waterfowl refuges, and historic sites in transportation project development. Section 4(f) requirements are implemented by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA). Section 4(f) applies to any significant publicly owned public park, recreation area, or wildlife and waterfowl refuge and any land from a historic site of national, state or local significance.

The proposed southern terminus relocation action and the resulting inland realignment and extension of the Lahaina Bypass Highway is not anticipated to affect Section 4(f) properties.

B. SECTION 106, NATIONAL HISTORIC PRESERVATION ACT

Due to the involvement of federal funds, the proposed project is considered a federal action subject to the consultation requirements of Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's implementation procedures (CFR Part 800). Section 106 of the National Historic Preservation Act requires federal agencies to take into account the effects of federal actions on historic properties. Historic properties are defined as properties that are included in the National Register of Historic Places or that meet the criteria for the National Register. The Section 106 process seeks to accommodate historic preservation concerns with the needs of federal actions through consultation among the agency official and interested parties. The goal of consultation is to identify historic properties potentially affected by the action, assess the effects and seek ways to avoid, minimize or mitigate any adverse effects on historic properties.

The Section 106 consultation has been integrated with the State of Hawaii environmental review process. The Section 106 consultation activities have thus far included the pre-

assessment, agency, and public consultation efforts conducted during the preparation of this Draft EA. An extensive archaeological inventory survey was completed in 2006 for the project area, as well as a field inspection in October and November 2006 for the proposed corridor. The archaeological inventory survey was accepted by the State Historic Preservation Division (SHPD) in November 2006. The Draft EA provides the opportunity for review of the proposed project and facilitates SHPD's final determination of the project's effect on historic properties under Section 106.

C. ENDANGERED SPECIES ACT

The Endangered Species Act provides a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The law requires federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. The law also prohibits any action that causes a "taking" of any listed species of endangered fish or wildlife.

As previously discussed in the Flora and Fauna section, no federally listed endangered or threatened plant species were found in the project area. Additionally, no federally listed endangered or threatened fauna were found in the project area.

D. EXECUTIVE ORDER 11990 PROTECTION OF WETLANDS

Executive Order 11990 Protection of Wetlands was issued to minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. There are no wetlands found in the vicinity of the project corridor.

E. EXECUTIVE ORDER 11988 FLOODPLAIN MANAGEMENT

Executive Order 11988 Floodplain Management was issued to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. As discussed in the Flood and Tsunami Hazard section, the project area is located within Flood Insurance Rate Map Zone C, an area of minimal flooding. However, the proposed road corridor will traverse over three (3) drainageways, which will be subject to the provisions of Code of Federal Regulations (CFR) 650 Bridges,

Structures, and Hydraulics. These drainageways generally flow from the mountain slopes to the ocean along natural contours. As such, there is no practical alternative to avoidance. The design of these encroachments can be readily mitigated during the design phase to maintain the status quo in compliance with the provisions of CFR 650. Therefore, no adverse effects from development of a floodplain area are expected as a result of the proposed action.

F. COASTAL ZONE MANAGEMENT ACT

Coastal Zone Management Act (CZMA) encourages management of coastal areas. The CZMA requires federal agencies to be consistent with the policies of the State Coastal Zone Management programs for protection, and where possible, enhancement of the nation's coastal zones.

Compliance with CZMA is outlined in the Hawaii Coastal Zone Management Program section. It is noted that the new southern terminus point where the Lahaina Bypass connects to the existing Honoapiilani Highway may involve work within the County's Special Management Area.

G. FARMLAND PROJECT POLICY ACT

Farmland Project Policy Act requires federal agencies to identify and consider adverse effects of their actions on the preservation of farmland. Lands underlying the new right-of-way alignment are presently fallow and not expected to affect the inventory of land for diversified or large-scale single crop agricultural use.

H. EXECUTIVE ORDER 12898 ON ENVIRONMENTAL JUSTICE AND TITLE VI OF THE CIVIL RIGHTS ACT OF 1964

Executive Order 12898 on Environmental Justice requires federal agencies and recipients of federal funds to take appropriate steps to identify and address disproportionately high and adverse human health or environmental effects of federal projects on minority or low income populations. Similar non-discrimination protection is provided under Title VI of the Civil Rights Act of 1964.

The proposed project does not create a disproportionately high and adverse human health or environmental effect on minority and low income populations. All ethnicities and socio-economic population of Maui will be allowed to utilize the proposed road corridor. In addition, compliance with outreach efforts for the project was provided through a public scoping meeting held on April 26, 2007. Also, the environmental review process allows for the public to provide feedback on the proposed project.

I. OTHER REGULATORY APPROVALS

The proposed action will involve the crossing of the Launiupoko Stream. Coordination is being undertaken with the U.S. Department of the Army to determine if a Department of the Army permit will be required for project implementation. Related regulatory requirements such as the Section 401 Water Quality Certification and Coastal Zone Management Consistency Approval will also be coordinated, as needed, with the State Department of Health and the State Office of Planning, respectively.

Additionally, coordination will be undertaken with the State Commission on Water Resource Management to determine if a Stream Channel Alteration Permit will be needed.

The above agencies will receive a copy of this EA document together with schematic engineering plans to facilitate determinations regarding the applicability of the respective regulatory jurisdictions.

VI. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECT AND IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

VI. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECT AND IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

During the short term, the proposed project will result in unavoidable construction-related impacts which include noise-generated impacts occurring from the construction of the proposed roadway. In addition, there may be temporary air quality impacts associated with dust generated from site work and exhaust emissions discharged by construction equipment. These impacts will be temporary in nature and will be mitigated to the extent practicable through implementation of appropriate BMPs.

Beneficial impacts are related to safety and the achievement of near-term and long-term objectives of shoreline erosion mitigation, expansion of coastal recreational resources and the provisions of a more inland highway alignment to meet regional planning needs.

The proposed southern terminus relocation for the Lahaina Bypass will result in additional acreage of agricultural land being utilized to meet roadway infrastructure needs. The current fallow state of these lands were considered in setting the roadway's alignment. Other resources which will be committed in the implementation of the proposed action include material and fuel resources.

The unavoidable impacts and commitments noted above have been weighed against the immediate and long-term benefits of the action. These tradeoffs consider shoreline erosion and coastal recreation enhancement opportunities.

VII. ANTICIPATED DETERMINATION AND FINDINGS AND REASONS SUPPORTING THE DETERMINATION

VII. ANTICIPATED DETERMINATION AND FINDINGS AND REASONS SUPPORTING THE DETERMINATION

The "Significance Criteria", Section 12 of the Administrative Rules, Title 11, Chapter 200, "Environmental Impact Statement Rules", were reviewed and analyzed to determine whether the proposed project will have significant impacts to the environment. The following criteria and analysis are provided.

1. **Involves an Irrevocable Commitment to Loss or Destruction of any Natural or Cultural Resource**

   The subject property has been previously disturbed in connection with former agricultural use of the subject property. Affected clearing mounds (Site 5950) will be monitored during construction. An Archaeological Monitoring Plan will be prepared and submitted to the SHPD for review and approval prior to ground altering activities. Should any artifacts or human remains be encountered during construction, work will stop in the immediate vicinity of the find and the SHPD will be immediately notified to establish an appropriate mitigation strategy.

   Based on findings of the Botanical Resources Survey and a Flora and Fauna Survey conducted on December 2006, the proposed action is not anticipated to adversely impact known habitats of rare, threatened, or endangered species of flora, fauna, or avifauna that are located along the project's alignment.

2. **Curtails the Range of Beneficial Uses of the Environment**

   The proposed project and the commitment of land resources are not expected to curtail the range of beneficial uses of the environment. No adverse physical environmental impacts associated with the proposed action are anticipated. The proposed project supports the County's goal of providing a continuous inland alignment of its main highway in the West Maui region. It further facilitates the state's goal of providing the needed additional highway capacity between Maalaea and Launiupoko.

3. **Conflicts with the State's Long-term Environmental Policies or Goals and Guidelines as Expressed in Chapter 344, HRS, and Any Revisions Thereof and Amendments Thereto, Court Decisions, or Executive Orders**

The State's Environmental Policy and Guidelines are set forth in Chapter 344, Hawaii Revised Statutes. The proposed action does not contravene provisions of Chapter 344, Hawaii Revised Statutes.

4. **Substantially Affects the Economic, Welfare, Social Welfare and Cultural Practices of the Community or State**

The proposed project would have a direct beneficial effect on the local economy during construction and ongoing operations. From a long-term perspective, the proposed action will enhance the community welfare benefit of a much needed highway inland and away from the shoreline to meet West Maui's long range transportation planning objectives.

5. **Substantially Affects Public Health**

No adverse impacts to the public's health and welfare are anticipated as a result of the proposed project. The proposed project will improve traffic circulation conditions enhancing responses to emergency conditions.

6. **Involves Substantial Secondary Impacts, Such as Population Changes or Effects on Public Facilities**

No significant population changes are anticipated as a result of the proposed project with no adverse secondary impacts anticipated. The design and implementation of the project will be coordinated with the appropriate governmental agencies.

7. **Involves a Substantial Degradation of Environmental Quality**

During the construction phase of the project, there will be short-term air quality and noise impacts as a result of the project. There are no sensitive environments (e.g., wetlands, erosion prone areas, etc.) which will be affected by the proposed action, nor will scenic views be negatively affected. No substantial degradation of environmental quality resulting from the project is anticipated.

8. **Is Individually Limited but Cumulatively has Considerable Effect Upon the Environment or Involves a Commitment for Larger Actions**

The proposed action is one component of the Lahaina Bypass project which stretches from Honokowai to the new southern terminus location. From a more global perspective, the action will be integrated as part of the Maalaea to Launiupoko study effort to identify viable alternatives for providing needed highway capacity along this corridor. However, the project is considered to have independent utility in terms of addressing shoreline erosion mitigation and meeting long-term local community planning objectives in the specific locale between Launiupoko and the former Olowalu Landfill. Thus, the action itself, does not hold implications for other environmental, design, and implementation elements of the overall Lahaina Bypass project. The proposed action will not affect construction timetables nor will it require a re-evaluation of the scope and impact parameters for other sections of the Bypass.

9. **Substantially Affects a Rare, Threatened or Endangered Species or Its Habitat**

There are no rare, threatened, or endangered species of flora, fauna, avifauna or their habitats that will be adversely affected by the proposed action.

10. **Detrimentally Affects Air or Water Quality Or Ambient Noise Levels**

Construction activities will result in short-term air quality and noise impacts. Dust control measures, such as regular watering and sprinkling, will be implemented to minimize wind-blown emissions. Noise impacts will occur primarily from construction-related activities. It is anticipated that construction will be limited to daylight working hours. Best Management Practices will be used during construction and water quality is not expected to be affected as a result.

11. **Affects Or Is Likely to Suffer Damage by Being Located In An Environmentally Sensitive Area Such as a Flood Plain, Tsunami Zone, Beach, Erosion-prone Area, Geologically Hazardous Land, Estuary, Fresh Water, or Coastal Waters**

The project is not located within and would not affect environmentally sensitive areas. The proposed action will result in a highway alignment removed from coastal wave and shoreline erosion areas. Importantly, hydraulic design parameters for

drainage gulch crossings will ensure the safe "pass-through" of runoff without adversely impacting roadway operations or downstream properties.

12. Substantially Affects Scenic Vistas and View Planes Identified in County or State Plans or Studies

The project site is not identified as a scenic vista or viewplane. The proposed project will not affect scenic corridors and coastal scenic and open space resources.

13. Requires Substantial Energy Consumption

The proposed project will involve the short-term commitment of fuel for equipment, vehicles, and machinery during construction activities. However, this use is not anticipated to result in a substantial consumption of energy resources. In the long-term, the proposed action will not create substantial new demand for energy sources.

Given the preceding analysis, it is anticipated that the proposed action will result in a Finding of No Significant Impact (FONSI).

VIII. AGENCIES, ORGANIZATIONS, AND PERSONS CONSULTED DURING THE PREPARATION OF THE DRAFT ENVIRONMENTAL ASSESSMENT, LETTERS RECEIVED, AND RESPONSES TO SUBSTANTIVE COMMENTS

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The following agencies and organizations were consulted during the EA preparation phase of work. Comment letters received and responses to substantive comments are included in this Chapter as well.

It is noted that public comments were received during the public scoping meeting held on April 26, 2007. Written comments received during that meeting, together with responses to those comments, are also included in this section.

FEDERAL AGENCIES

1. Larry Yamamoto, State Conservationist
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2. Ranae Ganske-Cerizo, Soil Conservationist
   Natural Resources Conservation Service
   U.S. Department of Agriculture
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3. Mike Johanns, Secretary of Agriculture
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   Office of the Secretary
   Administration Building, Rm. 240W
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4. Lt. Doug Jannusch, Commander
   U. S. Coast Guard
   Fourteenth Coast Guard District
   300 Ala Moana Boulevard
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5. Rod McInnis, Regional Director
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   Southwest Region
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6. George Young
   Chief, Regulatory Branch
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   U.S. Army Engineer District, Honolulu
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   Fort Shafter, Hawaii 96858-5440

7. Carol Borgstrom, Director
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14. James Weyman, Area Manager
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16. The Honorable Daniel K. Inouye
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17. The Honorable Daniel K. Akaka
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18. The Honorable Mazie Hirono
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STATE AGENCIES

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20. Ed Texeira, Vice Director
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21. Russ Saito, State Comptroller
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22. Sandra Lee Kunimoto, Chair
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23. Stanley Shiraki, Deputy Director
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24. Theodore Liu, Director
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25. Patricia Hamamoto, Superintendent
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33. Ron Okumura
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39. Vanessa Medeiros, Director
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46. Councilmember Michelle Anderson
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Department of Parks and Recreation
700 Hali'a Nakoa Street, Unit 2
Wailuku, Hawaii 96793

51. Thomas Phillips, Chief
County of Maui
Police Department
55 Mahalani Street
Wailuku, Hawaii 96793

52. Milton Arakawa, Director
County of Maui
Department of Public Works and Environmental Management
200 South High Street
Wailuku, Hawaii 96793

53. Don Medeiros, Director
County of Maui
Department of Transportation
200 South High Street
Wailuku, Hawaii 96793

54. Jeff Eng, Director
County of Maui
Department of Water Supply
200 South High Street
Wailuku, Hawaii 96793

OTHER CONSULTED PARTIES

55. Sandy Baz, Executive Director
Maui Economic Opportunity
99 Mahalani Street
Wailuku, Hawaii 96793

56. Stacie Thorlakson, President
Maui Chamber of Commerce
70 Kaahumanu Avenue, Unit B-9
Kahului, Hawaii 96732

57. Leimamo Lind, Executive Director
Maui Hotel Association
1727 Wili Pa Loop, Suite B
Wailuku, Hawaii 96793

58. Neal Shinyama, Manager - Engineering
Maui Electric Company, Ltd.
P. O. Box 398
Kahului, Hawaii 96732

59. Joe Pluta, President
West Maui Taxpayers Association
P. O. Box 10338
Lahaina, Hawaii 96761

60. Theo Morrison, Executive Director
Lahaina Bypass Now
505 Front Street, Suite 202
Lahaina, Hawaii 96761

61. Karee Karlucci, Executive Director
Lahaina Town Action Committee
648 Wharf Street, Suite 102
Lahaina, Hawaii 96761

62. Keoki Freeland, Executive Director
Lahaina Restoration Foundation
120 Dickenson Street
Lahaina, Hawaii 96761

63. **West Maui Mountains Watershed Partnership**
255B East Waiko Road
Wailuku, Hawaii 96793

U.S. Department of Homeland Security
United States Coast Guard

Commander
Fourteenth Coast Guard District

300 Ala Moana Blvd, 9-216
Honolulu, HI 96850-4982
Staff Symbol: (dpw)
Phone: (808) 541-2320
Fax: (808) 541-2309

16590

APR 26 2007

State of Hawaii
Department of Transportation
Attn: Mr. Wayne Kawahara
869 Punchbowl Street, Room 301
Honolulu, HI 96813-5097

Dear Mr. Kawahara,

The Coast Guard has received the State of Hawaii's proposed Lahaina Bypass Southern Terminus Relocation project overview and request for input dated 7 March 2007. The overview states that the proposed bypass will cross Launiupoko Stream.

Under 33 CFR 114-118, the Coast Guard is responsible for approving the locations and plans for bridges and causeways constructed across navigable waters of the United States. In order to assist us in making an accurate assessment regarding the navigability of Launiupoko Stream and any potential bridge permitting requirements, please complete the enclosed bridge project questionnaire and return it to this office.

If you have any questions or concerns, please do not hesitate to contact my representative in this matter, LT Doug Jannusch, at (808) 541-2319 or Douglas.A.Jannusch@uscg.mil.

Sincerely,

B. A. HAVLIK
Commander, U. S. Coast Guard
Chief, Waterways Management Branch
By direction

Enclosure: 1) Bridge Project Questionnaire

U.S. Department of Homeland Security
United States Coast Guard

Commander
Fourteenth Coast Guard District

300 Ala Moana Blvd.
Honolulu, HI 96850-4982
Staff symbol: dpw
Phone: (808) 541-2319
Fax: (808) 541-2309
Email:
Douglas.a.jannusch@uscg.mil

BRIDGE PROJECT QUESTIONNAIRE

Please provide the following information:

A. NAVIGATION DATA:

1. Name of Waterway: _____

1a. Mileage along waterway measured from mouth or confluence _____

1b. Tributary of: _____

2. Geographic Location: _____
(Road Number, City, County)

3. Township, section and range, if applicable: _____

4. Tidally influenced at proposed bridge site? Yes ____ No _____ .
Range of tide: _____
Tidal data source: _____

5. Depth and width of waterway at proposed bridge site:

	Depths	Widths
At Mean High Tide	_____	_____.
At Mean Low Tide	_____	_____.

6. Character of present vessel traffic on waterway. If none , so state: None _____.
Canoe _____ Rowboat _____ Small Motorboat _____ Cabin Cruiser _____ .
Houseboat _____ Pontoon Boat _____ Sailboat .

6a. Provide vertical clearance requirement for largest vessel using the waterway: ____.

6b. Provide photograph of each type of vessel using the waterway.

7. Are these waters used to transport interstate or foreign commerce?
Yes _____ No _____ .

7a. Are these waters susceptible to use in their natural condition or by reasonable improvement as a means to support interstate or foreign commerce?
Yes _____ No _____ .

7b. Any planned waterway improvements to permit larger vessels to navigate (to your knowledge)? _____ If so, what are they? _____

ENCLOSURE 1

8. Any natural or manmade obstructions, bridges, dams, weirs, etc. downstream or upstream? Yes _____ No _____ .

8a. If yes, provide upstream/downstream location with relation to the proposed bridge. _____

8b. If bridges are located upstream or downstream, provide vertical clearance at mean high water and mean low water and horizontal clearance normal to the axis of the channel. _____

8c. Provide a photograph of the bridge from the waterway showing channel spans.

9. Will the structure replace an existing bridge? Yes _____ No _____ .

9a. Provide permit number and issuing agencies of permits for bridge(s) to be replaced. _____

9b. Provide vertical clearance at mean high water and mean low water and horizontal clearance normal to the axis of the channel for the proposed bridge.

_____

10. List names and addresses of persons whose property adjoins bridge right-of-way.

_____
_____
_____
_____

11. List names and addresses/location of marinas, marine repair facilities, public boat ramps, private piers/docks along the waterway within ½ mile of the bridge site.

_____
_____
_____
_____

12. Attach location map and plans for the proposed bridge; including vertical clearances above mean high water and mean low water and horizontal clearance normal to axis of the waterway.

13. Attach three (3) photographs taken at the proposed bridge site: one looking upstream, one looking downstream, and one looking along the alignment centerline across the bridge site.

Name of applicant: _____
Name of agent completing questionnaire: _____
Name of agent's firm: _____
Agent's telephone number: _____

Address for correspondence: _____

_____

Applicant's telephone number: _____

Date: _____ Signature: _____

PLEASE NOTE: MISSING INFORMATION AND REQUIRED SIGNATURES WILL DELAY PROCESSING

Attachments: Location Map
Bridge Plans
Photographs

ENCLOSURE 1

4

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-PA
2.0629

February 3, 2012

Lt. Doug Jannusch
Commander, U.S. Coast Guard
300 Ala Moana Boulevard 9-126
Honolulu, Hawaii 96850-4982

Dear Lt. Jannusch:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

Enclosed is the completed bridge project questionnaire form. Also enclosed are the following:

- Drain Area Map, Figure 2 (see drainage Basin No. 3)
- Proposed alignment map with profile sections for Alternative 3 (Launiupoko Stream is south of and roughly parallel to section "D")
- Photographs of the stream/gulch bed at various locations taken on March 13, 2009

According to the Hawaii Stream Assessment, Launiupoko Stream is not perennial, flowing during storm events only. The average slope of the Stream bed in the vicinity of the project area is approximately 8% (see transect D on enclosed alignment map).

A copy of the Draft Environmental Assessment will be provided to your office for review and comment. If you have any questions, please do not hesitate to contact Darell Young at 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

Enclosures

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

U.S. Department of Homeland Security
United States Coast Guard

Commander
Fourteenth Coast Guard District

300 Ala Moana Blvd.
Honolulu, HI 96850-4982
Staff symbol: dpw
Phone: (808) 541-2319
Fax: (808) 541-2309
Email:
Douglas.a.jannusch@uscg.mil

BRIDGE PROJECT QUESTIONNAIRE

Please provide the following information:

A. NAVIGATION DATA:

1. Name of Waterway: Launiuopoko Stream - not perennial, only flows during storms

1a. Mileage along waterway measured from mouth or confluence Approx. 1,300 ft.

1b. Tributary of: n/a

2. Geographic Location: Honoapiilani Hwy, Lahaina, Maui
(Road Number, City, County)

3. Township, section and range, if applicable: N/A

4. Tidally influenced at proposed bridge site? Yes ____ No XX .
Range of tide: N/A
Tidal data source: N/A

5. Depth and width of waterway at proposed bridge site:

	Depths	Widths
At Mean High Tide *	N/A	N/A .
At Mean Low Tide *	N/A	N/A .

* Stream is intermitant

6. Character of present vessel traffic on waterway. If none , so state: None X .
Canoe _____ Rowboat _____ Small Motorboat _____ Cabin Cruiser _____ .
Houseboat _____ Pontoon Boat _____ Sailboat .

6a. Provide vertical clearance requirement for largest vessel using the waterway: N/A.

6b. Provide photograph of each type of vessel using the waterway.

7. Are these waters used to transport interstate or foreign commerce?
Yes _____ No XX .

7a. Are these waters susceptible to use in their natural condition or by reasonable improvement as a means to support interstate or foreign commerce?
Yes _____ No x,not at all, it rarely flows

7b. Any planned waterway improvements to permit larger vessels to navigate (to your knowledge)? N/A If so, what are they? _____

ENCLOSURE 1

8. Any natural or manmade obstructions, bridges, dams, weirs, etc. downstream or upstream? Yes xx No _____.

8a. If yes, provide upstream/downstream location with relation to the proposed bridge. _____

8b. If bridges are located upstream or downstream, provide vertical clearance at mean high water and mean low water and horizontal clearance normal to the axis of the channel. N/A

8c. Provide a photograph of the bridge from the waterway showing channel spans.

9. Will the structure replace an existing bridge? Yes _____ No X.

9a. Provide permit number and issuing agencies of permits for bridge(s) to be replaced. N/A

9b. Provide vertical clearance at mean high water and mean low water and horizontal clearance normal to the axis of the channel for the proposed bridge.
N/A

10. List names and addresses of persons whose property adjoins bridge right-of-way.
Makila Land Co., LLC
33 Lono Ave, Suite 450, Kahului, HI 96732

11. List names and addresses/location of marinas, marine repair facilities, public boat ramps, private piers/docks along the waterway within ½ mile of the bridge site.
N/A

12. Attach location map and plans for the proposed bridge; including vertical clearances above mean high water and mean low water and horizontal clearance normal to axis of the waterway.

13. Attach three (3) photographs taken at the proposed bridge site: one looking upstream, one looking downstream, and one looking along the alignment centerline across the bridge site.

Name of applicant: State of Hawaii, Dept of Transportation, Highways
Name of agent completing questionnaire: Rory Frampton
Name of agent's firm: Rory Frampton, Land Use Planning Consultant
Agent's telephone number: 808 298 4956

7

Address for correspondence: 869 Punchbowl, Rm 301, Honolulu 96813
attn: Wayne Kawahara
Applicant's telephone number: 808 587 6357

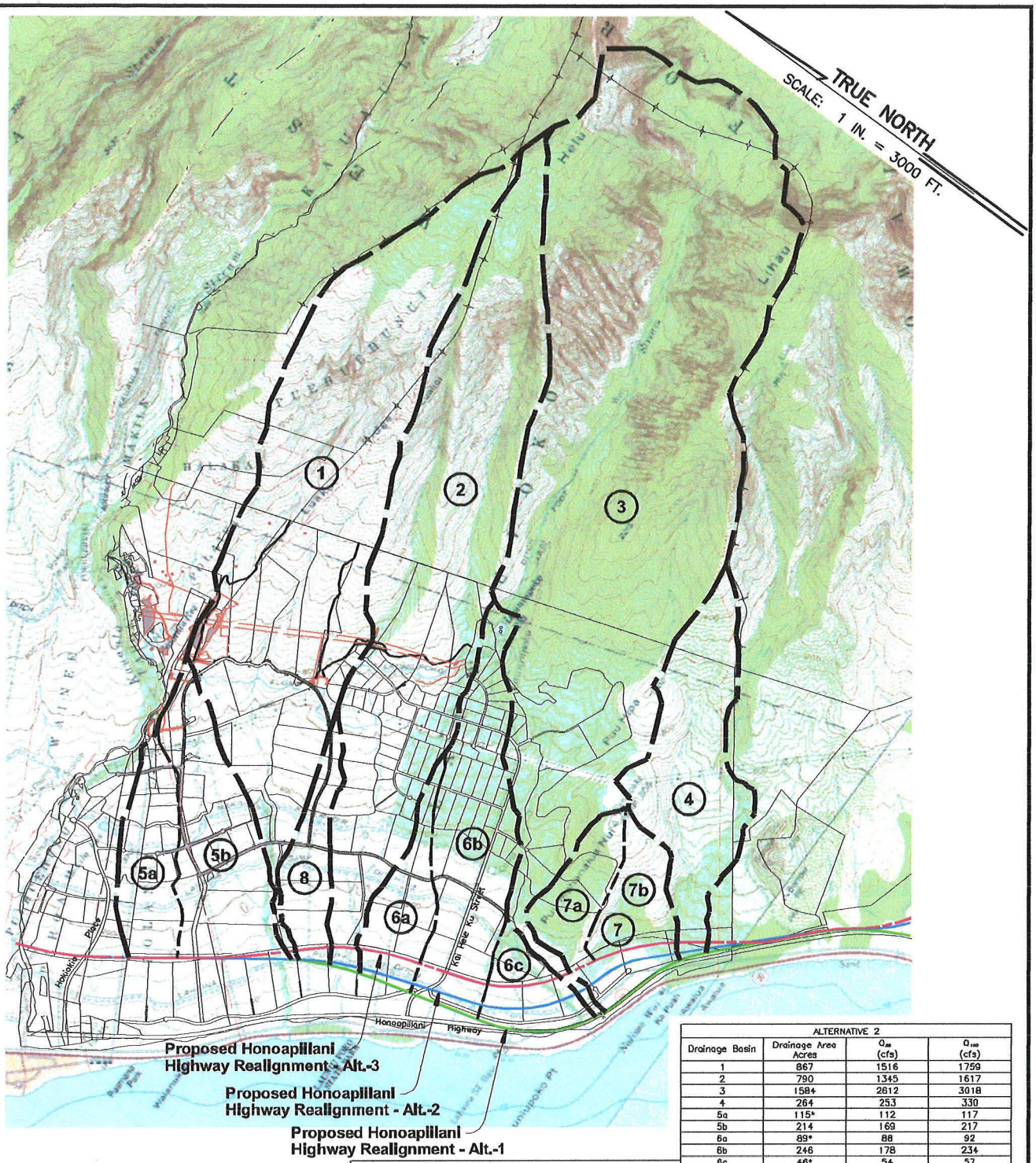
Date: _____ Signature: _____

PLEASE NOTE: MISSING INFORMATION AND REQUIRED SIGNATURES WILL DELAY PROCESSING

Attachments: Location Map
Bridge Plans
Photographs

ENCLOSURE 1

8



ALTERNATIVE 1			
Drainage Basin	Drainage Area Acres	Q_{25} (cfs)	Q_{100} (cfs)
1	867	1514	1758
2	791	1342	1613
3	1587	2539	2960
4	265	251	327
5a	115*	112	117
5b	214	184	217
6a	93*	91	95
6b	255	169	243
6c	73*	80	85
7	197*	188	192
8	86*	78	81

Note: Calculations were Based on a 24-Hour Storm Duration
* A 1-Hour Storm Duration was Used for Areas Less Than 200 Acres

ALTERNATIVE 2			
Drainage Basin	Drainage Area Acres	Q_{25} (cfs)	Q_{100} (cfs)
1	867	1516	1759
2	790	1345	1617
3	1584	2612	3018
4	264	253	330
5a	115*	112	117
5b	214	169	217
6a	89*	88	92
6b	246	178	234
6c	46*	54	57
7	175*	175	192
8	85*	78	82

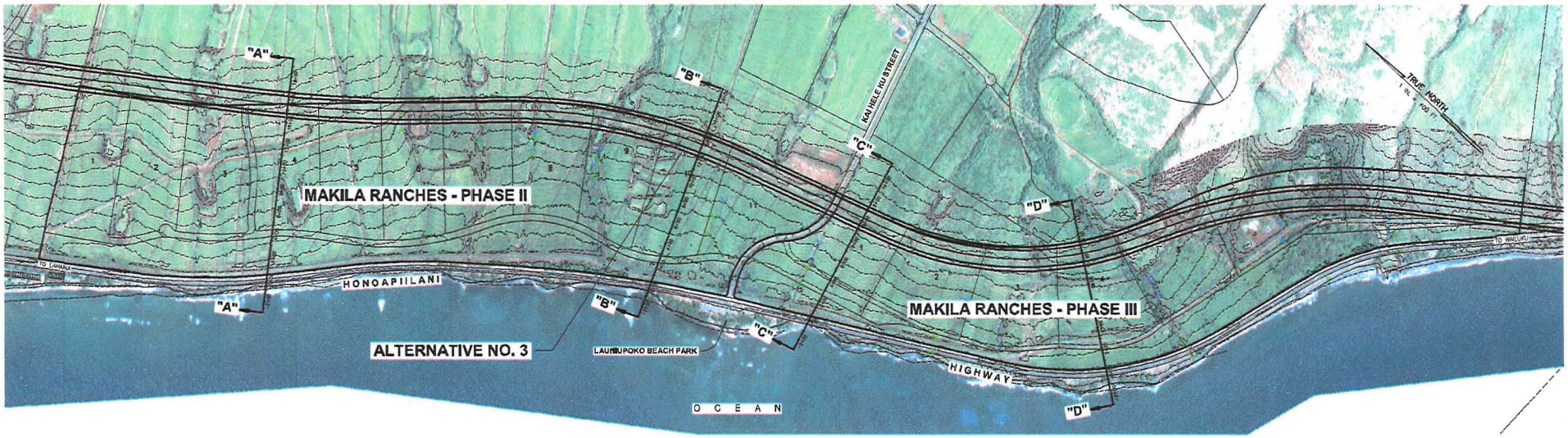
ALTERNATIVE 3			
Drainage Basin	Drainage Area Acres	Q_{25} (cfs)	Q_{100} (cfs)
1	866	1524	1768
2	785	1369	1646
3	1581	2655	3067
4	261	255	333
5a	115*	112	117
5b	212	168	216
6a	76*	78	80
6b	231	177	227
6c	26*	32	34
7a	82*	90	94
7b	78*	86	91
8	81*	75	79

DRAIN AREA MAP

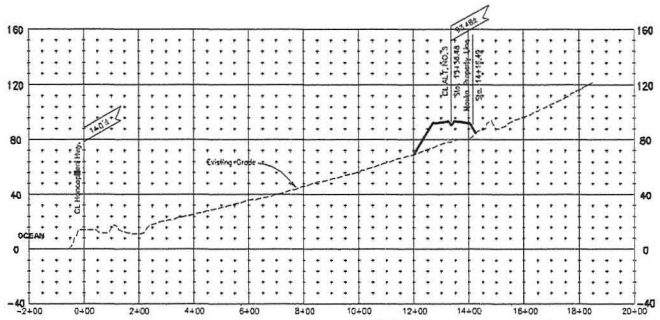
FIGURE 2

April 10, 2008

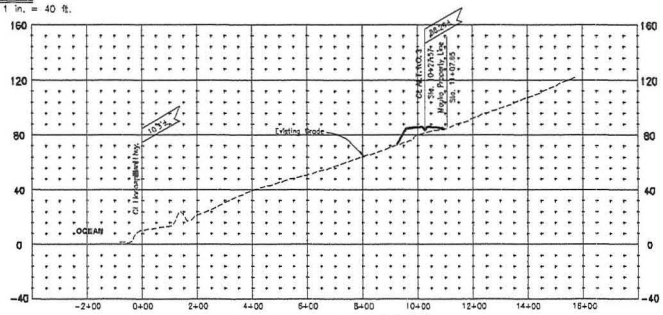
V:\Projdata\04PROJ\04044 - DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\EXB-DRAINAGE-AREA-00.dwg



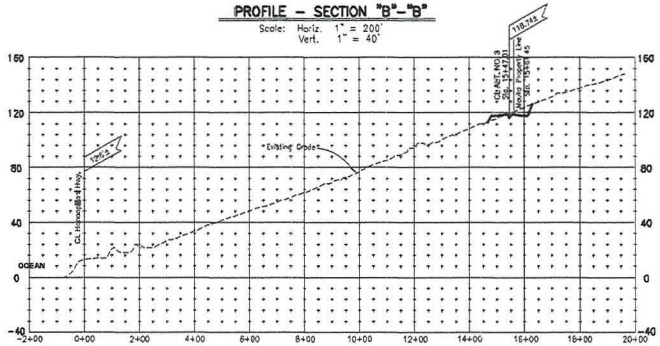
PLAN
Scale: 1 in. = 40 ft.



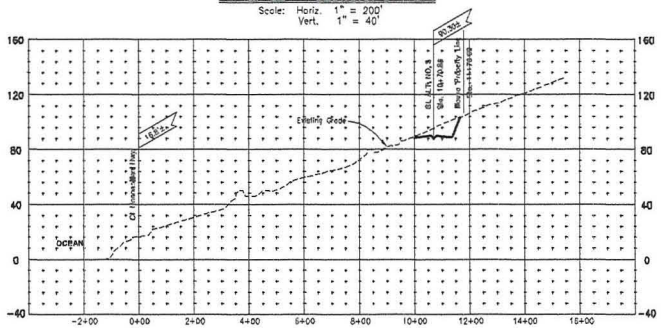
PROFILE – SECTION "B"–"B"
Scale: Horiz. 1" = 200'
Vert. 1" = 40'



PROFILE – SECTION "C"–"C"
Scale: Horiz. 1" = 200'
Vert. 1" = 40'



PROFILE – SECTION "A"–"A"
Scale: Horiz. 1" = 200'
Vert. 1" = 40'



PROFILE – SECTION "D"–"D"
Scale: Horiz. 1" = 200'
Vert. 1" = 40'

HONOAPIILANI HIGHWAY REALIGNMENT - ALTERNATIVE NO. 3 THRU MAKILA - RANCH II AND III

0 400 800 1200 1600
SCALE: 1 IN. = 400 FT.

WARREN S. UNEMORI ENGINEERING, INC.
CIVIL ENGINEERS / LAND SURVEYORS

March 18, 2008

24"x36"

W31E E06058

10

Photo 1 – Launiupoko Stream: Mauka crossing, looking west (makai)

Photo 2 – Launiupoko Stream: Mauka crossing, looking east (mauka)

Photo 3 – Launiupoko Stream: Cane Haul road crossing, looking west (makai)

Photo 4 – Launiupoko Stream: Cane Haul road crossing, looking east (mauka)

Photo 5 – Launiupoko Stream: Cane Haul road crossing bridge, north view

Photo 6 – Launiupoko Stream: Looking east (mauka) from shoreline towards Honoapiilani Highway Bridge

Photo 7 – Launiupoko Stream: Looking west (makai) from Honoapiilani Highway Bridge towards shoreline

APR 6 2007

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858-5440

REPLY TO
ATTENTION OF

April 5, 2007

Regulatory Branch

File No. **POH-2007-99**

Rochelle Ka'ula
Munekiyo & Hiraga, Inc.
305 South High Street, Suite 104
Wailuku, HI 96793

Dear Ms. Ka'ula

This is in response to a State of Hawaii, Department of Transportation letter dated March 7, 2007 for comments on the proposed relocation of the southern terminus of the proposed Lahaina Bypass Highway from its current terminus point at Launiupoko to the vicinity of the former Olowalu Landfill Site, Maui Island, Hawaii. We have reviewed the information you provided under the Corps' authority to issue Department of the Army (DA) permits pursuant to Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 USC 403) and Section 404 of the Clean Water Act (CWA) (33 USC 1344).

Based on the information provided in letter on behalf of the applicant, the State of Hawaii Department of Transportation, we can not conclusively determine whether a permit will be required for the proposed relocation project. Please forward to this office for review a copy of the draft Environmental Assessment, project plans, and area photographs of all streams and waterbodies (i.e. wetlands, ditches, drainages, etc) that the proposed relocated bypass road will cross.

Should the applicant or his designated agent have any questions regarding this information request, please contact Ms. Joy Anamizu by phone at 808-438-7023 or by e-mail at *joy.n.anamizu@usace.army.mil* and refer to the file number above.

Sincerely,

George P. Young, P.E.
Chief, Regulatory Branch

Copy Furnished
Ronald Tsuzuki, State of HI, Dept. of Transportation, 869(Punchbowl Street, Honolulu, HI 96813-5097

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:

HWY-PA
2.0621

February 3, 2012

Mr. George P. Young, P.E.
Chief
U.S. Department of the Army
Regulatory Branch
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858

Dear Mr. Young:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

Thank you for your letter providing comments on the subject project.

We will forward your office a copy of the Draft Environmental Assessment (EA) as soon as it is available. The Draft EA will include project plans and information regarding all streams and waterbodies that the proposed project will traverse. In addition, a request for jurisdictional determination related to drainageways that will be crossed by the project has been sent to your office and is currently under review (Corps file number: POH-2007-00099).

If you have any questions, please do not hesitate to contact Darell Young at 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

APR 0 2 2007

U.S. Department of Homeland Security
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, CA. 94607-4052

FEMA

March 28, 2007

Rochelle Ka'ula
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Ka'ula:

This is in response to your request for comments on the Early Consultation Input for Proposed Lahaina Bypass Southern Terminus Relocation project.

Please review the current effective Flood Insurance Rate Maps (FIRMs) for the County of Maui (Community Number 150003), Map revised May 15, 2002. Please note that the County of Maui, Hawaii is a participant in the National Flood Insurance Program (NFIP). The minimum, basic NFIP floodplain management building requirements are described in Vol. 44 Code of Federal Regulations (44 CFR), Sections 59 through 65.

A summary of these NFIP floodplain management building requirements are as follows:

- All buildings constructed within a riverine floodplain, (i.e., Flood Zones A, AO, AH, AE, and A1 through A30 as delineated on the FIRM), must be elevated so that the lowest floor is at or above the Base Flood Elevation level in accordance with the effective Flood Insurance Rate Map.

- If the area of construction is located within a Regulatory Floodway as delineated on the FIRM, any ***development*** must not increase base flood elevation levels. **The term *development* means any man-made change to improved or unimproved real estate, including but not limited to buildings, other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, and storage of equipment or materials.** A hydrologic and hydraulic analysis must be performed *prior* to the start of development, and must demonstrate that the development would not cause any rise in base flood levels. No rise is permitted within regulatory floodways.

16

- All buildings constructed within a coastal high hazard area, (any of the "V" Flood Zones as delineated on the FIRM), must be elevated on pilings and columns, so that the lowest horizontal structural member, (excluding the pilings and columns), is elevated to or above the base flood elevation level. In addition, the posts and pilings foundation and the structure attached thereto, is anchored to resist flotation, collapse and lateral movement due to the effects of wind and water loads acting simultaneously on all building components.

- Upon completion of any development that changes existing Special Flood Hazard Areas, the NFIP directs all participating communities to submit the appropriate hydrologic and hydraulic data to FEMA for a FIRM revision. In accordance with 44 CFR, Section 65.3, as soon as practicable, but not later than six months after such data becomes available, a community shall notify FEMA of the changes by submitting technical data for a flood map revision. To obtain copies of FEMA's Flood Map Revision Application Packages, please refer to the FEMA website at http://www.fema.gov/business/nfip/forms.shtm.

Please Note:

Many NFIP participating communities have adopted floodplain management building requirements which are more restrictive than the minimum federal standards described in 44 CFR. Please contact the local community's floodplain manager for more information on local floodplain management building requirements. The Maui County floodplain manager can be reached by calling Francis Cerizo, Civil Engineer at (808) 270-2753.

If you have any questions or concerns, please do not hesitate to call Cynthia McKenzie of my staff at (510) 627-7190.

Sincerely,

For Michael Shore
Branch Chief
Community Mitigation Programs

cc:
Ronald Tsuzuki, State of Hawaii, Department of Transportation
Francis Cerizo, Civil Engineer, County of Maui
Carol L. Tyau-Beam, State of Hawaii, NFIP Coordinator
Cynthia McKenzie, Floodplanner, DHS/FEMA Region IX
Sandro Amaglio, Environmental Officer, DHS/FEMA Region IX

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-PA
2.0628

February 3, 2012

Mr. Michael Shore
Branch Chief
U. S. Department of Homeland Security
FEMA Region IX
1111 Broadway, Suite 1200
Oakland, California 94607-4052

Attention: Cynthia McKenzie

Dear Mr. Shore:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

Thank you for your letter providing early consultation input on the subject project. We offer the following in response to your comments.

1. A review of the current effective Flood Insurance Rate Map for the County of Maui will be discussed in the Draft Environmental Assessment (EA) report.

2. We note that the County of Maui, Hawaii is a participant in the National Flood Insurance Program (NFIP).

The project will be designed to conform to applicable NFIP flood plan building requirements as set forth by Volume 44 (Sections 59-65) of the Code of Federal Regulations.

We appreciate the input provided by your office. A copy of the Draft EA will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, Federal Highways Administration
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA
DY:th

MAR 1 5 2007

LINDA LINGLE
GOVERNOR

RUSS K. SAITO
COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810

(P)1060.7

MAR 1 4 2007

Ms. Rochelle Ka'ula
Munekiyo & Hiraga, Inc
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Ka'ula:

Subject: Request for Early Consultation Input for
Proposed Lahaina Bypass Southern Terminus Relocation

Your letter of March 7, 2007 requested early review and comment on the proposed action to relocate the southern terminus of the proposed Lahaina Bypass Highway from its current terminus point at Launiupoko to the vicinity of the former Olowalu Landfill Site. The relocation of the terminus point does not impact any of the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer.

If you have any questions regarding the above, please have your staff call Mr. Clarence Kubo of the Planning Branch at 808-586-0488.

Sincerely,

ERNEST Y.W. LAU
Public Works Administrator

CKK:mo
c: Mr. Ronald Tsuzuki, DOT Highways Division, Planning

APR 0 4 2007

LINDA LINGLE
GOVERNOR

PATRICIA HAMAMOTO
SUPERINTENDENT

STATE OF HAWAI'I
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAI'I 96804

OFFICE OF THE SUPERINTENDENT

April 2, 2007

Ms. Rochelle Ka`ula, Planner
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawai`i 96793

Dear Ms. Ka`ula:

Subject: Early Consultation on Relocation of Southern Terminus of the Lahaina Bypass, Olowalu, Maui

The Department of Education has no comment to offer as early consultation.

If you have any questions, please call Heidi Meeker of the Facilities Development Branch at (808) 733-4862.

Very truly yours,

Patricia Hamamoto
Superintendent

PH:jmb

c: Randolph Moore, Acting Assistant Superintendent, OBS
Duane Kashiwai, Public Works Administrator, FDB
Ronald Tsuzuki, Department of Transportation

20

APR 1 0 2007

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

April 9, 2007

Munekiyo & Hiraga, Inc.
305 High Street Suite 104
Wailuku, Hawaii 96793
Attention: Rochelle Ka'ula

Department of Transportation
Highways Division, Planning Branch
869 Punchbowl Street Suite 301
Honolulu, Hawaii 96813
Attention: Ronald Tsuzuki

Gentlemen:

Subject: Early Consultation for Proposed Lahaina Bypass Southern Terminus Relocation, Launiupoko to Honokowai, Maui

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comment.

Other than the comments from Division of Boating & Ocean Recreation, Engineering Division, Division of State Parks, Division of Water Resource Management, Land Division – Maui District, Division of Forestry & Wildlife, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Should you have any questions, please feel free to call our office at 587-0433. Thank you.

Sincerely,

Russell Y. Tsuji
Administrator

21

LINDA LINGLE
GOVERNOR OF HAWAII

SVCS OFFICE
2007 MAR 16 AM 10: 57
DEPT OF LAND &
NATURAL RESOURCES

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
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LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 13, 2007

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Div. of Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division – Maui District

FROM: Russell Y. Tsuji
SUBJECT: Consultation for Draft Environmental Assessment for Proposed Lahaina Bypass Southern Terminus Relocation
LOCATION: Launiupoko to Honokowai, Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of Department of Transportation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 5, 2007.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

(X) We have no objections.
( ) We have no comments.
( ) Comments are attached.

Signed:
Date: 3/15/07

NRR14'07 PM 6:34 BOR DIV

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
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KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 13, 2007

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Div. of Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division – Maui District

RECEIVED
LAND DIVISION
2007 MAR 15 A 8: 33

FROM: Russell Y. Tsuji
SUBJECT: Consultation for Draft Environmental Assessment for Proposed Lahaina Bypass Southern Terminus Relocation
LOCATION: Launiupoko to Honokowai, Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of Department of Transportation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 5, 2007.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed: [signature]
Date: 3/15/07

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/RYT
ReF.: ConDEALahainaBypass
Maui.354

COMMENTS

( ) We confirm that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone ___.

(X) **Please take note that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Flood Zone C. The National Flood Insurance Program does not have any regulations for developments within Zone C.**

( ) Please note that the correct Flood Zone Designation for the project site according to the Flood Insurance Rate Map (FIRM) is ___.

( ) Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken. If there are any questions, please contact the State NFIP Coordinator, Ms. Carol Tyau-Beam, of the Department of Land and Natural Resources, Engineering Division at (808) 587-0267.

Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:

( ) Mr. Robert Sumimoto at (808) 523-4254 or Mr. Mario Siu Li at (808) 523-4247 of the City and County of Honolulu, Department of Planning and Permitting.

( ) Mr. Kelly Gomes at (808) 961-8327 (Hilo) or Mr. Kiran Emler at (808) 327-3530 (Kona) of the County of Hawaii, Department of Public Works.

( ) Mr. Francis Cerizo at (808) 270-7771 of the County of Maui, Department of Planning.

( ) Mr. Mario Antonio at (808) 241-6620 of the County of Kauai, Department of Public Works.

( ) The applicant should include project water demands and infrastructure required to meet water demands. Please note that the implementation of any State-sponsored projects requiring water service from the Honolulu Board of Water Supply system must first obtain water allocation credits from the Engineering Division before it can receive a building permit and/or water meter.

( ) The applicant should provide the water demands and calculations to the Engineering Division so it can be included in the State Water Projects Plan Update.

( ) Additional Comments:

( ) Other:_____

Should you have any questions, please call Ms. Alyson Yim of the Planning Branch at 587-0259.

Signed: _____
ERIC T. HIRANO, CHIEF ENGINEER

Date: 3/15/07

MAR 13 2007

→ NA-press

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
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KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 13, 2007

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
~~x Engineering Division~~
x Div. of Forestry & Wildlife
~~x Div. of State Parks~~
x Div. of Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division – Maui District

RECEIVED
LAND DIVISION
2007 MAR 22 A 10: 10

FROM: Russell Y. Tsuji
SUBJECT: Consultation for Draft Environmental Assessment for Proposed Lahaina Bypass Southern Terminus Relocation
LOCATION: Launiupoko to Honokowai, Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of Department of Transportation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 5, 2007.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

DOFAW will wait to review the EISPN for this project.

( ) We have no objections.
(X) We have no comments.
( ) Comments are attached.

Signed:
Date:
PAUL J. CONRY, ADMINISTRATOR
DIVISION OF FORESTRY AND WILDLIFE

MAR 21 2007

25

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LINDA LINGLE
GOVERNOR OF HAWAII

RECEIVED
LAND DIVISION

2007 MAR 19 P 3:07

RECEIVED
STATE PARKS DIV

'07 MAR 13 A11:34

DEPT OF LAND & NATURAL RESOURCES

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
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LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 13, 2007

TO:
___ADMINISTRATOR
___ASST ADMIN
___DEV BR
___PLAN BR
___RES MGT BR
___CLERICAL
___ADMIN ASST
___INTERP BR
___

FOR:
___CIRC/POST/STAFF RM
___COMMENTS & REC
___DRAFT REPLY
___FILE
___FOLLOW UP
___INFO
___RUN COPIES___
___RUSH DUE___
___SEE ME
___FAX/SEND COPY TO___

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Div. of Water Resource Management
x Office of Conservation & Coastal Lands
x Land Division – Maui District

FROM: Russell Y. Tsuji
SUBJECT: Consultation for Draft Environmental Assessment for Proposed Lahaina Bypass Southern Terminus Relocation
LOCATION: Launiupoko to Honokowai, Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of Department of Transportation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 5, 2007.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: [signature]
Date: 3/16/07

26

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON

MEREDITH J. CHING
JAMES A. FRAZIER
NEAL S. FUJIWARA
CHIYOME L. FUKINO, M.D.
LAWRENCE H. MIIKE, M.D., J.D.
STEPHANIE A. WHALEN

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

March 15, 2007

RECEIVED
LAND DIVISION
2007 MAR 16 P 3:38

REF:

TO: Russell Tsuji, Administrator
Land Division

FROM: W. Roy Hardy, Hydrologic Program Manager
Commission on Water Resource Management

SUBJECT: Lahaina Bypass Supplemental EIS

FILE NO.:

Thank you for the opportunity to review the subject document. The Commission on Water Resource Management (CWRM) is the agency responsible for administering the State Water Code (Code). Under the Code, all waters of the State are held in trust for the benefit of the citizens of the State, therefore, all water use is subject to legally protected water rights. CWRM strongly promotes the efficient use of Hawaii's water resources through conservation measures and appropriate resource management. For more information, please refer to the State Water Code, Chapter 174C, Hawaii Revised Statutes, and Hawaii Administrative Rules, Chapters 13-167 to 13-171. These documents are available via the Internet at *http://www.hawaii.gov/dlnr/cwrm*.

Our comments related to water resources are checked off below.

☐ 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.

☐ 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.

☐ 3. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

Permits required by CWRM: Additional information and forms are available at *www.hawaii.gov/dlnr/cwrm/forms.htm*.

☐ 4. The proposed water supply source for the project is located in a designated ground-water management area, and a Water Use Permit is required prior to use of ground water.

☐ 5. A Well Construction Permit(s) is (are) required before the commencement of any well construction work.

☐ 6. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.

4-2-07

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
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KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 13, 2007

RECEIVED
07 MAR 13 A11:34
COMMISSION ON WATER RESOURCE MANAGEMENT

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x ~~Div. of State Parks~~
x Div. of Water Resource Management
x ~~Office of Conservation~~ & Coastal Lands
x Land Division – Maui District

FROM: Russell Y. Tsuji
SUBJECT: Consultation for Draft Environmental Assessment for Proposed Lahaina Bypass Southern Terminus Relocation
LOCATION: Launiupoko to Honokowai, Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of Department of Transportation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 5, 2007.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed: W. Paty-Lacy
Date: 3/14/07

28

LINDA LINGLE
GOVERNOR OF HAWAII

MAUI DISTRICT
LAND DIVISION

2007 MAR 14 PM 1:23

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
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LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

March 13, 2007

MEMORANDUM

RECEIVED
LAND DIVISION
2007 MAR 16 A 8:33

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
x Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
x Div. of State Parks
x Div. of Water Resource Management
x Office of ~~Conservation & Coa~~stal Lands
x Land Division – Maui District

FROM: Russell Y. Tsuji
SUBJECT: Consultation for Draft Environmental Assessment for Proposed Lahaina Bypass Southern Terminus Relocation
LOCATION: Launiupoko to Honokowai, Maui
APPLICANT: Munekiyo & Hiraga, Inc. on behalf of Department of Transportation

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 5, 2007.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed:
Date: 3/14/07

DOT should also consider realigning the northern terminus closer to the Kapalua airport to minimize traffic along Honoapiilani Hwy, connect major nodes of transportation, i.e. the airport, and to provide better access to State and DHHL lands in Honokowai mauka areas.

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

HWY-PA
2.0620

February 3, 2012

TO: RUSSELL TSUJI
ADMINISTRATOR
LAND DIVISION
DEPARTMENT OF LAND AND NATURAL RESOURCES

FROM: GLENN M. OKIMOTO, Ph.D.
DIRECTOR OF TRANSPORTATION

SUBJECT: PROPOSED LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION PROJECT, PORTION OF TMK: (2) 4-7-001: 026, 027 AND 030

Thank you for your letter providing early consultation input on the subject project. We offer the following in response to your comments.

1. The Draft Environmental Assessment (EA) will reflect the project area's flood zone designation.

2. Although long-term planning warrants consideration of providing required highway capacity north of Honokowai, the State Department of Transportation has determined that priority for the provision of highway capacity and alignment improvements lies at the southern terminus of the Lahaina Bypass. This prioritization allows for the allocation of limited State and Federal funds to a segment of the bypass highway which can most readily benefit West Maui highway users.

We appreciate the input provided by your office. A copy of the Draft EA will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at 587-1835.

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

APR 17 2007

LINDA LINGLE
GOVERNOR
THEODORE E. LIU
DIRECTOR
MARK K. ANDERSON
DEPUTY DIRECTOR
LAURA H. THIELEN
DIRECTOR
OFFICE OF PLANNING

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

OFFICE OF PLANNING
235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Telephone: (808) 587-2846
Fax: (808) 587-2824

Ref. No. P-11708

April 13, 2007

Ms. Rochelle Ka'ula
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Ka'ula:

Subject: Request for Early Consultation on Draft Environmental Assessment
Project: Proposed Lahaina Bypass Southern Terminus Relocation
Applicant: State Department of Transportation, Federal Highway Administration
Landowner: Makila Land Company, LLC
Location: Olowalu, Maui

We have received the State Department of Transportation's (DOT) request for early consultation on the proposed Lahaina Bypass Southern Terminus relocation and we offer the following comments.

The proposed relocation of the southern terminus of the proposed Lahaina Bypass highway will extend the mauka alignment almost a mile further before merging with the existing Honoapi'ilani Highway. The landowner, Makila Land Company, LLC, is proposing to set-aside the required road right-of-way to DOT as part of a preliminary agricultural subdivision application filed with the County of Maui. The proposed agricultural subdivision will include agricultural lots, a subdivision roadway, and 75 acres for future shoreline recreational purposes.

The draft environmental assessment should address the impacts of the relocation project in its entirety, including the following cross-cutting issues of State concern:

1. **Agricultural lands** --- Preservation of important agricultural lands is a priority for the State. Please address how the extension of the bypass highway will impact the agricultural lands that will be bisected by the new alignment.

2. **Ocean Resources** --- The State has an affirmative duty to protect Hawaii's nearshore waters. Please discuss what design standards, including low impact design strategies, will be incorporated to reduce stormwater runoff from the highway to the ocean.

3. **Coastal Zone Management** --- The State oversees protection of natural and cultural resources within the coastal zone. Please discuss how the proposed relocation will balance the competing values of economic development and preservation of coastal resources, including protection from hurricanes, tsunami, and shoreline erosion.

The Office of Planning looks forward to receiving the DEA with the potential impacts and mitigation measures for the above issues addressed. If you have any questions, please call Mary Alice Evans at 587-2802.

Sincerely,

Laura H. Thielen
Director

c: Mr. Ronald Tsuzuki, Planning Branch, Highways Division, DOT

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:

HWY-PA
2.0618

February 3, 2012

TO: MARY ALICE EVANS, DEPUTY DIRECTOR
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

ATTN: JESSE K. SOUKI, DIRECTOR
OFFICE OF PLANNING
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

FROM: GLENN M. OKIMOTO, Ph.D.
DIRECTOR OF TRANSPORTATION

SUBJECT: PROPOSED LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION
PORTION OF TMK: (2) 4-7-001: 026, 027 AND 030

Thank you for your letter providing comments on the subject project. The Draft Environmental Assessment (EA) report will discuss agricultural lands, ocean resources and coastal zone management, its potential impacts and mitigation measures, as it relates to the proposed Lahaina Bypass Southern Terminus Relocation project.

We appreciate the input provided by your office. A copy of the Draft EA will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at 587-1835.

c: Richard Lim, Director, Department of Business, Economic Development & Tourism

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

MAR 2 8 2007

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M. D.
DIRECTOR OF HEALTH

LORRIN W. PANG, M. D., M. P. H.
DISTRICT HEALTH OFFICER

STATE OF HAWAII
DEPARTMENT OF HEALTH
MAUI DISTRICT HEALTH OFFICE
54 HIGH STREET
WAILUKU, MAUI, HAWAII 96793-2102

March 27, 2007

The Honorable Brennon T. Morioka, Ph.D., P.E.
Deputy Director – Highways
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawai'i 96813-5097

Dear Mr. Morioka:

Subject: **Proposed Lahaina Bypass Southern Terminus Relocation Olowalu, Maui**

Thank you for the opportunity to participate in the early consultation process for the proposed relocation of the southern terminus of the Lahaina Bypass. The following comments are offered:

1. The noise created during the construction phase of the project may exceed the maximum allowable levels as set forth in Hawaii Administrative Rules (HAR), Chapter 11-46, "Community Noise Control". A noise permit may be required and should be obtained before the commencement of work.

2. National Pollutant Discharge Elimination System (NPDES) permit coverage is required for this project. The Clean Water Branch should be contacted at 808 586-4309.

It is strongly recommended that the Standard Comments found at the Department's website: www.state.hi.us/health/environmental/env-planning/landuse/landuse.html be reviewed, and any comments specifically applicable to this project should be adhered to.

Should you have any questions, please call me at 808 984-8230.

Sincerely,

Herbert S. Matsubayashi
District Environmental Health Program Chief

c: Rochelle Ka`ula
Ronald Tsuzuki
EPO

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-PA
2.0716

February 3, 2012

TO: PATTI KITKOWSKI
ACTING DISTRICT ENVIRONMENTAL HEALTH PROGRAM CHIEF
MAUI DISTRICT HEALTH OFFICE
DEPARTMENT OF HEALTH

FROM: GLENN M. OKIMOTO, Ph.D.
DIRECTOR OF TRANSPORTATION

SUBJECT: PROPOSED LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION PROJECT, PORTION OF TMK: (2) 4-7-001:026, 027, AND 030

Thank you for the letter from your department providing comments on the subject project. We offer the following information in response to your comments:

1. Construction noise parameters will be monitored to ensure compliance with Hawaii Administrative Rules, Chapter 11-46, "Community Noise Control." A noise permit, if applicable, will be obtained prior to the commencement of construction.

2. A National Pollutant Discharge Elimination System Permit will be secured for the proposed action, as applicable.

We note that other applicable regulatory requirements of the State Department of Health will be addressed as well.

We appreciate the input provided by your office. A copy of the Draft Environmental Assessment will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

DEPARTMENT OF
HOUSING AND HUMAN CONCERNS
HOUSING DIVISION
COUNTY OF MAUI

MAR 2 8 2007

CHARMAINE TAVARES
Mayor

VANESSA A. MEDEIROS
Director

LORI TSUHAKO
Deputy Director

86 W. KAMEHAMEHA AVENUE • KAHULUI, HAWAII 96732-2259 • PHONE (808) 270-7351 • FAX (808) 270-6284

March 19, 2007

Ms. Rochelle Ka'ula
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Ka'ula:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project

We have reviewed the project overview that was attached to Mr. Brennon T. Morioka's early consultation letter of March 7, 2007, and would like to offer the following comments:

1. We support the relocation of the southern terminus of the project from Launiupoko to the vacinity of the former Olowalu landfill site.

2. The proposed project will provide a better intersection at Kai Hele Ku Street since it will be along a straight section of Kai Hele Ku Street as opposed to the existing location which is on a curve.

3. The relocation of the southern terminus to an area further south will move the Honoapiilani Highway further inland in the Launiupoko Park-former Olowalu landfill area and avoid an area that is subject to high surf inundation.

4. Makila Land Company, LLC's offer to dedicate the right-of-way to extend the roadway to the southern boundary of its land holdings near the vacinity of the former Olowalu landfill site is a significant contribution to the project.

5. The relocation of the Honoapiilani Highway further inland will provide greater opportunities for coastal recreational uses.

Thank you for the opportunity to comment.

Very truly yours,

Vanessa A. Medeiros

VANESSA A. MEDEIROS
Director

ETO:bp

c: Housing Administrator
Mr. Ronald Tsuzaki

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:

HWY-PA
2.0619

February 3, 2012

Ms. JoAnn Riodao
Director
County of Maui
Department of Housing and Human Concerns
Housing Division
One Main Plaza
2200 Main Street, Suite 546
Wailuku, Hawaii 96793

Dear Ms. Riodao:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

Thank you for your letter providing comments on the subject project. We appreciate your support for the proposed relocation of the southern terminus of the Lahaina Bypass to the vicinity of the former Olowalu Landfill site.

A copy of the Draft Environmental Assessment will be provided to your office for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

CHARMAINE TAVARES
Mayor

JEFFREY S. HUNT
Director

COLLEEN M. SUYAMA
Deputy Director

MAY 1 8 2007

COUNTY OF MAUI
DEPARTMENT OF PLANNING

May 15, 2007

Ms. Rochelle Ka'ula
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

Dear Ms. Ka'ula:

SUBJECT: Pre-consultation Comments in Preparation of a Draft Environmental Assessment for the Proposed Lahaina Bypass Southern Terminus Relocation (EAC2007/0008)

The Maui Planning Department (Department) is in receipt of the State of Hawaii Department of Transportation's (SDOT) letter dated March 7, 2005, requesting early consultation comments on the proposal to relocate the southern terminus of the proposed Lahaina Bypass Highway from its current terminus point at Launiupoko to the vicinity of the former Olowalu Landfill Site.

The proposed action involves extending the terminus of the Lahaina Bypass 10,000 lineal feet (proposed right-of-way) to the south and shifting the intersection at Kai Hele Ku Street more mauka or inland. The proposed right-of-way is reflected in Makila Land Company, LLC's preliminary subdivision application filed with the County of Maui. This subdivision includes the creation of agricultural lots makai of the proposed right-of-way.

The Department has reviewed this information and provides the following comments:

1. The Department recommends review by the Cultural Resources Commission (CRC) relative to potential impacts to cultural, historic, or archaeological sites in the area. Please contact Mr. Stanley Solamillo, of my office, at 270-7506 for scheduling.

2. Discuss how this proposal is consistent with the West Maui Community Plan policies regarding the:

   a. Preservation of coastal scenic views.

250 SOUTH HIGH STREET, WAILUKU, MAUI, HAWAII 96793
MAIN LINE (808) 270-7735; FACSIMILE (808) 270-7634
CURRENT DIVISION (808) 270-8205; LONG RANGE DIVISION (808) 270-7214; ZONING DIVISION (808) 270-7253

b. Provision of shoreline access.
c. Accommodating a sufficient supply of land for parks.
d. Preservation of archeological, historical and cultural resources.
e. Protection and enhancement of open space.
f. Support of bikeways and pedestrian walkways.

3. Discuss how the proposal is consistent with the Pali to Puamana Parkway Master Plan which designates the area makai of the currently proposed highway alignment in this area as open space (Figure 15, page 45).

4. Discuss the options and implications of relocating the bypass further mauka of the currently proposed highway alignment, tsunami inundation areas, coastal erosion areas and coastal flood hazard zones (i.e. views, development potential, open space and park expansion, etc.)

5. The SDOT should coordinate with the County to determine what is the best location of the realignment in consideration of applicable plans and policies.

The Department supports the relocation of the southern terminus of the Lahaina Bypass from Launiupoko to Olowalu. However, the Pali to Puamana Parkway Master Plan, which included two years of both general public and public agency input, outlines a plan to not only relocate the highway out of the danger zones but to also provide a continued corridor of open space and park land with little or no development makai of the highway alignment. The Department is concerned of the proposal to move the alignment further mauka which will lead to challenges in the County's ability to finance the acquisition of the all the lands makai of the realigned highway in order to support the intent of the West Maui Community Plan. This proposed mauka alignment also provides more opportunity for the landowner to develop the lands makai of the alignment than would be available should the alignment follow what is proposed in the Pali to Puamana Parkway Master Plan.

The Department is currently processing an Environmental Assessment to address proposed changes in land use designations for areas identified in the Pali to Puamana Parkway Master Plan as well as some additional lands for open space and park. The Department will be incorporating the comments provided by the major landowner in this area as well as those provided by others. The Department is open to discussing this project with SDOT and the landowner, however, the Department is ultimately obligated to

abide by, as well, as implement the goals, objectives and policies of the West Maui Community Plan.

Thank you for the opportunity to comment. Please include the Department on the distribution list for the Draft EA. Should you require further clarification, please contact Ms. Kathleen Ross Aoki, Staff Planner, at 270-5529.

Sincerely,

JEFFREY S. HUNT
Planning Director

JSH:KRA:
c: Colleen Suyama, Deputy Planning Director
Ronald Tsuzuki, State Department of Transportation
Clayton I Yoshida, Planning Program Administrator
John Summers, Planning Program Administrator
Kathleen Ross Aoki, Staff Planner
Robyn Loudermilk, Staff Planner
Project File
General File
K:\WP_DOCS\PLANNING\EAC\2007\0008_LahainaByPassSouth\0008 early consult final 05-15-07.wpd

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:

HWY-PA
2.0626

February 3, 2012

Mr. William Spence
Director
Department of Planning
County of Maui
250 South High Street
Wailuku, Hawaii 96793

Dear Mr. Spence:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

Thank you for your offering your comments on the proposed Lahaina Bypass Southern Terminus Relocation Project. The following responses (listed in the same order as your letter) are provided for your consideration:

1. An archaeological report and cultural impact assessment will be included in the Draft Environmental Assessment (EA). Since the proposed action is subject to Section 106 requirements of the National Historic Preservation Act, copies of the Draft EA will be transmitted to the Cultural Resources Commission for review and comment.

2. The Draft EA will discuss Community Plan policies relating to scenic views, shoreline access, coastal recreation and open space, archaeological and cultural resources, and bikeways and pedestrian walkways.

3. The Draft EA will discuss the relationship of the proposed action to the Pali to Puamana Parkway Master Plan.

4. Options and alternatives to the proposed action will be addressed in the Draft EA. Evaluative parameters such as coastal erosion, tsunami inundation, coastal recreation and development considerations will be included in the alternatives assessment.

5. The State Department of Transportation (SDOT) is coordinating with the County to determine the best location of the Lahaina Bypass Terminus Relocation in consideration with applicable plans and policies.

As part of the EA process, the SDOT will arrange a meeting with the Planning Department to continue dialogue to foster outcomes of a mutual benefit.

We appreciate the input provided by your office. A copy of the Draft EA will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

CHARMAINE TAVARES
Mayor

MAY 1 0 2007

TAMARA HORCAJO
Director

ZACHARY Z. HELM
Deputy Director

(808) 270-7931
Fax (808) 270-7162

DEPARTMENT OF PARKS & RECREATION

Planning & Development Division
700 Hali'a Nakoa Street, Unit 2, Wailuku, Hawaii 96793

April 30, 2007

Rochelle Ka'ula, Planner
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Hawaii 96793

RE: Request for Early Consultation Input for Proposed Lahaina Bypass Southern Terminus Relocation

Dear Ms. Ka'ula:

Thank you for the opportunity to review and comment on the Request for Early Consultation Input for Proposed Lahaina Bypass Southern Terminus Relocation.

At this time we do not have any comment to offer regarding this relocation.

Should you have any questions or need of additional information, please call me or Patrick Matsui, Chief of Parks Planning & Development at 808-270-7387

Sincerely,

Tamara Horcajo
for Director

c: Patrick Matsui, Chief of Parks Planning & Development
Ronald Tsuzuki, State DOT, Highways Division

MAR 1 9 2007

POLICE DEPARTMENT

COUNTY OF MAUI

CHARMAINE TAVARES
MAYOR

OUR REFERENCE
YOUR REFERENCE

55 MAHALANI STREET
WAILUKU, HAWAII 96793
(808) 244-6400
FAX (808) 244-6411

THOMAS M. PHILLIPS
CHIEF OF POLICE

GARY A. YABUTA
DEPUTY CHIEF OF POLICE

March 15, 2007

Ms. Rochelle Ka'ula
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, HI 96793

Dear Ms. Ka'ula:

SUBJECT: Request for Early Consultation Input for Proposed Lahaina Bypass Southern Terminus Relocation

Thank you for your letter of March 7, 2007, requesting comments on the above subject.

We have reviewed the information submitted for this project and offer the enclosed comments and recommendations. Thank you for giving us the opportunity to comment on this project.

Very truly yours,

AC Wayne T. Ribao

Assistant Chief Wayne T. Ribao
for: Thomas M. Phillips
Chief of Police

c: Jeff Hunt, Planning Department
Ronald Tsuzuki, State Dept. of Transportation

Enclosure

46

COPY

TO	:	**THOMAS PHILLIPS, CHIEF OF POLICE, MAUI POLICE DEPARTMENT**
VIA	:	**CHANNELS**
FROM	:	**CHARLES M. HIRATA, CAPTAIN, LAHAINA PATROL**
SUBJECT	:	**PROPOSED LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION**

CONCUR WITH CAPT. HIRATA
AC [illegible]
03/14/07

Sir,

I am in agreement with the proposal to shift the southern terminus of the Lahaina Bypass to the vicinity of the former Olowalu Landfill site. This action will move the bypass away from Launiupoko Park. During periods of good surf, there is increased traffic in and out of Launiupoko Park, impacting through traffic on Honoapiilani Hwy.

I am also in agreement that the original alignment will be impacted by coastal processes, namely shoreline erosion. During periods of high tide and high surf, the highway is often covered with salt water and debris. This tends to slow traffic. In addition, the presence of whales during the winter months slows traffic when cetaceans are active close to shore. This occurs a lot near Mile Post 17, which is in the area where the highway would be moved further mauka.

Moving the highway further mauka will facilitate evacuation and movement before or after a tsunami or hurricane. Since there are no residences in the proposed route, there will be no displacement of people and impact will be minimal.

I support the proposed realignment of Honoapiilani Hwy. and new terminus.

Charles M. Hirata E-4855
Captain, Lahaina Patrol
3/12/2007 4:36 PM

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

HWY-PA
2.0625

February 3, 2012

Mr. Gary Yabuta
Chief of Police
Maui Police Department
55 Mahalani Street
Wailuku, Hawaii 96793

Dear Chief Yabuta:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

Thank you for your department's letter providing comments on the subject project. We appreciate the Department's support for the proposed relocation of the southern terminus of the Lahaina Bypass to the vicinity of the former Olowalu Landfill site.

We appreciate the input provided by your office. A copy of the Draft Environmental Assessment will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

APR 1 0 2007

CHARMAINE TAVARES
Mayor

MILTON M. ARAKAWA, A.I.C.P.
Director

MICHAEL M. MIYAMOTO
Deputy Director

Telephone: (808) 270-7845
Fax: (808) 270-7955

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS AND ENVIRONMENTAL MANAGEMENT
200 SOUTH HIGH STREET, ROOM 322
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Development Services Administration

DAVID TAYLOR, P.E.
Wastewater Reclamation Division

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

TRACY TAKAMINE, P.E.
Solid Waste Division

April 3, 2007

Ms. Rochelle Ka`ula
Munekiyo & Hiraga, Inc.
305 High Street, Suite 104
Wailuku, Maui, Hawaii 96793

Dear Ms. Ka`ula:

SUBJECT: EARLY CONSULTATION INPUT FOR PROPOSED LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION

We reviewed the subject application and have no comments to offer at this time.

Please call Michael Miyamoto at 270-7845 if you have any questions regarding this letter.

Sincerely,

MILTON M. ARAKAWA, A.I.C.P.
Director of Public Works and
Environmental Management

MMA:MMM:ls
S:\LUCA\CZM\Draft Comments\Porp_Lah_bypass_south_terminus_reloc_erly_consult_ls.wpd

APR 0 5 2007

CHARMAINE TAVARES
Mayor

MILTON M. ARAKAWA, A.I.C.P.
Director

MICHAEL M. MIYAMOTO
Deputy Director

Telephone: (808) 270-7745
Fax: (808) 270-7975

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
AND ENVIRONMENTAL MANAGEMENT
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Development Services
Administration

DAVID TAYLOR, P.E.
Wastewater Reclamation Division

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

TRACY TAKAMINE, P.E.
Solid Waste Division

April 2, 2007

Munekiyo and Hiraga, Inc.
Attn: Rochelle Ka'ula
305 High Street, Suite 104
Wailuku, HI. 96793

SUBJECT: REQUEST FOR EARLY CONSULTATION INPUT FOR PROPOSED LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION

Dear Ms. Ka'ula:

Thank you for the opportunity to comment on the proposed relocation of the southern terminus for the Lahaina Bypass . We have no comments to offer at this time.

If you have any questions regarding this matter, please call Cary Yamashita of our Engineering Division at 270-7745.

Sincerely,

MILTON M. ARAKAWA, A.I.C.P.
Director of Public Works
and Environmental Management

CY:nco(ED07-215)
S:\ENG\ALL\cary\lahainabypasssoutherterminus.wpd

cc: Ronald Tsuzuki, State of Hawaii DOT

MAR 2 8 2007

CHARMAINE TAVARES
MAYOR

DON A. MEDEIROS
Director
WAYNE A. BOTEILHO
Deputy Director
Telephone (808) 270-7511
Facsimile (808) 270-7505

DEPARTMENT OF TRANSPORTATION

COUNTY OF MAUI
200 South High Street
Wailuku, Hawaii, USA 96793-2155

March 21, 2007

Ms. Rochelle Ka'ula
Munekiyo & Hiraga, Inc.
305 High Street
Suite 104
Wailuku, HI 96793

SUBJECT: Request for Early Consultation Input for Proposed Lahaina Bypass Southern Terminus Relocation

Dear Ms. Ka'ula:

In response to your letter regarding the above subject matter, we have reviewed the project overview and location maps and have no comments to add at this time.

Should you have any questions, or require additional information, please feel free to contact our office at 270-7511.

Sincerely,

Don Medeiros
Director

/dcy

xc: Ronald Tsuzuki, State of Hawaii DOT

MAR 1 6 2007

Maui Electric Company, Ltd. • 210 West Kamehameha Avenue • PO Box 398 • Kahului, Maui, HI 96733-6898 • (808) 871-8461

March 15, 2007

Munekiyo & Hiraga, Inc.
Attn: Rochelle Ka'ula
305 High Street, Suite 104
Wailuku, Hawaii 96793

Subject: Request for Early Consultation Input for Proposed Lahaina Bypass Southern Terminus Relocation

Dear Ms. Ka'ula,

Thank you for allowing us to comment on the "Request for Early Consultation Input" for the subject project, which was received on March 9, 2007.

In reviewing our records and the information received, Maui Electric Company (MECO) has no objection to the subject project at this time.

Should you have any other questions or concerns, please call Mark Suehiro at 872-3273.

Sincerely,

Fred Oshiro

for Neal Shinyama
Manager, Engineering

NS/ms:lh
cc: Ronald Tsuzuki

52

APR 2 3 2007

Lahaina Bypass.com

Let's get it built!

April 17, 2007

Munekiyo & Hiraga, Inc.
Atten: Rochelle Ka'ula
305 High Street, Suite 104
Wailuku, HI 96793

Ronald Tsuzuki
State of Hawaii
Department of Transportation
Highways Division, Planning Branch
869 Punchbowl Street, #301
Honolulu, HI 96813

Re: Comments on Proposed Lahaina Bypass Southern Terminus Relocation

Aloha,

Lahaina Bypass Now is a community group committed to accelerating the development of an effective regional transportation system for West Maui.

We support DOT's proposed relocation of the southern terminus of the Lahaina Bypass Highway from its current terminus point at Launiupoko to the vicinity of the former Olowalu Landfill Site. We cite the following as our rationale:

1) Continuing shoreline erosion of the existing highway in this area
2) An inland road relocation supports a costal recreation plan for this area
3) The area for the road relocation does not show any historic sites, Kuleana lands, LCA's and has few native plant species. In addition no current residences would be affected. The land is designated agriculture and is of gentle topography with only one stream crossing.
4) This relocation is in keeping with HDOT's long range transportation planning considerations for West Maui.

Thank you for allowing us to comment.

Sincerely,

Theo Morrison
Executive Director

505 Front Street, Suite 202 · Lahaina, HI 96761
Telephone: 808-667-2516, Fax: 808-661-2058
www.lahainabypassnow.com

53

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:

HWY-PA
2.0623

February 3, 2012

Mr. Bob Pure
President
Lahaina Bypass Now
P. O. Box 11205
Lahaina, Hawaii 96761

Dear Mr. Pure:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

Thank you for your letter providing comments on the subject project. We appreciate your support for the proposed relocation of the southern terminus of the Lahaina Bypass to the vicinity of the former Olowalu Landfill site.

A copy of the Draft Environmental Assessment will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, Federal Highways Administration
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

COMMENT FORM

PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

Aloha! Welcome to the public scoping meeting for the proposed Relocation of the Lahaina Bypass Southern Terminus project. The Hawaii Department of Transportation (HDOT) and Federal Highway Administration (FHWA) encourage all interested individuals and organizations to comment on the project.

To submit this comment form at tonight's meeting, please deposit into the Comment Box. To submit this comment form by mail, please fold and staple, and affix proper postage (see reverse side for guide). We ask that written comments be submitted by May 15, 2007. For more information on the project, please contact Wayne Kawahara at HDOT by phone at (808)587-6357, or by email at wayne.kawahara@hawaii.gov.

Name: JOSEPH PLUTA Address: PO BOX 12278 LAHAINA, HI 96761

Phone: 661-7990

Email: PLUTA@MAUI.NET

Comments:

1) CONCERN OF ANY FURTHER DELAY IN COMPLETION OF BY PASS DUE TO EXTENSION.

2) IF EXTENDING, WHY NOT EXTEND TO WHERE IT TRULY SHOULD BE EXTENDED TO, THAT IS MAALEA!

3) THE LENGTH OF TIME TO GET PROJECT COMPLETED NEEDS TO BE BROUGHT TO GET THE BYPASS PORTION TO MAALEA HAS TO BE EXPEDITED.

4) COMMENT: RUSHING TO GET STUCK ON THE PALI DUE TO A ROAD CLOSURE, EARTHQUAKE ROCK SLIDE, SOUTH SWELL WASHING OUT THE ROAD AT UKUMEHAME IS THE REAL PENDING DISASTER.

COMMENT 5) THERE IS CURRENTLY AN IMMINENT PENDING HEALTH + SAFETY DISASTER ISOLATING WEST MAUI'S 50,000 + FROM SOLE HOSPITAL + MAJOR AIRPORT. THE IMMINENT DANGER IS SEEN BY ROCKS FALLING ONTO HIGHWAY NOW + ROADWAY FALLING INTO OCEAN NOW!

6. STUDY SHOULD EXAMINE IF FEDERAL FUNDING AVAILABILITY OF LAND OR ROAD CAN INCLUDE GETTING FUNDS FROM ALL OTHER SOURCES DUE TO URGENCY AND PENDING ECONOMIC CHAOS WHEN WEST MAUI IS ISOLATED FROM HOSPITAL + AIRPORT. WE MUST HAVE ANOTHER FUNDING ANALYSIS THAT LOOKS + WEIGHS THE ECONOMIC COST OF LIMITATIONS ON WAITING FOR FEDERAL FUNDS VS USING IN-BOUNDS THE BOX' STATE + PRIVATE FUNDING VIA LAND OWNERS. INCLUDING TOW ROAD OPTIONS.

7. FUNDING OF $40 MILLION FOR PHASE BI + BII – WHAT HAPPENS WHEN BIDS COME IN HIGHER? CAN IT BE STRUCTURED TO CONTINUE THE PROJECT TO THE EXTENT EXISTING FUNDS PERMIT WHILE THE SHORTFALL IS BEING DEALT WITH, RATHER THAN STOPPING THE WHOLE THING?

FOLD HERE

Return Address

Place Postage Here

Hawai'i Department of Transportation
Highways Division
Attention: Proposed Relocation of
The Lahaina Bypass Southern Terminus
869 Punchbowl Street, Room 301
Honolulu, HI 96813

STAPLE HERE

E6

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:

HWY-PA
2.0627

February 3, 2012

Mr. Joseph Pluta
P.O. Box 12278
Lahaina, Hawaii 96761

Dear Mr. Pluta:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

The State Department of Transportation (SDOT) would like to thank you for attending the April 26, 2007 public scoping meeting for the Proposed Lahaina Bypass Southern Terminus Relocation project. SDOT also thanks you for taking the time to complete and submit a comment card at the meeting.

We offer the following in response to the comments that you submitted:

CONSTRUCTION SCHEDULE

Due to project scope and funding requirements, the Lahaina Bypass project is being implemented in phases. The proposed relocation of the southern terminus is scheduled as the final segment of Phase 1B-2 and as such, is not anticipated to affect the overall construction schedule for the Lahaina Bypass project. Information regarding the projected timing for each phase of the Lahaina Bypass project will be included in the Draft Environmental Assessment (EA).

SCOPE OF PROJECT

The relocation of the southern terminus is being undertaken by SDOT in conjunction with the Federal Highway Administration. The length of the new right-of-way alignment created by the relocation is approximately 10,300 feet and falls within lands owned by Makila Land Co., LCC. As noted in your comment card, the proposed project creates an opportunity for government and private sector to work together.

The project is being proposed to increase traffic capacity in the project area, provide a long-term solution for coastal erosion, and ensure consistency with the long-term transportation and land-use planning objectives in the region including synchronization with regional planning efforts for the SDOT's Honoapiilani Highway Realignment/Widening (Maalaea to Launiupoko) project and the County of Maui's Pali to Puamana Parkway Master Plan.

EMERGENCY ACCESS CONSIDERATIONS

SDOT notes your comments regarding the current Honoapiilani Highway and its access implications to emergency and transportation services located in the central valley in Wailuku-Kahului. Efforts are currently underway to minimize the vulnerability of this roadway to threats from coastal erosion, high waves, storm damage and other hazards. From a regional perspective, SDOT is currently involved in the early planning phases of the Honoapiilani Highway Realignment/Widening (Maalaea to Launiupoko) project, a master-planning study that proposes the widening and relocation of portions of the existing Honoapiilani Highway further mauka (inland) away from coastal erosion, tsunami evacuation and flood hazard zones. An Environmental Impact Statement (EIS) is currently being prepared for this project to evaluate the feasibility, funding requirements, probable impacts and suggested mitigation measures for a range of alternative design solutions aimed at providing additional access opportunities to and from the West Maui region. In regards to the project at hand, the relocation of the southern bypass terminus will allow a greater proportion of the Lahaina Bypass to be located further mauka away from high coastal hazard areas, thereby reducing maintenance costs across the lifetime of this new regional roadway. The completion of the Lahaina Bypass project and the Honoapiilani Highway Realignment/Widening (Maalaea to Launiupoko) project will provide a regional highway connection between West Maui and Central Maui that offers enhanced functionality and reliability under emergency situations or in times of natural disasters.

FUNDING

Financing sources for the Honoapiilani Highway Realignment/Widening (Maalaea to Launiopoko) project will be identified and secured as planning and design for the project proceeds.

Once again, we would like to thank you for your input at the public scoping meeting. A copy of the Draft EA will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

COMMENT FORM

PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

Aloha! Welcome to the public scoping meeting for the proposed Relocation of the Lahaina Bypass Southern Terminus project. The Hawaii Department of Transportation (HDOT) and Federal Highway Administration (FHWA) encourage all interested individuals and organizations to comment on the project.

To submit this comment form at tonight's meeting, please deposit into the Comment Box. To submit this comment form by mail, please fold and staple, and affix proper postage (see reverse side for guide). We ask that written comments be submitted by May 15, 2007. For more information on the project, please contact Wayne Kawahara at HDOT by phone at (808)587-6357, or by email at wayne.kawahara@hawaii.gov.

Name: [redacted] Barry Aoki Address: 761 Paunau St

Phone: 244-6400 Lahaina, HI 96761

Email:

Comments:

① Concerned about the existing highway. What happens to it? Is the SDOT going to maintain ownership? Or turn it over to the County? Concerned SDOT will transfer ownership to the landowner in exchange for their "donation" of the right-of-way.

② I applaud public-private partnership. However, this must involve the landowner getting something in exchange for their 1) paying for this study and 2) donating the right-of-way?! Why is this alignment advantageous to the landowner? Worried about shoreline access! Worried about development between the new alignment and the shoreline.

③ This proposed extention is a great idea - IF it/the landowner supports the Pali to Puamana project. There's no need to go more mauka than necessary - doing so only makes it look like the landowner wants to develop (more density than currently allowed) makai of the bypass.

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

HWY-PA
2.0617

February 3, 2012

Mr. Barry Aoki
761 Paunau Street
Lahaina, Hawaii 96761

Dear Mr. Aoki:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

The State Department of Transportation (SDOT) would like to thank you for attending the April 26, 2007 public scoping meeting for the Proposed Lahaina Bypass Southern Terminus Relocation project. SDOT also thanks you for taking the time to complete and submit a comment card at the meeting.

We offer the following response to your comments that you submitted:

OWNERSHIP OF HONOAPIILANI HIGHWAY

The current alignment of Honoapiilani Highway is owned and maintained by the State of Hawaii. Upon completion of the proposed relocation of the southern terminus for the Lahaina Bypass, the portion of the Honoapiilani Highway from Launiupoko Beach Park to the new terminus is intended to function as a secondary (local) roadway into Lahaina Town. The new alignment for the Lahaina Bypass between Hokiokio Road and the new southern terminus will fall under the ownership and control of the State of Hawaii. No portion of the Lahaina Bypass or the Honoapiilani Highway will fall under the ownership of Makila Land Co., LLC.

SHORELINE ACCESS

The relocation of the southern terminus is being undertaken by SDOT in conjunction with the Federal Highway Administration as part of the overall Lahaina Bypass project. The length of the new right-of-way alignment created by the relocation is approximately 10,300 feet and falls within lands owned by Makila Land Co., LLC. As noted in your comment card, the proposed project creates an opportunity for government and private sector to work together. Following implementation of the project, the realigned section of highway will fall under public ownership. By virtue of the roadway alignment being adjusted inland, opportunities to create added coastal recreational opportunities become available.

A discussion of shoreline access considerations in relation to the proposed southern terminus relocation project will be included in the Draft EA.

LOCATION AND ROADWAY ALIGNMENT FOR SOUTHERN TERMINUS

The relocation of the southern terminus of the Lahaina Bypass to the new proposed location (in the vicinity of the Olowalu Landfill) is being proposed to increase traffic capacity in the project area. It will also ensure consistency with the long-term transportation and land-use planning objectives in the region including synchronization with regional planning efforts for the SDOT's Honoapiilani Highway Realignment/Widening (Maalaea to Launiupoko) project and the County of Maui's Pali to Puamana Parkway Master Plan.

The possible alignments for the section of the Lahaina Bypass that would connect to the Honoapiilani Highway (at the new Southern Terminus) are based on the need to account for the above-noted long-term planning considerations while also meeting the design requirements imposed by physical parameters such as topographic conditions, locations of existing gulches and connections with intersecting roadways such as Kai Hele Ku Street.

Once again, we would like to thank you for your input at the public scoping meeting. A copy of the Draft EA will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

COMMENT FORM

PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

Aloha! Welcome to the public scoping meeting for the proposed Relocation of the Lahaina Bypass Southern Terminus project. The Hawaii Department of Transportation (HDOT) and Federal Highway Administration (FHWA) encourage all interested individuals and organizations to comment on the project.

To submit this comment form at tonight's meeting, please deposit into the Comment Box. To submit this comment form by mail, please fold and staple, and affix proper postage (see reverse side for guide). We ask that written comments be submitted by May 15, 2007. For more information on the project, please contact Wayne Kawahara at HDOT by phone at (808)587-6357, or by email at wayne.kawahara@hawaii.gov.

Name: JUDY FLEMATE Address: 50 Puu Ano and St #2801

Phone: 808 - 667-9300 Lahaina HI

Email: jaflemate@AOL.com 96761

Comments: I'm against relocation of the Lahaina bypass southern terminus, because what I see are developers benefiting from the property by developing million dollar homes. We will loose our world class view that makes Maui so unique; why tourist come to visit or peoples dreams to live in such a unique Island, I feel is previledge to live on this beautiful Island. I talk to people from the community their mis informed, they think they're going to be a parkway & bike / walking paths. This is a misconception. Please tell the community the TRUTH!!

Please Keep our shoreland, only 10% needs to be reconstructed to prevent further erosion. This bypass will only cause more congestion, and more development, who will benefit, only the rich, who don't even live here all year round!!; or care about our community!

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:

HWY-PA
2.0622

February 3, 2012

Ms. Judy Flemate
50 Puu Anoano, #2801
Lahaina, Hawaii 96761

Dear Ms. Flemate:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

The State Department of Transportation (SDOT) would like to thank you for attending the April 26, 2007 public scoping meeting for the Proposed Lahaina Bypass Southern Terminus Relocation project. SDOT also thanks you for taking the time to complete and submit a comment card at the meeting.

We offer the following to the comments that you submitted:

RATIONALE FOR PROPOSED RELOCATION OF SOUTHERN TERMINUS

The relocation of the southern terminus of the Lahaina Bypass to the new proposed location (in the vicinity of the Olowalu Landfill) is being proposed to increase traffic capacity in the project area. It will also ensure consistency with the long-term transportation and land-use planning objectives in the region including synchronization with regional planning efforts for the SDOT's Honoapiilani Highway Realignment/Widening (Maalaea to Launiupoko) project and the County of Maui's Pali to Puamana Parkway Master Plan. Implementation of the southern terminus relocation project will also provide an opportunity to address a long-term solution for coastal erosion mitigation and as such will reduce maintenance expenditures over the lifetime of the new roadway. The existing Honoapiilani Highway has been vulnerable to the effects of coastal erosion over the years, portions of which have required various shoreline hardening, pavement widening and restriping improvements to ensure continued functionality as a regional roadway. Occasional high surf episodes in the area impact the operational viability of the present roadway, which would be avoided with the relocation of the southern terminus. Further, the area of land selected for the proposed project does not present any apparent adverse impacts to sensitive environments or human settlements. A discussion of the foregoing transportation and land-use planning considerations will be included in the Draft Environmental Assessment (EA) that is currently being prepared for the project.

PROPOSING ENTITY

The relocation of the southern terminus is being undertaken by SDOT in conjunction with the Federal Highway Administration. The length of the new right-of-way alignment created by the relocation is approximately 10,300 feet and falls within lands owned by Makila Land Co., LLC. The proposed project creates an opportunity for government and private sector to work together. Following project implementation, the realigned highway corridor will fall under public ownership.

SHORELINE ACCESS & RECREATIONAL RESOURCES

The section of Honoapiilani Highway from Launiupoko to the proposed southern terminus of the Lahaina Bypass is intended to be maintained to function as a local (County owned and maintained) roadway which will provide both secondary access and scenic tour opportunities into Lahaina Town. By virtue of the roadway alignment being adjusted inland, opportunities to create added coastal recreational opportunities become available.

A discussion of shoreline access and recreational resources considerations in relation to the proposed southern terminus relocation project will be included in the Draft EA.

Once again, we would like to thank you for the input provided at the public scoping meeting. A copy of the Draft EA will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

COMMENT FORM

PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

Aloha! Welcome to the public scoping meeting for the proposed Relocation of the Lahaina Bypass Southern Terminus project. The Hawaii Department of Transportation (HDOT) and Federal Highway Administration (FHWA) encourage all interested individuals and organizations to comment on the project.

To submit this comment form at tonight's meeting, please deposit into the Comment Box. To submit this comment form by mail, please fold and staple, and affix proper postage (see reverse side for guide). We ask that written comments be submitted by May 15, 2007. For more information on the project, please contact Wayne Kawahara at HDOT by phone at (808)587-6357, or by email at wayne.kawahara@hawaii.gov.

Name: George LAVENSON, MD Address: 50 PUU ANOANO #2801

Phone: 667-9300 LAHAINA

Email: GLAVENSON@AOL.COM HI 96761

Comments:

(1) THE LAHAINA BY PASS SHOULD END AT PUUNENE
THE SOUTHERN END OF LAHAINA — THE ORIGINAL PLAN
(2) THERE IS NOTHING SOUTH OF PUUNENE TO BY-PASS
(3) THE ONLY REASON FOR EXTENDING IT IS SO LANDOWNERS & DEVELOPERS CAN BUILD MAUI TO REALIGNED PILANI HIGHWAY & MILLIONAIRES ON THE SHORE —
(4) THIS WILL BLOCK THE PUBLIC FROM THE SHORE — GIVING IT PREFERENTIALLY TO MILLIONAIRES & MAUI LAND
(5) PILANI HIGHWAY DOES NOT NEED TO BE MOVED ONLY 10% MIGHT NEED TO BE ENBOWED IN ETC —
(6) IT IS ONLY BEING REALIGNED FOR DEVELOPERS — LAHAINA BY-PASS COMMITTEE ENTIRELY FUNDED BY MAUI LAND & PINE —
(7) THE SHORELINE DRIVE SHOULD NOT BE TAKEN FROM THE PUBLIC OR MAUI IE. BEACHING FISHING, SURFING ETC
(8) DOT A PUBLIC ENTITY SHOULD NOT PARTNER WITH THE RICH LANDOWNERS + DEVELOPERS AGAINST THE PUBLIC —
(9) THE PUBLIC HAS NOT BEEN TOLD THAT THE PRESENT PILANI HWY WILL BE TORN UP FOR DEVELOPMENT & THAT THEIR ACCESS WILL BE RESTRICTED —

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-PA
2.0624

February 3, 2012

Dr. George Lavenson, M.D.
50 Puu Anoano Street, #2801
Lahaina, Hawaii 96761

Dear Dr. Lavenson:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001: 026, 027, and 030

The State Department of Transportation (SDOT) would like to thank you for attending the April 26, 2007 public scoping meeting for the Proposed Lahaina Bypass Southern Terminus Relocation project. SDOT also thanks you for taking the time to complete and submit a comment card at the meeting.

We offer the following in response to the comments that you submitted:

LOCATION OF SOUTHERN TERMINUS

We note your comment regarding your preference in favor of the original southern terminus location (in the vicinity of Puamana Beach Park) for the Lahaina Bypass.

RATIONALE FOR PROPOSED RELOCATION OF SOUTHERN TERMINUS

The relocation of the southern terminus of the Lahaina Bypass to the new proposed location (in the vicinity of the Olowalu Landfill) is being proposed to increase traffic capacity in the project area. It will also ensure consistency with the long-term transportation and land-use planning objectives in the region including synchronization with regional planning efforts for the SDOT's Honoapiilani Highway Realignment/Widening (Maalaea to Launiupoko) project and the County of Maui's Pali to Puamana Parkway Master Plan. Implementation of the southern terminus relocation project will also provide an opportunity to address a long-term solution for coastal erosion mitigation and as such will reduce maintenance expenditures over the lifetime of the new roadway. The existing Honoapiilani Highway has been vulnerable to the effects of coastal erosion over the years, portions of which have required various shoreline hardening, pavement widening and restriping improvements to ensure continued function as a regional roadway. Occasional high surf episodes in the area impact the operational viability of the present roadway, which would be avoided with the relocation of the southern terminus. Further, the area of land selected for the proposed project does not present any apparent adverse impacts to sensitive environments or human settlements. A discussion of the foregoing transportation and land-use planning considerations will be provided in the Draft Environmental Assessment (EA) that is currently being prepared for the project.

VIEW IMPACT CONSIDERATIONS

A discussion of the potential for perceived impacts from the project on mauka/makai view corridors will be provided in the Draft EA.

PROPOSING ENTITY

The relocation of the southern terminus is being undertaken by SDOT in conjunction with the Federal Highway Administration. The length of the new right-of-way alignment created by the relocation is approximately 10,300 feet and falls within lands owned by Makila Land Co., LLC. The proposed project creates an opportunity for government and private sector to work together. Following project implementation, the realigned highway corridor will fall under public ownership.

SHORELINE ACCESS

The section of Honoapiilani Highway from Launiupoko to the proposed southern terminus of the Lahaina Bypass is intended to be maintained to function as a local (County owned and maintained) roadway which would provide both secondary access and scenic tour opportunities into Lahaina Town. In addition, by virtue of the roadway alignment being adjusted inland, opportunities to create added coastal recreational opportunities become available.

A discussion of shoreline access considerations in relation to the proposed southern terminus relocation project will be included in the Draft EA.

PUBLIC INVOLVEMENT

The proposed project is currently in the early planning phase of work, an element of which includes (due to use of federal funding) the preparation of an EA in accordance with the requirements of Chapter 343, Hawaii Revised Statutes and National Environmental Policy Act.

Once again, we would like to thank you for providing input at the public scoping meeting. A copy of the Draft EA will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

67

COMMENT FORM

PROPOSED RELOCATION OF THE LAHAINA BYPASS SOUTHERN TERMINUS

Aloha! Welcome to the public scoping meeting for the proposed Relocation of the Lahaina Bypass Southern Terminus project. The Hawaii Department of Transportation (HDOT) and Federal Highway Administration (FHWA) encourage all interested individuals and organizations to comment on the project.

To submit this comment form at tonight's meeting, please deposit into the Comment Box. To submit this comment form by mail, please fold and staple, and affix proper postage (see reverse side for guide). We ask that written comments be submitted by May 15, 2007. For more information on the project, please contact Wayne Kawahara at HDOT by phone at (808)587-6357, or by email at wayne.kawahara@hawaii.gov.

Name: MIKE WHITE Address: 2525 KAANAPALI PKWY

Phone: 667-0211 LAHAINA, HI 96761

Email: MWHITE@KBHMAUI.COM

Comments: I SUPPORT THE RELOCATION OF THE SOUTHERN TERMINUS.

NEIL ABERCROMBIE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

GLENN M. OKIMOTO
DIRECTOR

Deputy Directors
JADE T. BUTAY
FORD N. FUCHIGAMI
RANDY GRUNE
JADINE URASAKI

IN REPLY REFER TO:
HWY-PA
2.0630

February 3, 2012

The Honorable Mike White
Chair
Economic Development, Agriculture
and Recreation Committee
County Council
County of Maui
200 South High Street
Wailuku, Hawaii 96793

Dear Councilmember White:

Subject: Proposed Lahaina Bypass Southern Terminus Relocation Project
Portion of TMK: (2) 4-7-001:026, 027, and 030

The State Department of Transportation (SDOT) would like to thank you for attending the April 26, 2007 public scoping meeting for the Proposed Lahaina Bypass Southern Terminus Relocation project. SDOT also thanks you for taking the time to complete and submit a comment card at the meeting.

We appreciate your support for the proposed relocation of the southern terminus for the Lahaina Bypass.

A copy of the Draft Environmental Assessment will be provided to you for review and comment. If you have any questions, please do not hesitate to contact Darell Young at (808) 587-1835.

Very truly yours,

GLENN M. OKIMOTO, Ph.D.
Director of Transportation

bc: Wayne Kaneshiro, FHWA
Mark Alexander Roy, Munekiyo & Hiraga, Inc.
HWY-M, HWY-PA

DY:th

REFERENCES

REFERENCES

AECOS, Inc., Maui Coastal Zone Atlas, 1981.

County of Maui, The General Plan of the County of Maui 1990 Update, 1990.

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Munekiyo & Hiraga, Inc. Draft Environmental Assessment for Proposed Keawe Street Extension, Prepared for County of Maui, Department of Public Works and Environmental Management, January 2006.

Munekiyo & Hiraga, Inc. Special Management Area Use Permit Application, Subdivision of Olowalu Lands, November 1999.

State of Hawaii, Department of Education, Official Enrollment Count, 2006-07 School Year.

APPENDIX A.

Pali to Puamana Master Plan Alignment

Camping Areas

Pāpalaua Wayside Park

Ukumehame Beach Park

"Mōpua View Area" and Parking

"Mōpua Park at MP 14"

Puamana Beach Park

Launiupoko Wayside Park

"Awalua Park"

"Awalua View Area"

"Hekili Pt. Beach Park"

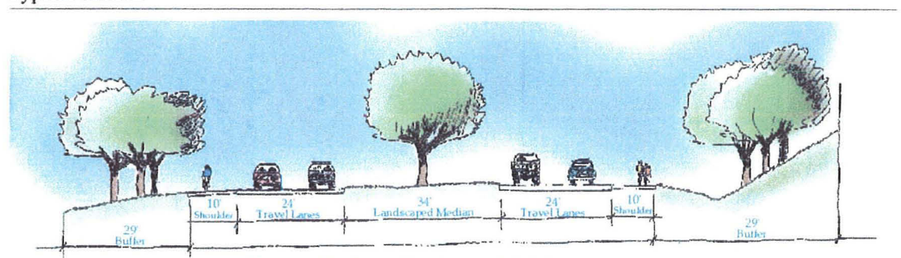
"Olowalu Beach Park"

"Village Center"

Legend

- Proposed By-Pass Road
- Extg. Honoapi'ilani Hwy
- Proposed Multipurpose Pathway (Honoapi'ilani Hwy Alignment)
- Mauka-Makai Access
- Park Landscape
- Natural Open Space
- Trees
- Streams
- Park Structure
- Camping
- Snorkel
- Surf
- Fish
- 16 Mile Post
- Views

Typical Section



Proposed Right-of-Way Varies, 160' Minimum
(Near Intersection)

FIGURE 2
MASTER PLAN
Pali to Puamana Parkway
County of Mau'i, Hawai'i

0 500 2,000 3,000 4,000 Feet

R. M. Towill Corporation

FEBRUARY 2005 (Rev.)

APPENDIX B.

Preliminary Drainage Report

Established 1969

Drainage Report for

The Proposed Lahaina Bypass Southern Terminus Relocation Project

Prepared For: Makila Land Company
33 Lono Avenue, Suite 450
Kahului, Hawaii 96732

ALAN L. UNEMORI
LICENSED PROFESSIONAL ENGINEER
NO. 9354-C
HAWAII, U.S.A.

Date: January 2009
Revised: April 13, 2012

WARREN S. UNEMORI ENGINEERING, INC.
Civil and Structural Engineers - Land Surveyors
Wells Street Professional Center - Suite 403
2145 Wells Street
Wailuku, Maui, Hawaii 96793

Vprojdata\06058\reports\drainage report\cover000.crd

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FIGURE

1 Southern Terminus Relocation Project Limits
2 Drainage Map

EXHIBIT

A Plan and Profile - Alternative 1
B Plan and Profile - Alternative 2
C Plan and Profile - Alternative 3

TABLE

1 Alternative 1 Drainage Area Calculations
2 Alternative 2 Drainage Area Calculations
3 Alternative 3 Drainage Area Calculations
4 Culvert Sizing Summary
5 Summary of Drainage Channel and Culvert Data

APPENDIX

A Worksheets for Drainage Basins 1, 2 and 3

DRAINAGE REPORT for
THE PROPOSED LAHAINA BYPASS
SOUTHERN TERMINUS RELOCATION PROJECT
Phase I-B-2

I. INTRODUCTION

This report has been prepared to examine the existing drainage conditions and the improvements that may be required to comply with Code of Federal Regulation - CFR 650.

II. PROPOSED PROJECT

A. Site Location

The Lahaina Bypass Project extends from Honokowai to Launiupoko. Design and construction of Phase I-A between Lahainaluna Road and Keawe Street is currently underway. The design contract for Phase I-B-1 between Lahainaluna Road and Hoki`oki`o Place has been awarded and is in progress. Design of subject project, Phase I-B-2 is expected to begin upon approval of the Environmental Assessment.

B. Project Description

Three (3) alignments are being evaluated for the project. All three alternatives begin at Hokiokio Place and end at the Launiupoko/Olowalu boundary as shown on Figure 1.

Alternative 1: (See Exhibit A.)

This alternative begins at the southern end of Phase I-B-1 at Hoki`oki`o Place and extends in a southerly direction to a point approximately 1,000 feet south of Launiupoko Park where it intersects with Honoapiilani Highway. It then follows the existing highway to the Launiupoko/Olowalu boundary on the north side of the now closed Olowalu Landfill.

Alternative 2: (See Exhibit B.)

This alternative follows an alignment ranging between 300 to 500 feet inland of Alternative 1. It is generally located midway between Alternative 1 and 3.

Alternative 3: (See Exhibit C.)

Alternative 3 is located farthest inland and ranges between 600 to 900 feet mauka and east of the existing Honoapiilani Highway.

III. EXISTING CONDITIONS

A. Topography and Soil Conditions

The existing topography across all three alternatives range between 7 and 8 percent. Grades along the profile varies between 0.5 and 3.0 percent.

According to the *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, prepared by the United States Department of Agriculture, Natural Resource Conservation Service, most of the project site is classified as Stony Alluvial Land (rSM). This soil is comprised of stones, boulders, and stream deposited soil. The remainder of the project site is classified as Wainee extremely stony silty clay (WyC) sloped 7 to 15 percent and Wainee very stony silty clay (WxB) sloped 3 to 7 percent. The Wainee Series is characterized as having moderately rapid permeability and slow to medium runoff, with a slight to moderate erosion hazard.

B. Drainage

This report identifies the location of floodplains within the project limits. It also discusses the hydraulic design of drainage structure with supporting documentation to

minimize the impact of encroachments, all in accordance with the provisionsof CFR 650.

1. Definition (CFR 650.105)

As defined in this section of the CFR, *base flood* refers to flood or tide that have a 1 percent chance of being exceeded in any given year, comparable to a 100-year recurrence storm.

Base floodplain are areas subject to flooding by the base flood.

Encroachment means any action within the limits of the base floodplain.

2. Applicability of CFR 650.107

There are no regulatory floodways established by the Federal Emergency Management Agency (FEMA) for administration of the National Flood Insurance program within the project limits. However, since all three alternatives do encroach on base floodplains, the provisions of CFR 650.105 will be applicable. Base floodplain refers to areas that are subject to 100-year storm or a storm event that have a 1 percent chance of being exceeded in any given year. See Figure 2.

Since none of the drainage basins have stream flow gauging stations or gage data, the Soil Conservation (NRCS) Method was used to determine runoff in areas greater than 200 Acres in accordance with State of Hawaii, Department of Transportation's (HDOT) *Design Criteria for Highway Drainage*. For drainage basin less than 200 Acres the rational formula was used.

3. Location of Hydraulic Study (CFR 650.111)

Although there are eight (8) contributory drainage areas located above, or upstream, of the proposed realignment project, only three (3) of them, areas 1, 2 and

3 are greater than one square mile. These three basins are contiguous and extend up the slopes of the West Maui Mountains. Drainage basins 1 and 2 straddle Luakoi Ridge approximately 2 miles northeast of the project area. Drainage basin 3 encompasses Launiupoko Gulch and extends about 2.2 miles inland of the project site. These floodways will be bifurcated by all three alternative alignments being considered. By definition any such action would be considered an encroachment.

Since the three drainageways generally flow from the mountain slopes to the ocean normal to the natural contours and highway corridors, there is no practical alternative to avoid encroachment. To mitigate any adverse impact, the status quo will be maintained. The existing water surface elevation will be used to set the water surface elevations in the drainage structure. Major drainage structures will be sized not only to convey the design flood across the highway but also to prevent overtopping. To establish the height of drainage structures and channels its depth will be measured from the existing water surface elevation down to the invert of the structure or channel. This is to maintain the existing water surface elevation or to ensure that it will not rise more than one (1) foot above the existing water surface elevation in the drainageway in accordance with the regulations established by FEMA. The size of these larger drainage structures must also be high and deep enough for access by maintenance equipment.

The capacities of these major drainage structures can also be increased substantially by installing side-tapered and slope-tapered transitional inlets to the box culverts. With the installation of these transitional tapered inlets and allowance for

freeboard in the box culverts, these structures can serve as open channels, thereby increasing their capacities substantially as indicated in the last column of Table 5.

4. Design Standards (CFR 650.115)

The existing flood inundation limits are shown on Exhibits 1, 2 and 3. These exhibits show the existing floodways and sizes of culverts that will be needed at each crossing to maintain the status quo. Although Section (a) - (2) of these design standards state that design flood encroachments by through lanes of interstate highways may be sized to handle floods that have a 2 percent chance of being exceeded in any give year, (50-year storm), culverts for drainage areas 4 through 7 inclusive will be oversized to pass 100-year storm at HW/D of 1.2 instead to reduce the probability of overtopping. Size and material of culverts shall be designed in accordance with HDOT's *Design Criteria for Highway Drainage.*

5. Content of Design Studies (CFR 650.117)

The results of our studies are tabulated in Tables 4 and 5 respectively.

According to our studies, the water level in the drainageways at the highway crossings will remain the same or where there is an increase, the increase will not be greater than one foot consistent with standards established by FEMA.

Supporting calculations for Tables 4 and 5 are included in Tables 1, 2 and 3 and also in Appendix A.

IV. SUMMARY AND CONCLUSION

All three base floodways identified within the project limits will be affected by the project. There is no practical alternative to avoid encroachment by the project. These encroachments are not significant and can be mitigated by sizing and designing the drainage structures to maintain the status quo.

With the installation of side-tapered and slope-tapered transitional inlet structures in the drainageways that are being lowered and channelized, these structures could function as open channels. Open channels would have much greater capacities than inlet control structures.

Although Section 650.115 of CFR and HDOT's design standards allow the use of 50-year storms to size the drainage structures for smaller drainage basins, these structures will be sized to handle 100-year storms to minimize the probability of overtopping.

The degree of encroachments by all three alternatives are generally the same. Encroachments can be mitigated readily during the design phase to maintain the status quo in compliance with the provisions of CFR 650.

Desilting and retention basins will also be installed to capture the additional runoff generated by the impermeable pavement structures on the new highway to maintain the current peak runoff during a 100-year (1%) storm. Energy dissipators will also be installed at outlets of drainage structures where necessary to maintain the existing velocities in the drainageways.

V. REFERENCES

1. *Soil Survey of Islands of Kauai, Oahu, Molokai, and Lanai, State of Hawaii.* August 1972. United States Department of Agriculture, Soil Conservation Service.

2. *Code of Federal Regulation CFR 650 - Bridges, Structures and Hydraulics.* Federal Highway Administration, Department of Transportation.

3. *Design Criteria for Highway Drainage.* State of Hawaii, Department of Transportation Highways Division.

4. *Highway Drainage Guidelines.* 1992. American Association of State Highway and Transportation Officials.

5. *Storm Water Permanent Best Management Practices Manual.* State of Hawaii, Department of Transportation Highways Division.

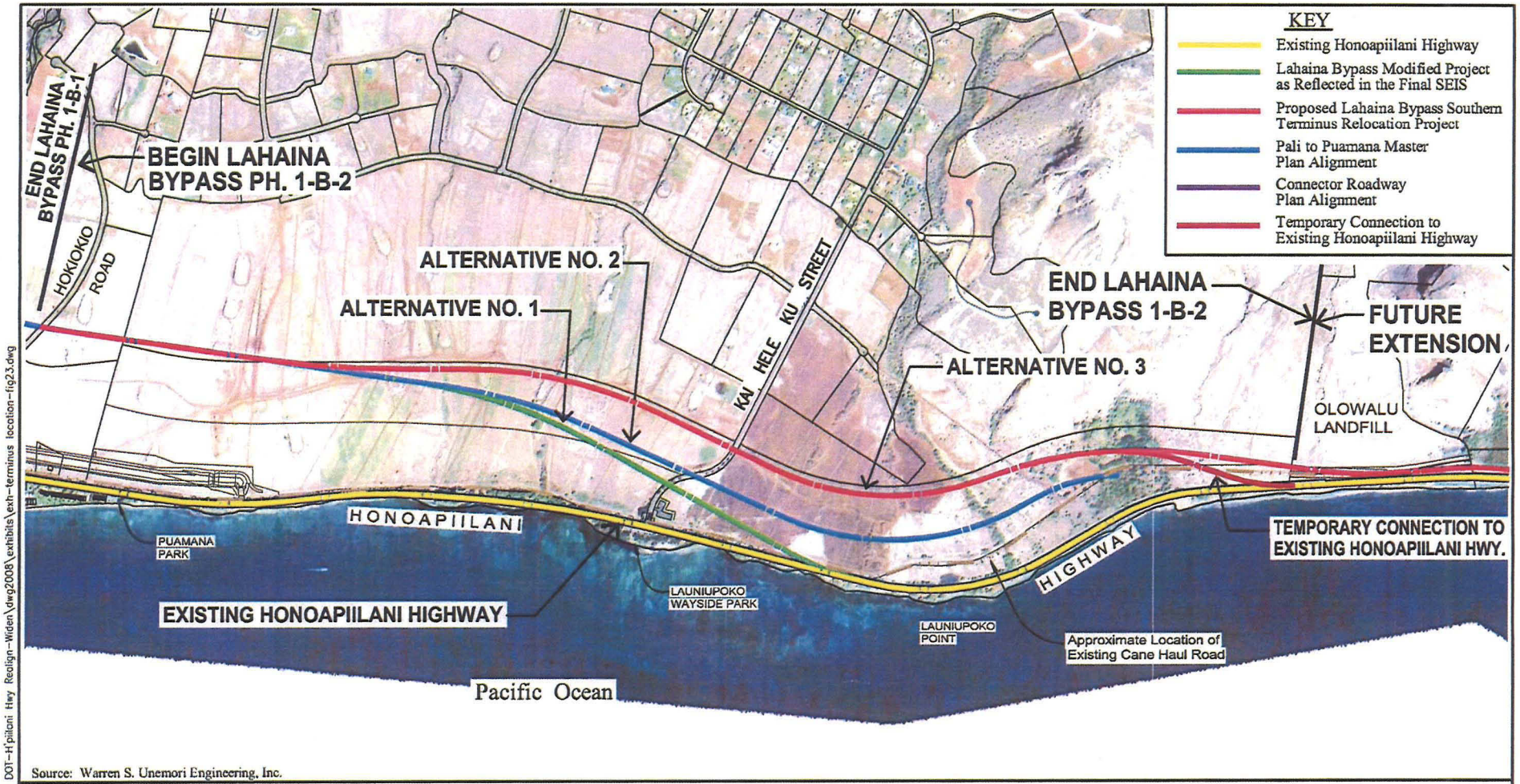
6. *Hydraulic Design of Highway Culverts.* Federal Highway Administration, Department of Transportation.

7. *Flood Insurance Study.* August 1998. County of Maui, Federal Emergency Management Agency Community Number 150003.

FIGURE

1 Southern Terminus Relocation Project Limits

2 Drainage Map



Source: Warren S. Unemori Engineering, Inc.

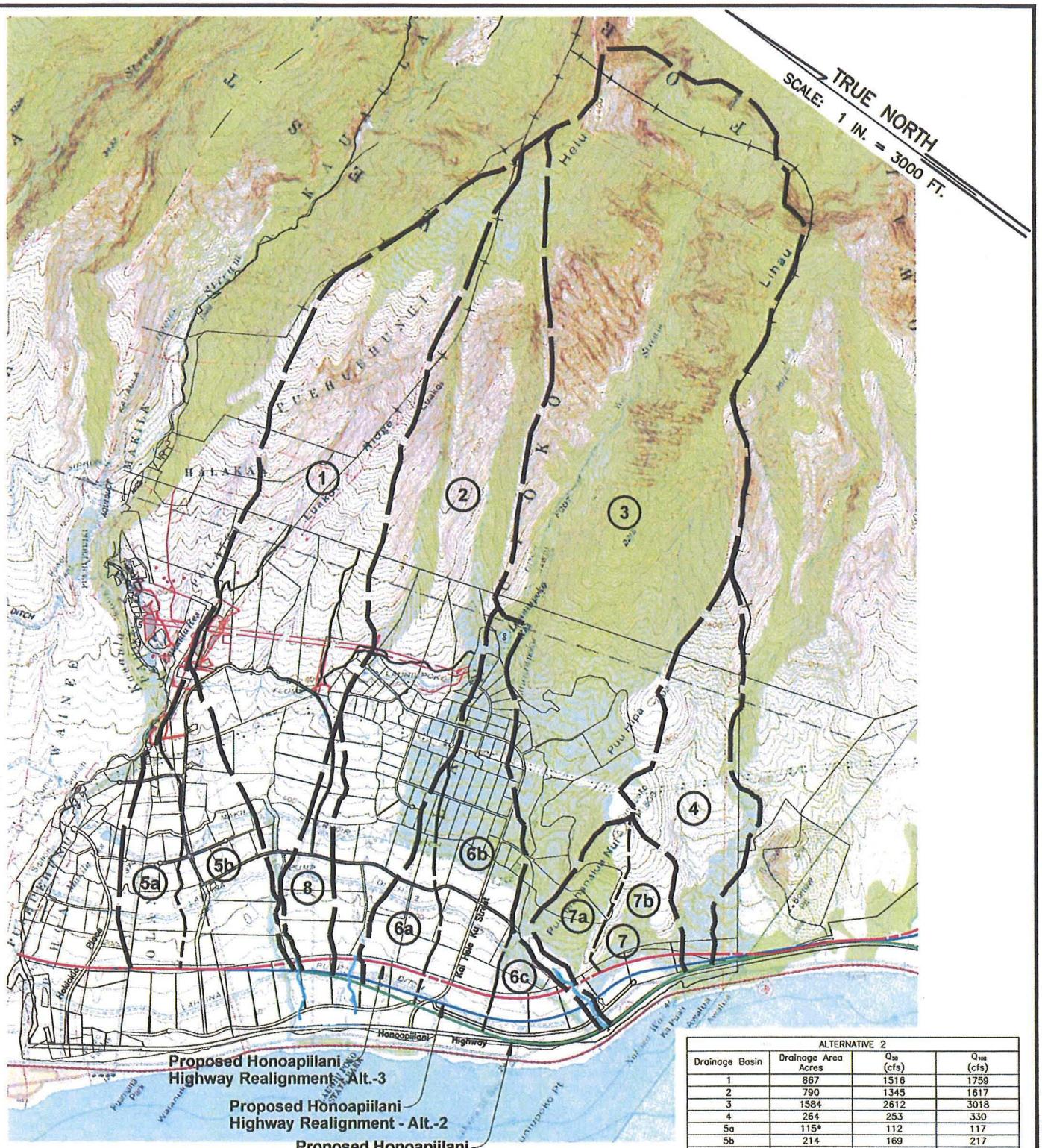
Scale: 1 in. = 1000 ft.

Prepared For: State of Hawaii, Department of Transportation

Proposed Lahaina Bypass Southern Terminus Relocation
Alignment Comparison: Pali to Puamana Master Plan vs. Proposed Action

FIGURE 1

V:\Projdata\04PROJ\04044 – DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\exh-terminus location-fig23.dwg



ALTERNATIVE 1			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	867	1514	1758
2	791	1342	1613
3	1587	2539	2960
4	265	251	327
5a	115*	112	117
5b	214	184	217
6a	93*	91	95
6b	255	169	243
6c	73*	80	85
7	197*	188	192
8	86*	78	81

Note: Calculations were Based on a 24-Hour Storm Duration
*A 1-Hour Storm Duration was Used for Areas Less Than 200 Acres

ALTERNATIVE 2			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	867	1516	1759
2	790	1345	1617
3	1584	2612	3018
4	264	253	330
5a	115*	112	117
5b	214	169	217
6a	89*	88	92
6b	246	178	234
6c	46*	54	57
7	175*	175	192
8	85*	78	82

ALTERNATIVE 3			
Drainage Basin	Drainage Area Acres	Q_{50} (cfs)	Q_{100} (cfs)
1	866	1524	1768
2	785	1369	1646
3	1581	2655	3067
4	261	255	333
5a	115*	112	117
5b	212	168	216
6a	76*	76	80
6b	231	177	227
6c	26*	32	34
7a	82*	90	94
7b	78*	86	91
8	81*	75	79

DRAIN AREA MAP

FIGURE 2

April 10, 2008

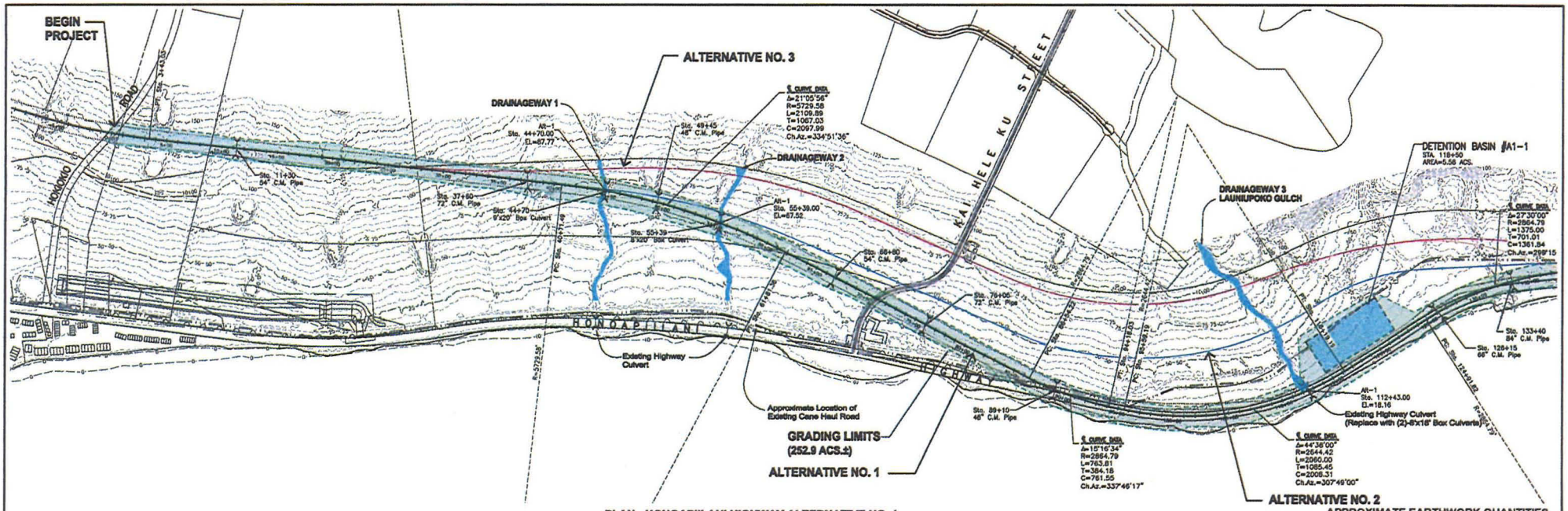
V:\Projects\04044 - Honoapiilani Hwy Realign-Wailuku\dwg2000\exhibits\LAD-DRAINAGE-AREA-00.dwg

EXHIBIT

A Plan and Profile - Alternative 1

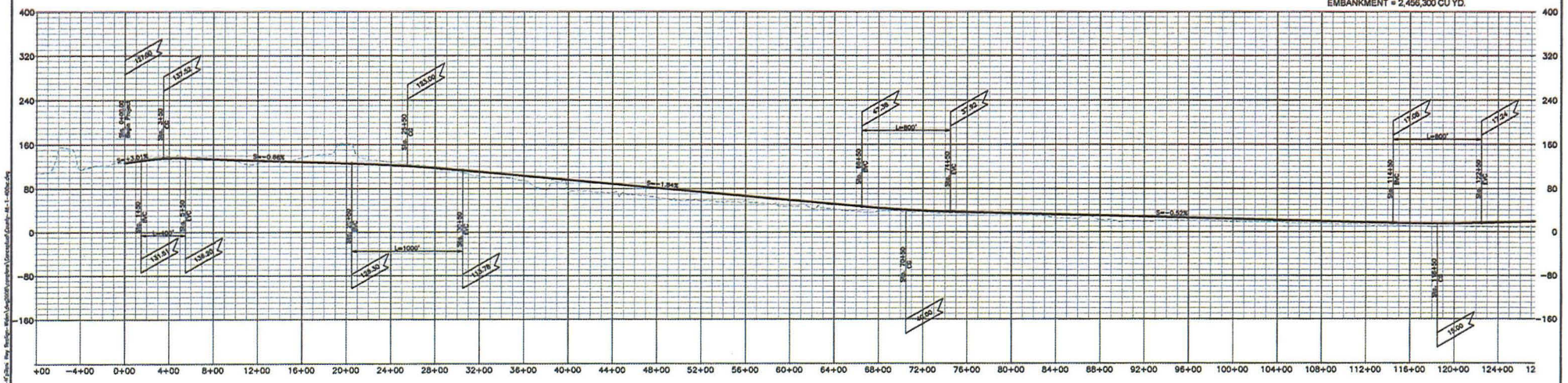
B Plan and Profile - Alternative 2

C Plan and Profile - Alternative 3



PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 1
SCALE: HORIZ. 1"=400'

APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 1)
EXCAVATION = 142,200 CU.YD.
EMBANKMENT = 2,456,300 CU YD.

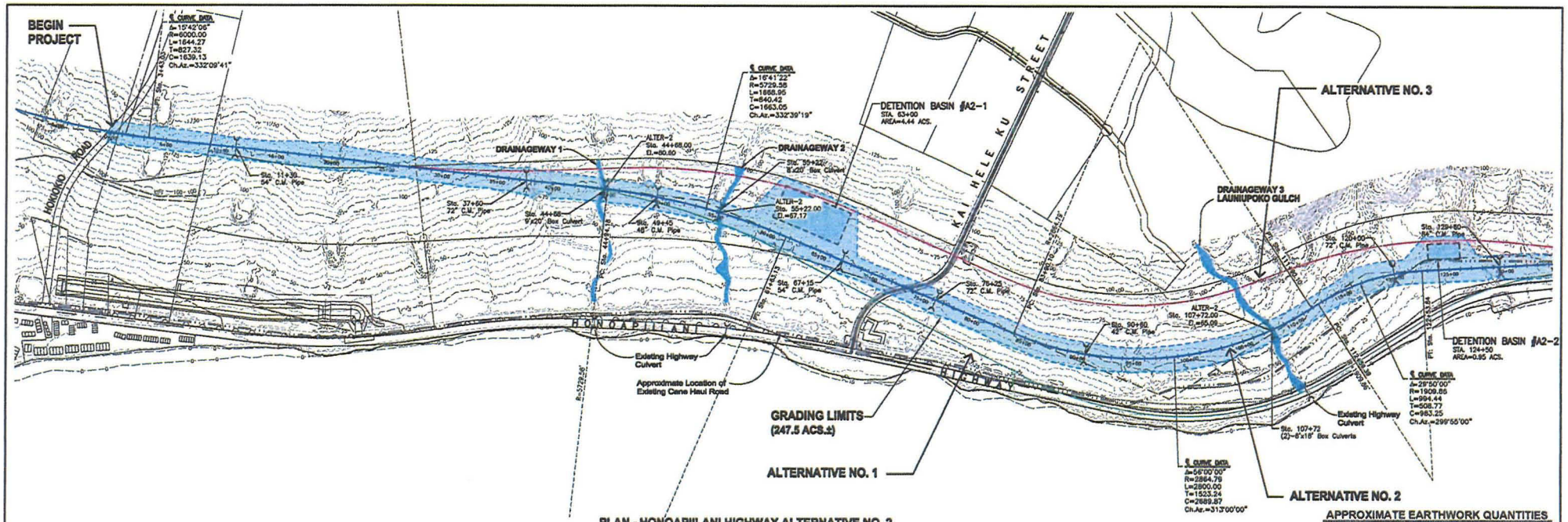


PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 1
SCALE: HORIZ. 1"=400'
VERT. 1"=80'

EXHIBIT A

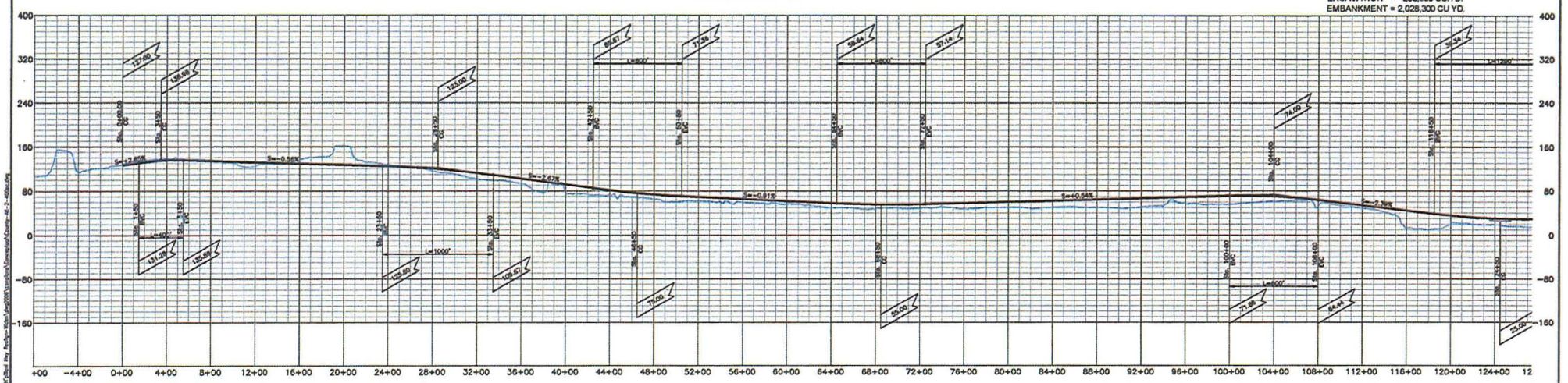
WARREN S. UNSON ENGINEERING INC.

July 31, 2007
Revision No. 1 – August 24, 2007
Revision No. 2 – Sept. 6, 2007
Revision No. 3 – Nov. 24, 2008



PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 2
SCALE: HORIZ. 1"=400'

APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 2)
EXCAVATION = 280,900 CU.YD.
EMBANKMENT = 2,028,300 CU YD.

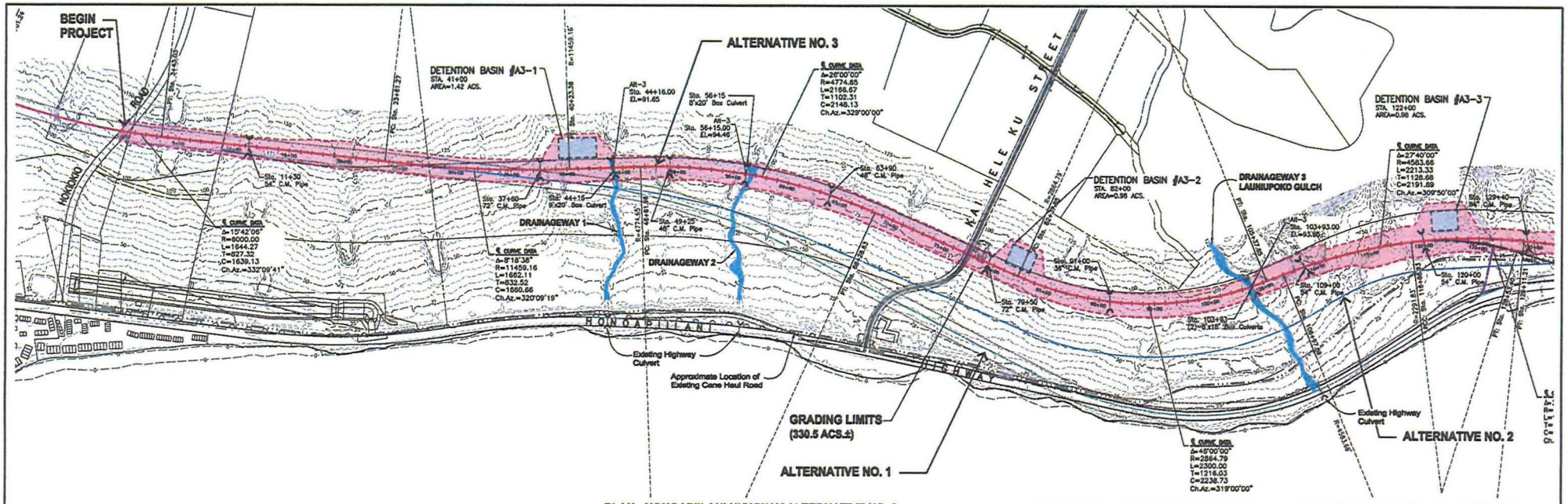


PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 2
SCALE: HORIZ. 1"=400'
VERT. 1"=80'

EXHIBIT B

WARREN S. UNSON

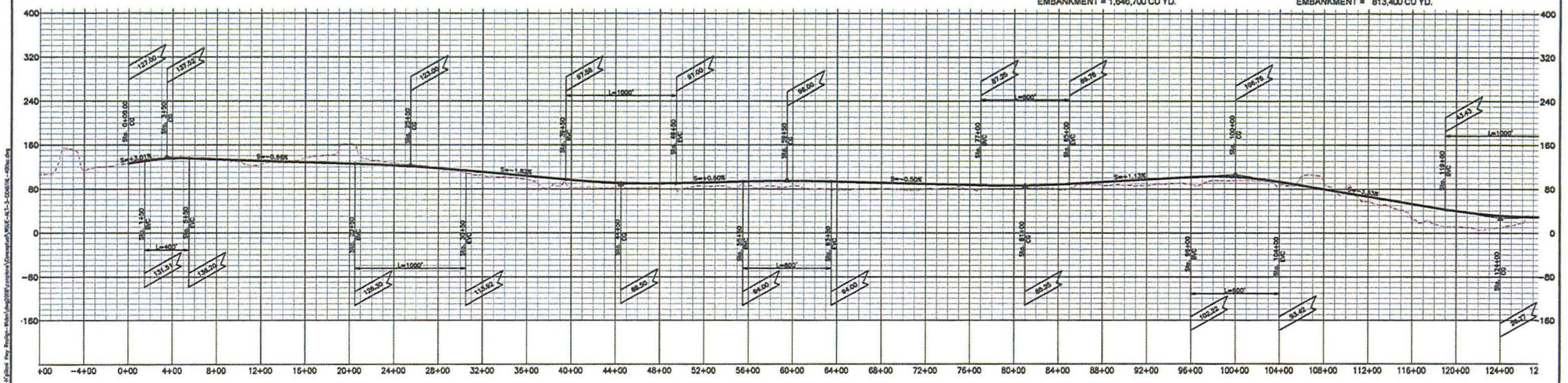
July 31, 2007
Revision No. 1 – August 24, 2007
Revision No. 2 – Sept. 6, 2007
Revision No. 3 – Nov. 24, 2008



PLAN - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 3
SCALE: HORIZ. 1"=400'

APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 3 - COASTAL SECTION)
EXCAVATION = 412,300 CU.YD.
EMBANKMENT = 1,646,700 CU YD.

APPROXIMATE EARTHWORK QUANTITIES (ALTERNATIVE 3 - PALI SECTION)
EXCAVATION = 2,481,000 CU.YD.
EMBANKMENT = 813,400 CU YD.



PROFILE - HONOAPIILANI HIGHWAY ALTERNATIVE NO. 3
SCALE: HORIZ. 1"=400'
VERT. 1"=80'

EXHIBIT C

WARREN S. UEMORI ENGINEERING, INC.

July 31, 2007
Revision No. 1 – August 24, 2007
Revision No. 2 – Sept. 6, 2007
Revision No. 3 – Dec. 17, 2007
Revision No. 4 – Nov. 24, 2008

TABLE

1 Alternative 1 Drainage Area Calculations

2 Alternative 2 Drainage Area Calculations

3 Alternative 3 Drainage Area Calculations

4 Culvert Sizing Summary

5 Summary of Drainage Channel and Culvert Data

TABLE 1

Project Site Surface Runoff (100 Yr. - 24 Hr. = varies) (100 Yr. - 1 Hr. = 2.9 in.)

SCS Method (TR-20) and Universal Rational Method

Watershed No.	Total Drainage Area (acs.)	Soil Group B Area (acs.)	Soil Group C Area (acs.)	Soil Group D Area (acs.)	Curve Number	Runoff Coeff't	Approx. 100-yr, 24-hr Rainfall (in)	Approx. 50-yr, 24-hr Rainfall (in)	100-yr, 1-hr. Rainfall Intensity	Longest Run (ft)	Elevation Change (ft)	Average Slope (%)	Pre-Development Runoff 100-yr, 24-hr (cfs)	Pre-Development Runoff 50-yr, 24-hr (cfs)	Pre-Development Runoff 100-yr, 1-hr (cfs)	Hw/D	Culvert Size	Culvert Capacity @ Hw/D=1.2
1	866.7	196.3	239.5	430.9	70.3	n/a	13.0	11.7	n/a	20461.0	4335.0	21.19%	1758	1514	n/a	1.04	9'x20' Box Culvert	2060
2	791.1	258.8	106.9	425.5	69.2	n/a	12.6	11.1	n/a	18382.0	4345.0	23.64%	1613	1342	n/a	1.12	8'x20' Box Culvert	1720
3	1586.9	385.9	0.0	1201.1	71.9	n/a	13.0	11.7	n/a	24538.0	4380.0	17.85%	2960	2539	n/a	1.15	(2)-8'x18' Box Culverts	3095
4	265.2	238.2	0.0	27.0	58.1	n/a	10.3	9.0	n/a	8714.0	1680.0	19.28%	327	251	n/a	1.10	84" C.M. Pipe	370
5a	114.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4860.0	420.0	8.64%	n/a	n/a	117	1.20	54" C.M. Pipe	120
5b	214.0	214.0	0.0	0.0	56.0	n/a	10.4	9.2	n/a	6835.0	630.0	9.22%	217	169	n/a	1.07	72" C.M. Pipe	255
6a	92.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5043.0	460.0	9.12%	n/a	n/a	95	0.97	54" C.M. Pipe	120
6b	255.2	255.2	0.0	0.0	56.0	n/a	10.4	9.2	n/a	8310.0	860.0	10.35%	243	169	n/a	1.08	72" C.M. Pipe	255
6c	72.5	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	2290.0	180.0	7.86%	n/a	n/a	85	1.11	48" C.M. Pipe	91
7	196.8	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5448.0	800.0	14.68%	192	188	n/a	1.15	66" C.M. Pipe	200
8*	85.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5651.0	553.0	9.79%	n/a	n/a	81	1.09	48" C.M. Pipe	91

TABLE 2

Project Site Surface Runoff (100 Yr. - 24 Hr. = varies) (100 Yr. - 1 Hr. = 2.9 in.)

SCS Method (TR-20) and Universal Rational Method

Watershed No.	Total Drainage Area (acs.)	Soil Group B Area (acs.)	Soil Group C Area (acs.)	Soil Group D Area (acs.)	Curve Number	Runoff Coeff't	Approx. 100-yr, 24-hr Rainfall (in)	Approx. 50-yr, 24-hr Rainfall (in)	50-yr, 1-hr. Rainfall Intensity	Longest Run (ft)	Elevation Change (ft)	Average Slope (%)	Pre-Development Runoff 100-yr, 24-hr (cfs)	Pre-Development Runoff 50-yr, 24-hr (cfs)	Pre-Development Runoff 100-yr, 1-hr (cfs)	Hw/D	Culvert Size	Culvert Capacity @ Hw/D=1.2
1	866.7	196.2	239.5	430.9	70.3	n/a	13.0	11.7	n/a	20433.0	4330.0	21.19%	**1759**	**1516**	n/a	1.04	**9'x20' Box Culvert**	2060
2	789.7	257.4	106.9	425.5	69.2	n/a	12.6	11.1	n/a	18278.0	4338.0	23.73%	**1617**	**1345**	n/a	1.12	**8'x20' Box Culvert**	1720
3	1583.7	382.6	0.0	1201.1	71.9	n/a	13.0	11.7	n/a	23895.0	4340.0	18.16%	**3018**	**2612**	n/a	1.17	**(2)-8'x18' Box Culverts**	3095
4	263.6	236.7	0.0	27.0	58.1	n/a	10.3	9.0	n/a	8550.0	1680.0	19.65%	**330**	**253**	n/a	1.10	**84" C.M. Pipe**	370
5a	114.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4860.0	420.0	8.64%	n/a	n/a	**117**	1.20	**54" C.M. Pipe**	120
5b	214.0	214.0	0.0	0.0	56.0	n/a	10.4	9.2	n/a	6835.0	630.0	9.22%	**217.0**	**169.0**	n/a	1.07	**72" C.M. Pipe**	255
6a	88.7	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4857.0	452.0	9.31%	n/a	n/a	**92**	0.96	**54" C.M. Pipe**	120
6b	246.1	246.1	0.0	0.0	56.0	n/a	10.5	9.2	n/a	8488.0	845.0	9.96%	**234.0**	**178.0**	n/a	1.13	**72" C.M. Pipe**	255
6c	45.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	1859.0	150.0	8.07%	n/a	n/a	**57**	1.08	**42" C.M. Pipe**	65
7	174.8	174.8	0.0	0.0	56.0	n/a	9.6	8.8	n/a	5109.0	790.0	15.46%	**210**	**175**	n/a	1.08	**72" C.M. Pipe**	255
8*	85.3	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5594.0	545.0	9.74%	n/a	n/a	**82**	1.11	**48" C.M. Pipe**	91

TABLE 3

Project Site Surface Runoff (100 Yr. - 24 Hr. = varies) (100 Yr. - 1 Hr. = 2.9 in.)

SCS Method (TR-20) and Universal Rational Method

Watershed No.	Total Drainage Area (acs.)	Soil Group B Area (acs.)	Soil Group C Area (acs.)	Soil Group D Area (acs.)	Curve Number	Runoff Coeff't	Approx. 100 yr, 24-hr Rainfall (in)	Approx. 50-yr, 24-hr Rainfall (in)	50-yr, 1-hr. Rainfall Intensity	Longest Run (ft)	Elevation Change (ft)	Average Slope (%)	Pre-Development Runoff 100 yr, 24-hr (cfs)	Pre-Development Runoff 50-yr, 24-hr (cfs)	Pre-Development Runoff 100-yr, 1-hr (cfs)	Hw/D	Culvert Size	Culvert Capacity @ Hw/D=1.2
1	866.0	195.6	239.5	430.9	70.3	n/a	13.0	11.7	n/a	20253.0	4315.0	21.31%	**1768**	**1524**	n/a	1.05	**9'x20' Box Culvert**	2060
2	784.7	252.3	106.9	425.5	69.3	n/a	12.6	11.1	n/a	17916.0	4310.0	24.06%	**1646**	**1369**	n/a	1.13	**8'x20' Box Culvert**	1720
3	1581.0	380.0	0.0	1201.1	72.0	n/a	13.0	11.7	n/a	23352.0	4310.0	18.46%	**3067**	**2655**	n/a	1.20	**(2)-8'x18' Box Culverts**	3095
4	261.0	234.0	0.0	27.0	58.2	n/a	10.3	9.0	n/a	8342.0	1673.0	20.06%	**333**	**255**	n/a	1.10	**84" C.M. Pipe**	370
5a	114.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4860.0	420.0	8.64%	n/a	n/a	**117**	1.20	**54" C.M. Pipe**	120
5b	211.5	211.5	0.0	0.0	56.0	n/a	10.4	9.2	n/a	6740.0	625.0	9.27%	**216.0**	**168.0**	n/a	1.07	**72" C.M. Pipe**	255
6a	76.1	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	4383.0	422.0	9.63%	n/a	n/a	**80**	1.07	**48" C.M. Pipe**	91
6b	231.0	231.0	0.0	0.0	56.0	n/a	10.5	9.3	n/a	8029.0	813.0	10.13%	**227.0**	**177.0**	n/a	1.11	**72" C.M. Pipe**	255
6c	25.9	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	1343.0	112.0	8.34%	n/a	n/a	**34**	0.97	**36" C.M. Pipe**	44
7a	81.5	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	3916.0	722.0	18.44%	n/a	n/a	**94**	0.99	**54" C.M. Pipe**	120
7b	77.5	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	3669.0	795.0	21.67%	n/a	n/a	**91**	0.95	**54" C.M. Pipe**	120
8*	81.2	n/a	n/a	n/a	n/a	0.3	n/a	n/a	2.9	5327.0	530.0	9.95%	n/a	n/a	**79**	1.06	**48" C.M. Pipe**	91

LAHAINA BYPASS CULVERT SIZING SUMMARY TABULATION

Table 4

Alternative 1

Drainage Basin	Drainage Area Acres	Method used to obtain flow	Q_{50} (cfs)	Method used to obtain flow	Q_{100} (cfs)	Q_{100} HW/D	Culvert Size
1	867	SCS	1514	SCS	1758	1.04	Single 9'x20'
2	791	SCS	1342	SCS	1613	1.12	Single 8'x20'
3	1587	SCS	2539	SCS	2960	1.15	Twin 8'x18'
4	265	SCS	251	SCS	327	1.10	84" Sect. PL CAP
5a	115	Rational	112	Rational	117	1.20	54" CAP
5b	214	SCS	184	SCS	217	1.07	72" Sect. PL CAP
6a	93	Rational	91	Rational	95	0.97	54" CAP
6b	255	SCS	169	SCS	243	1.08	72" Sect. PL CAP
6c	73	Rational	80	Rational	85	1.11	48" CAP
7	197	Rational	188	Rational	192	1.08	66" Sect. PL CAP
8	86	Rational	78	Rational	81	1.09	48" CAP

Alternative 2

Drainage Basin	Drainage Area Acres	Method used to obtain flow	Q_{50} (cfs)	Method used to obtain flow	Q_{100} (cfs)	Q_{100} HW/D	Culvert Size
1	867	SCS	1516	SCS	1759	1.04	Single 9'x20'
2	790	SCS	1345	SCS	1617	1.12	Single 8'x20'
3	1584	SCS	2612	SCS	3018	1.17	Twin 8'x18'
4	264	SCS	253	SCS	330	1.10	84" Sect. PL CAP
5a	115	Rational	112	Rational	117	1.20	54" CAP
5b	214	SCS	169	SCS	217	1.07	72" Sect. PL CAP
6a	89	Rational	88	Rational	92	0.96	54" CAP
6b	246	SCS	178	SCS	234	1.13	72" Sect. PL CAP
6c	46	Rational	54	Rational	57	1.08	42" CAP
7	175	Rational	175	Rational	192	1.08	72" Sect. PL CAP
8	85	Rational	78	Rational	82	1.11	48" CAP

Alternative 3

Drainage Basin	Drainage Area Acres	Method used to obtain flow	Q_{50} (cfs)	Method used to obtain flow	Q_{100} (cfs)	Q_{100} HW/D	Culvert Size
1	866	SCS	1524	SCS	1768	1.05	Single 9'x20'
2	785	SCS	1369	SCS	1646	1.13	Single 8'x20'
3	1581	SCS	2655	SCS	3067	1.20	Twin 8'x18'
4	261	SCS	255	SCS	333	1.10	84" Sect. PL CAP
5a	115	Rational	112	Rational	117	1.20	54" CAP
5b	212	SCS	168	SCS	216	1.07	72" Sect. PL CAP
6a	76	Rational	76	Rational	80	1.07	48" CAP
6b	231	SCS	177	SCS	227	1.11	72" Sect. PL CAP
6c	26	Rational	32	Rational	34	0.97	36" CAP
7a	82	Rational	90	Rational	94	0.99	54" CAP
7b	78	Rational	86	Rational	91	0.95	54" CAP
8	81	Rational	75	Rational	79	1.06	48" CAP

Note: Rational Method Calculation Based on a 1-hour Storm Duration
SCS Method Calculation Based on a 24-hour Storm Duration

TABLE 5

Summary of Drainage Channel and Culvert Data

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Drainage Basin No.	Q_{100} (cfs)	Sta. Dwy.	Sta. Hwy.	Water Surface Elevation	Wetted Width of Channel Flow	Bottom of Channel Elevation	Centerline Hwy. Grade	Culvert Inv. = WS - 1.2 x D	Cut Channel Inv. to Culvert Inv.	Hw from Hwy. Centerline to Culvert Invert	Size of Culvert (DxW)	Available Hw/D	Q to overtop Hwy. Assuming Inlet Control (cfs)	Factor Safety	Q Open Channel D-1', assume 1' FB S = 1.0% (cfs)
Alternative Alignment 1															
1	1758	9+06	44+60	67.93	25	63.07	87.77	57.13	5.94	30.64	9' x 20'	3.40	4600	262%	4944
2	1613	6+32	55+58	55.23	34	50.73	67.52	45.63	5.1	21.89	8' x 20'	2.74	3380	210%	4111
3	2960	0+21	112+43	16.83	88	13.36	18.16	7.23	6.13	10.93	Twin 8' x 18'	1.37	3460	117%	8467
Alternative Alignment 2															
1	1759	9+20	44+58	69.11	26	64.14	80.6	58.31	5.83	22.29	9' x 20'	2.48	3800	216%	4944
2	1617	7+38	55+11	59.83	28	54.45	67.17	50.23	4.22	16.94	8' x 20'	2.12	2740	169%	4111
3	3018	6+51	107+72	56.48	30	50.04	65.09	46.88	3.16	18.21	Twin 8' x 18'	2.28	5360	178%	8467
Alternative Alignment 3															
1	1768	11+06	44+13	81.76	29	77.3	91.65	70.96	6.34	20.69	9' x 20'	2.30	3600	204%	4944
2	1646	11+14	56+55	82.77	43	80	94.46	73.17	6.83	21.29	8' x 20'	2.66	3300	200%	4111
3	3067	11+84	103+93	90.82	86	87.36	93.65	81.22	6.14	12.43	Twin 8' x 18'	1.55	3925	128%	8467

Note:

Column 9 = Column 8 - 1.2*D

Column 10 = Column 7 - Column 9

Column 11 = Column 8 - Column 9

Column 13 = Column 11 - D

Column 15 = Column 14 / Column 2

APPENDIX

A Worksheets for Drainage Basins 1, 2 and 3

Worksheet for Drainage Basin No. 1 (9'x20' Box w/ 1' freeboard)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	8.00	ft
Bottom Width	20.00	ft

Results

Discharge	4943.68	ft^3/s
Flow Area	160.00	ft^2
Wetted Perimeter	36.00	ft
Top Width	20.00	ft
Critical Depth	12.38	ft
Critical Slope	0.00312	ft/ft
Velocity	30.90	ft/s
Velocity Head	14.84	ft
Specific Energy	22.84	ft
Froude Number	1.93	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	8.00	ft
Critical Depth	12.38	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00312	ft/ft

Messages

Notes	Assumes Open channel Crossing With Side and Slope-Tapered Inlets

Worksheet for Drainage Basin No. 2 (8'x20' Box w/ 1' freeboard)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	7.00	ft
Bottom Width	20.00	ft

Results

Discharge	4110.99	ft^3/s
Flow Area	140.00	ft^2
Wetted Perimeter	34.00	ft
Top Width	20.00	ft
Critical Depth	10.95	ft
Critical Slope	0.00297	ft/ft
Velocity	29.36	ft/s
Velocity Head	13.40	ft
Specific Energy	20.40	ft
Froude Number	1.96	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.00	ft
Critical Depth	10.95	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00297	ft/ft

Messages

Notes	Assumes Open channel Crossing With Side and Slope-Tapered Inlets

Worksheet for Drainage Basin No. 3 (Twin 8"x18' Box w/ 1' freeboard)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.01000	ft/ft
Normal Depth	7.00	ft
Bottom Width	36.00	ft

Results

Discharge	8467.19	ft^3/s
Flow Area	252.00	ft^2
Wetted Perimeter	50.00	ft
Top Width	36.00	ft
Critical Depth	11.98	ft
Critical Slope	0.00212	ft/ft
Velocity	33.60	ft/s
Velocity Head	17.54	ft
Specific Energy	24.54	ft
Froude Number	2.24	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	7.00	ft
Critical Depth	11.98	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00212	ft/ft

Messages

Notes	Assumes Open channel Crossing With Side and Slope-Tapered Inlets

APPENDIX C.

Biological Resources Survey

BIOLOGICAL RESOURCES SURVEY

for the

LAHAINA BYPASS CORRIDOR PROJECT

LAHAINA , MAUI, HAWAII

by

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Kokomo, Maui
December 2006

Prepared for:
Makila Land Company, LLC

BIOLOGICAL RESOURCES SURVEY
Lahaina Bypass Corridor Project

INTRODUCTION

The Lahaina Bypass Corridor project lies within the lands of Launiupoko and Polanui in leeward West Maui. The proposed highway corridor route is a 180 foot wide strip of land somewhat more than 2 miles in length stretching from the southern Launiupoko boundary near the recycling transfer station to the center of Polanui on the outskirts of Lahaina town TMK (2) 4-7-01:2 (por.).

SITE DESCRIPTION

The subject corridor crosses the entire length of the property along a gentle grade between the elevations of 30 feet and 100 feet above sea level. The northern and central portions of the corridor lie within former agricultural lands, much of it along the old Lahaina Pump Ditch. This area is presently an open grassland. The southern portion of the corridor passes through the lower Launiupoko Stream valley which has a dense growth of trees, brush and tall grass. Soils are mostly Waine'e Extremely Stony Silty Clay in the former agricultural lands and are Stony Alluvial land in the lower Launiupoko Valley (Foote et al, 1972). Rainfall averages about 15 inches per year with the bulk falling between November and April (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 Heteropogon, Eragrostis and Panicum, shrubs such as Dodonaea, Gouania and Hibiscus, and trees such as Erythrina and Reynoldsia.

The Launiupoko area came into sugar cane production during the 1860's and this use continued for over 100 years. All vestiges of the original flora have long since disappeared. Since the demise of sugar in West Maui in 1999 the subject parcel has largely stood fallow with only some grazing activities currently being pursued. The highly modified vegetation consists mainly of grasses and weedy species.

SURVEY OBJECTIVES

This report summarizes the findings of a flora and fauna survey of the proposed Lahaina Bypass Corridor which was conducted in December 2006.
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 following both sides of the proposed corridor to ensure maximum coverage of the area. Areas most likely to harbor native or rare plants were more intensively examined. Notes were made on plant species, distribution and abundance as well as terrain and substrate.

DESCRIPTION OF THE VEGETATION

About 80% of this corridor consists primarily of grass species with a mixture of agricultural and pasture weeds. The remaining 20% is made up of mixed dryland forest and shrubland. One species, buffelgrass (*Cenchrus ciliaris*), is dominant throughout most of this corridor. Also common are swollen fingergrass (*Chloris barbata*), Carolina lovegrass (*Eragrostis pectinacea*), Guinea grass (*Panicum maximum*), desert horsepurslane (*Trianthema portulacastrum*), spiny amaranth (*Amaranthus spinosus*), hairy merremia (*Merremia aegyptia*), kiawe (*Prosopis pallida*), lion's ear (*Leonotis nepetifolia*) and 'uhaloa (*Waltheria indica*). A total of 65 plant species were recorded during the survey. Of these 3 species: 'ilima (*Sida fallax*), 'a'ali'i (*Dodonaea viscosa*)

and 'uhaloa, were indigenous to Hawaii as well as other Pacific islands. Each of these is extremely widespread and common throughout Hawaii. The remaining 62 species are all common non-native agricultural or pasture plants.

DISCUSSION AND RECOMMENDATIONS

The vegetation along the entire length of the proposed corridor is dominated by non-native plant species. The three native species indigenous to Hawaii are all widespread and common and of no particular environmental concern.

No Federally listed Endangered or Threatened plant species (USFWS, 1999) were found in the project area, nor were any species found that are candidate for such status. Populations of two Endangered species, (*Gouania hillebrandii*) no common name and (*Spermolepis hawaiiensis*) no common name, are known to occur about 1.5 miles up slope of the project area in the foothills of the West Maui Mountains, but these populations lie far beyond the influence of any disturbances that might be associated with this project.

No special habitats were identified within the project area. Nothing resembling a wetland occurs within this corridor either.

Because of the above existing conditions it has been determined that there is little of botanical concern within the project area and that the anticipated disturbances associated with the development of a highway within this corridor are not expected to have a significant impact on the botanical resources in this part of Maui. No recommendations are considered appropriate or necessary with regard to the botanical resources in this area.

PLANT SPECIES LIST

Following is a checklist of all those vascular plant species inventoried during the field studies. Plant families are arranged alphabetically within two groups: Monocots and Dicots. Taxonomy and nomenclature of the flowering plants are in accordance with Wagner et al. (1999).

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
MONOCOTS			
ARECACEAE (Palm Family)			
Washingtonia robusta Wendl.	desert palm	non-native	rare
CYPERACEAE (Sedge Family)			
Cyperus rotundus L.	nut sedge	non-native	uncommon
POACEAE (Grass Family)			
Cenchrus ciliaris L.	buffelgrass	non-native	abundant
Chloris barbata (L.) Sw.	swollen fingergrass	non-native	common
Chloris virgata Sw.	feather fingergrass	non-native	uncommon
Cynodon dactylon (L.) Pers.	Bermuda grass	non-native	rare
Digitaria insularis (L.) Mez ex Ekman	sourgrass	non-native	rare
Echinochloa colona (L.) Link	jungle-rice	non-native	rare
Eleusine indica (L.) Gaertn.	wiregrass	non-native	rare
Eragrostis amabilis (L.) Wight & Arnott	Japanese lovegrass	non-native	rare
Eragrostis pectinacea (Michx.) Nees	Carolina lovegrass	non-native	common
Leptochloa fusca (L.) Kunth	Malabar sprangletop	non-native	rare
Melinis repens (Willd.) Zizka	Natal redtop	non-native	uncommon
Panicum maximum Jacq.	Guinea grass	non-native	common
Setaria verticillata P. Beauv.	bristly foxtail	non-native	rare
Tragus berteronianus Schult.	bur grass	non-native	rare
DICOTS			
AIZOACEAE (Fig-marigold Family)			
Trianthema portulacastrum L.	desert horsepurslane	non-native	common
AMARANTHACEAE (Amaranth Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Amaranthus spinosus L.	spiny amaranth	non-native	common
ASTERACEAE (Sunflower Family)			
Eclipta prostrata (L.) L.	false daisy	non-native	rare
Pluchea carolinensis (Jacq.) G. Don	sourbush	non-native	uncommon
Pluchea indica (L.) Less	Indian fleabane	non-native	rare
Synedrella nodiflora (L.) Gaertn.	nodeweed	non-native	rare
Tridax procumbens L.	coat buttons	non-native	rare
Xanthium strumarium L.	*kikania*	non-native	uncommon
Zinnia peruviana (L.) L.	zinnia	non-native	rare
BUDDLEIACEAE (Butterfly Bush Family)			
Buddleia asiatica Lour.	dog tail	non-native	rare
CAPPARACEAE (Caper Family)			
Cleome gynandra L.	wild spider flower	non-native	rare
CONVOLVULACEAE (Morning Glory Family)			
Ipomoea triloba L.	little bell	non-native	uncommon
Merremia aegyptia (L.) Urb.	hairy merremia	non-native	common
CUCURBITACEAE (Gourd Family)			
Cucumis dipsaceus Ehrenb. ex Spach	hedgehog gourd	non-native	uncommon
Momordica charantia L.	balsam pear	non-native	rare
EUPHORBIACEAE (Spurge Family)			
Chamaesyce hirta (L.) Millsp.	hairy spurge	non-native	uncommon
Ricinus communis L.	Castor bean	non-native	uncommon
FABACEAE (Pea Family)			
Acacia farnesiana (L.) Willd.	klu	non-native	uncommon
Albizia lebbek (L.) Benth.	white monkeypod	non-native	rare
Chamaecrista nictitans (L.) Moench	partridge pea	non-native	rare

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Crotalaria incana L.	fuzzy rattlepod	non-native	uncommon
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
Indigofera hendecaphylla Jacq.	creeping indigo	non-native	rare
Indigofera suffruticosa Mill.	*iniko*	non-native	rare
Leucaena leucocephala (Lam.) deWit	*koa haole*	non-native	uncommon
Macroptilium lathyroides (L.) Urb.	wild bean	non-native	rare
Pithecellobium dulce (Roxb.) Benth.	*'opiuma*	non-native	uncommon
Prosopis pallida (Humb.&Bonpl.ex.Willd.) Kunth	*kiawe*	non-native	common
Samanea saman (Jacq.) Merr.	monkeypod	non-native	rare
LAMIACEAE (Mint Family)			
Leonotis nepetifolia (L.) R. Br.	lion's ear	non-native	common
MALVACEAE (Mallow Family)			
Abutilon grandifolium (Willd.)Sweet	hairy abutilon	non-native	uncommon
Malva parviflora L.	cheese weed	non-native	uncommon
Malvastrum coromandelianum (L.) Garcke	false mallow	non-native	rare
Sida fallax Walp.	*'ilima*	indigenous	uncommon
Sida rhombifolia L.	Cuban jute	non-native	uncommon
Sida spinosa L.	prickly sida	non-native	rare
MYRTACEAE (Myrtle Family)			
Syzygium cumini (L.) Skeels	Java plum	non-native	rare
NYCTAGINACEAE (Four-o'clock Family)			
Boerhavia coccinea Mill.	scarlet spiderling	non-native	uncommon
ONAGRACEAE (Evening Primrose Family)			

SCIENTIFIC NAME	COMMON NAME	STATUS	ABUNDANCE
Ludwigia octovalvis (Jacq.) Raven	primrose willow	non-native	rare
PASSIFLORACEAE (Passion Flower Family)			
Passiflora foetida L.	love-in-a-mist	non-native	rare
PORTULACACEAE (Purslane Family)			
Portulaca oleracea L.	pigweed	non-native	rare
SAPINDACEAE (Soapberry Family)			
Dodonaea viscosa Jacq.	*'a'ali'i*	indigenous	rare
SOLANACEAE (Nightshade Family)			
Datura stramonium L.	jimson weed	non-native	rare
Solanum lycopersicum L.	cherry tomato	non-native	rare
STERCULIACEAE (Cacao Family)			
Waltheria indica L.	*'uhaloa*	indigenous	common
VERBENACEAE (Verbena Family)			
Lantana camara L.	lantana	non-native	rare
ZYGOPHYLLACEAE (Creosote Bush Family)			
Tribulus terrestris L.	puncture vine	non-native	rare

FAUNA SURVEY REPORT

SURVEY METHODS

A walk-through fauna survey method was conducted in conjunction with the botanical survey. All parts of the project area 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 Hawaiian hoary bat (*Lasiurus cinereus semotus*) in the area.

RESULTS

MAMMALS

Four species of mammals were observed within the project area during three site visits to the property. Taxonomy and nomenclature follow Tomich (1986).

Mongoose (*Herpestes auropunctatus*) – Several mongoose were seen in field margins. These carnivores hunt for rodents, birds and insects on these types of land.

Cattle (*Bos Taurus*) – Several domestic cattle were pastured in fields along this corridor.

Horse (*Equus caballus*) – Several domestic horses were also being pastured in a field adjacent to the cattle.

Dog (*Canis familiaris*) – Sign (scat) of domestic dogs was seen along roadways along the corridor. These are most likely pets that are either accompanied by their owners or wandering on their own.

Deep, dense grass cover over much of the project area prevented good visibility of other ground dwelling animals, but a significant population of cats (*Felis catus*), mice (*Mus domesticus*) and rats (*Rattus rattus*) would also be expected. Cats and mongoose feed on rats and mice. No cats, rats or mice were seen but their presence is virtually guaranteed by the abundant food supply in the form of grass seed and herbaceous vegetation. No sign of axis deer or other large herbivores was observed.

A special effort was made to look for the native Hawaiian hoary bat by making an evening survey of the area. When present in an area these bats can be easily identified as they forage for insects, their distinctive flight patterns clearly visible in the glow of twilight.

No evidence of such activity was observed though visibility was excellent and many flying insects were seen. Bats have not been seen in this part of Maui.

BIRDS

There was moderate birdlife diversity in this normally dry area. An ample supply of grass and herbaceous plant seeds were available. Thirteen species of non-native birds were seen, most taking advantage of this seasonal food supply. Taxonomy and nomenclature follow American Ornithologists' Union (2005).

Barred dove (*Geopelia striata*) – Many barred doves were seen and heard throughout the project. Their smaller size and striated body distinguish this species from the spotted dove.

Common myna (*Acridotheres tristis*) - Many of these easily recognizable and assertive birds were seen feeding in the open areas during the late afternoon and heading toward roosting trees in the evening.

Gray francolin (*Francolinus pondicerianus*) – Many families of gray francolins were seen in ground openings and in kiawe trees, but their loud and distinctive calls were heard frequently throughout the area indicating a larger population than seen.

House finch (*Carpodacus mexicanus*) – Several flocks of these finches were seen within the grasslands.

Northern cardinal (*Cardinalis cardinalis*) – Several of these distinctive red birds were seen in kiawe trees and heard calling.

Japanese white-eye (*Zosterops japonica*) – a few white-eyes were seen feeding in the trees and their high pitched calls were occasionally heard.

Northern mockingbird (*Mimus polyglottos*) – A few mockingbirds with their variety of calls were heard scattered across the property.

Spotted dove (*Streptopelia chinensis*) – This large dove was seen frequently in the trees and transiting overhead. Their smooth flight and evenly modulated cooing are distinctive.

Cattle egret (*Bubulcus ibis*) – A few of these large white birds were seen feeding among the cattle and flying overhead.

Black francolin (*Francolinus francolinus*) – A few of these dark francolins were seen in the grasslands and their distinctive buzzing calls were heard.

African silverbill (*Lonchura cantans*) – A few small groups of these pale tan birds were seen in trees within the grasslands.

Red-crested cardinal (*Paroaria coronata*) A few individuals and pairs were seen in the trees.

Skylark (*Alauda arvensis*) – A single skylark was seen on the ground and taking flight from the grasslands.

This area is not habitat for Hawaii's native forest birds because it lacks the flowers and fruits they prefer and because of the presence in the lowland of mosquito-born diseases that severely affect them.

INSECTS

While insects in general were not tallied, they were abundant throughout the area and fueled the bird activity observed. Only one native insect Blackburn's sphinx moth (*Manduca blackburni*) has been put on the Federal Endangered Species List (USFWS 2000) and this designation requires special focus to ascertain if it is present. None were found.

Blackburn's sphinx moth occurs on Maui although it has not been found in this area. Its native host plants are species of 'aiea (*Nothocestrum*). A non-native alternative host plant is tree tobacco (*Nicotiana glauca*). There are no 'aiea on or near the project area nor were any tree tobacco plants found anywhere on the property. No Blackburn's sphinx moths or their larvae were observed.

DISCUSSION

Fauna surveys are seldom comprehensive due to the short windows of observation, the seasonal nature of animal activities and the usually unpredictable nature of their daily movements. This survey should be considered fairly representative, although a few other common non-native species such as house sparrow and nutmeg mannikin would be expected here.

Only common, non-native mammals, birds and insects were observed on the property during the course of the survey. No Federally listed Endangered or Threatened fauna (USFWS, 1999) were found. No special fauna habitats were identified either.

As a result of the above conditions it has been determined that the proposed project is not expected to have a significant negative impact on the fauna resources in this part of Maui.

No recommendations with respect to the fauna resources in this project area are deemed appropriate or necessary.

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.

COMMON NAME	SCIENTIFIC NAME	STATUS	ABUNDANCE
MAMMALS			
Mongoose	*Herpestes auropunctatus*	non-native	uncommon
Cattle	*Bos taurus*	non-native	uncommon
Horse	*Equus caballus*	non-native	uncommon
Dog	*Canis familiaris*	non-native	rare
BIRDS			
Zebra dove	*Geopelia striata*	non-native	common
Common myna	*Acridotheres tristis*	non-native	common
Gray francolin	*Francolinus pondicerianus*	non-native	common
House finch	*Carpodacus mexicanus*	non-native	common
Northern cardinal	*Cardinalis cardinalis*	non-native	uncommon
Japanese white-eye	*Zosterops japonica*	non-native	uncommon
Northern mockingbird	*Mimus polyglottos*	non-native	uncommon
Spotted dove	*Streptopelia chinensis*	non-native	uncommon
Cattle egret	*Bubulcus ibis*	non-native	uncommon
Black francolin	*Francolinus francolinus*	non-native	uncommon
African silverbill	*Lonchura cantans*	non-native	rare
Red-crested cardinal	*Paroaria coronata*	non-native	rare
Sky lark	*Alauda arvensis*	non-native	rare

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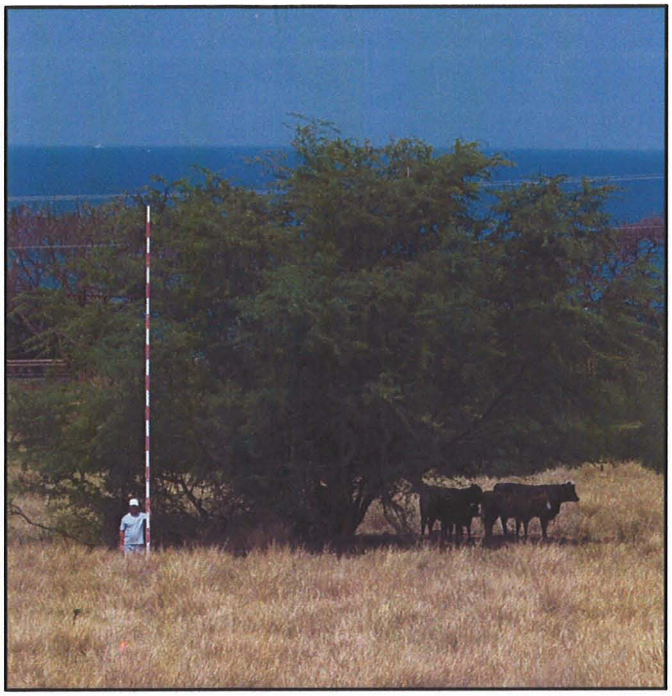
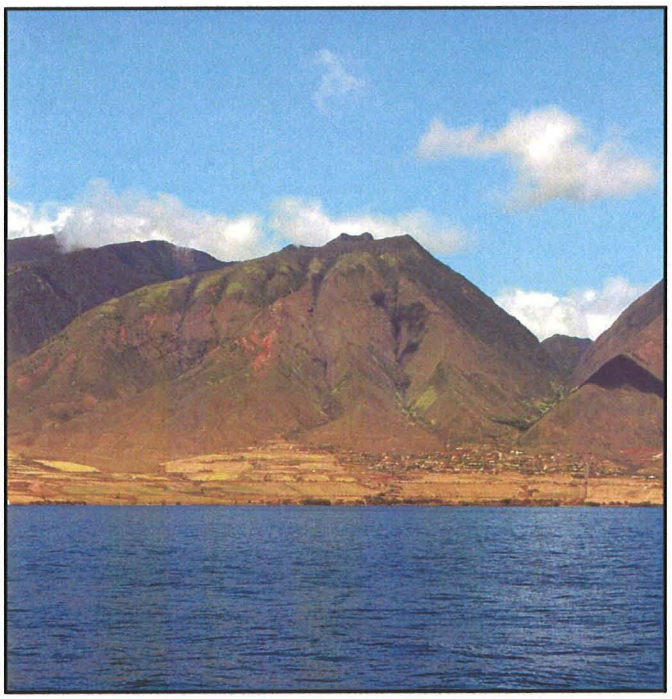
APPENDIX D.

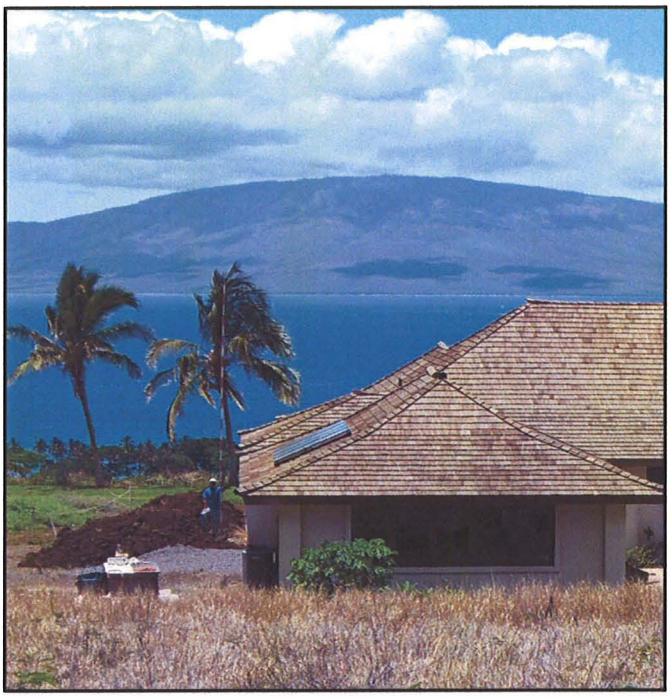
Massing and Viewplane Simulation Study for Makila Phase II and Phase III Subdivisions

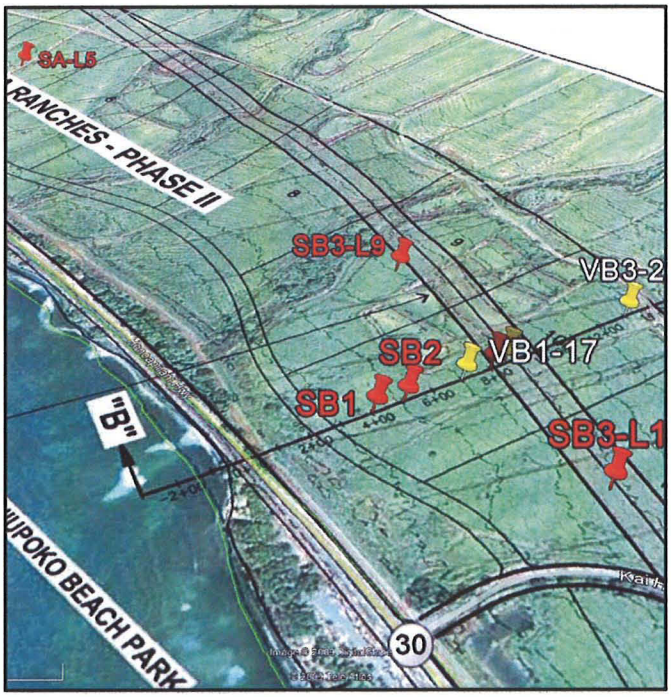




LAHAINA BYPASS - SOUTHERN EXTENSION / MAKILA RANCHES II SUBDIVISION

MASSING / VIEWPLANE SIMULATION





PREPARED FOR
MAKILA LAND CO., LLC

PREPARED BY

HAWAII LAND USE GROUP LLC

MARCH 2009

HAWAII LAND USE GROUP LLC
PO BOX 880779 PUKALANI HI 96788

March 2009

Proposed Lahaina Bypass Southern Terminus Relocation & Makila Ranches II Development Massing / Viewplane Simulation

Overview

This visual study has been prepared to simulate views towards the ocean with regard to two developments are being proposed in the Launiupoko ahupua`a just east of Lahiana Town in the West Maui region. The projects evaluated are the proposed extension of the Lahaina Bypass Southern Terminus and the subdivision known as the 11-lot Makila Ranches II subdivision.

The study consists of four (4) exhibits; of which each contains:

- A photographic simulation of the coastal viewplane from one of four selected vantages associated with the future highway alignment alternatives within the proposed Ranches II subdivision. The simulation depicts the coastal views over the subject subdivision from the proposed highway corridor.
- A plan-view map identifying the location of the vantage, the proposed highway alignment, and the locations of simulated dwellings.

Purpose

The visual study has been developed for the primary purposes of:

- Provide an elevation-correct simulation the coastal views from the 3 proposed Highway Alignments
- Provide a scale-accurate simulation of development massing in the proposed subdivision from pre-selected highway vantages and building locations

Mapping and View/Vantage Selection

In preparation for selecting the views and vantages to be included in the study, the preparer met with Mr. Rory Frampton, a consultant to Makila Land Co., LLC (landowner) to review background information and choose representative locations for vantage points and dwelling-simulation locations.

Source mapping of lot boundaries, topography, aerial photography, and proposed highway alignments were provided in exhibits entitled "Honoapiilani Highway Realignment Alternatives" prepared by Warren S. Unemori Engineering Inc. prepared on February 27th and March 18th 2008.

Four shoreline-perpendicular transects labeled A through D were selected and mapped as a baseline for photographic simulations. Transects A and B occur within the Makila Ranches II subdivision.

Locations for the simulated agricultural dwellings were selected by Makila in locations deemed representative of natural homeowner selection, and generally in the middle of the developable area, as bound by the proposed coastal roads and respective highway realignment.

Upon selection, vantage and simulation locations were located by GPS and flagged on site.

Vantages – Panoramic Photos

Vantage shots were taken along each transect at a point representing the approximate middle of the seaward traffic lane of the respective highway alignment. The elevations of the vantage photographs were established 5 feet above the proposed elevation of the highway to mimic the view of a pedestrian, cyclist, or occupant in a vehicle.

Because the proposed highway alternatives would be constructed above grade, vantages were photographed from a calculated elevated position above existing grade. Calculations were based upon the profile data included in the 2008 Unemori exhibits. A telescoping survey pole with a camera mount was utilized to provide the correct elevation for the photographs.

Elevations of the vantages were as follows:

A-0	Transect A	Alignment 1,2,3	8 feet above existing grade
B-1	Transect B	Alignment 1	17 feet above existing grade
B-2	Transect B	Alignment 2	14 feet above existing grade
B-3	Transect B	Alignment 3	21 feet above existing grade

A second 25-foot stadia pole was hand held or erected at the pre-designated dwelling simulation locations during vantage photography to provide ground reference scale in photographic panoramas. Three simulated dwelling locations were photographed in the vantage shots of Transect A and that of Transect B-3. Vantages B-1 and B-2 contained one simulation point.

Vantage Photographs were taken on 5/15/08, 5/20/08, 6/18/08, and 7/14/08. Vantage photographs were assembled into panoramic photographs utilizing Photomerge/Photoshop application software made by Adobe Systems Incorporated.

Views - Simulated Dwellings

The regional neighborhood was surveyed for a photographic "source" "Specimen Dwelling" that would represent a large-sized single story dwelling or a two-story structure no greater than 25 feet in height. A suitable one-story dwelling with a significant roof height was selected from the abutting neighborhood. The specimen is a 5215 s.f. (per County RPT, TMK (2) 4-7-011:004) dwelling over 100 feet in width and having a peak roof height (along width) of approximately 23.5 feet (as observed). The specimen was photographed from various angles. A 25-foot graduated stadia pole was aligned with the peak of the roof to serve for future reference when the photographs were scaled to the ground controls photographed in the vantage panoramas.

Vegetation

Vegetation / Landscape Planting associated with agricultural dwellings or large-scale farming was not simulated in the viewplane simulations. It was felt that the State and County land use controls specifying agricultural use of the subject property would permit the planting of obstructive crops (trees) with or without the proposed subdivision or the development of dwellings. Because the viewplane obstruction due to farming or landscape planting had infinite possibilities with or without the proposed subdivision, the scope of the study focused on the finite and measurable differences due to the subdivision, specifically the view impacts due to the siting and massing of agricultural dwellings.

Viewplane Simulations

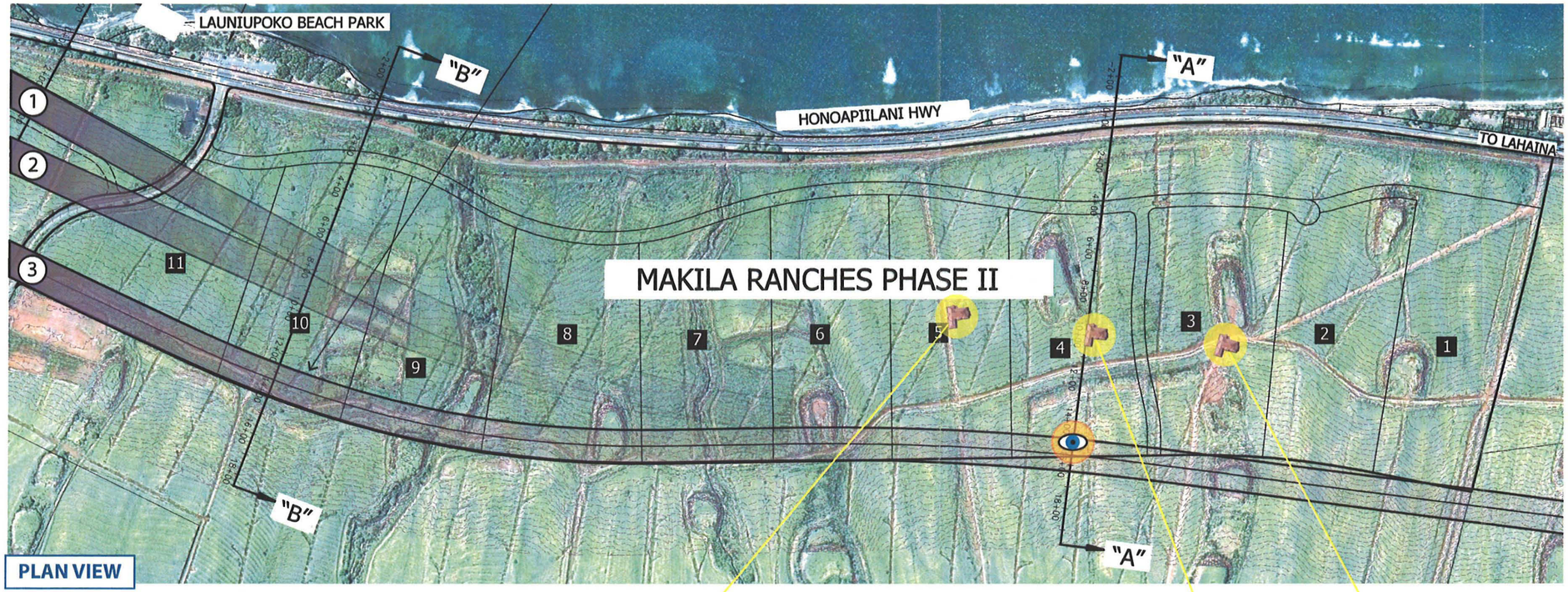
Four simulations were created from the four selected vantage points. One simulation was created along Transect A, the point of divergence of the three highway alignments. Three simulations were created along Transect B, one for each of the alternative highway alignments.

In each simulation, photographs of the specimen dwelling were inserted into the vantage panorama and scaled to the correct size utilizing the physical ground controls photographed in both photographs. Lighting levels in the dwelling photograph were adjusted to match those in the panorama. Where the simulated dwelling was obstructed by existing topography, the simulated dwelling was cropped to provide a realistic view. Where cropping was significant, the outline of the pre-cropped structure was provided to retain visual scale despite the obstruction by topography.

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

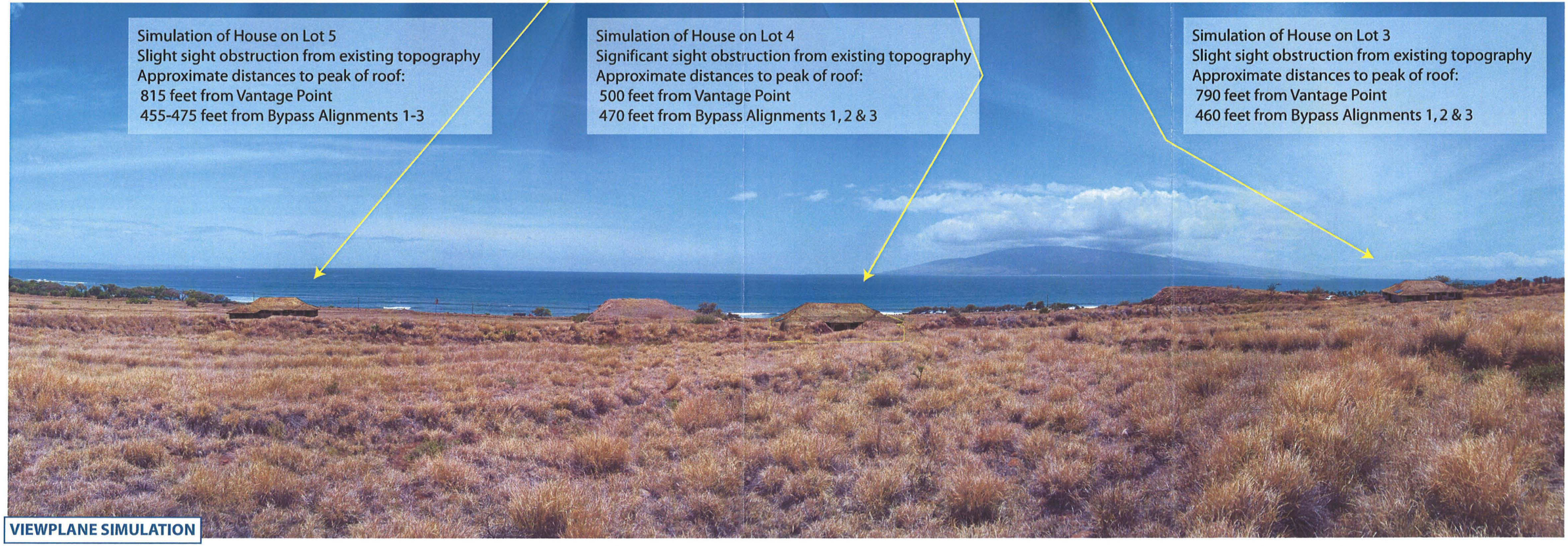
TRANSECT : A

HWY ALIGNMENT # : ALL



PLAN VIEW

- # — LAHAINA BYPASS ALTERNATIVE NUMBER
- # — MAKILA SUBDIVISION LOT NUMBER
- LOCATIONS OF SIMULATED HOMES
- VANTAGE POINT OF SIMULATION

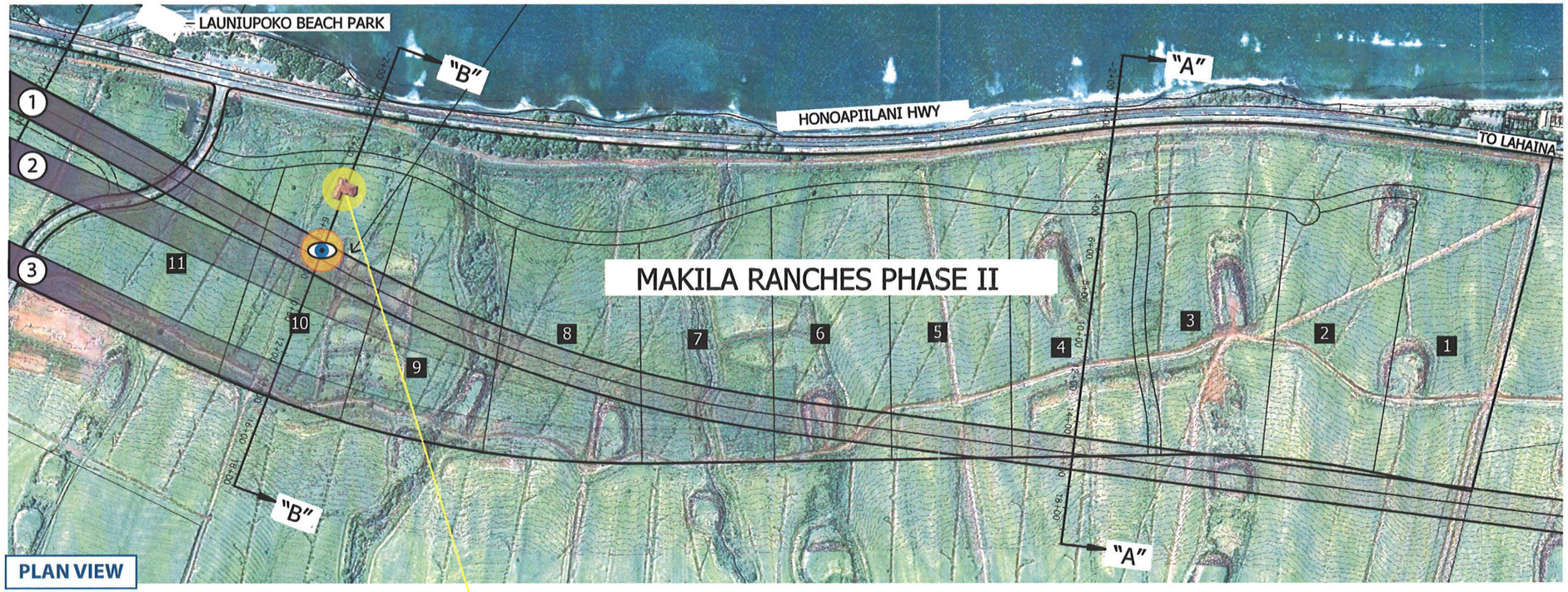


VIEWPLANE SIMULATION

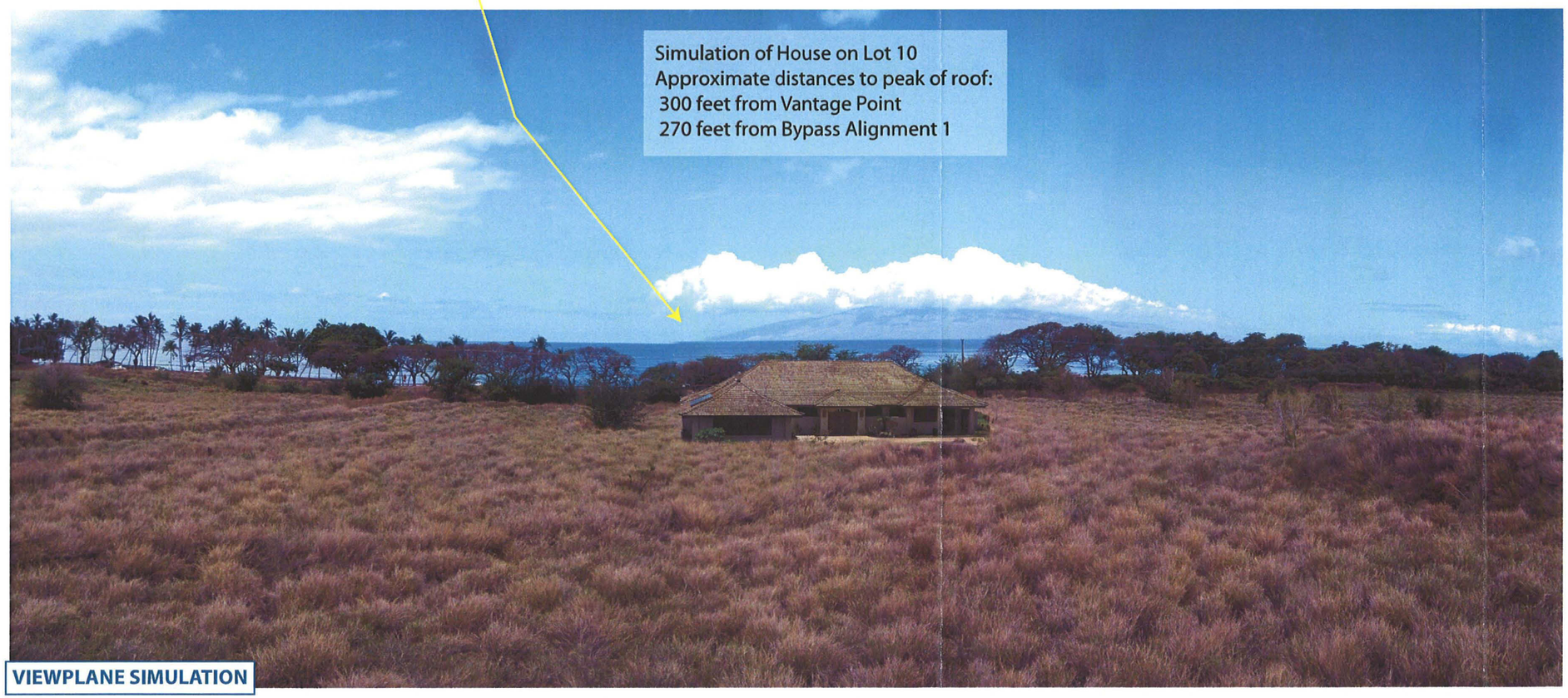
LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : B

HWY ALIGNMENT # : 1



PLAN VIEW

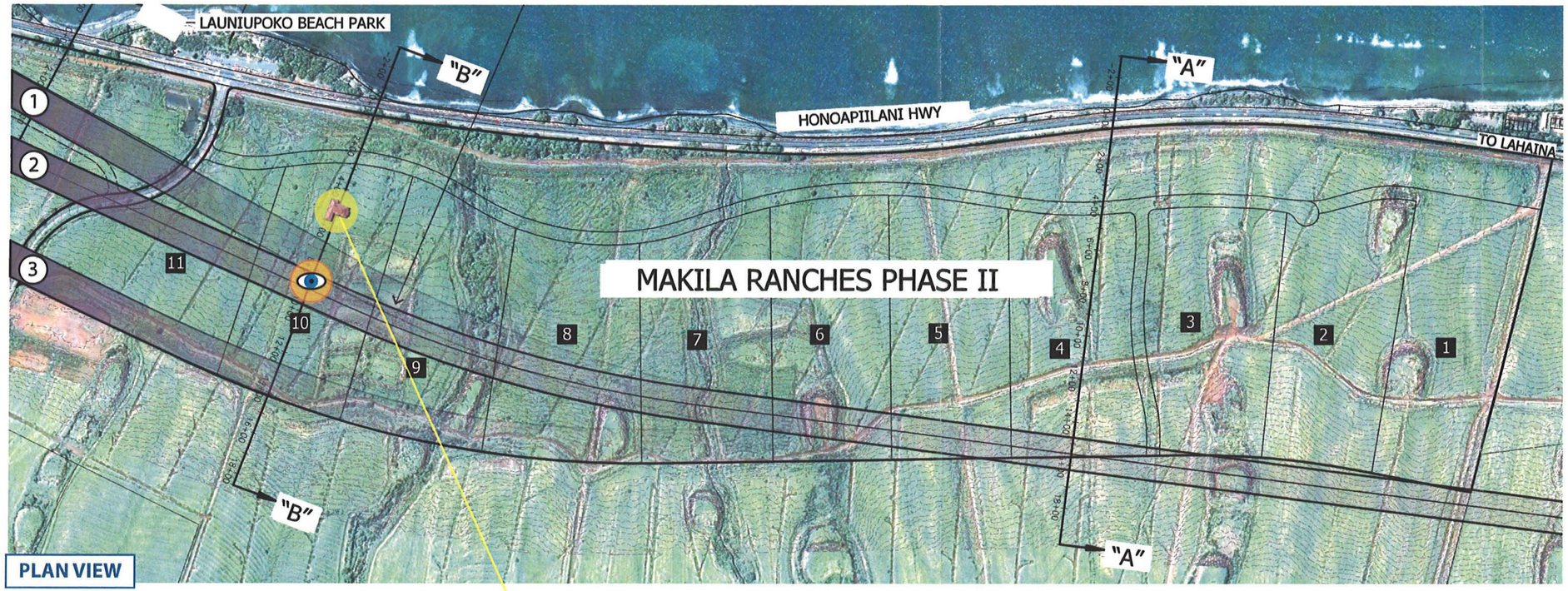


VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : B

HWY ALIGNMENT # : 2



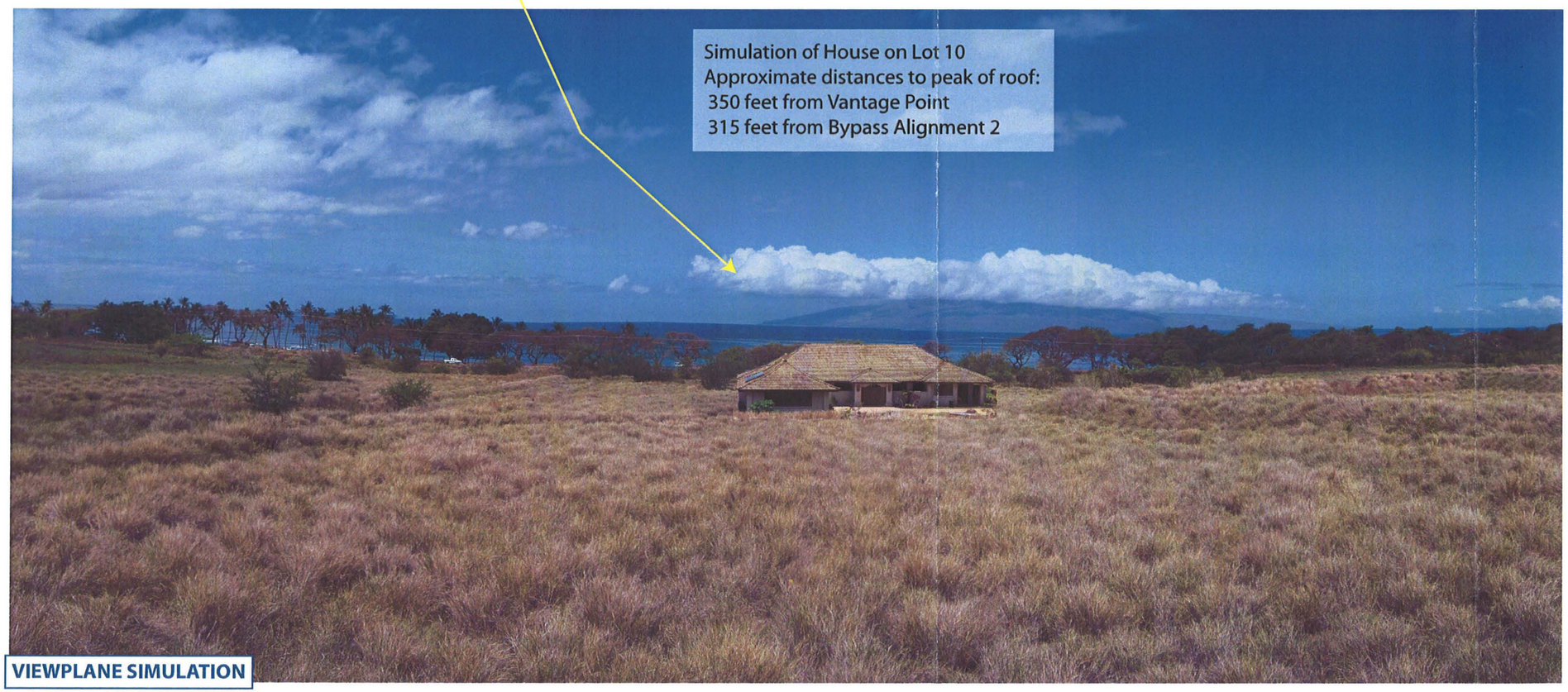
PLAN VIEW

LAHAINA BYPASS ALTERNATIVE NUMBER

MAKILA SUBDIVISION LOT NUMBER

LOCATIONS OF SIMULATED HOMES

VANTAGE POINT OF SIMULATION

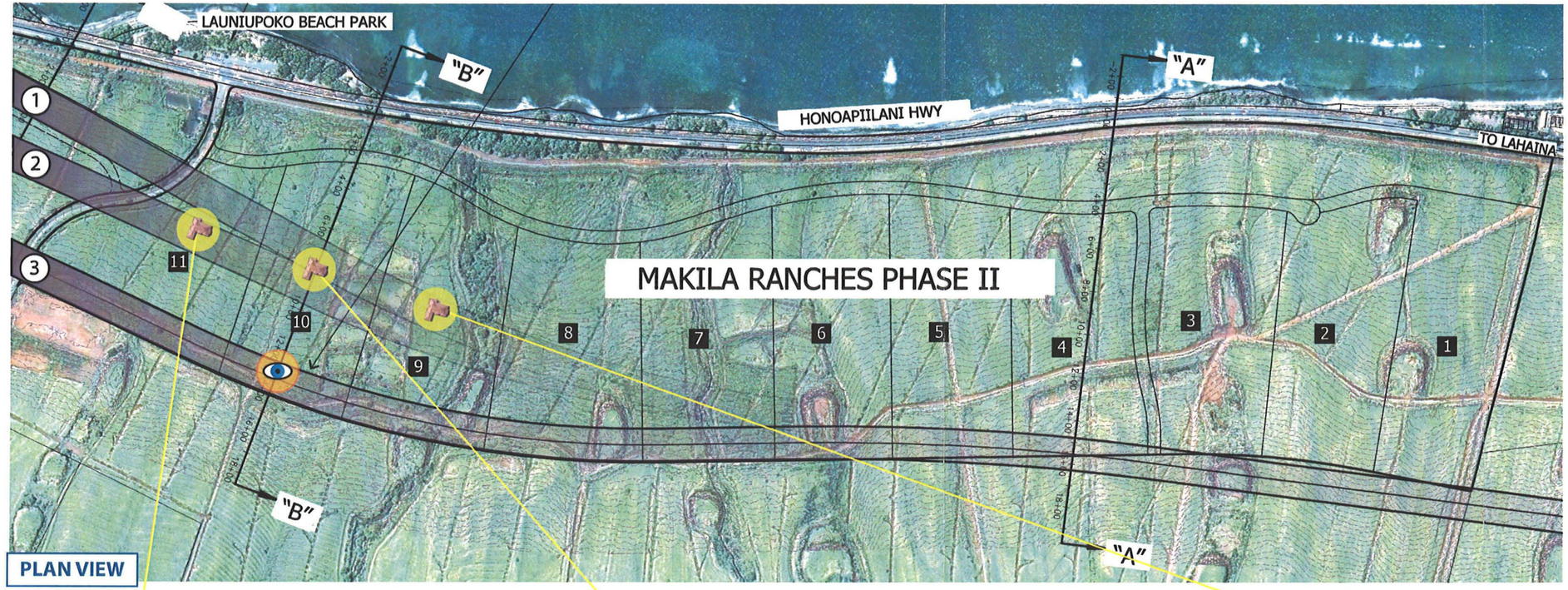


VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

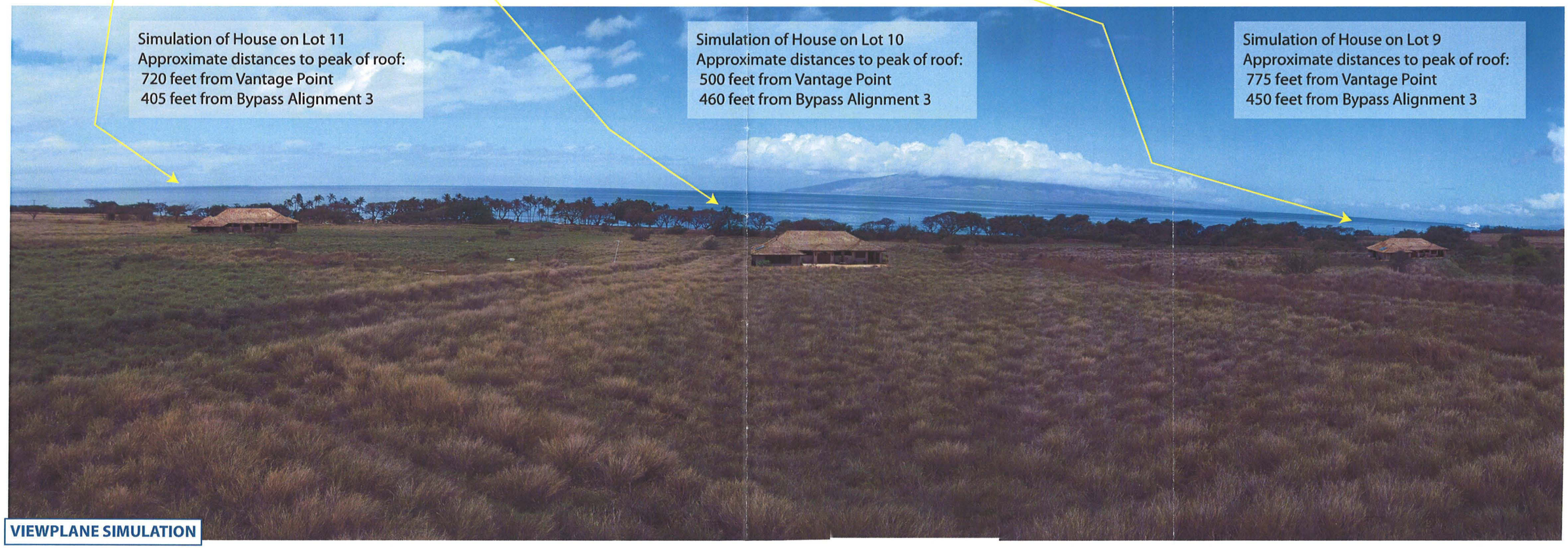
TRANSECT : B

HWY ALIGNMENT # : 3

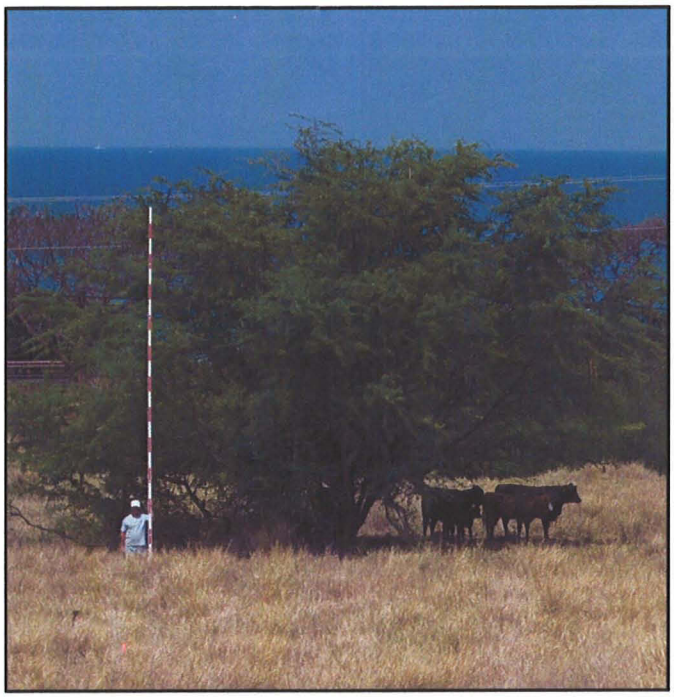


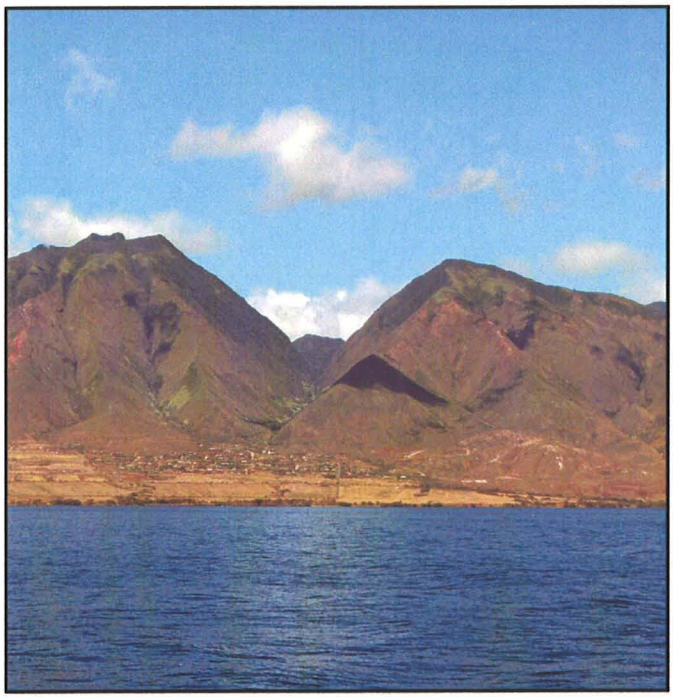
PLAN VIEW

- # — LAHAINA BYPASS ALTERNATIVE NUMBER
- # — MAKILA SUBDIVISION LOT NUMBER
- LOCATIONS OF SIMULATED HOMES
- VANTAGE POINT OF SIMULATION



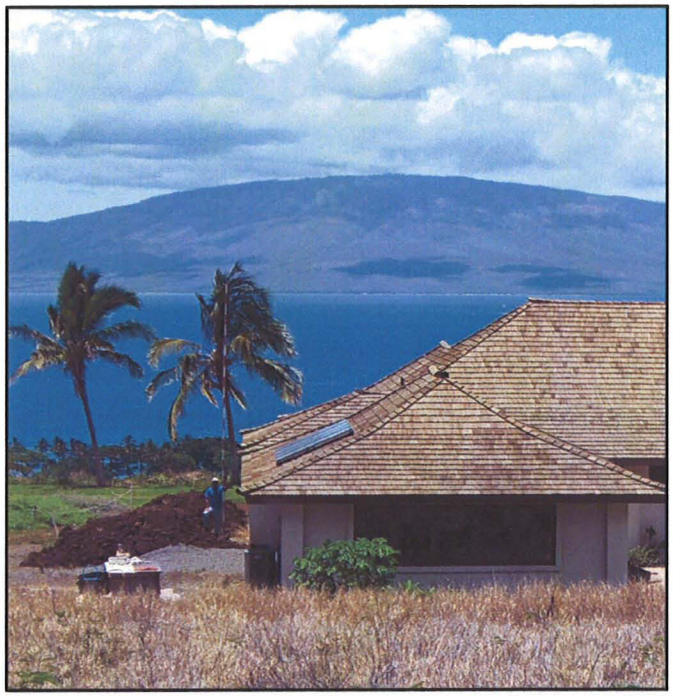
VIEWPLANE SIMULATION

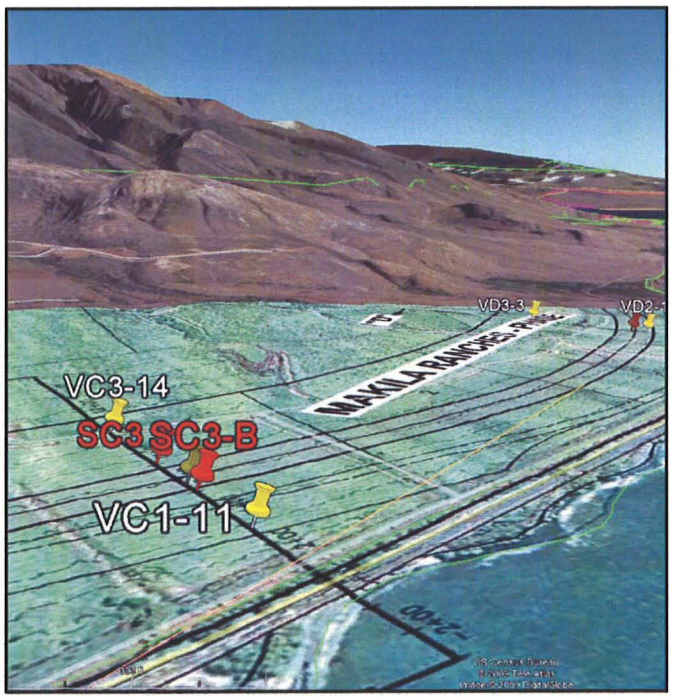




LAHAINA BYPASS - SOUTHERN EXTENSION / MAKILA RANCHES III SUBDIVISION

MASSING / VIEWPLANE SIMULATION





PREPARED FOR
MAKILA LAND CO., LLC

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HAWAII LAND USE GROUP LLC
MARCH 2009

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March 2009

Proposed Lahaina Bypass Southern Terminus Relocation & Makila Ranches III Development Massing / Viewplane Simulation

Overview

This visual study has been prepared to simulate views towards the ocean with regard to two developments are being proposed in the Launiupoko Ahupua`a just east of Lahiana Town in the West Maui region. The projects evaluated are the proposed extension of the Lahaina Bypass Southern Terminus and the subdivision known as the 7-lot Makila Ranches III subdivision.

The study consists of six (6) exhibits; of which each contains:

- A photographic simulation of the coastal viewplane from one of six selected vantages associated with the future highway alignment alternatives within the proposed Ranches III subdivision. The simulation depicts the coastal views over the subject subdivision from the proposed highway corridor.
- A plan-view map identifying the location of the vantage, the proposed highway alignment, and the locations of simulated dwellings.

Purpose

The visual study has been developed for the primary purposes of:

- Provide an elevation-correct simulation the coastal views from the 3 proposed Highway Alignments
- Provide a scale-accurate simulation of development massing in the proposed subdivision from pre-selected highway vantages and building locations

Mapping and View/Vantage Selection

In preparation for selecting the views and vantages to be included in the study, the preparer met with Mr. Rory Frampton, a consultant to Makila Land Co., LLC (landowner) to review background information and choose representative locations for vantage points and dwelling-simulation locations.

Source mapping of lot boundaries, topography, aerial photography, and proposed highway alignments were provided in exhibits entitled "Honoapiilani Highway Realignment Alternatives" prepared by Warren S. Unemori Engineering Inc. prepared on February 27th and March 18th 2008.

Four shoreline-perpendicular transects labeled A through D were selected and mapped as a baseline for photographic simulations. Transects A and B occur within the Makila Ranches II subdivision.

Locations for the simulated agricultural dwellings were selected by Makila in locations deemed representative of natural homeowner selection, and generally in the middle of the developable area, as bound by the proposed coastal roads and respective highway realignment.

Upon selection, vantage and simulation locations were located by GPS and flagged on site.

Vantages – Panoramic Photos

Vantage shots were taken along each transect at a point representing the approximate middle of the seaward traffic lane of the respective highway alignment. The elevations of the vantage photographs were established 5 feet above the proposed elevation of the highway to mimic the view of a pedestrian, cyclist, or occupant in a vehicle.

Because the proposed highway alternatives would be constructed above grade, vantages were photographed from a calculated elevated position above existing grade. Calculations were based upon the profile data included in the 2008 Unemori exhibits. A telescoping survey pole with a camera mount was utilized to provide the correct elevation for the photographs.

Elevations of the vantages were as follows:

C-1	Transect C Alignment 1	11 feet above existing grade
C-2	Transect C Alignment 2	16 feet above existing grade
C-3	Transect C Alignment 3	14 feet above existing grade
D-1	Transect D Alignment 1	13 feet above existing grade
D-2	Transect D Alignment 2	19 feet above existing grade
D-3	Transect D Alignment 3	3 feet above existing grade

A second 25-foot stadia pole was hand held or erected at the pre-designated dwelling simulation locations during vantage photography to provide ground reference scale in photographic panoramas. Dwelling locations were photographed in the vantage shots C-3 and D-3. No dwellings were simulated for Bypass alternatives 1 or 2 based upon the presumption that the buildable area of the lot would be above, not below the bypass due to the alternative's proximity to the ocean.

Vantage Photographs were taken on 5/15/08, 5/20/08, 6/18/08, and 7/14/08. Vantage photographs were assembled into panoramic photographs utilizing

Photomerge/Photoshop application software made by Adobe Systems Incorporated.

Views - Simulated Dwellings

The regional neighborhood was surveyed for a photographic "source" "Specimen Dwelling" that would represent a large-sized single story dwelling or a two-story structure no greater than 25 feet in height. A suitable one-story dwelling with a significant roof height was selected from the abutting neighborhood. The specimen is a 5215 s.f. (per County RPT, TMK (2) 4-7-011:004) dwelling over 100 feet in width and having a peak roof height (along width) of approximately 23.5 feet (as observed). The specimen was photographed from various angles. A 25-foot graduated stadia pole was aligned with the peak of the roof to serve for future reference when the photographs were scaled to the ground controls photographed in the vantage panoramas.

Vegetation

Vegetation / Landscape Planting associated with agricultural dwellings or large-scale farming was not simulated in the viewplane simulations. It was felt that the State and County land use controls specifying agricultural use of the subject property would permit the planting of obstructive crops (trees) with or without the proposed subdivision or the development of dwellings. Because the viewplane obstruction due to farming or landscape planting had infinite possibilities with or without the proposed subdivision, the scope of the study focused on the finite and measurable differences due to the subdivision, specifically the view impacts due to the siting and massing of agricultural dwellings.

Viewplane Simulations

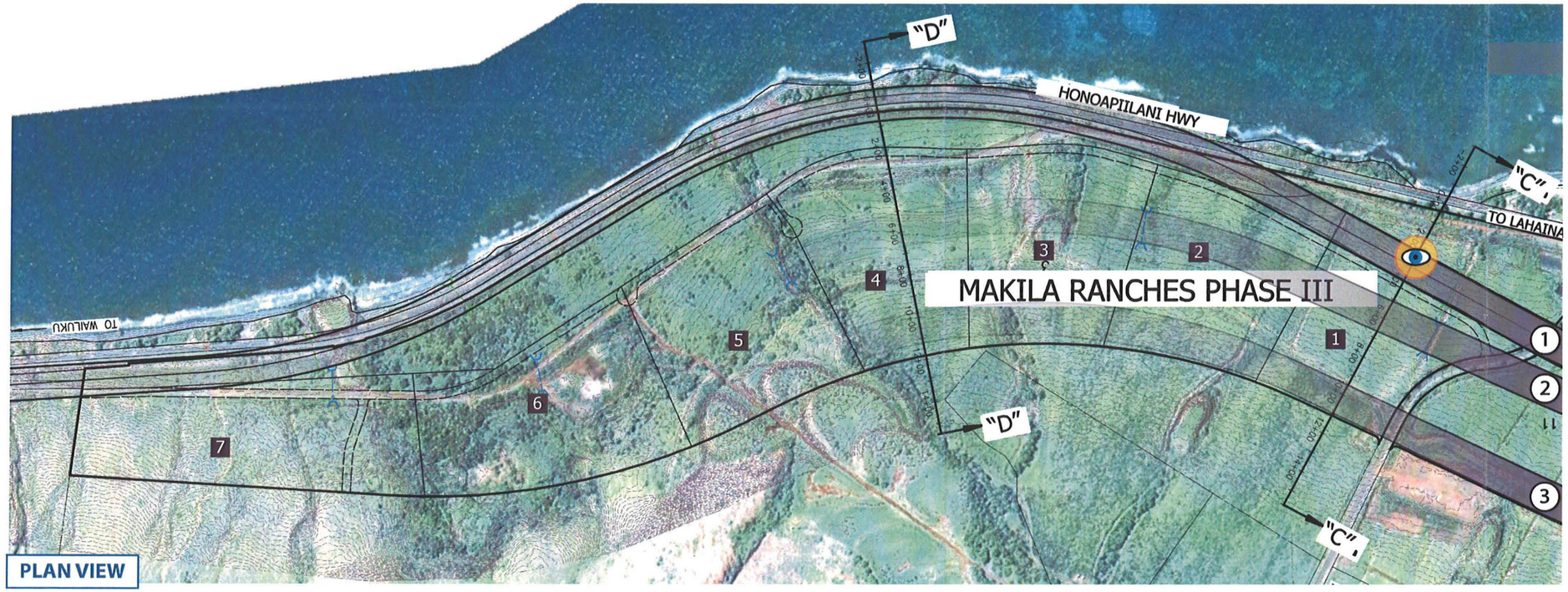
Six simulations were created from the selected vantage points.

In the two simulations from Bypass alternative 3 (C-3 and D-3), photographs of the specimen dwelling were inserted into the vantage panorama and scaled to the correct size utilizing the physical ground controls photographed in both photographs. Lighting levels in the dwelling photograph were adjusted to match those in the panorama. Where the simulated dwelling was obstructed by existing topography, the simulated dwelling was cropped to provide a realistic view. Where cropping was significant, the outline of the pre-cropped structure was provided to retain visual scale despite the obstruction by topography.

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : C

HWY ALIGNMENT # : 1



PLAN VIEW

LAHAINA BYPASS ALTERNATIVE NUMBER

MAKILA SUBDIVISION LOT NUMBER

LOCATIONS OF SIMULATED HOMES

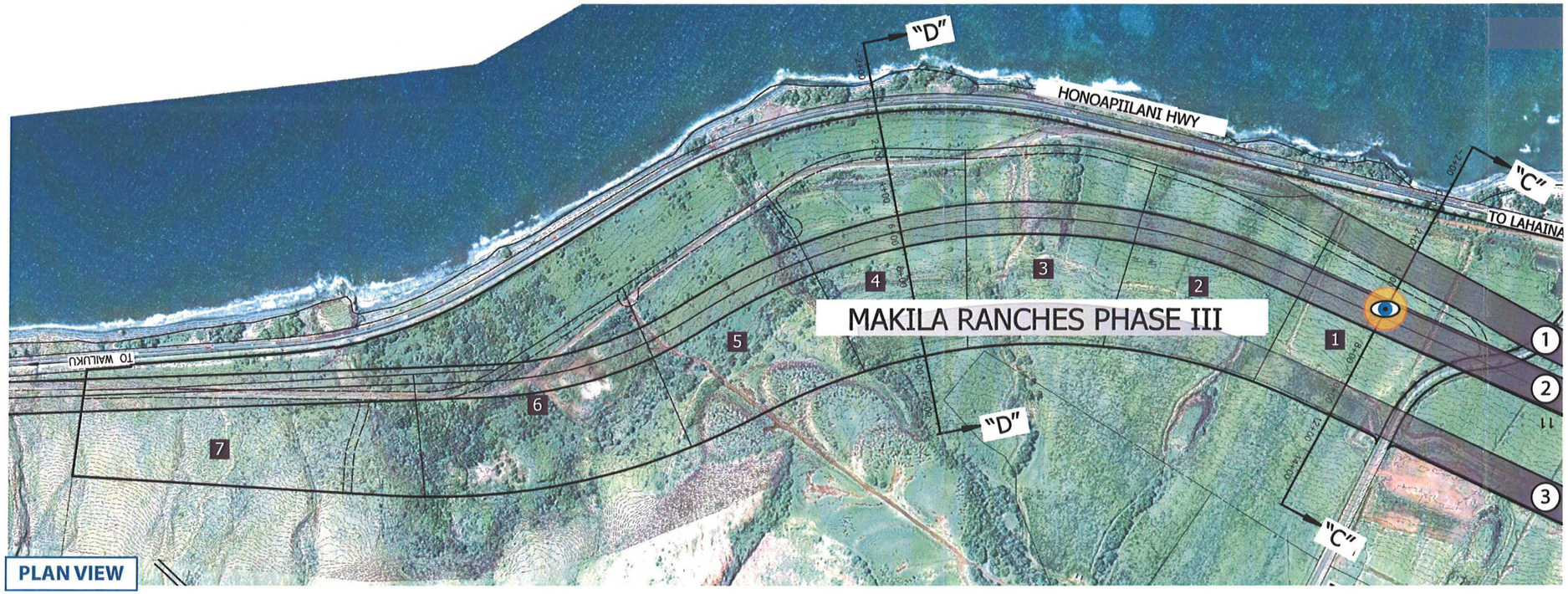
VANTAGE POINT OF SIMULATION

VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : C

HWY ALIGNMENT # : 2



PLAN VIEW

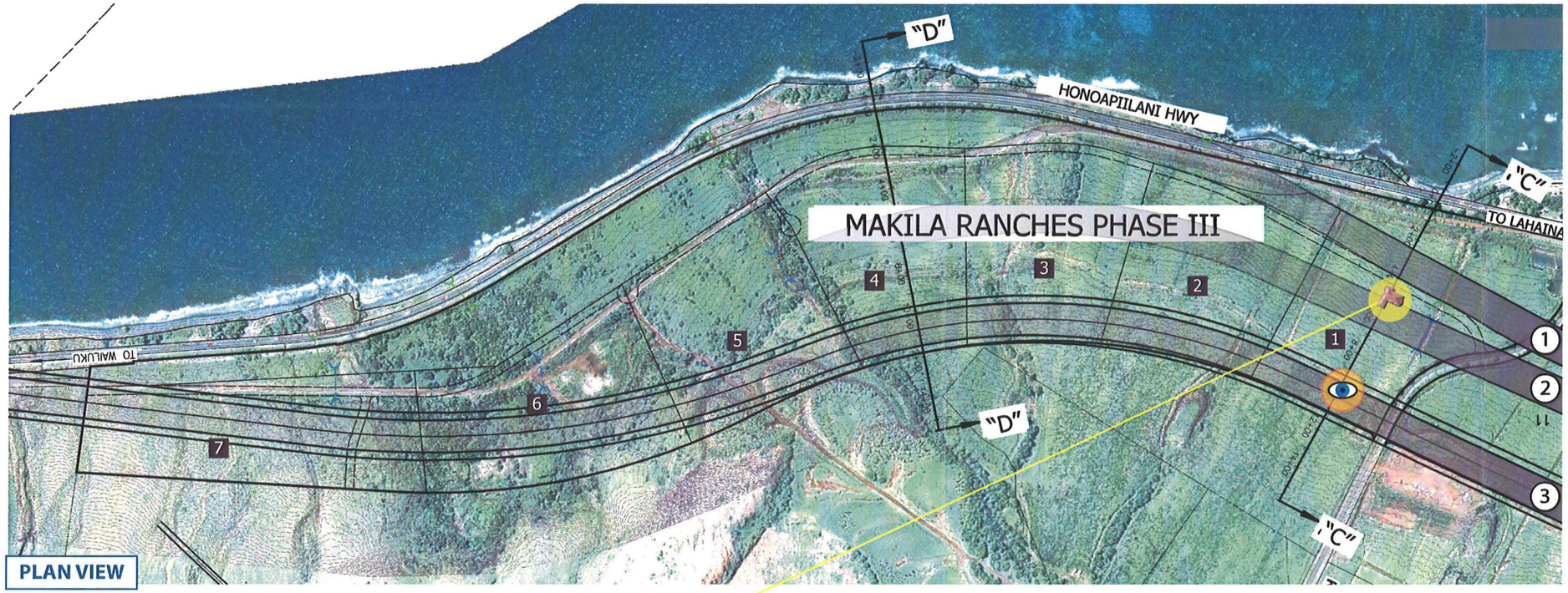
- # — LAHAINA BYPASS ALTERNATIVE NUMBER
- # — MAKILA SUBDIVISION LOT NUMBER
- LOCATIONS OF SIMULATED HOMES
- VANTAGE POINT OF SIMULATION

VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : C

HWY ALIGNMENT # : 3



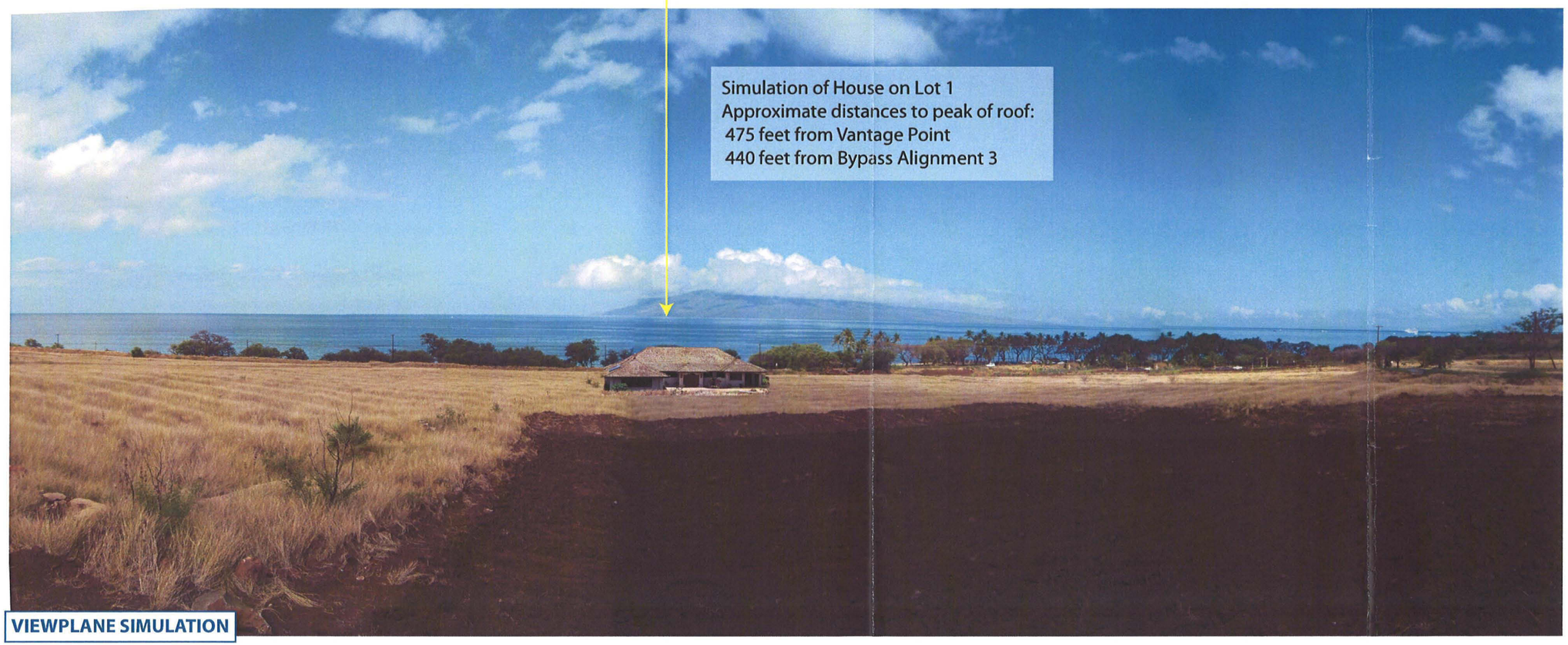
PLAN VIEW

LAHAINA BYPASS ALTERNATIVE NUMBER

MAKILA SUBDIVISION LOT NUMBER

LOCATIONS OF SIMULATED HOMES

VANTAGE POINT OF SIMULATION

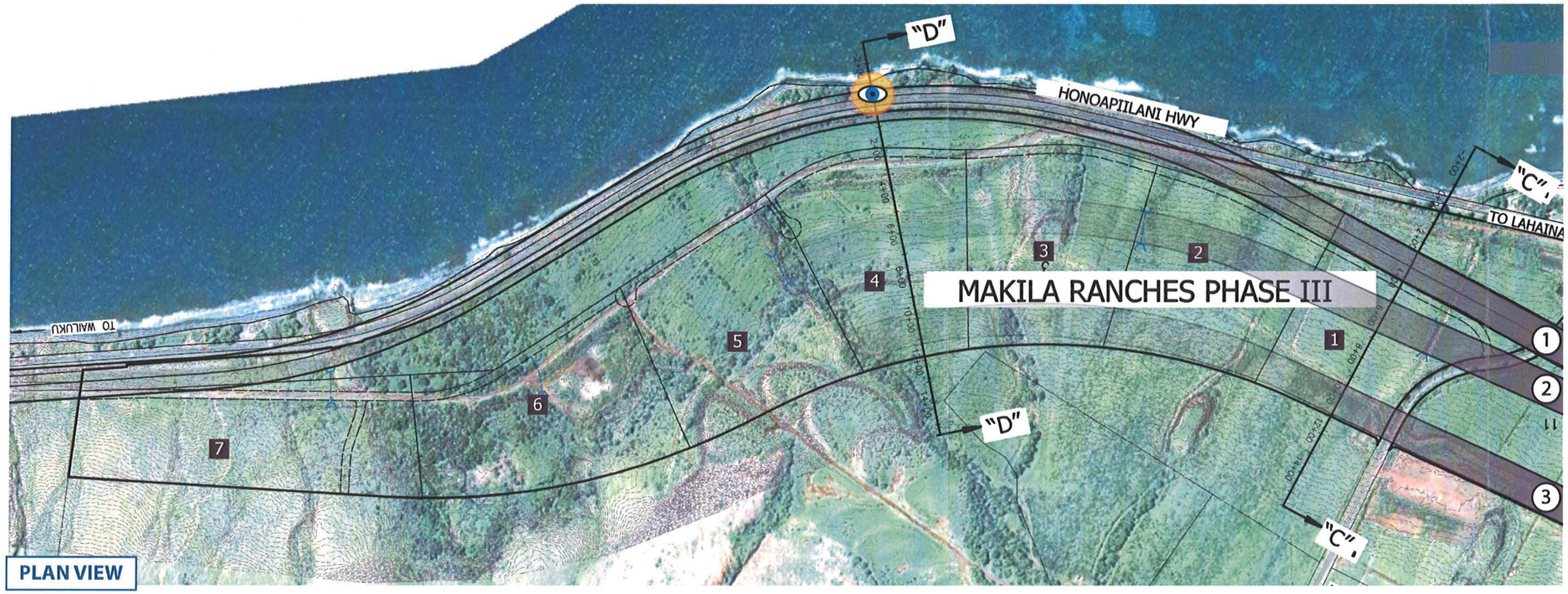


VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : D

HWY ALIGNMENT # : 1



PLAN VIEW

LAHAINA BYPASS ALTERNATIVE NUMBER

MAKILA SUBDIVISION LOT NUMBER

LOCATIONS OF SIMULATED HOMES

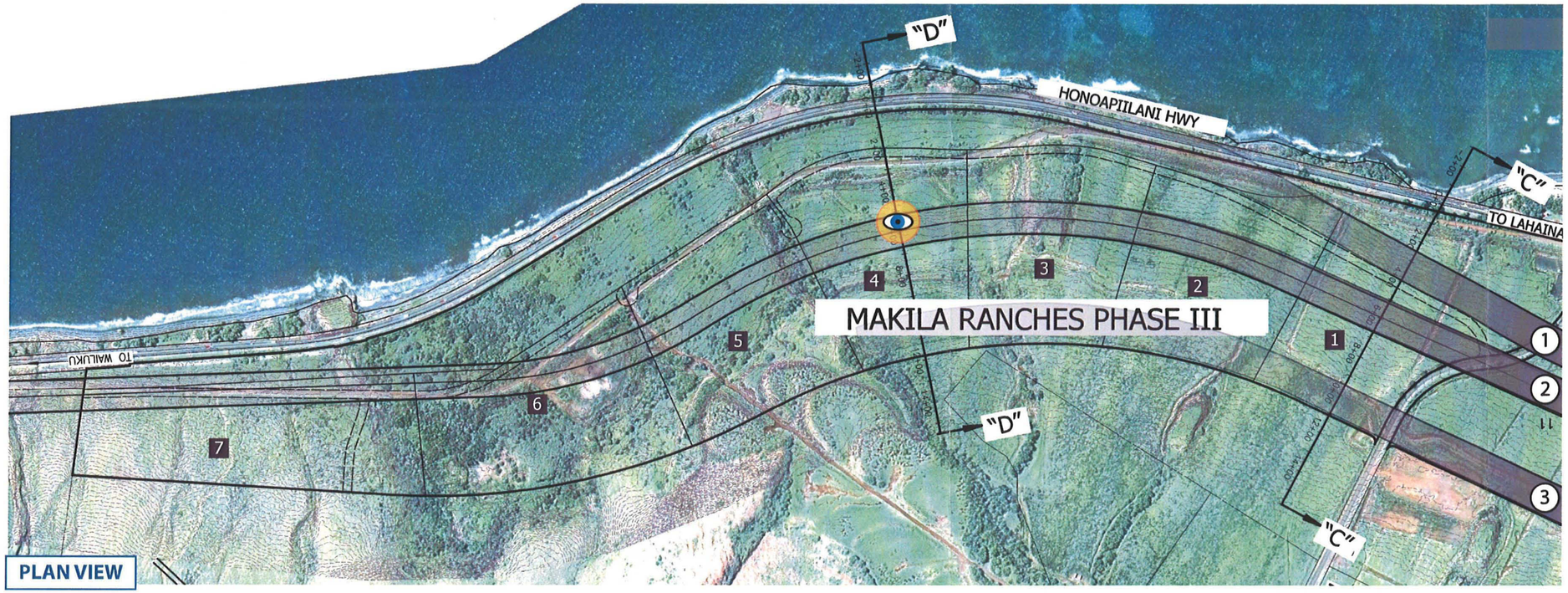
VANTAGE POINT OF SIMULATION

VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : D

HWY ALIGNMENT # : 2



PLAN VIEW

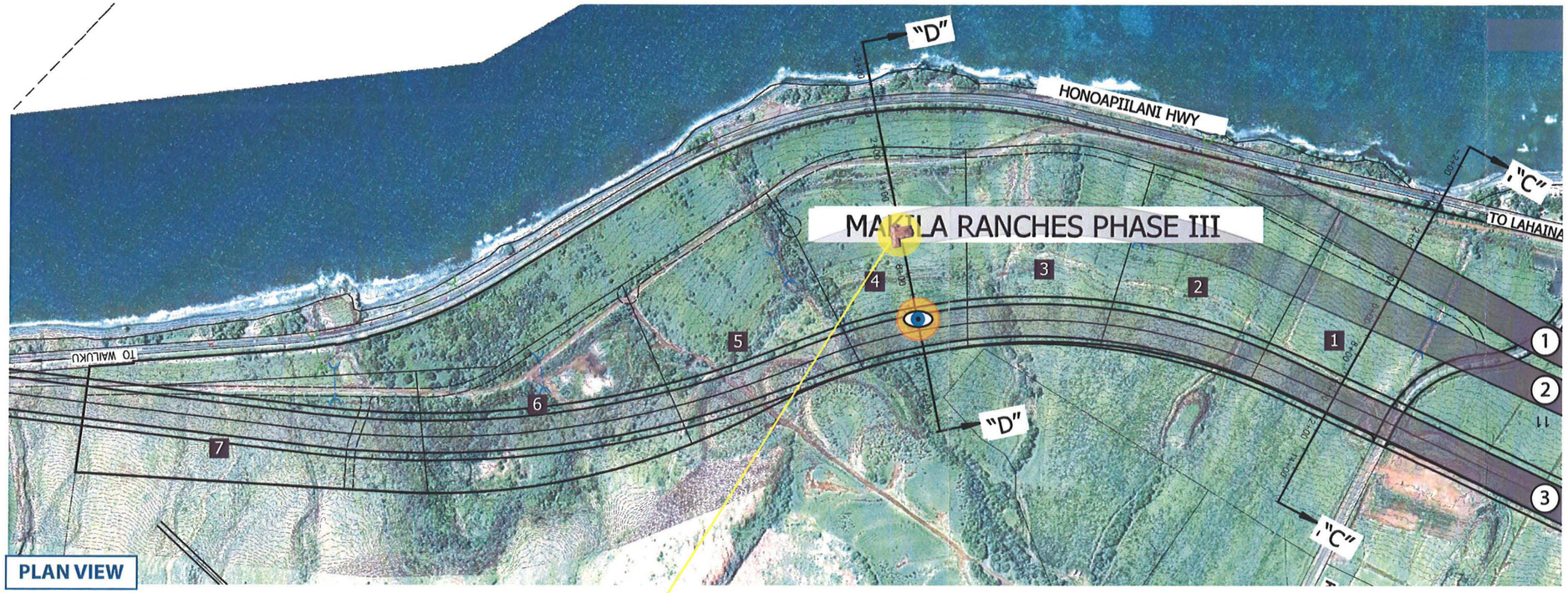
- # — LAHAINA BYPASS ALTERNATIVE NUMBER
- # — MAKILA SUBDIVISION LOT NUMBER
- LOCATIONS OF SIMULATED HOMES
- VANTAGE POINT OF SIMULATION

VIEWPLANE SIMULATION

LAHAINA BYPASS / MAKILA SUBDIVISION
MASSING / VIEWPLANE SIMULATION

TRANSECT : D

HWY ALIGNMENT # : 3



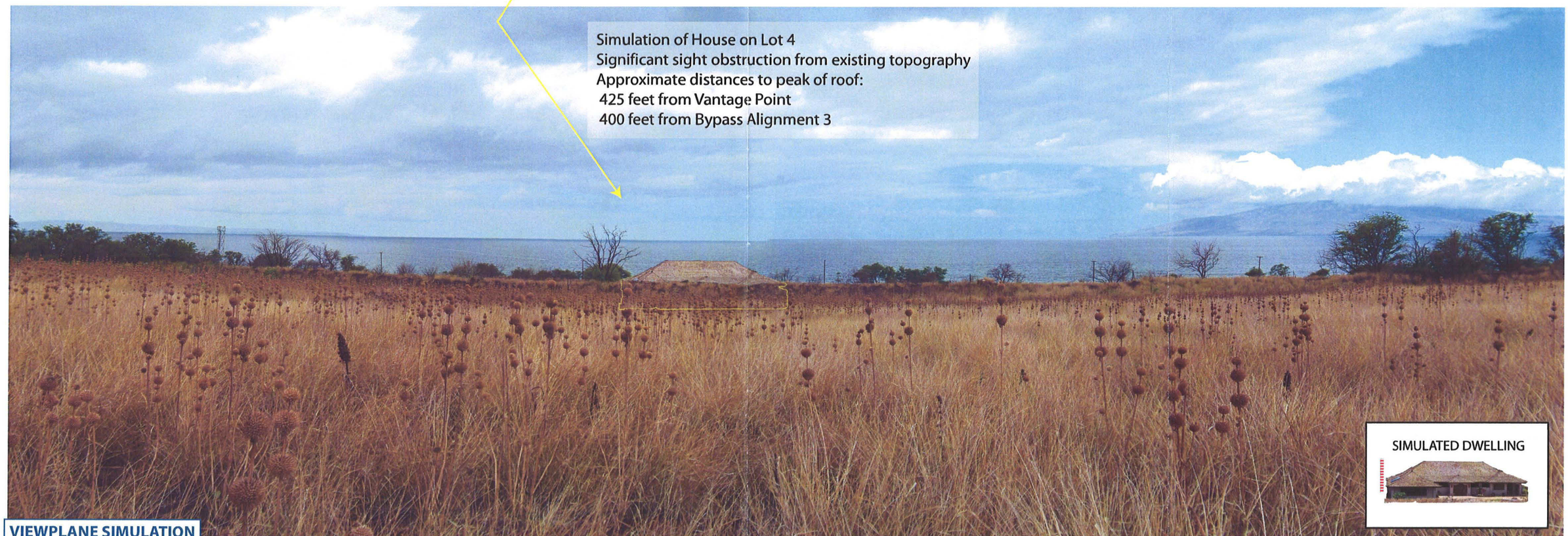
PLAN VIEW

LAHAINA BYPASS ALTERNATIVE NUMBER

MAKILA SUBDIVISION LOT NUMBER

LOCATIONS OF SIMULATED HOMES

VANTAGE POINT OF SIMULATION



VIEWPLANE SIMULATION

APPENDIX E.

Archaeological Inventory Survey

SCS Project Number 652-2

AN ARCHAEOLOGICAL INVENTORY SURVEY OF 633 ACRES IN THE LAUNIUPOKO (LARGE LOT) SUBDIVISION NOS 3, 4, and 7 LAUNIUPOKO AND POLANUI AHUPUA`A DISTRICT OF LAHAINA (FORMERLY KĀ`ANAPALI) ISLAND OF MAUI, HAWAI`I [TMK (2) 4-7-01:2 por.]

Prepared by:
C. Kanani Paraso, M.A.
and
Michael Dega, Ph.D.

Revised August 2006

Prepared for:
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ABSTRACT

Scientific Consultant Services (SCS), Inc. conducted Archaeological Inventory Survey on 633 acres of undeveloped land known as Launiupoko (Large Lot) Subdivision No. 3, 4, & 7, located in Launiupoko and Polanui Ahupua`a, Lahaina District (formerly Kā`anapali District), Maui Island, Hawai`i [TMK (2) 4-7-01:2 por.]. The project involved full systematic survey of the entire parcel, mapping and recording of identified sites and features, and limited testing.

A total of ten sites were identified, the majority of which are historic in age. Five of the ten sites are associated with the sugarcane plantation era. These sites include large rock mounds, terraces, and irrigation ditches. One of the irrigation ditches was previously recorded by PHRI (2000) as State Site Number 50-50-03-4787 Feature D and is referred to as Lahaina Pump Ditch No. 1. Site 50-50-03-5950 is composed of 17 linear, large rock mounds scattered throughout the project area. Site 50-50-03-5951 consists of an irrigation ditch, water pipes, reservoir, and flume. Site 50-50-03-5952 is a terrace complex associated with the manual cultivation of sugarcane. Site 50-50-03-5957 is also a terrace associated with sugarcane cultivation. Two of the ten sites are rock walls associated with the cattle ranching era, one of which was previously recorded by Graves *et al.* (1998) and Haun *et al.* (2001) as State Site Number 50-50-03-2665. The other rock wall is designated Site 50-50-03-5954. One of the ten sites (Site 50-50-03-5953) is a scatter of slag fragments and cores interpreted to be a historic work area. As slag is a mill by-product, the slag scatter is historic in age. The function and age of Sites 50-50-03-5955 and 50-50-03-5956 are indeterminate but are simply referred to as activity areas. Site 50-50-03-5955 is a modestly modified rock deposit/bedrock area containing a small cache of coral fragments. This is site is simply interpreted as a modified area as disturbance, erosion, and lack of cohesiveness renders interpretations difficult. Site 50-50-03-5956 is a midden and lithic scatter that also contains historic material such as glass and metal fragments. Material was sampled during surface collection. No cultural materials were observed during subsurface testing.

All of the sites identified during Inventory Survey are significant under Criterion D. All the sites have been thoroughly mapped and recorded. No further work is recommended for these sites. SIHP 50-50-03-5950, the large plantation era clearing mounds, have been discussed within the community from a cultural perspective. Oral documentation by former plantation employees suggests that the mounds may have been constructed upon existing stone structures, and cultural materials were periodically placed within the mounds during field clearing (Kirkendall 2006). If development of the area requires any deconstruction of these mounds, Site 5950, a qualified archaeologist should monitor these activities. In general the project area has been tremendously altered by sugarcane cultivation and subsurface testing yielded negative results, the presence of intact subsurface cultural deposits is very low. Other then Archaeological Monitoring at Site 50-50-03-5950 No further work is recommended in the project area.

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INTRODUCTION

At the request of West Maui Land Company, Inc., Scientific Consultant Services (SCS), Inc. conducted Archaeological Inventory Survey on 633 acres of undeveloped land known as Launiupoko (Large Lot) Subdivision No. 3, 4, & 7, located in Launiupoko and Polanui Ahupua`a, Lahaina District (formerly Kā`anapali District), Maui Island, Hawai`i [TMK (2) 4-7-01:2 por.] (Figures 1 and 2). The project area includes Large Lots 3 (214 acres), 4 (271 acres), and 7 (148 acres). The lands are currently owned by Makila Land Company, LLC. The majority of the project area was used for sugarcane cultivation and subsequently for cattle ranching; a portion of the project area (Lot 4) is still used for ranching.

This Inventory Survey included historic background research and settlement pattern analysis prior to fieldwork, systematic pedestrian survey of the entire project area, mapping and recording of identified features, and representative manual and mechanical testing of sites. Mechanical testing through trenching was also conducted in areas without surface sites to assess the presence/absence of subsurface cultural deposits in representative portions of the project area. Fieldwork was conducted between January 23, 2006 and February 28, 2006 by SCS employees Tomasi Patolo, B.A. (Field Director), Jennifer Frey, B.A., Eric Pope, B.A, and Donna Shefcheck, B.A. The Principle Investigator for this project is Michael Dega, Ph.D.

Archaeological Inventory Survey of the project area was conducted to determine the presence/absence of archaeological sites and features in surface and subsurface contexts through complete systematic pedestrian survey and representative subsurface testing. The ultimate goals were to identify archaeological sites, adequately record and document all of the sites present, determine the significance of the sites, and to provide recommendations to the State Historic Preservation Division (SHPD) regarding site significance and mitigation in regards to future land use in the project area.

ENVIRONMENTAL SETTING

LOCATION

The project area consists of 633 acres of "undeveloped" land located on the western slopes of the West Maui range situated between coastal areas to the west and mountainous terrain to the east. The land is "undeveloped" per current housing but has been formerly developed through sugar cane cultivation (see below). The majority of the project area falls within the bounds of Launiupoko Ahupua`a. The northern portion of the project area extends into the southern half of Polanui Ahupua`a. Elevation of the project area ranges from sea level to

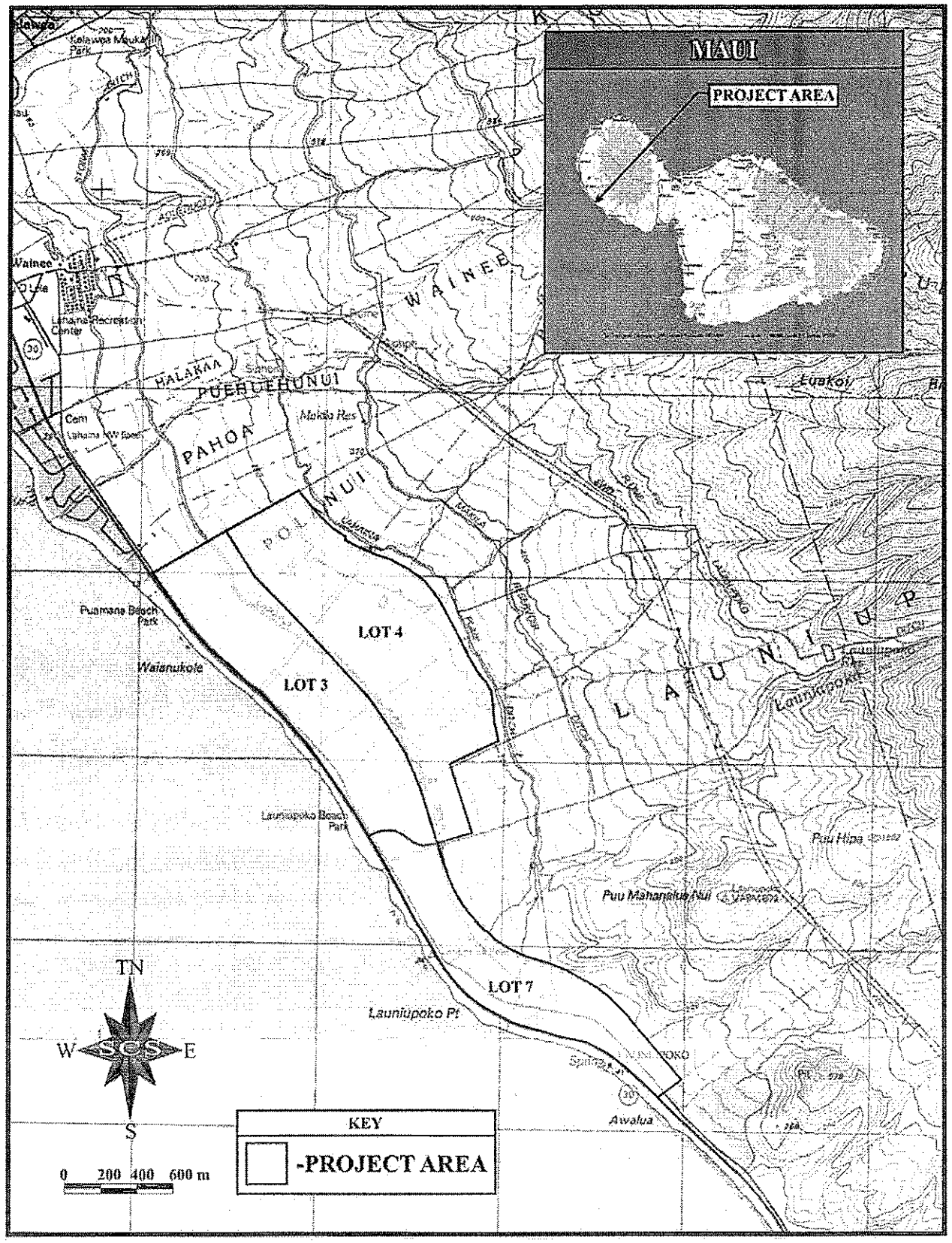

Figure 1: USGS Lahaina Quadrangle Map Showing Project Area.

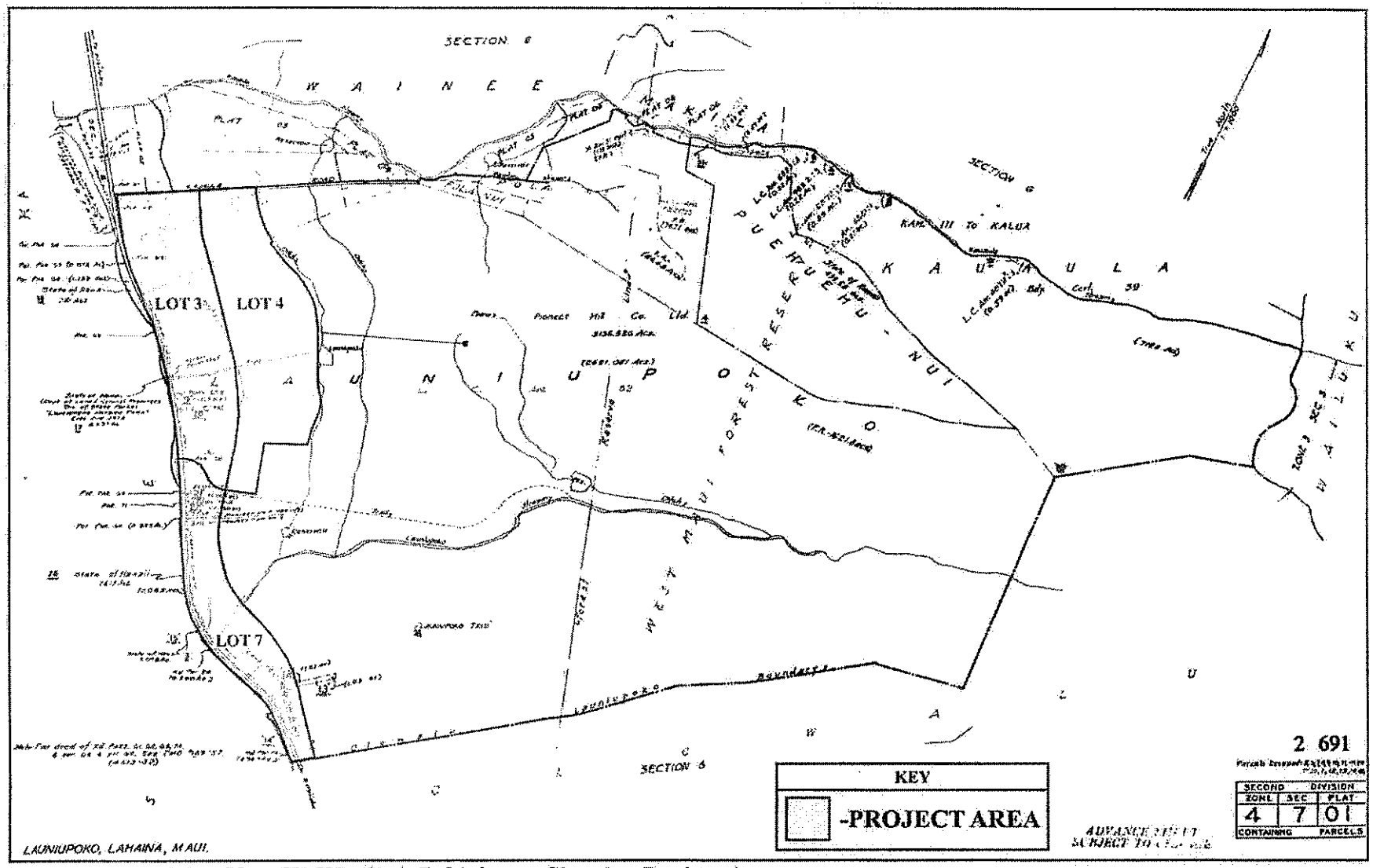

Figure 2: Tax Map Key (TMK) (2) 4–7–01:2 por. Showing Project Area.

approximately 250 feet above mean sea level (amsl). The project area is bound on the west by Honoapi'ilani Highway and on the north by Kaua'ula Road. Hāniu Street forms the eastern boundary in the northern half of the project area. The southern half of the project area narrows, crosses Kai Hele Ku Street, and extends to the Launiupoko and Olowalu Ahupua'a boundary.

LANDFORM AND SOILS

According to Foote *et al.* (1972), soils in the project area fall primarily into three sub-classifications of the Wainee soil series. The Wainee soil series consists of well-drained soils on alluvial fans, developed in alluvium derived from weathered basic igneous rock, and are gently to moderately sloping. These soils are used mostly for sugarcane. The Wainee Series derivatives are similar yet differ primarily by slope and stone content. Within the project area the WxB (Wainee very stony silty clay) soil is present near the coast. This soil is only mildly sloping (3–7%) with slow runoff and a slight erosion hazard. Stones cover as much as 3 percent of the surface. The WyC soil (Wainee extremely stony silty clay) is found inland of the WxB soil and along the coast in the southern portion of the project area. The WyC soil is moderately sloping (7–15%), has moderately rapid permeability, slow to medium runoff, and a slight to moderate erosion hazard. Stones cover 3 to 15 percent of the surface. The WyB soil (Wainee extremely stony silty clay) is found inland within the WyC soil. The WyB soil is only mildly sloping (3–7%), has slow runoff, and a slight erosion hazard. Stony alluvial land (rSM) is found at the very southern portion of the project area, immediately northwest of Launiupoko Gulch. This land type consists of stones, boulders, and soil deposited by streams along the bottoms of gulches and on alluvial fans. In most places the slope is 3 to 15 percent.

VEGETATION

The vegetation in the project area includes both indigenous and introduced species. Vegetation consists mainly of shrubs and grasses that occur rather densely in some areas. Shrubs include lantana (*Lantana camara*) and *'ilima* (*Sida fallax*). Trees such as *kiawe* (*Prosopis pallida*), java plum (*Syzygium cumini*), and *'opiuma* (*Pithecellobium dulce*) are present. *Koa haole* (*Leucaena leucocephala*) are also present as shrubs and small trees.

CLIMATE

Rainfall in this environmental zone is very low. The project area receives an average annual rainfall of only 10 to 15 inches with most of it occurring during the winter months (November through April) (Foote *et al.* 1972). Seasonal variation in rainfall amount follows normal orographic patterns for leeward-type areas of Maui (Armstrong 1983).

TRADITIONAL AND HISTORIC SETTING

Archaeological settlement pattern data indicates that initial colonization and occupation of the Hawaiian Islands first occurred on the windward shoreline areas of the main islands between the A.D. 4th and 11th centuries, with populations eventually settling in drier leeward areas during later periods (Kirch 1985). Although coastal settlement was dominant native Hawaiians began cultivating and living in the upland *kula* zones. Greater population expansion to inland areas began between A.D. 11th and 12th centuries and continued through the 16th century. Large scale or intensive agriculture was implemented in association with habitation, religious, and ceremonial activities. Coastal lands were used primarily for settlement while staple crops (i.e. *kalo*/taro) were cultivated in near-coastal reaches, as well as, in watered regions along the plain and in the uplands.

The District of Lahaina, located on the western side of the West Maui Mountains (Mauna Kahalawai), extends from Honokohau Ahupua`a on the north to Ukumehame Ahupua`a on the south. A number of traditional activities took place in this district from fishing and cultivation by early Hawaiians to residential occupation and recreational use by members of the *ali`i* (ruling) class. The district served as an important center both politically and socially during the late prehistoric and early historic period. It was the royal chiefly center for centuries (Thrum 1974; Walker 1981; Kirch 1985; Kamakau 1992; Sterling 1998) and played a key role in the intra-island warfare associated with island unification. By the late 1700s, Kamehameha I had firmly established his presence on Maui with the invasion of Lahaina. By the early 1800s, Kamehameha I designated Lahaina the capital of the Hawaiian Kingdom. Lahaina served as the capital until 1850 when it was moved to Honolulu. In 1819, the first whaling ship Bellina arrived in what would later be known as Lahaina Harbor. Lahaina served as the center of commercial whaling in the Pacific until the mid-1800s. After the decline of the whaling industry, Lahaina and surrounding areas became a base for sugarcane plantations. Most recently tourism is the main industry in Lahaina.

TRADITIONAL SETTING OF LAHAINA

Lāhainā is the traditional spelling and pronunciation of what we presently call Lahaina. Lāhainā literally translated means "cruel sun," said to be named for a time of terrible droughts (Pukui *et al.* 1974:127). Others believe the original name for Lahaina was Lele which is usually the flying piece of a *kuleana* (small piece of property) near the shore (Sterling 1998:17). As Lahaina is situated along the shoreline the name is applicable. Pukui *et al.* (1974:127) also note

that Lahaina is associated with the Kaua`ula wind that caused the destruction of churches and buildings in Lahaina in 1828 and again in 1858.

Lahaina is traditionally and historically known for its verdant and abundant groves of breadfruit. Sterling's (1998) *Sites of Maui* references Lahaina as second only to Puna, Hawai`i as a favorable location for breadfruit cultivation. In *mele* (songs) Lahaina is even referred to as *ka malu ulu o Lele*, "the breadfruit shade of Lele" (Handy 1940:190). Ashdown (1970) writes that the name Lele was changed to Laha`ina when it became the home of the noted prophet, Laha`inaloa for whom all of West Maui was named.

According to Handy and Handy (1972:492), the District of Lahaina was a favored place among the high chiefs of Maui and their entourage because of its abundant resources from both land and sea, its warm climate, easy communication with other populated areas around West Maui, and close proximity to the outer islands of Moloka`i and Lāna`i.

Early descriptions of Lahaina village provided by Westerners paint a picture of idyllic tranquility and cooperation among the inhabitants. Menzies, the surgeon and naturalist on board the HMS Discovery during Captain George Vancouver's expedition, states that he and the members of his party "...observed the rugged banks of a large rivulet that came out of a chasm cultivated and watered with great neatness and industry" (Handy and Handy 1972:493). Menzies goes on to describe an afternoon tour of the village on March 17, 1793, as follows:

> I accompanied Vancouver and a party of officers, with the two Niihau women, to see the village of Lahaina, which we found scattered along shore on a low tract of land that was neatly divided into little fields and laid out in the highest state of cultivation and improvement by being planted in the most regular manner with the different esculent roots and useful vegetable of the country, and watered at pleasure by aqueducts that ran here and there along the banks of intersecting fields...In short , the whole plantation was cultivated with such studious care and artful industry as to occupy our minds and attention with a constant gaze of admiration... [Handy and Handy 1972:493].

Little had changed twenty-six years later when J. Arago visited Hawai`i with Captain Louis de Freycinet in 1819. Arago, impressed by the verdant quality of Lahaina and the skill the Hawaiians exhibited in farming, writes:

> The environs of Lahaina are like a garden. It would be difficult to find a soil more fertile, or a people who can turn it to a greater advantage; little pathways

> sufficiently raised and kept in excellent condition...These are frequently divided by trenches, through which a fresh and limpid stream flows tranquilly, giving life to the plantations...[Handy and Handy 1972:493].

In *The Hawaiian Planter*, Handy (1940:159) discusses the proliferation of fishing settlements and isolated fishermen's houses all the way from Kihei to Honokahua and mentions the cultivation of *`uala* (*Ipomea batatas*, sweet potato) in the red *lepo* (sandy soil) near the shore. Handy (1940) points out that this coast is the most favorable on Maui for fishing and that *kula* lands (uplands) were ideal for the cultivation of sweet potato. According to Handy (1940:106), the *ali`i* Kaka`alaneo lived on Keka`a Hill in Lahaina District. Keka`a became the capital of Maui during Kaka`alaneo's reign and was also an area of intense cultivation. Fornander (1918–19, Vol. 5:540–41) discusses how Kaka`alaneo planted *kukui* (*Aleurites moluccana,* candlenut) and *`ulu* (*Artocarpus incisus*, breadfruit) at Lahaina village.

According to Thrum (1974), in *Hawaiian Annual*, an infamous chief named Hua, who was born in Lahaina and reigned prior to the 10th century, is credited with the construction of the first *heiau* (temple) on Maui. Hua is also referred to as Hua-a-Pohukaina and Hua-a-Kapuaimanaku, names by which his father was also known. Hua is known for the construction of two *heiau* in Lahaina. Another Hua, two generations later, is credited with the construction of a third. Three additional *heiau* are said to date to or just prior to the reign of Kahekili (Thrum 1974).

Lahaina was known as a *pu`uhonua* or place of refuge in Maui. The *pu`uhonua* at Lahaina was associated with Ka`ahumanu who inherited her lands from her husband Kamehameha. In *Ruling Chiefs of Hawai`i*, Kamakau (1992:312) discusses how Ka`ahumanu's lands of Waipukua in Waihe`e, Kalua`aha in Moloka`i, and Pu`umau in Lahaina were deemed places where people could be saved from death.

Fornander (1969) discusses how Lahaina figured prominently in battles between various island chiefs. In the early 1700s, wars between Alapa`inui of Hawai`i, in conjunction with Kamehamehanui of Maui, and Kauhi (Kamehamehanui's brother) occurred. Alapa`inui established his headquarters at Lahaina village while the rest of his army occupied the coast extending from Honokowai to Ukumehame. With the pending arrival of Peleioholani from O`ahu, who was to assist Kauhi, Alapa`inui destroyed the *kalo* patches and broke down *`auwai* belonging to the followers of Kauhi in the vicinity of Lahaina. Eventually the forces met, Fornander writes:

> ...The fortune of the battle swayed back and forth from Honokowai to near Lahaina; and to this day heaps of human bones and skulls, half buried in various places in the sand, attest to the bitterness of the strife and carnage committed [Fornander 1969, Vol. 2:140].

Lahaina also played a crucial role in the intra-island warfare that led to island unification and the establishment of the capital of the Hawaiian Kingdom by Kamehameha I. In February of 1795, Kamehameha established his presence on Maui with the invasion of Lahaina. Kamehameha's great fleet of war canoes landed in Lahaina covering the coast from Launiupoko to Mala (Kamakau 1992). That part of Lahaina, covered in food patches and cane fields, was overrun by Kamehameha's men from the island of Hawai`i (Kamakau 1992:171). By 1802, Kamehameha I constructed the brick palace, Moku`ula, in Lahaina, from which the collection of taxes was administered. Lahaina served as the capital of the Hawaiian Kingdom from that time until 1850 when Kamehameha moved it to Honolulu.

TRADITIONAL SETTING OF THE PROJECT AREA

The project area is situated in the *ahupua`a* of Launiupoko, in the District of Lahaina, on the southwest side of West Maui. Launiupoko Ahupua`a is bordered from north to northeast by Polanui, Polaiki, and Pūehuehunui Ahupua`a on the north and Olowalu Ahupua`a on the south. Literally translated Launiupoko means "short coconut leaf" (Pukui *et al.* 1974:130). Launiupoko is known to be rocky and dry, as rainfall is scarce. In *The Hawaiian Planter*, Handy states that:

> Although there is a sizable stream bed and a deep valley here, there is no visible evidence of wet taro cultivation, and the Hawaiian planters at Olowalu say that *lo`i* never existed in Launiupoko. It is possible that there may have been a few terraces on the level land at the base of the valley, but this is wholly arid land now and covered with dense brush [Handy 1940:103].

According to Handy and Handy (1972:272), the Lahaina District is "flanked by excellent fishing grounds." Although there appears to be few legends pertaining to the Launiupoko area, a search of the literature reveals several references indicating the importance of fishing in Launiupoko Ahupua`a. In *Sites of Maui,* Sterling (1998:27) quotes A.D. Kahaulelio from an article titled "Fishing Lore," *Ka Nupepa Kuokoa*, May 30, 1902, as saying "[t]he schools of *nehu* [*Stolephorus Purpureus,* an important bait fish used to catch tuna] were accustomed to coming in to Launiupoko and Keonepoko in the District of Lahaina, and sometimes at Mala." Kahaulelio also wrote the following about shark fishing in the area:

> Hoomoemoe Fishing for Sharks—It was much practiced by old timers of this ahupua`a of Makila, and also by the people of the upland of Kauaula since we

> were children...The kinds of sharks caught by the hoomoemoe method were lalakea and hammerheads...the place where hoomoemoe fishing was done was at Pahee, in Launiupoko, Lahaina. When you arrive at the little cape of Keahuiki and down the small incline, the first stretch you come to extending over to the rocky beach and adjoining with the sand on the left side, that is the place where the nets were laid [Sterling 1998:27].

LAND TENURE

The land tenure system in prehistoric Hawai`i was rooted in a different epistemological framework than the subsequent colonially-imposed framework of private land ownership. The idea of holding land was not synonymous with owning it, but is described as closer to a trusteeship between the *ali`i nui* (ruling chiefs) of the island and the traditional Hawaiian *akua* (gods) Lono and Kāne (Handy and Handy 1972:41). Each island was divided into *moku* (districts) that were solely geographical subdivisions. The number of these *moku* depended upon the size of each island. *Moku* were partitioned into smaller landholding units known as *ahupua`a* that were governed by *ali`i* or designated *konohiki*. The *ahupua`a* varied in size but ideally encompassed land from the mountain to the sea, allowing the chiefs and *maka`āinana* (commoner) access to both land and marine resources. All persons from chiefs to commoners were entitled to portions of these resources (Chinen 1994).

The prehistoric period in the Hawaiian Islands came to an end with the arrival of Captain Cook to the island of Kaua`i in 1778. The years to follow would drastically alter the political, agricultural, and social foundation of the Hawaiian Kingdom. Destabilization of Hawaiian society was further intensified by the profound reformation of the traditional land system.

The 1848 Māhele introduced land privatization putting an end to the traditional Hawaiian land system. Under the Māhele both chiefs and commoners alike were required to obtain private land titles (Kame`eleihiwa 1992). Individuals holding land were required by new Western notions of law to submit their claims or forfeit their land. Hawaiians were permitted to claim lands on which they had lived and cared for, however, often times *maka`āinana* were ill informed of the procedures and failed to make claims, ultimately resulting in the loss of land that they had occupied for generations. Kirch discusses traditional Hawaiian land use strategies as revealed through Land Court Award testimonies and records and the effect the Māhele had on the fundamental structure of traditional Hawaiian culture:

> While LCA (Land Court Awards) establish historic land utilization in Hawai`i (during the *Māhele*), documented testimony from many land recipients have also demonstrated continuous generational occupation of the land. Settlement

> patterns illustrated in the LCA records highlight the multi-functional land use practices related to habitation and agriculture and perhaps the clear connection of these strategies. By mid-century, the fledgling [Hawaiian] Kingdom undertook the single most significant inducement to cultural change, the Great Māhele or division of lands between the king, chiefs, and government, establishing land ownership on a Western-style, fee-simple basis. From this single act, an entire restructuring of the ancient social, economic, and political order followed [Kirch 1985:309].

The Waihona `Aina database (2000) compiles land ownership data from the Indices of Awards (Indices 1929), Native Register (NR n.d.), Native Testimony (NT n.d.), Foreign Register (FR n.d.), and Foreign Testimony (FT n.d.). The database lists only one claim for Launiupoko. The entire *ahupua`a* of Launiupoko consisting of 3,778 acres was awarded to Thomas Phillips (Royal Patent 1358 LCA 82); no *kuleana* lands were awarded within the *ahupua`a* (Figure 3). This LCA proved to be somewhat controversial as Kekauluohi (Kamehameha III) made a stipulation that "this land shall not be conveyed to a haole and one who does not reside in Hawai`i." Testimonies concerning the boundaries reference a rock called Kohe Kili Pōhaku, which is described as "a place of one of the kohe (female genitalia) dropping diversions used by Pele's sister as she was fleeing the unwanted advances of Kamapua`a (Orr in Graves *et al.* 1998: Appendix A). The testimony also references two graveyards, one in Launiupoko and one in Polanui. Additional testimony over the boundary of Phillips's claim mentions the same rock, it states, "I have always heard the old people say that the parting here between the two lands runs down to Keahoiki, which is a point near a large rock called Kohe Kili pohaku. It is a place where the old Gods stood" (Waihona `Aina 2000). Orr's research of archival information from the Bureau of Conveyances document several mortgage transactions regarding the parcel. In 1853, Phillips mortgaged the property to Z. Kaauwai and then in 1856 to Antonio Sylvia (Graves *et al.* 1998: Appendix A). In 1857 it was mortgaged and paid off to James R. Dow. Orr (Graves *et al.* 1998: Appendix A) provides the last reference to the property, "4 pcs" in Launiupoko, from the Grantor Index 1845-1869, which shows Grantor C. Coady by Atty to Grantee Charles Lake in 1864, the year Phillips died. This same Grantor Index shows there was a record of a deed transaction between Grantor Benjamin Pittman by Atty to Grantee Campbell and Thurton concerning "various Pioneer Mill Plantation" lands in Lahaina (no date) (Graves *et al.* 1998: Appendix A). Additional Circuit Court documents concerning Phillips's landholding in Launiupoko were located by Orr at the Hawai`i State Archives. These documents describe how Phillips's Hawaiian wife and heir, Kahoomaeha, was denied rights to the property although she was named as heir in Phillips's two wills (Graves *et al.* 1998: Appendix A).

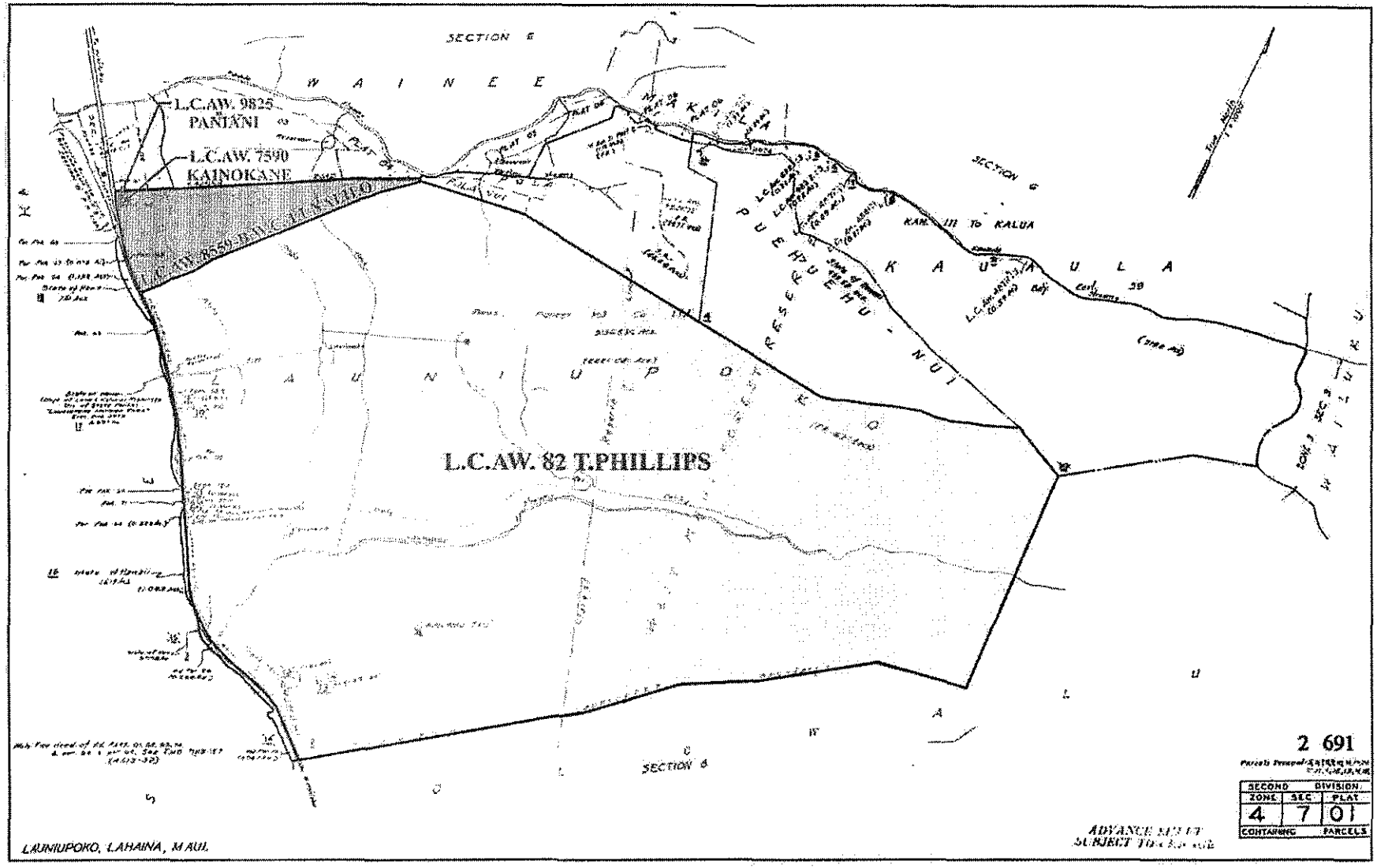

Figure 3: Tax Map Key [TMK] Showing Land Commission Awards in the Project Area.

The northern portion of the project area falls within Polanui Ahupua`a. With the exception of 66 acres of *kuleana* parcels, all 377 acres of Polanui Ahupua`a was awarded to William C. Lunalilo (Royal Patent 8395 LCA 8559-B, Apana 25) (see Figure 3). Among the *kuleana* parcels were 6.12 acres awarded to Kainokane (Royal Patent 1190, 1191 LCA 7590) and 2.7 acres awarded to Paniani (Royal Patent 1704 LCA 9825). Paniani's parcel which is in the very northwestern corner of the project area is documented as being a house lot. Kainokane's parcel, located directly south of Paniani's, is documented as having 37 *lo`i*, 5 coconut trees, and 3 *hala* (*Pandanus odoratissimus*) clumps.

HISTORIC SETTING IN THE PROJECT AREA

Land use in Launiupoko Ahupua`a in the mid 19th and early 20th century was largely devoted to the sugar industry. The Pioneer Mill Company was founded in 1860 by James Campbell, Henry Thurton, and James Dunbar. In 1864, Benjamin Pittman acquired lands in Launiupoko which he deeded to Campbell, Thurton, and Dunbar. In 1885, Thurton constructed a railroad system to transport sugarcane from the fields to the mill in Lahaina (Condé 1973). One railroad line crosses through the northeast portion of the project area and the other follows the coastline.

Between 1885 and 1895 the mill changed hands three times before finally falling under the control of Homer and Isenberg who incorporated the mill in 1895 (Goodwin and Leineweber 1997). Homer and Isenberg's agent was H. Hackfield Co. which later became Amfac, Inc.

In 1900, when the Pioneer Mill Company was reorganized, the plantation controlled a total of 12,500 acres. Although the land was believed to be "...the rockiest of the irrigated plantations in Hawaii..." the Pioneer Mill Company developed an extensive and powerful irrigation and water collection system, consisting of tunnels, ditches, and flumes that extended into the valleys of the West Maui Mountains, including Launiupoko (Graves *et al.* 1998). The terrains rockiness required that the land be cultivated by hand (Gilmore 1936). The cleared rocks were used to construct walls that formed banks of the cane row and the areas between the walls were softened and planted. The soil beneath the rocks was very fertile and produced good yields. However, by 1930, the fields at Launiupoko were no longer used for sugarcane cultivation due to labor shortages and the difficulty associated with working such rocky fields (Graves *et al.* 1998). Thereafter, the fields were used for cattle grazing by the Pioneer Mill Company. A 1939 Pioneer Mill Company map of Launiupoko (Figure 4) shows the old field designations, as well as, the ditches and reservoirs, including Lahaina Pump Ditch No. 1 which traverses the project area.

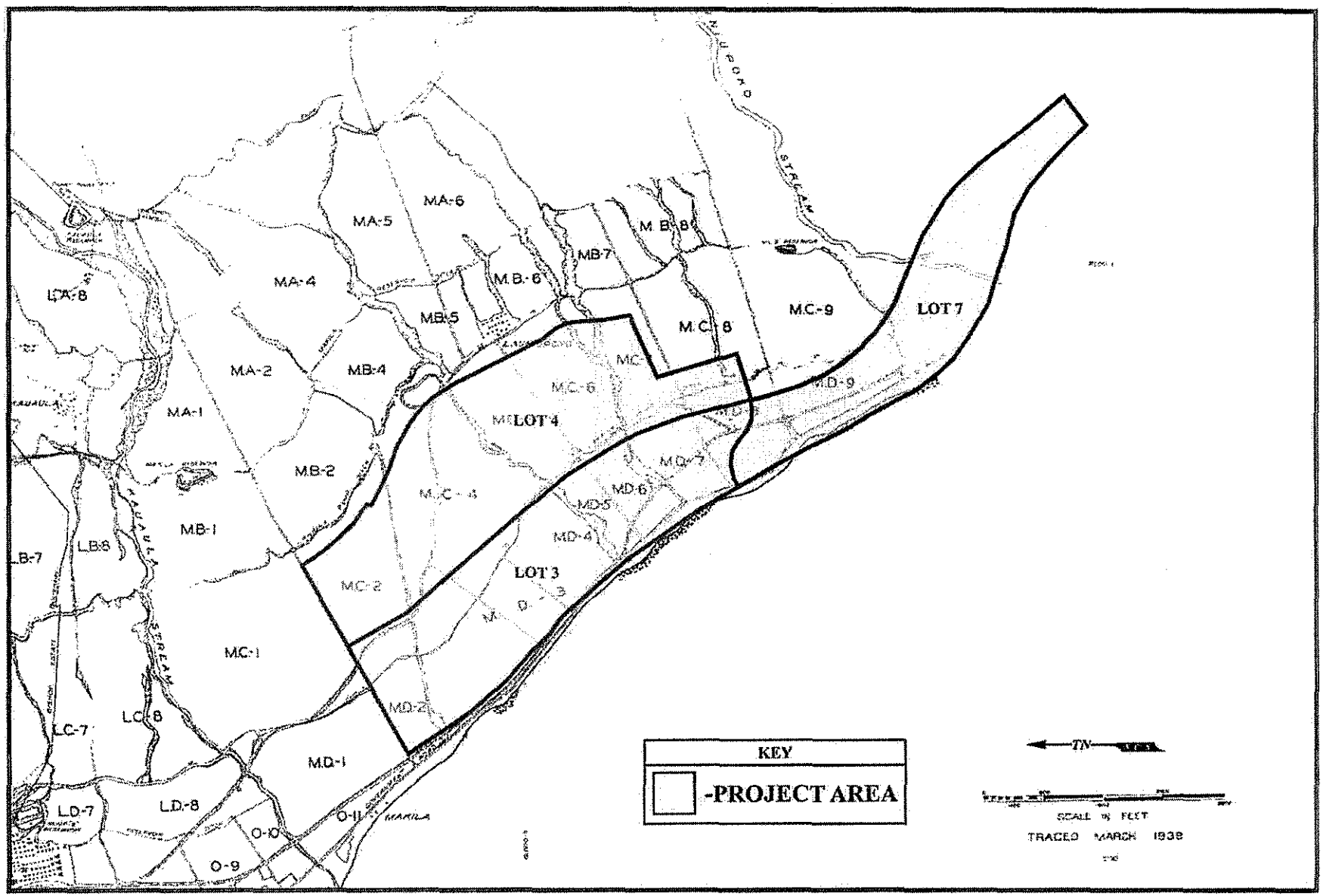

Figure 4: 1939 Pioneer Mill Company Map Showing Agricultural Fields and Irrigation Ditches.

Ranching activities which began in the 1930s continued until the mid-1970s. In a telephone interview, Herbert Kinores, former Pioneer Mill Company ranch foreman, tells Donna Graves (Graves *et al.* 1998) that a number of structures and features associated with ranching were constructed during this time. Walls and fences were built to enclose pastures. Small wooden corrals were built and used to capture free-roaming cattle. The cattle was then either herded or brought by truck to larger stone corrals. Cattle operations were halted in the mid-1970s due to an extended drought and falling market prices.

PREVIOUS ARCHAEOLOGY CONDUCTED IN THE LAUNIUPOKO AREA

A number of projects have been undertaken in the vicinity, however, only one has taken place within the project area. In 1991, as part of the Honoapi`ilani Highway Realignment Project, Paul H. Rosendahl, Ph.D., Inc. (PHRI) (Jensen 1991), surveyed a 7 mile long corridor part of which went through the current project area. No archaeological sites were recorded within the portion of the corridor that transected the project area.

Several projects have taken place in areas adjacent to the project area (Figure 5). In 1988, Chiniago, Inc. (Barrera 1988) conducted a reconnaissance survey of three alternate routes for Honoapi`ilani Highway. The routes extended from Honokowai to Lahaina. The southern portion of the surveyed corridors entered Polanui Ahupua`a and PHRI's 2000 project area (PHRI 2000). The corridors passed through a number of historic sites, including the Lahaina Historic District. An agricultural complex and a possible habitation terrace were also recorded, however, none of the sites fell within the bounds of the current project area.

In 1991, the Department of Land and Natural Resources State Historic Preservation Division (Donham 1991) surveyed a 1600 ft section of coastal zone between the shoreline and Honoapi`ilani Highway located immediately west of the current project area. No archaeological sites or features were observed.

In 1998, PHRI (Graves *et al.* 1998) conducted an inventory survey on 430 acres located *mauka* of the current project area within Launiupoko Ahupua`a. They recorded 47 sites consisting of 67+ component features. Sites associated with both permanent and temporary habitation were terraces, rock alignments, walls, enclosures, an L-shape, a C-shape, rockshelters, and a paved area. Sites associated with agricultural activities were terraces, clearing piles, agricultural plots, modified rock piles, canals, retaining walls, and a flume. Sites associated with

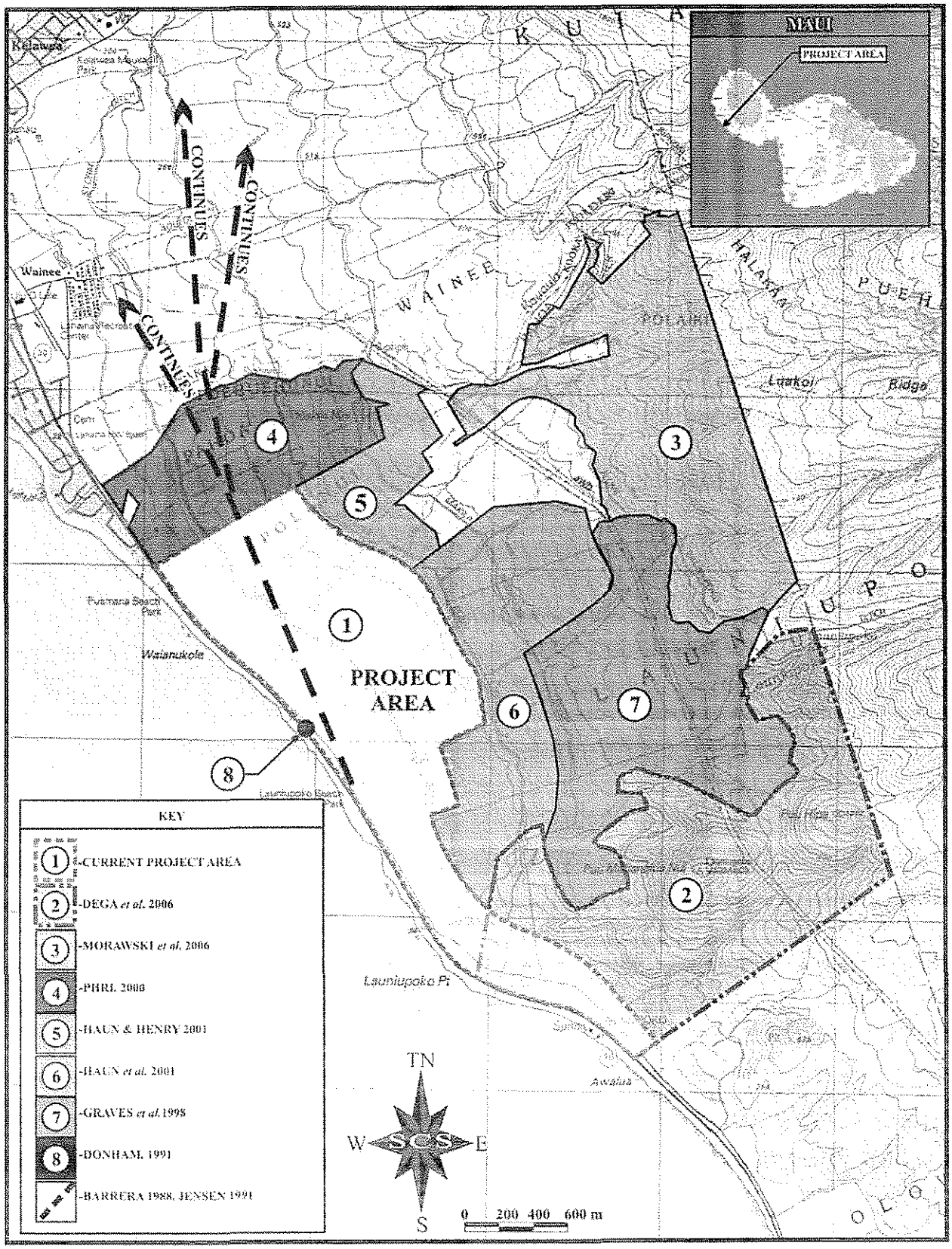

Figure 5: Previous Archaeological Work in the Vicinity of the Project Area.

animal husbandry were corrals and walls/fencelines. Additional sites recorded were cairns, uprights, one petroglyph panel, and a road.

In 2000, PHRI (2000) conducted an inventory survey on 230 acres located just north of the current project area in Polanui Ahupua`a. The entire parcel, except for three small areas, had been used for sugarcane cultivation. The area surveyed was 15 to 440 ft amsl, gently to moderately sloped, and rocky, very similar to the current project area. PHRI identified three sites (note that all site numbers are official Hawai`i state site number and are preceded by 50-50-03-): 1) two irrigated terraces (Site 4789) identified as *lo`i* situated adjacent to Kaua`ula Stream that are late prehistoric to pre-1900s in age; 2) nine historical features associated with the sugar mill operation scattered throughout the project area are collectively identified as Site 4787; and 3) a wall segment (Site 4795) along Kaua`ula Stream that probably formed part of a garden enclosure dating to the late prehistoric or early historic era. A total of 15 trenches were mechanically excavated but no cultural material was recorded.

In 2001, Haun and Associates (Haun and Henry 2001) conducted an inventory survey on 124 acres located northeast of the current project area in Launiupoko and Polanui Ahupua`a. They identified four sites consisting of six component features. One of the sites (Site 4787) was previously recorded by PHRI (2000). The remaining three sites are: 1) two linear rock piles (Site 5187); 2) a series of low terraces associated with a concrete and mortared stone ditch (Site 5188); and 3) a terrace interpreted as a *lo`i* based on appearance and proximity to Kaua`ula Stream. A test unit was excavated in the level soil surface of the terrace; no cultural material was observed.

In 2001, Haun and Associates (Haun *et al.* 2001) conducted an inventory survey on 300 acres located directly east and *mauka* of the current project area within Launiupoko Ahupua`a. They identified six sites consisting of seven component features. Two of the sites had been previously recorded by PHRI, a cattle wall (Site 2665) documented in Graves *et al.* (1998) and irrigation ditches associated with Site 4787 documented in PHRI (2000). Of the remaining four sites, two are cattle walls (Sites 5049 and 5050) from the ranching era, one is a historic roadbed (Site 5051) used to transport sugar, and the last consists of linear rock mounds or terraces (Site 5052) found along an unnamed drainage. The mounds/terraces are similar to those documented by PHRI (in Graves *et al.* 1998 and PHRI 2000) who report that these features are the result of manual sugarcane cultivation from the early 1900s, occurring in areas were mechanized cultivation was not possible.

SCS (Dega *et al.* 2006) conducted an inventory survey on 570.3 acres in Launiupoko Ahupua`a situated south and southeast of the current project area. They identified 50 sites comprised of 146+ features. Of these sites, four sites had been previously recorded by PHRI (Graves *et al.* 1998). These sites include Site 2665, Site 2674, Site 2675, and Site 2682, the latter in which two new features were documented. The sites identified generally relate to traditional pre-Contact Hawaiian settlement, sugarcane cultivation during the plantation era, and ranching. The traditional Hawaiian sites recorded are related to permanent and temporary habitation, ceremonial functions, work areas, tool manufacturing, and agriculture. Traditional pre-Contact site types identified on the parcel include: permanent habitation platforms, enclosures, paving, cupboards, and terraces; temporary habitation rockshelters and rock overhangs; a petroglyph panel; a burial; and agricultural features, including terrace complexes, modified outcrops, alignments, C-shaped enclosures, mounds, walls, and planting depressions within modified boulder fields. Sites associated with the plantation era include walls, terrace complexes with terrace alignments, pavings, borrow pits, a quarry pit, a water control gate, an incised boulder, and a road cut. Sites associated with the ranching era include walls, fences, a platform, a modified outcrop, feeding trough, metal water station for livestock, a corral, a dike, and an overhang. Sites of indeterminate age but likely related to the plantation era include terraces, retaining walls, alignments, mounds, a ditch, two markers, and a wall.

SCS (Morawski *et al.* 2006) conducted an inventory survey on 520 acres located northeast of the current project area within Launiupoko Ahupua`a. A total of thirty-five sites were identified, three of which were previously recorded by Cultural Surveys Hawai`i in Robins *et al.* (1994). The previously recorded sites are: 1) a boulder wall (Site 3173) interpreted as an irrigation ditch associated with the sugarcane plantation era; 2) a prehistoric agricultural complex (Site 3175) composed of mounds, retaining walls, and enclosures, including one C-shaped enclosure; and 3) a wall segment (Site 3176). The 32 newly recorded sites (Sites 5880 to 5911) span the pre-Contact through plantation eras. Traditional wetland taro cultivation features were recorded. Several large agricultural complexes, both traditional and post-Contact in nature, consisting of terraces, enclosures, and modified outcrops were identified within the project area.

PROJECT AREA EXPECTATIONS

A review of archival resources and the results of previous archaeological work conducted in the area was undertaken to assess the types of sites expected to be encountered during fieldwork. While Launiupoko may not have supported a sizable population during the pre-Contact period, archaeological work to the north, south, and east of the project area provides evidence of dryland and wetland agriculture and permanent and temporary habitation in the area.

These findings indicate occupation of the area began by the 11th century and continued through the plantation era. The coastal area of Launiupoko may have supported permanent habitation, ceremonial activities, fishing and other ocean activities, and work areas for tool manufacturing. However, the area has been heavily impacted by 70 years of sugarcane cultivation and subsequent cattle ranching activities. Therefore, it is highly probable that pre-Contact sites in the area are heavily disturbed and much of the remaining archaeological sites are associated with sugarcane cultivation or cattle ranching.

METHODOLOGY

FIELD METHODOLOGY

Multiple field tasks were completed during this Archaeological Inventory Survey, including pedestrian survey, site mapping and recording, and testing. Written and photographic documentation occurred during each phase of research. First, a full systematic pedestrian survey of the entire project area was conducted in order to identify any archaeological structures or surface scatters and to assess geographical and topographical features. When structures, artifacts, or unusual topographic changes were identified, they were plotted on an overall site map and flagged. Surface artifact assemblages, surface features, or anomalies were assigned temporary site numbers. Temporary site numbers were converted to State Site Numbers upon review by SHPD following completion of fieldwork.

After surveying was completed, the crew returned to each flagged location to map and record each site/feature and to assess excavation locations within sites. Limited hand-testing was conducted for sites that had the potential to be associated with the pre-Contact or early historic periods. Each unit was thoroughly documented and its location plotted on a project area map. Stratigraphic profiles were drawn and photographed. Artifacts were collected and catalogued on-site and shipped to the SCS laboratory for analysis. Charcoal samples were taken from individual features. Additionally, 10 trenches were mechanically excavated with a backhoe. Soil samples were taken from two of the backhoe trenches.

LABORATORY METHODOLOGY

All field notes, maps, photographs, and collected archaeological materials from this project are housed at the SCS laboratory in Honolulu. All artifacts and midden samples were sorted, weighed, identified, and catalogued on standard laboratory forms, then entered into a table produced in Microsoft Excel (Appendix A). Marine shell was identified to genus and to species when possible. The lithics were analyzed by Dr. Robert L. Spear of SCS. Dr. John Sinton from the Department of Geology and Geophysics at The University of Hawai'i at Mānoa

identified sampled material as slag from the mill. Site location maps, plan view sketches, and stratigraphic profiles were digitally drafted at the SCS laboratory.

ARCHAEOLOGICAL INVENTORY SURVEY RESULTS

A total of ten sites, two of which were previously recorded, were identified during Inventory Survey (Figure 6)(Table 1). Several of the sites contain multiple component features.

Table 1: Sites Identified During Project 652 Inventory Survey in the Launiupoko Large Lot Subdivision No. 2 Lots 3, 4, 7 [TMK (2)4-7-01:2 por.]

State # 50-50-03-	Temp. #	# of Features	Form (include shape)	Function
5950	T-1	16	Rock mounds (linear)	Agricultural (associated with sugarcane cultivation)
5951	T-2	1	Irrigation ditch, water pipes, reservoir (irregular)	Agricultural (associated with sugarcane cultivation)
5952	T-3	1	Terraces (irregular)	Agricultural (associated with sugarcane cultivation)
5953	T-4	1	Slag scatter (50 by 35 m)	Work area
5954	T-5	1	Rock wall (linear)	Ranching
5955	T-6	1	Modified rock deposit (irregular)	Indeterminate/Activity Area
5956	T-7	1	Midden and lithic scatter (173 by 141 m)	Activity Area
5957	T-8	1	Terrace (rectangular)	Agricultural (associated with sugarcane cultivation)
2665	T-9	1	2 rock wall segments (linear)	Ranching
4787 Feature D	T-10	1	Lahaina Pump Ditch No. 1	Agricultural (associated with sugarcane cultivation)

SITE DESCRIPTIONS

STATE SITE NUMBER 50-50-03-2665

FORM: Two (2) rock wall segments
FUNCTION: Ranching
AGE: Historic
DIMENSIONS: 1.2 m wide by 1.4 m high
CONDITION: Poor
SURFACE ARTIFACTS: None
EXCAVATION: None

DESCRIPTION: This wall runs along the north and south edges of Launiupoko Gulch. *Mauka* portions of this wall were previously documented by Graves *et al.* (1998) and Haun *et al.* (2001). Graves *et al.* (1998) describe it was a long core-filled wall with a barbed wire fence strung across

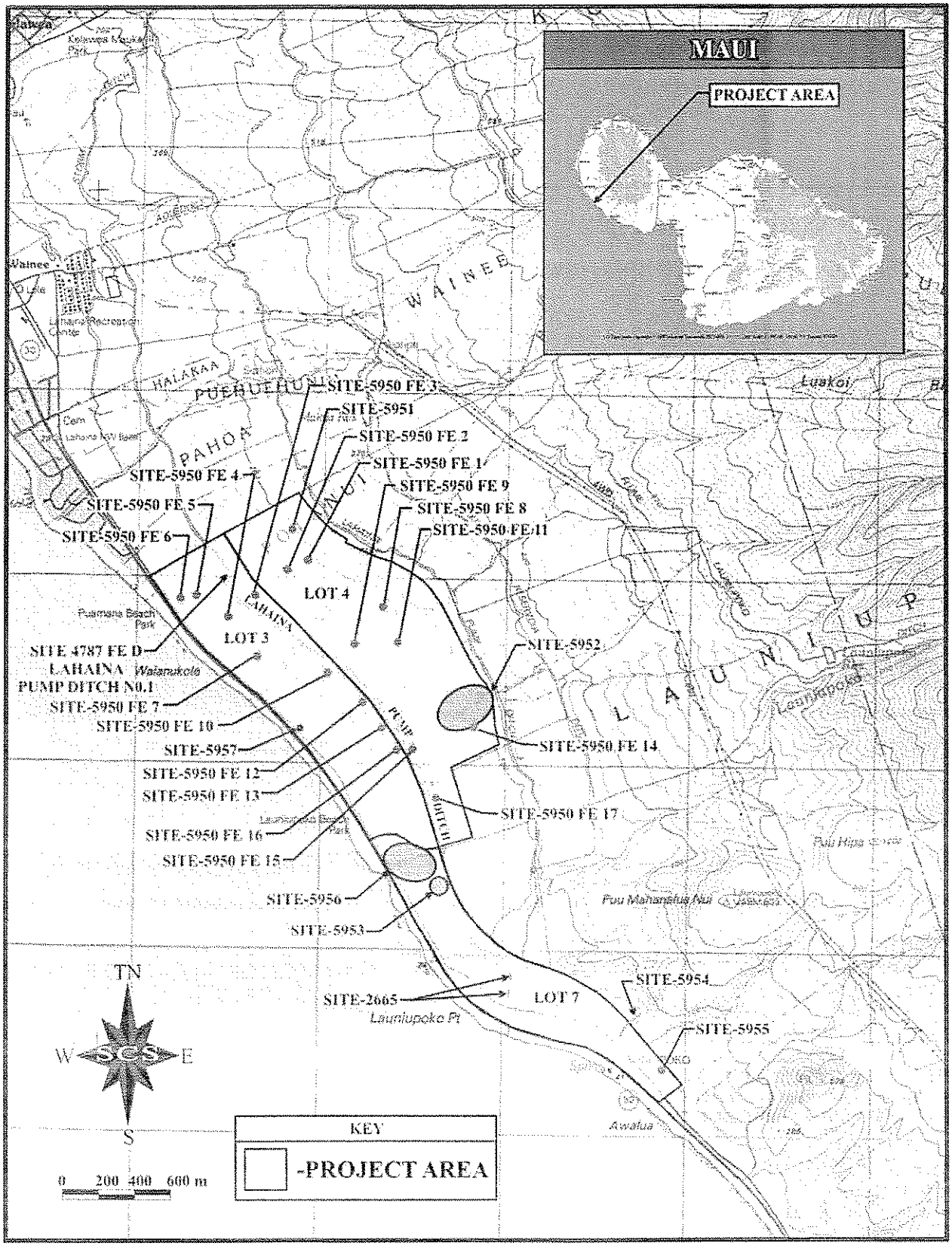

Figure 6: USGS Lahaina Quadrangle Map Showing Site Locations.

the top. It was constructed during the ranching era to keep cattle out of the gulch. The portion of the wall documented during this project consists of two rock wall segments that run along the north and south edges of lower Launiupoko Gulch. The walls are situated on the steep slopes of the gulch in areas of dense vegetation consisting of grass, *kiawe*, and lantana. The walls are largely obscured by vegetation. Not much of the walls remain and what is present is in poor condition. The wall along the south edge of the gulch extends only a very short distance. The wall along the north edge is very disturbed. It is a cobble faced, core-filled wall approximately 1.2 m wide and 1.4 m tall at its highest (Figure 7). The wall is bisected by Lahaina Pump Ditch No. 1 (Site 4787 Feature D) that spans the entire project area and is described below. Recent bulldozing has destroyed the wall 10.0 m east of the ditch.

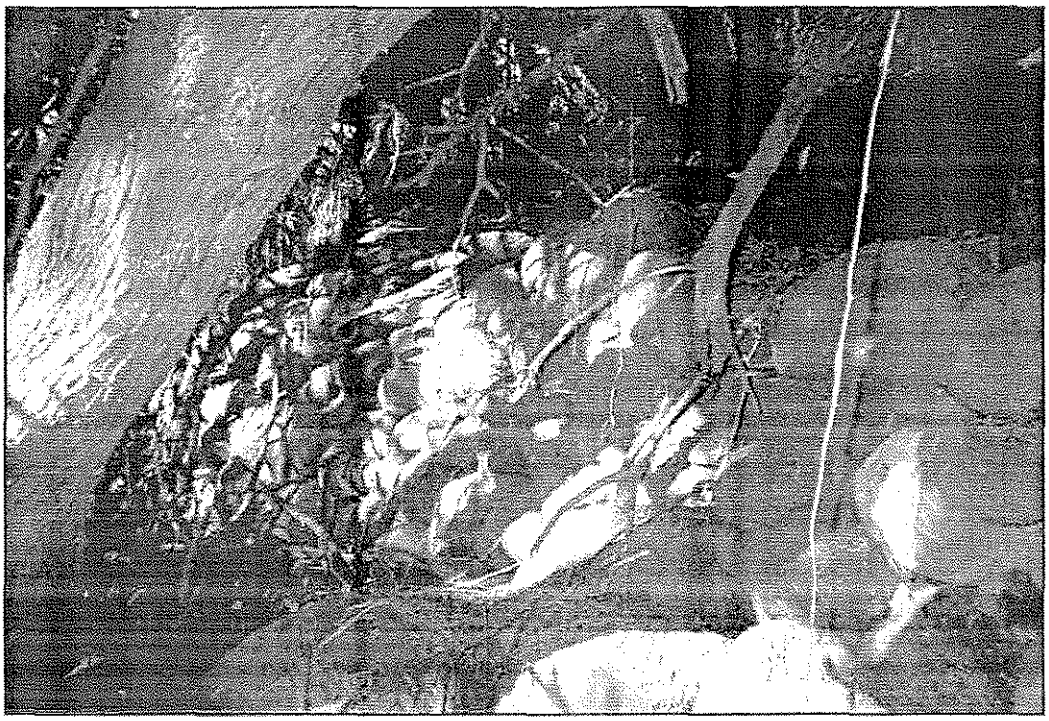

Figure 7: Photo of Site 50-50-03-2665 Rock Wall on North Side of Launiupoko Gulch.

STATE SITE NUMBER 50-50-03-4787 Feature D

FORM:	Irrigation Ditch
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	88.0 cm wide by 60.0 cm deep
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	None

DESCRIPTION: This concrete ditch is identified as the *makai* most Lahaina Pump Ditch on the USGS map (see Figure 1) and as Lahaina Pump Ditch No. 1 on the 1939 Pioneer Mill Company map (see Figure 4). It is also known as the Mill Ditch or the Lahaina Mill Ditch (PHRI 2000). This ditch was one of nine features previously recorded by PHRI (2000). It extends the entire length of the project area through grass covered terrain and crosses over Launiupoko Gulch as a large metal pipe (Figure 8). Portions of the ditch are lined by stone walls but for the most part the ditch is retained by earthen berms. Pipes extending perpendicular from the ditch served as irrigation lines to the sugarcane fields. These pipes contain numerous small trapdoors (Figure 9), which would have controlled the amount of water released into the fields.

STATE SITE NUMBER 50-50-03-5950

FORM:	Seventeen (17) rock mounds
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	Varied
CONDITION:	Fair to good
SURFACE ARTIFACTS:	Metal cables; historic trash
EXCAVATION:	None

DESCRIPTION: This site consists of 17 rock mounds (Features 1 through 17) associated with sugarcane cultivation. Surface sediments are a silty clay. Visibility around the mounds is limited by a moderate amount of grass. Small *koa haole* trees are also present. The mounds are found throughout Lots 3 and 4 of the project area. They are constructed of very large boulders (greater than 3 tons) and are flat on top. They vary in length from 55.0 m to 100.0 m and in width from 22.0 to 68.0 m. Their long axes follow the gently sloped topography *mauka* to *makai*. They are situated end to end with the *mauka* side graded to ground surface and the *makai* side forming a terrace 15.0 to 20.0 m high (Figure 10). The series of mounds extend downslope east to west to the old railroad in a stair step fashion throughout Lots 3 and 4. The mounds are thought to have been used to transport sugarcane to the rail system below.

Feature 1 is 100.0 m long by 30.0 m wide and has an exterior height of 15.0 to 20.0 m. The top of the mound is composed mainly of cobbles and compact, dried silty clay fill. It is in good condition, however, portions of the south side may have been altered by bulldozers during construction of the road located to the south. A piece of twisted ferrous cable was observed on top of the mound, supporting the idea that the mounds formed some kind of transportation system.

Figure 8: Photo of Site 50-50-03-4787 Feature D Showing Lahaina Pump Ditch No. 1 Crossing Launiupoko Gulch.

Figure 9: Photo of Site 50-50-03-4787 Feature D Showing One of Many Trapdoors in Lahaina Pump Ditch No. 1.

Figure 10: Overview Photo of Site 50-50-03-5950 Feature 2 Rock Mound. Feature 1 is in the Background.

Feature 2 is 70.0 m long by 32.0 m wide. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition but may have been affected bulldozer activity.

Feature 3 is 58.0 m long by 47.0 m wide with an exterior height of 10.0 to 15.0 m on the *makai* end (Figure 11). The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. This mound is in good condition but may have been affected by bulldozer activity as well.

Feature 4 is 81.0 m long by 26.0 m wide with an exterior height of 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. This mound is in good physical condition and has not been altered by bulldozer activity. Historic trash was observed in association with this mound.

Feature 5 is 65.0 m long by 37.0 m wide with an exterior height of 15.0 to 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good physical condition and has not been altered by bulldozer activity. Historic trash was observed in association with this mound.

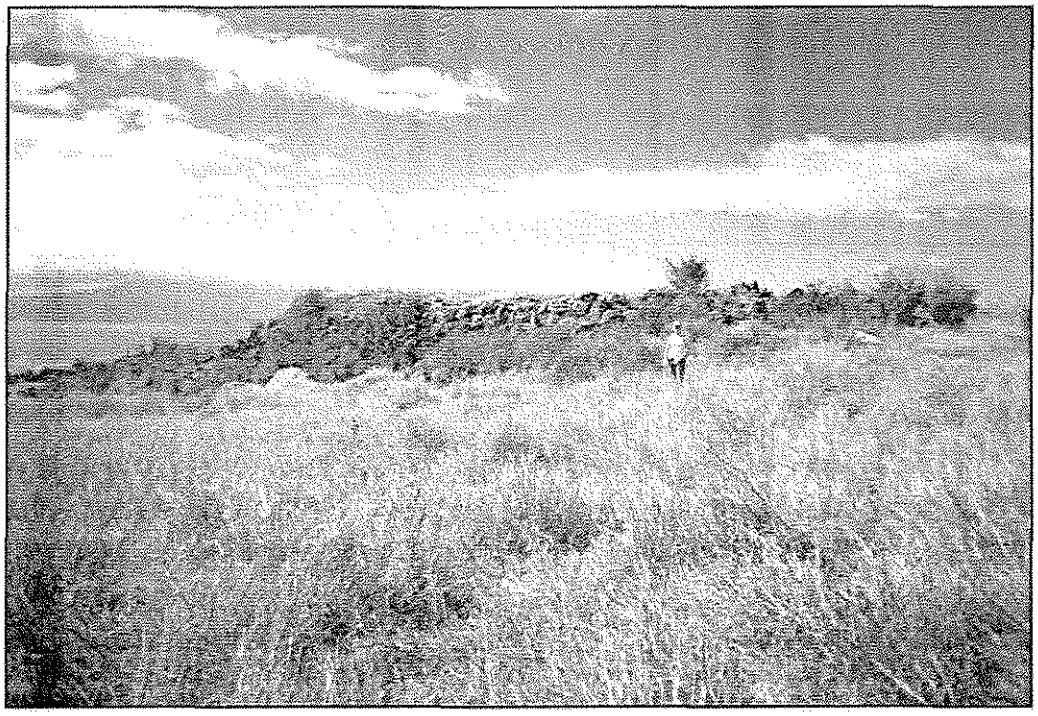

Figure 11: Photo of the South Side of Site 50-50-03-5950 Feature 3 Rock Mound. View is to the Northwest.

Feature 6 is 82.0 m long by 28.0 m wide with an exterior height of 10.0 to 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good physical condition and has not been altered by bulldozer activity. A metal cable was observed in association with this mound.

Feature 7 is 110.0 m long by 24.0 m wide with an exterior height of 15.0 to 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good physical condition and has not been altered by bulldozer activity.

Feature 8 is 78.0 m long by 25.0 m wide with an exterior height of 30.0 m. The top of this mound unlike the previous mounds contains numerous boulders. The boulders are most likely the result of bulldozer activity. A metal cable was observed on the south side of the mound.

Feature 9 is 68.0 m long by 68.0 m wide with an exterior height of 15.0 to 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. The *makai* side of the mound has been altered. A ring of large boulders is present around the *makai* edge of the mound forming a stepped area leading up to the mound. This step may be more recent in origin than the mound.

Feature 10 is 78.0 m long by 31.0 m wide with an exterior height of 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. Piles of old sugarcane are present along the southern edge of the mound.

Feature 11 is 91.0 m long by 23.0 m wide with an exterior height ranging from 15.0 to 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. No cultural material was observed.

Feature 12 is 55.0 m long by 33.0 m wide with an exterior height of 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. No cultural material was observed.

Feature 13 is 75.0 m long by 30.0 m wide with an exterior height of 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. No cultural material was observed.

Feature 14 is 87.0 m long by 32.0 m wide with an exterior height of 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. A metal cable was observed in association with the mound. The feature has been altered by bulldozer piles of old asphalt and gravel debris but the mound is in fair condition.

Feature 15 is 59.0 m long by 34.0 m wide with an exterior height of 10.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. No cultural material was observed. An unnamed gully is present northwest of the mound.

Feature 16 is 93.0 m long by 22.0 m wide with an exterior height of 15.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition. There is evidence for bulldozer activity at the *mauka* end of the mound. No cultural material was observed.

Feature 17 is 76.0 m long by 25.0 m wide with an exterior height of 20.0 m. The top of the mound consists of 80 percent cobbles and gravel with a silty clay fill. The mound is in good condition but has been altered by bulldozer activity.

STATE SITE NUMBER 50-50-03-5951

FORM:	Irrigation ditch, pipes, reservoir, and flume
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	6.0 m by 2.5 m (includes only reservoir and flume area)
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	None

DESCRIPTION: The irrigation ditch, pipes, reservoir, and flume form part of the extensive irrigation system constructed by Pioneer Mill Company used for sugarcane cultivation. It is located on terrain that slopes gently to the west. The ground surface is a silty clay sediment. The rather dense vegetation coverage consists of grasses, shrubs, and trees, including *koa haole*, young java plum, and *`opiuma*. This portion of the irrigation system (Figure 12) consists of an underground water pipe that extends northwestward from a main irrigation pipe located 45.0 m to the south. The north end of the pipe terminates at a small concrete reservoir constructed of stones, concrete, and cinder blocks.

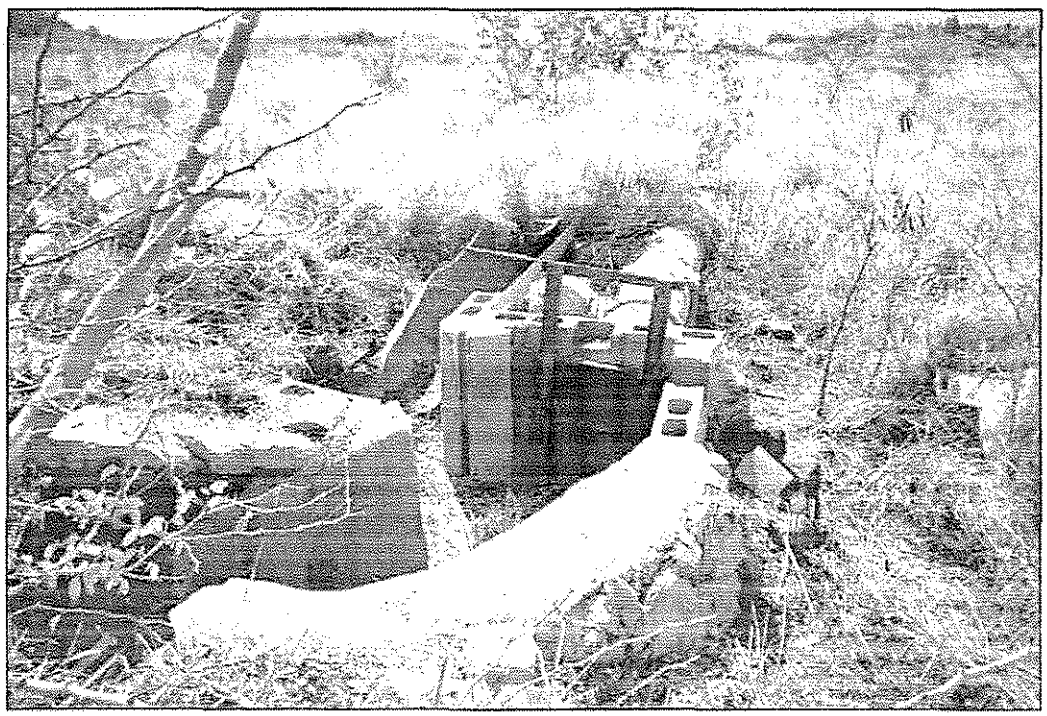

Figure 12: Overview Photo of Site 50-50-03-5951 Irrigation Ditch. View is to the Southwest.

A wooden trap door at the *makai* end of the reservoir opens to an irrigation pipe that at one time distributed water to the fields below. This pipe extends all the way down to the western boundary of the project area and eventually leads to a large concrete ditch below. Also

extending from the *makai* side of the reservoir is a 3.0 m long aluminum flume that runs along the south side of the pipe. Overflow from the reservoir was probably diverted into the flume. Grooves on the concrete between the reservoir and the flume suggest a trapdoor was present at one time. Broken gourds are present in the ditch between the reservoir and the main pipe, however, they do not appear to be of great antiquity.

STATE SITE NUMBER 50-50-03-5952

FORM:	Terraces (15+)
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	248.0 m by 74.0 m
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	Stratigraphic Trenches (ST) 1 through 7; Test Units 1 and 2

DESCRIPTION: This site is located *mauka* of Site 5950 Feature 14 on a low gently sloping ridge between two unnamed gullies. The area is vegetated with dense grass and individual *kiawe* and *koa haole* trees. The site is a complex of terraces (Figure 13) associated with sugarcane cultivation. The complex is 248.0 m long from east to west and 74.0 m at its widest point. The terraces, oriented perpendicular to the slope, are constructed of small to medium sized basalt boulders mixed with dirt to form berms. Terraces range in height from 15 to 70 cm tall and are spaced approximately 1.0 m apart. Ditches running parallel to the slope, spaced 4.0 to 8.0 m apart, would have served to irrigate the terraces. The larger ditches (55 to 90 cm deep) have concrete water diversions. These terraces are very similar to those reported in Graves *et al.* (1998), PHRI (2000), and Haun *et al.* (2001) who identified them as the remains of manually constructed terraces from the early 1900s that are found in areas not used for mechanized sugarcane cultivation. A complex of such terraces, located *mauka* of this site, is designated Site 2639 (Graves *et al.* 1998).

EXCAVATION: A total of seven stratigraphic trenches (see Figure 13) and two test units were excavated. Five of the stratigraphic trenches (ST-1 through ST-5) were excavated by hand, the remaining two (ST-6 and ST-7) were mechanically excavated with a backhoe. Stratigraphic trenches were excavated perpendicular to the terraces in order to examine their construction.

Stratigraphic Trench 1, measuring 1.0 m by 3.3 m, cross cuts two terraces and is located just south of one of the earthen water channels. Two stratigraphic layers were encountered (Figure 14). Layer I (0–24 cmbs) is a dark brown (7.5 YR 3/3) fine silt containing 20 percent pebbles. Grass roots are common in this layer. In profile this layer dips down lower in the center due to

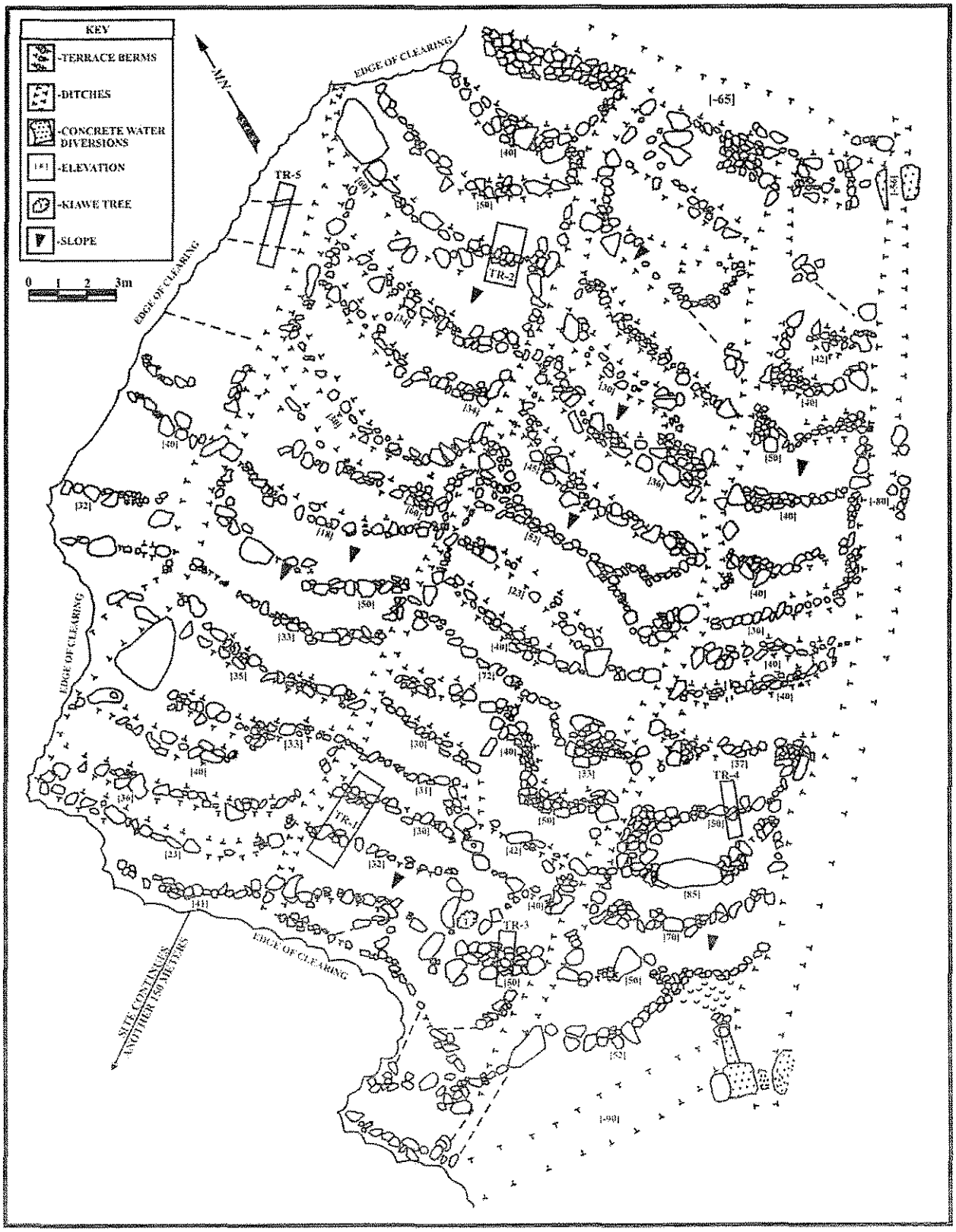

Figure 13: Map of a Portion of Site 50-50-03-5952 Showing the Locations of Stratigraphic Trenches 1 Through 5.

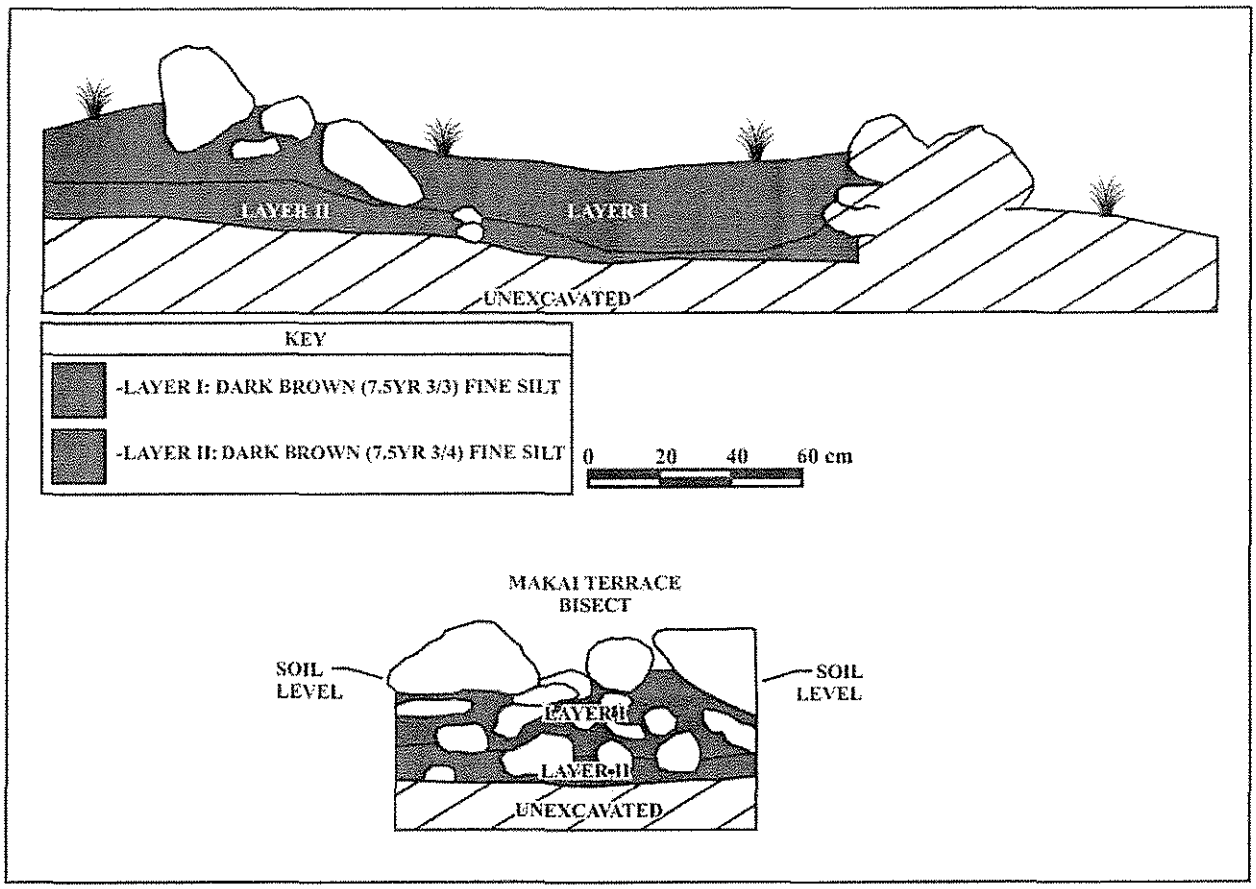

Figure 14: Site 50-50-03-5952 Stratigraphic Trench 1 South Profile.

running water in the channels. A modern nail, four small pieces of coral, and a very small charcoal sample were recovered from this layer. Layer II (24–30 cmbs) is a dark brown (7.5 YR 3/3) fine silt containing 35 percent pebbles and cobbles, and few roots. No cultural material was observed in Layer II.

Stratigraphic Trench 2, measuring 2.0 m by 1.0 m, cross cuts one rock terrace. Material collected from the surface includes slag and cement fragments. Layer I (0–10 cmbs) is a very dark brown (7.5 YR 2.5/3) humic layer containing dense grass roots. Layer II (10–25 cmbs) is a dark brown (7.5 YR 3/3) silty loam that is very rocky. No additional cultural material was observed in this trench.

Stratigraphic Trench 3, measuring 2.0 m by 0.5 m, cross cuts a terrace located next to a water channel. This terrace is wider and is constructed of larger rocks than other terraces in the area. Rocks vary in size from 20 to 60 cm in diameter and are stacked 1 to 3 courses high. Layer I (0–16 cmbs) is a very dark brown (7.5 YR 2.5/2) fine silty loam containing few roots. A charcoal

sample (4 cmbs) was recovered from this layer. Layer II (16–18 cmbs) is a dark brown (7.5 YR 3.3) gravelly silty loam containing roots.

Stratigraphic Trench 4, measuring 2.0 m by 0.5m, cross cuts one rock terrace. Both sides of the terrace were excavated, however, the rock of the terrace was left in place. Layer I (0–18 cmbs) is a dark brown (7.5 YR 3/3) very fine silt containing 10 percent rocks and a fair amount of roots. Layer II (18–24 cmbs) is a dark brown (7.5 YR 3/4) fine silt containing 35 percent rocks and few roots. No cultural material was recovered.

Stratigraphic Trench 5, measuring 3.0 m by 0.6 m, cross cuts two rock terraces. The trench is parallel to a small water channel located to the southeast. Layer I (0–28 cmbs) is a dark reddish brown (10 YR 2.5/3) sandy silt very high in organic material. Layer II is a lens of possibly burnt sediment appearing in patches throughout the trench at approximately 20 cmbs. Charcoal samples, as well as, a bulk soil sample were taken from the lens. Fragments of historic glass were recovered below the Layer II lens.

Stratigraphic Trench 6 was mechanically excavated with a backhoe. The trench, measuring 10.0 m long by 1.0 m wide, cross cuts four terraces. The terraces range from 27 to 65 cm high. A water channel is present to the southwest of the trench and a concrete and rock faced channel is located to the southeast of the trench. Layer I (0–20 cmbs) is a very dark greyish brown (10 YR 3/2) very fine silt containing 1 to 2 percent cobbles and 70 percent grass roots. The peds are friable and the layer boundary appears wavy. No cultural material was observed in Layer I. Layer II (20–35 cmbs) is a dark brown (7.5 YR 3/3) silty clay containing more than 5 percent rootlets. Peds are moderately hard and slightly blocky in structure. Saprolite gravel is present along the bottom boundary which is wavy in nature. No cultural material was observed in Layer II. Layer III (35–80 cmbs) is a dark brown (7.5 YR 3/4) to yellowish brown (10 YR 5/4) silty clay. Peds are very dry and hard to very hard but friable when pressed. Saprolite rocks are present in this layer. No cultural material was observed. Two columns of soil samples were taken from Stratigraphic Trench 6.

Stratigraphic Trench 7 was mechanically excavated with a backhoe. The trench, measuring 14.5 m long by 1.0 m wide, cross cuts a number of terraces ranging in height from 40 to 50 cm and a number of alignments ranging from 15 to 30 cm high. A bulldozer pile is present at the northeast corner of the trench and a water channel crosses the southern end of the trench in an east-west direction. Layer I (0–16 cmbs) is a dark reddish brown (5 YR 3/2) sandy silt that is high in organic material. Layer II (16–38 cmbs) is a dark reddish brown (5 YR 3/3) sandy silt

containing less organic material than the above layer. Layer III (38–53 cmbs) is a dark reddish brown (2.5 YR 3/4) sandy silt containing more than 10 percent gravel. Layer IV (53–76 cmbs) is a dark reddish brown (5 YR 3/3) sandy silt interspersed with rock. No cultural material was observed. Two columns of soil samples were taken from Stratigraphic Trench 7.

Two test units were excavated on a platform identified as Feature 1 (Figure 15 and 16). The platform is located to the northwest of the larger mapped area approximately 60.0 m away. The platform is irregular in shape and appears to have been altered by bulldozing activity. Cobbles on the eastern side of the platform display bulldozer scars. Facing is visible on the north and south sides of the platform. Two test units were placed next to one another on a level area atop the platform.

Test Unit 1 is 50 cm by 50 cm. Layer I (0–28 cmbs) is a dry, greyish brown very fine silt high in organic material. Charcoal and burnt *koa haole* seeds are present in this layer. Both materials were sampled. Layer II (28–42 cmbs) is a dry, reddish brown fine silt with 20 percent gravel and some fine roots. Rocks in this layer made it increasingly difficult to continue excavation.

Test Unit 2 is 50 cm by 50 cm. Layer I (0–26 cmbs) is a dry, greyish brown silt high in organic material. Slag fragments are abundant in this layer. Charcoal and burnt *koa haole* seeds are also present. Layer II (not visible in the north profile) is a dry, reddish brown fine silt with 20 percent gravel and some fine roots. Rocks in this layer made it increasingly difficult to continue excavation. No cultural material was observed in this layer.

STATE SITE NUMBER 50-50-03-5953

FORM:	Slag scatter
FUNCTION:	Work area
AGE:	Historic
DIMENSIONS:	50.0 m by 35.0 m
CONDITION:	Good
SURFACE ARTIFACTS:	Worked slag
EXCAVATION:	Stratigraphic Trenches 1 and 2

DESCRIPTION: This site is a scatter of slag flakes and cores measuring 50.0 m long by 35.0 m wide. It is located in the northeastern portion of Lot 7. The ground surface is very gently sloping and the vegetation coverage consists of burnt grass and *koa haole*. The eastern edge of the site is within an old cane road and the western portion of the site contains earthen berms associated with sugarcane cultivation. The berms range in height from a few centimeters to 20

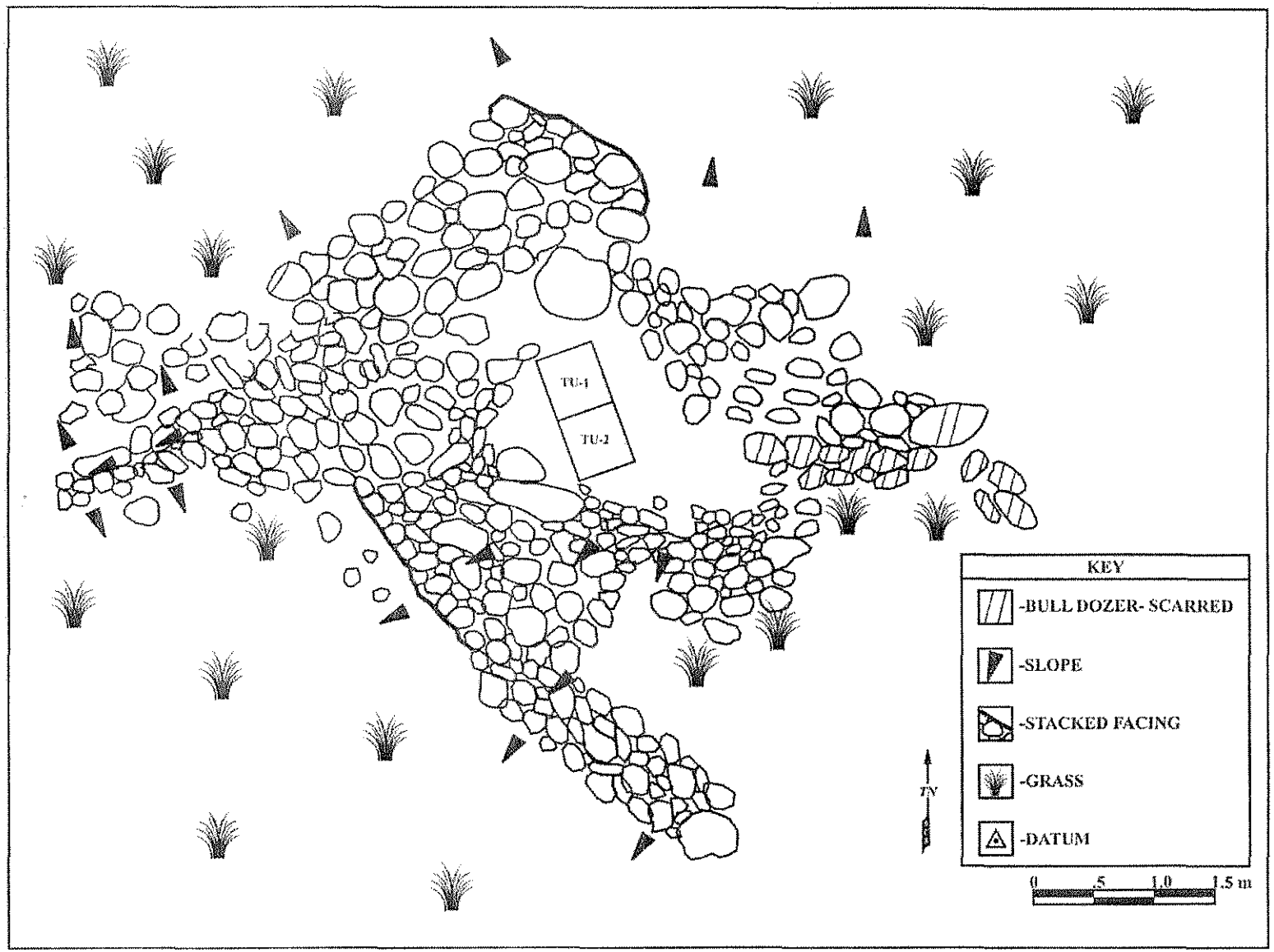

Figure 15: Plan View of Site 50-50-03-5952 Feature 1 Platform.

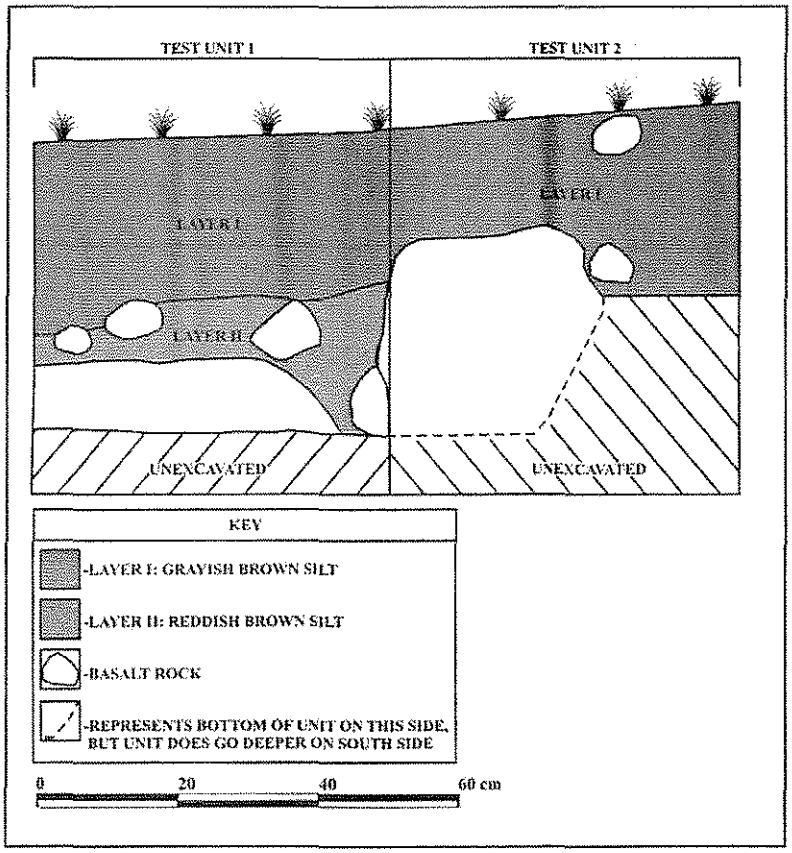

Figure 16: Site 50-50-03-5952 Feature 1 Test Unit 1 (left) and Test Unit 2 (right) North Profile.

centimeters high (Figure 17). The densest concentration of slag is found within the road (Figure 18). Larger pieces of slag are scattered in the area of the berms.

During the Inventory Survey the slag was thought to be volcanic glass. Twenty-one bags of samples were collected off the surface for further analysis. Representative samples were examined by Dr. John Sinton, Professor in the Department of Geology and Geophysics at The University of Hawai`i at Mānoa. Dr. Sinton identified the material as slag, a mill by-product. Like lava, slag is formed from melted rock. During the process of sugar production, rock and dirt is inadvertently melted at very high temperatures producing slag which can have a smooth glassy appearance very similar to volcanic glass (J. Sinton, pers. comm.). In fact, slag is often referred to as human-made "lava" rock. Originating from the same parent material and under similar conditions of extremely high heat, slag has similar flaking properties to volcanic glass. Its usefulness did not go unrecognized. The slag was produced at the Lahaina mill then transported to the site where it appeared to have been utilized. Additional research directly related to the slag is undergoing and will be published in several months in an academic paper.

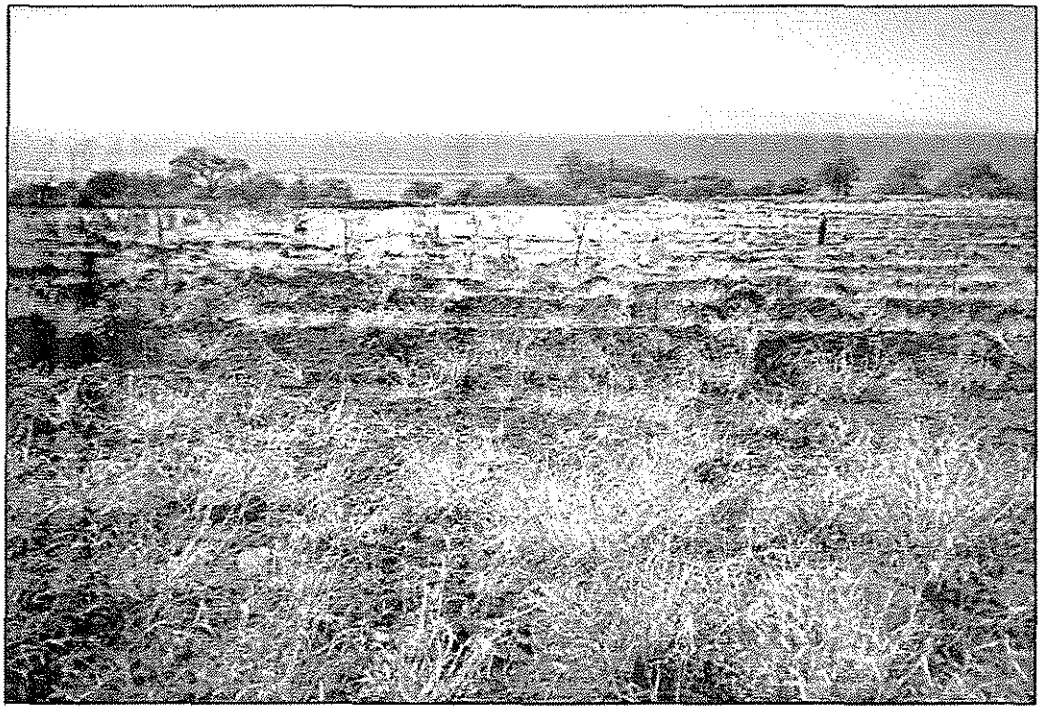

Figure 17: Overview of Site 50-50-03-5953 Slag Scatter. View is to the West.

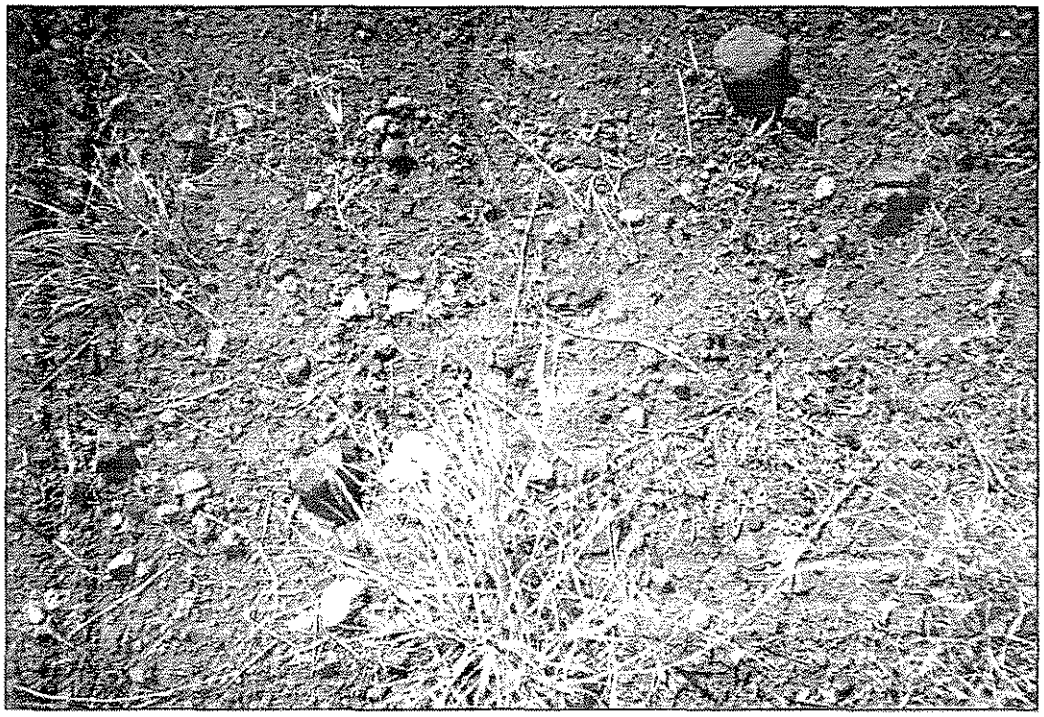

Figure 18: Site 50-50-03-5953 Slag Scatter in the Road.

EXCAVATION: Two stratigraphic trenches were mechanically excavated with a backhoe. Stratigraphic Trench 1 is 21.0 m long by 1.0 m wide. A 5.0 m representative profile was drawn of the trench (Figure 19). Layer I (0–20 cmbs) is a dark brown (7.5 YR 3/4) fine silt containing 5 percent rocks and organic material. Layer II (20–46 cmbs) is a dark brown (7.5 YR 3/3) fine silt containing 5 percent rocks and few roots. Layer III (46–60 cmbs) is a dark reddish brown (5 YR 3/3) silt containing 10 percent rocks. No cultural material was recovered during excavation.

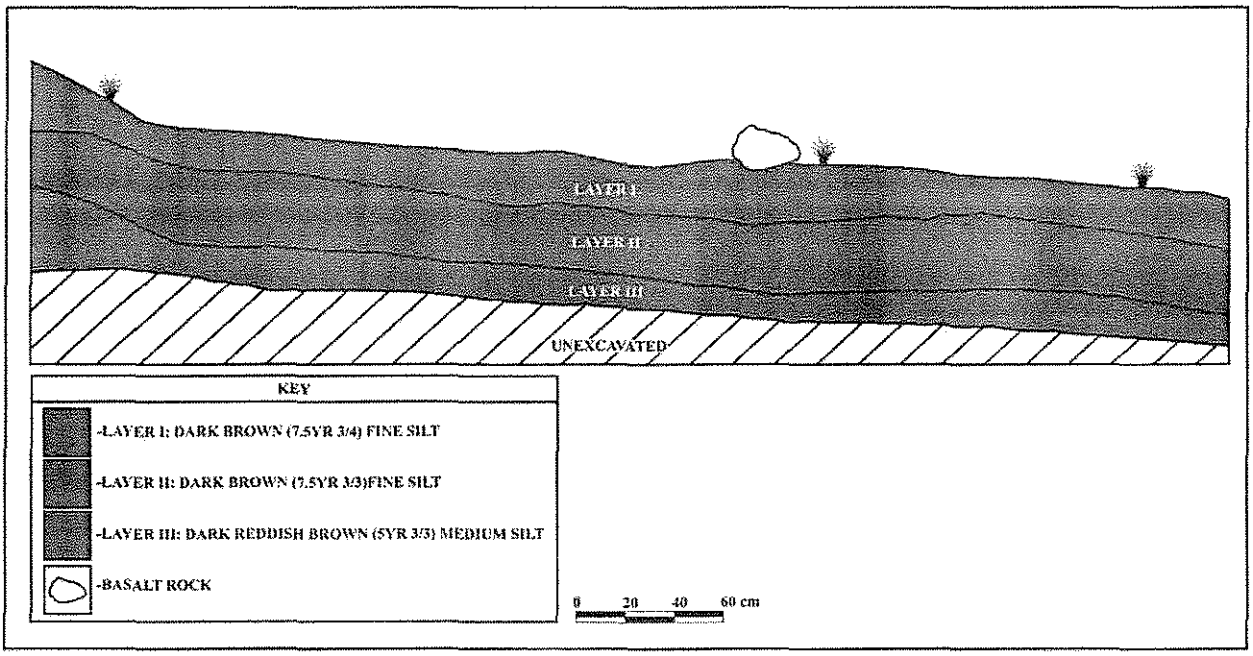

Figure 19: Site 50-50-03-5953 Stratigraphic Trench 1 South Profile (5 Meter Representation).

Stratigraphic Trench 2 is 20.0 m long by 1.0 m wide. A 5.0 m representative profile was drawn of the trench. Layer I (0–40 cmbs) is a dark brown (7.5 YR 3/3) sandy silt containing roots in the top 10 cm. Layer II (40–62 cmbs) is a dark yellowish brown (10 YR 4/4) saprolite. No cultural material was recovered during excavation.

STATE SITE NUMBER 50-50-03-5954

FORM:	Rock wall
FUNCTION:	Ranching
AGE:	Historic
DIMENSIONS:	169.5 m by 1.5 m
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	None

DESCRIPTION: This rock wall (Figure 20), located near the south end of the project area in Lot 7, is a cattle wall from the ranching era. It extends downslope from near the eastern project

Figure 20: Mauka End of Site 50-50-03-5954 Rock Wall. View is to the Southwest.

boundary through dense grass, shrubbery, and trees, including *koa haole*. This core-filled wall is constructed of weathered, poor quality, subangular basalt. The wall exterior is composed of cobbles ranging in size from 40 to 90 cm in diameter. The wall stands 2 to 6 courses high and is faced. The cobble filling ranges in size from 10 to 30 cm in diameter. The top of the wall is fairly level. No cultural material was observed in association with this wall.

STATE SITE NUMBER 50-50-03-5955

FORM:	Modified rock deposit
FUNCTION:	Indeterminate
AGE:	Indeterminate
DIMENSIONS:	20.0 m by 14.0 m
CONDITION:	Good
SURFACE ARTIFACTS:	Coral fragments
EXCAVATION:	Test Units (TU) 1 and 2; Shovel Probes (SP) 1 through 10

DESCRIPTION: This site consists of several potentially "modified" rock concentrations occurring on a rocky slope (Figure 21). The site is located downslope from several other amorphous rock concentrations that are outside the project area. Linear mounds resulting from road construction are present to the south and a water channel occurs to the north. Grass, *'ilima*, and burnt *kiawe* provide moderate vegetation coverage. This tri-level rock concentration

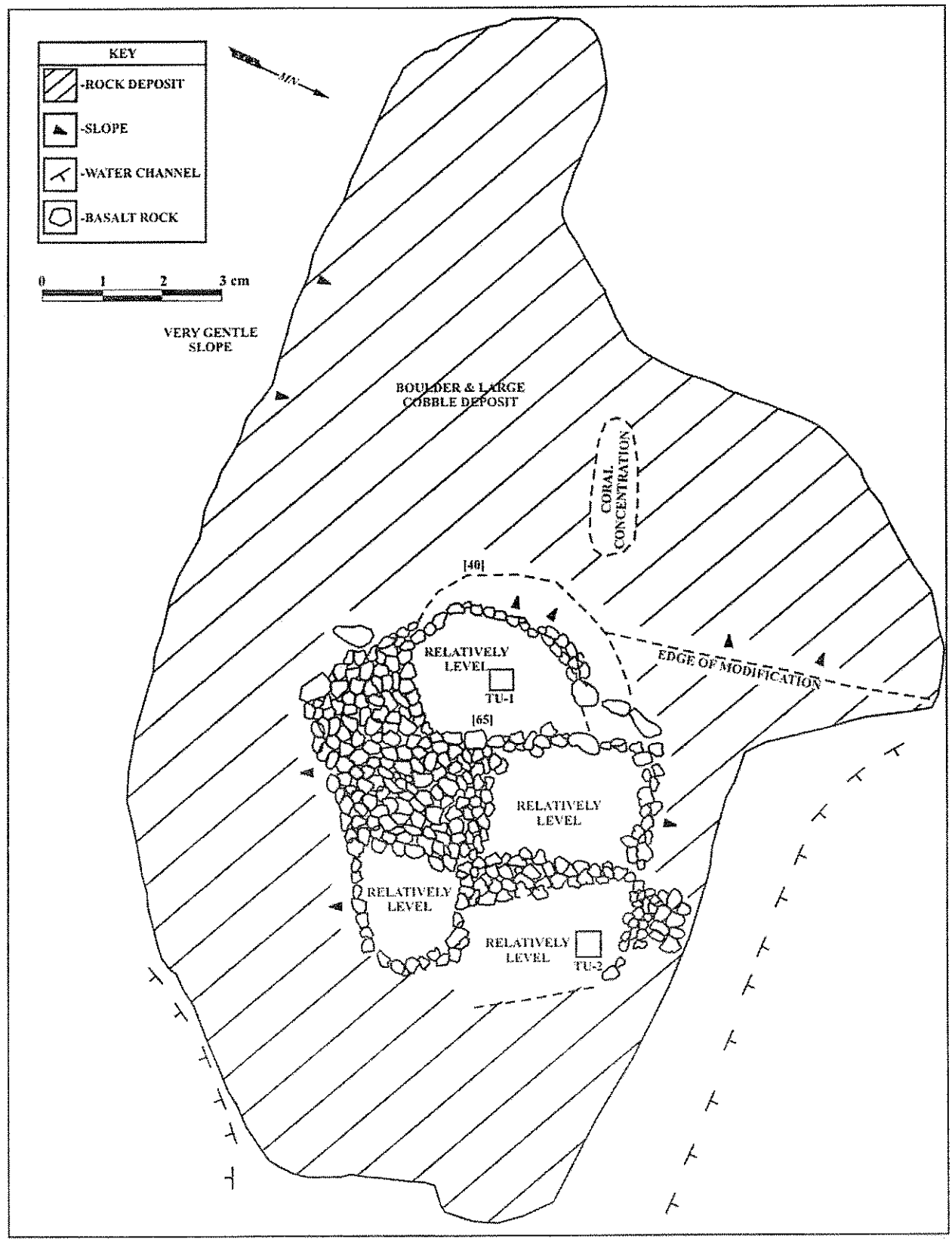

Figure 21: Plan View of Site 50-50-03-5955 Modified Rock Deposit.

contains two relatively level areas on its upper slopes. A larger rock deposit with no visible formal construction is located on the lower slopes of the feature where two additional relatively level areas are present. Several large pieces of branch coral and other coral fragments are present to the northwest, downslope of the modified portion of the feature. According to the field crew, the coral fragments appeared to have eroded (water erosion) to this location from the upper portions of the slope. The crew also noted that coral pieces were common in lower areas, this not surprising considering the proximity of this area to the coastline. The age and function of this feature are indeterminate and may simply be a modest activity area. As shown below, excavations did not show this feature to be more complex than documented from surface characteristics.

EXCAVATION: Two test units were excavated in two of the level areas on the rock deposit. Test Unit 1 is 50 cm by 50 cm. Layer I (0–35 cmbs) is a very dry, grey brown silt containing some sand and 25 percent pebbles and cobbles. The unit was terminated upon encountering large boulders. No cultural material was recovered from this unit.

Test Unit 2 is 50 cm by 50 cm. One layer was identified and excavated in two levels (Figure 22).

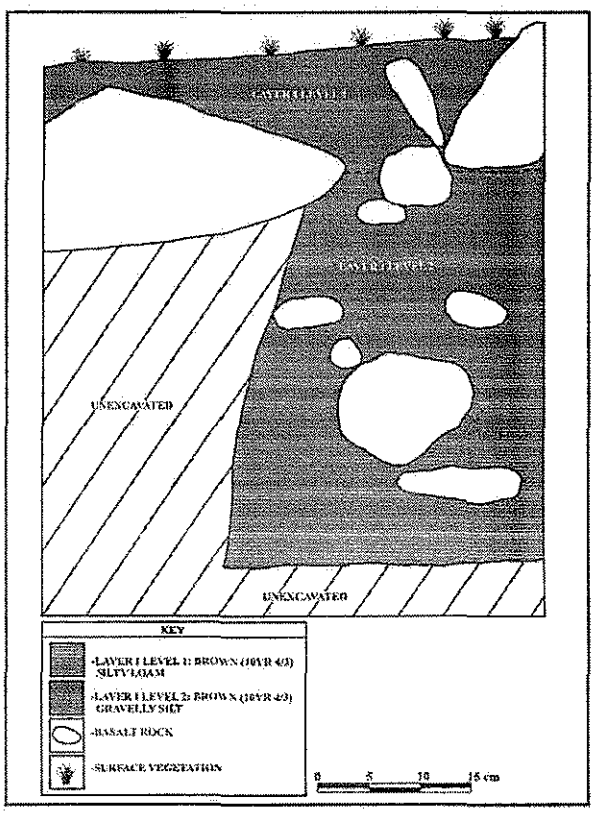

Figure 22: Site 50-50-03-5955 Test Unit 2 North Profile.

Layer I level 1 (0–12 cmbs) is a brown (10 YR 4/3) silty loam containing more than 50 percent rocks (cobble size and larger) and organic material. No cultural material was recovered from this level. Layer I level 2 (12–52 cmbs) is a brown (10 YR 4/3) very gravelly silt containing large cobbles and small boulders. The west end of the unit is dominated by very large rocks that were not removed. One coral fragment was recovered from this unit.

Ten shovel probes (Figure 23) (Table 2) were placed at regular intervals on a level area along the southwest edge of the modified feature. The shovel probes and their depths are presented below. No cultural material was recovered from any of the probes. Shovel Probes 5 and 8 were not excavated due to the lack of cultural material in the other probes.

Table 2: Shovel Probe Depths.

Shovel Probe	Depth (cmbs)
1	40
2	32
3	17
4	24
5	Not Excavated
6	24
7	20
8	Not Excavated
9	21
10	5

Shovel Probe 1 was the only probe that yielded any material. This probe was excavated to a maximum depth of 40 cmbs. Layer I (0–25 cmbs) is a very rocky, dark greyish brown (10 YR 4/2) silt. Four very small pieces of coral were collected from Layer I. Layer II (25–40 cmbs) is a very rocky, dark grey (10 YR 4/1) silt. This layer appears to represent either a stream or flood deposit based the presence of waterworn pebbles and gravel. No cultural material was recovered.

STATE SITE NUMBER 50-50-03-5956

FORM:	Shell midden and lithic scatter
FUNCTION:	Indeterminate
AGE:	Historic and possibly prehistoric
DIMENSIONS:	173 m by 141 m
CONDITION:	Fair
SURFACE ARTIFACTS:	Shell midden, lithics, metal and grass fragments
EXCAVATION:	Stratigraphic Trenches 1 and 2

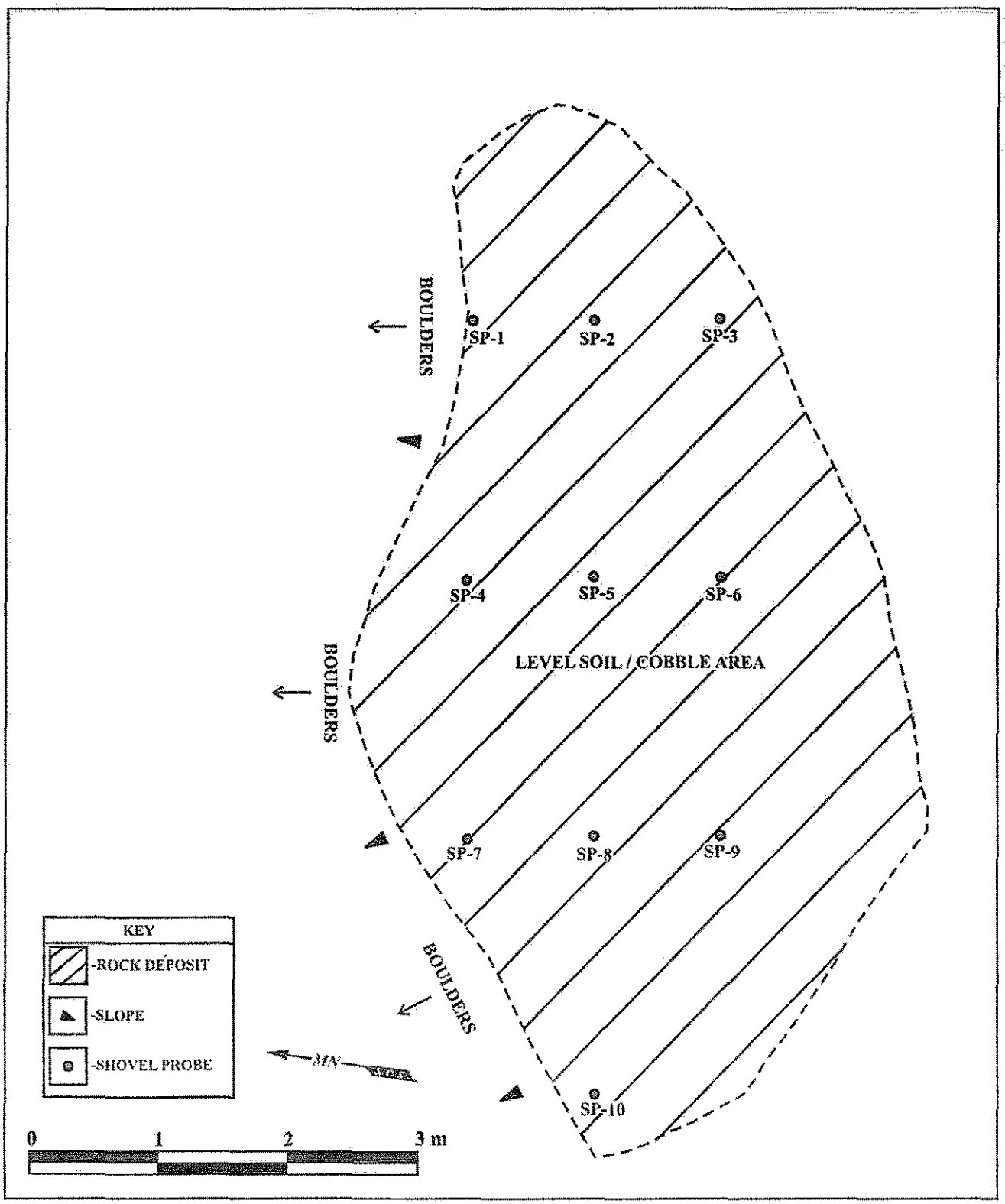

Figure 23: Plan View of Site 50-50-03-5955 Shovel Probes.

DESCRIPTION: This site is a large shell midden and lithic scatter with sparse historic debris, including glass and metal fragments. The area was heavily modified during the plantation era by the formation of earthen berms. The ground cover consists of sparse grass due to recent burning, therefore, visibility is good. Material appears to be more or less evenly distributed throughout the site.

Surface material was collected from two areas (Areas A and B). Different sampling strategies were used for each of the areas. Area A is approximately 170.0 m long by 85.0 m wide and covers approximately 14,450 sq m. Material collected consists of marine shells, coral, waterworn basalt, basalt flakes and cores, and historic debris, including metal railroad spikes and various colored glass fragments.

Area B is located northwest of Area A. Area B is irregular in shape and covers approximately 3,150 sq m. Only a portion of this area was sampled. A 20.0 m long by 10.0 m wide area was divided into eight 5.0 m by 5.0 m squares labeled Blocks A through H. The material collected from each block is summarized below (see also Appendix A).

Table 3: Material Collected from Blocks.

Block	Material Collected
A	marine shells, coral, basalt and slag flakes, glass fragments, metal
B	coral, basalt flake
C	marine shells, slag core, glass fragments, bisque potsherd
D	marine shells, coral, glass marble
E	marine shells, small mammal bone fragment, basalt and slag flakes, glass fragment
F	marine shells, coral, glass fragment
G	marine shells, basalt flakes, glass fragments, bisque potsherd
H	marine shell, coral, basalt and slag flakes, glass fragments, aluminum

The marine shells collected are very fragmentary and have suffered structural wear either from natural or human induced causes and therefore lack specific diagnostic features. Among the species identified are *Littorina* sp., *Conus* sp., *Cypraea* sp., and *Cellana* sp. (*'opihi*) which were extremely well liked as a food item and were reportedly the most commonly eaten shells in the Hawaiian Islands (Kay in Titcomb 1979). *'Opihi* shells were also good instruments for scooping, peeling, and scraping because of their sharp edges (Titcomb 1978). Other species identified include *Anachis miser*, which are common in shallow water and found on the fronds of certain kinds of algae, *Drupa ricina* and *Nerita picea, which* are found on rocky substrates, and *Nerita neglecta* (also called *Theodoxus neglecta*), *which* are found both in sea and brackish water.

Nerita picea and *Nerita neglecta*, called *pipipi* by the Hawaiians, were eaten as food and their shells used for lei (Kay 1979:63). *Cassis cornuta* which was eaten as food and whose shells were used as trumpets (Titcomb 1978) and *Purpura aperta* which was also eaten by the Hawaiians (Kay 1979) may also be present in the assemblage.

The basalt and slag flakes show an interesting adaptive behavior between different "lithic" materials being used for presumably similar purposes. The presence of the basalt flakes, while implying a prehistoric component, does not necessarily lead to the inference that they were deposited during prehistoric times. The slag flakes are undoubtedly historic in nature. The presence of both will be further assessed as part of a more in-depth study of the slag and slag flaking.

EXCAVATION: Two stratigraphic trenches were mechanically excavated with a backhoe. Stratigraphic Trench 1, 29.0 m long by 1.0 m wide, is located 18.5 m away from the northeast corner of the site. Layer I (0–30 cmbs) is a very dark brown (7.5 YR 2.5/3) sandy silt that is high in roots and burnt organic material and contains more than 5 percent gravel. The charred material originates from burning that took place one year ago. Layer II (30–50 cmbs) is a very dark brown (7.5 YR 2.5/3) sandy silt containing more than 10 percent gravel and cobbles. Layer III (50–80 cmbs) is a dark reddish brown (5 YR 3/4) and yellowish red (5 YR 4/6) sandy silt containing some gravel and saprolite. No cultural material was recovered during excavation.

Stratigraphic Trench 2 (Figure 24), 25.0 m long by 1.0 m wide, is located 28.5 m *makai* of Stratigraphic Trench 1. Layer I (0–30 cmbs) is a very dark brown (7.5 YR 2.5/3) sandy silt containing more than 5 percent rock and a high amount of organic material. Layer II (30–50 cmbs) is a dark brown (7.5 YR 3/3) sandy silt containing more than 10 percent rock. This layer is not continuous throughout the whole trench. Layer III (50–80 cmbs) is a dark yellowish brown (10 YR 4/4) saprolite. No cultural material was recovered during excavation.

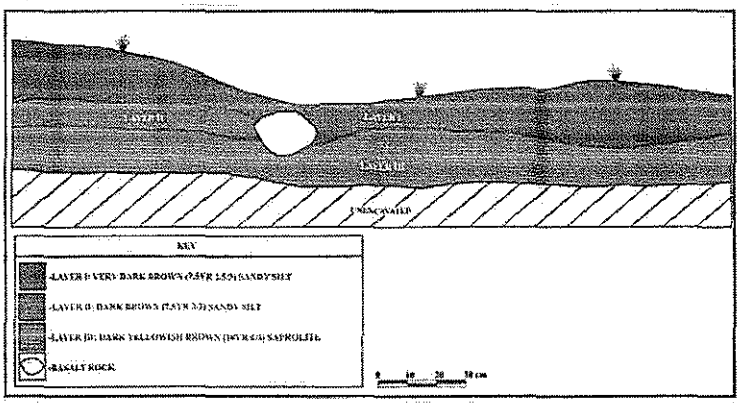

Figure 24: Site 50-50-03-5956 Stratigraphic Trench 2 South Profile.

STATE SITE NUMBER 50-50-03-5957

FORM:	Terrace
FUNCTION:	Agricultural
AGE:	Historic
DIMENSIONS:	9.5 m by 4.0 m
CONDITION:	Good
SURFACE ARTIFACTS:	None
EXCAVATION:	Test Unit 1

DESCRIPTION: This site consists of a terrace on the edge of an unnamed gulch (Figure 25). The terraced area is 9.5 m long by 4.0 m wide and is relatively level. Two additional terraces may be present on top of the level area. The terraced area is bound by a pile of mechanically pushed boulders to the south, earthen berms to the east and west, and an unnamed gulch to the north. The terrace face is constructed of cobbles and boulders stacked up to 90 cm high in some areas. The terrace has been altered by bulldozing activity and one section of the terrace face has been disturbed by cattle.

EXCAVATION: Test Unit 1 (Figure 26) measures 1.0 m by 1.0 m and is located in the northwest portion of the terrace directly behind the terrace wall. Layer I (0–7 cmbs) is a very dark brown (7.5 YR 2.5/2) fine silt containing 25 percent rocks. Layer I is ashy and contains large burnt roots due to recent burning. Layer II (7–23 cmbs) is a dark reddish brown (5 YR 3/3) silt. This layer is coarse grained and contains 70 percent pebbles. Layer III (23–41 cmbs) is a dark brown (7.5 YR 3/3) silt containing 30 percent rocks. Layer IV (41–58 cmbs) is a dark brown (7.5 YR 3/3) silt that is more compact and less rocky than Layer III. Layer V (58–63 cmbs) is a dark brown (7.5 YR 3/2) silty sand that is slightly more compact that Layer IV and contains fewer rocks.

DISCUSSION AND CONCLUSIONS

A total of ten sites were identified during Inventory Survey of large land parcels near coastal Launiupoko. A majority of the sites are historic in age. Five of the ten sites are associated with the sugarcane plantation era. These sites include large rock mounds, terraces, and irrigation ditches. One of the ten sites is a scatter of slag fragments and cores interpreted to be a historic work/dumping area. As slag is a mill by-product, the slag scatter is historic in age. The function and age of Sites -5955 and -5956 are indeterminate but both can be viewed as activity areas likely related to historic times. Only negative results were obtained during subsurface testing.

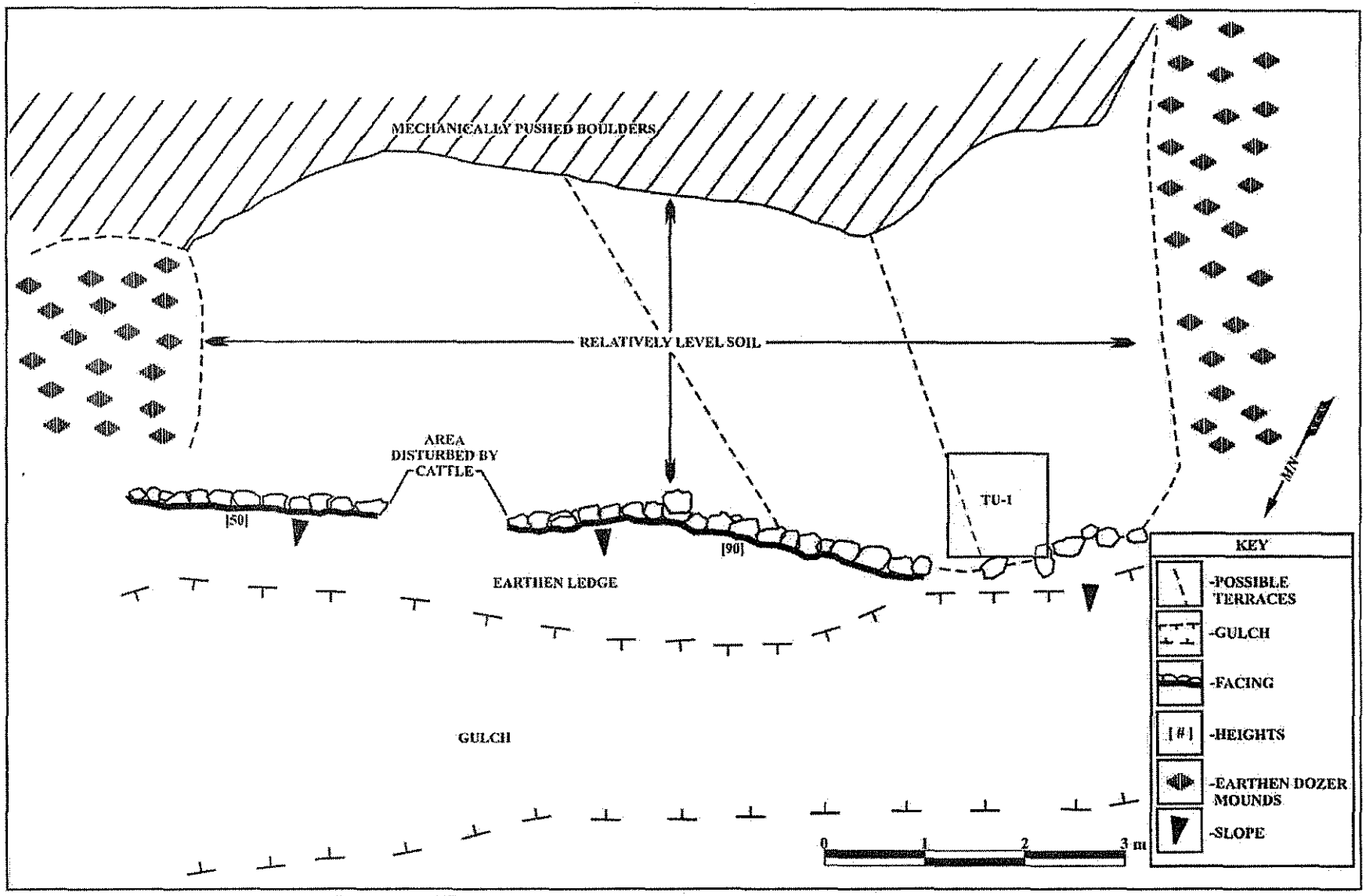

Figure 25: Plan View of Site 50-50-03-5957 Terrace.

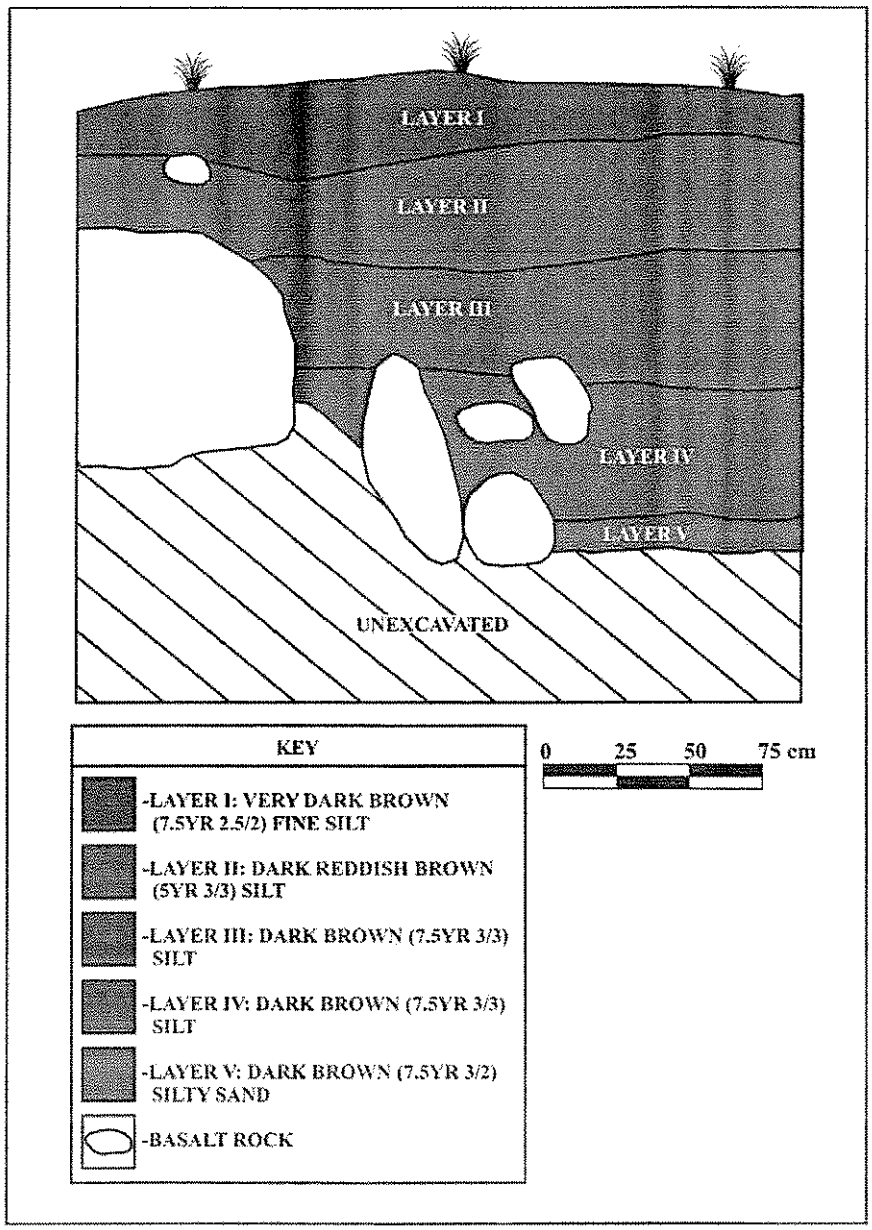

Figure 26: Site 50-50-03-5957 Test Unit 1 North Profile.

As expected, a majority of the sites identified during Inventory Survey are historic in age and are associated with either the plantation era or subsequent cattle ranching activities. These findings were "expected" based on the location of the project area: near modern infrastructure (highway, roadways) and on only moderately sloping lands (prime sugar cane cultivation land). The project area has been tremendously impacted by sugarcane cultivation practices through time. The large mounds composing Site -5950 indicate massive landscape clearance of rocks and boulders across this lower portion of the Launiupoko landscape. Even one flying near the project area in a commercial airplane is acutely aware of landscape alterations in Launiupoko.

However, only the lower portions of the landscape appear to have been most massively altered. Archaeological work occurring to the east (upslope) has revealed the presence of numerous prehistoric sites ranging from temporary work areas to habitation loci and ceremonial places dating from the c. A.D. 1200s (Graves *et al.* 1998; Haun and Henry 2001; Haun *et al.* 2001; Dega *et al.* 2006). The difference between the presence/absence of significant sites (or even prehistoric site presence) appears to primarily have been based on location. The lower areas were more amenable to sugar cane cultivation and were much drier. More *mauka* reaches contained undulating topography not necessarily as favorable to industrial-level sugar cane cultivation and also contained a different climate: wetter, a denser arboreal component, and deeper soils. Note that the difference between these two regions of Launiupoko is only 1-2 kilometers in distance. Overall, it appears as though occupants of the Launiupoko area, from the A.D. 1200s through historic times, had established a symbiotic relationship between their goals (farming, habitation, cultivation) and the micro-climates and micro-topography of the area. This appears one reason few sites were documented during this Inventory Survey in the lower reaches.

Finally, the current project occurs above the coast and below any real elevation gains along fairly modest undulating slopes. This area could be considered a relative "barren zone" compared to the other two resource areas. This is somewhat proven by the nature of sites in the coastal and slightly upland zones, when compared with this intermediate area. These intermediate were often the location of the most intensive historic use so may only be considered as "barren zones" for a short portion of history.

SITE SIGNIFICANCE ASSESSMENTS AND RECOMMENDATIONS

These sites have been evaluated for significance according to the criteria established for the Hawai`i State Register of Historic Places. The five criteria are presented below:

Criterion A: Site is associated with events that have made a significant contribution to the broad patterns of our history

Criterion B: Site is associated with the lives of persons significant to our past

Criterion C: Site is an excellent site type; embodies distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual construction

Criterion D: Site has yielded or has the potential to yield information important in prehistory or history

Criterion E: Site has cultural significance to an ethnic group; examples include religious structures, burials, major traditional trails, and traditional cultural places

All of the sites identified during Inventory Survey are significant under Criterion D. At this juncture, all the sites have been thoroughly mapped and recorded. Archaeological Monitoring will be required at Site 50-50-03-5950 in the event that these mounds are dismantled in conjunction with the areas development. With the exception of Site 50-50-03-5950 no further work is recommended for the additional sites. As the project area has been tremendously altered by sugarcane cultivation and subsurface testing yielded negative results, the presence of intact subsurface cultural deposits appears very low. With the exception of Archaeological Monitoring at Site 5950 no further archaeological testing work is recommended in the project area.

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APPENDIX A: CULTURAL MATERIAL INVENTORY

APPENDIX A

SCS PROJECT 652 TRADITIONAL ARTIFACT INVENTORY

Site	Field Bag #	Fea.	Unit	Layer	Depth (cmbd)	Depth (cmbs)	Artifact Type	Material/Species	Weight (grams)	Count	Remarks
T-7	1.1	Area B	Block A	Surface	-	-	Coral	-	0.2	2	
T-7	1.2	Area B	Block A	Surface	-	-	Coral	-	26.0	1	
T-7	1.3	Area B	Block A	Surface	-	-	Marine Shell	*Conus* sp.?	0.2	1	
T-7	1.4	Area B	Block A	Surface	-	-	Marine Shell	*Cellana* sp.	0.1	1	
T-7	1.5	Area B	Block A	Surface	-	-	Marine Shell	*Cypraea* sp.	0.2	1	
T-7	2.1	Area B	Block A	Surface	-	-	Flake	Basalt	-	4	
T-7	2.2	Area B	Block A	Surface	-	-	Flake	Slag	-	1	
T-7	3.1	Area B	Block A	Surface	-	-	Glass Sherd	Colorless	-	2	
T-7	3.2	Area B	Block A	Surface	-	-	Glass Sherd	Brown Transluscent	-	1	
T-7	3.3	Area B	Block A	Surface	-	-	Ferrous Metal	-	375.9	1	
T-7	4.1	Area B	Block B	Surface	-	-	Coral	-	4.9	4	
T-7	5.1	Area B	Block B	Surface	-	-	Flake	Basalt	-	1	
T-7	6.1	Area B	Block C	Surface	-	-	Marine Shell	*Conus* sp.	4.5	4	
T-7	6.2	Area B	Block C	Surface	-	-	Marine Shell	*Cypraea* sp.	3.0	6	
T-7	6.3	Area B	Block C	Surface	-	-	Marine Shell	*Conus* sp.?	0.1	1	
T-7	7.1	Area B	Block C	Surface	-	-	Core	Slag	-	1	
T-7	8.1	Area B	Block C	Surface	-	-	Glass Sherd	While Opaque	-	1	
T-7	8.2	Area B	Block C	Surface	-	-	Glass Sherd	Blue Transluscent	-	1	Double Lipped
T-7	8.3	Area B	Block C	Surface	-	-	Pot Sherd	Bisque	-	1	Light Blue Decorat's
T-7	9.1	Area B	Block D	Surface	-	-	Marine Shell	Unidentifiable	0.3	1	
T-7	9.2	Area B	Block D	Surface	-	-	Marine Shell	*Cypraea* sp.?	0.3	1	
T-7	9.3	Area B	Block D	Surface	-	-	Marine Shell	*Cypraea* sp.	1.3	2	
T-7	9.4	Area B	Block D	Surface	-	-	Marine Shell	*Narita picea*	0.2	1	
T-7	9.5	Area B	Block D	Surface	-	-	Coral	-	5.2	2	
T-7	10.1	Area B	Block D	Surface	-	-	Historic	Glass Marble	-	1	
T-7	11.1	Area B	Block E	Surface	-	-	Marine Shell	*Cypraea* sp.	1.0	2	
T-7	11.2	Area B	Block E	Surface	-	-	Bone	Sm. Mammal	0.5	1	
T-7	12.1	Area B	Block E	Surface	-	-	Flake	Basalt	-	1	
T-7	12.2	Area B	Block E	Surface	-	-	Flake	Slag	-	1	

SCS PROJECT 652 TRADITIONAL ARTIFACT INVENTORY											
Site	Field Bag #	Fea.	Unit	Layer	Depth (cmbd)	Depth (cmbs)	Artifact Type	Material/Species	Weight (grams)	Count	Remarks
T-7	13.1	Area B	Block E	Surface	-	-	Glass Sherd	-	-	1	
T-7	14.1	Area B	Block F	Surface	-	-	Marine Shell	*Cypraea* sp.	1.4	2	
T-7	14.2	Area B	Block F	Surface	-	-	Marine Shell	Unidentifiable	1.9	1	
T-7	14.3	Area B	Block F	Surface	-	-	Coral	-	19.3	2	
T-7	15.1	Area B	Block F	Surface	-	-	Glass Sherd	Blue Transluscent	-	1	
T-7	16.1	Area B	Block G	Surface	-	-	Marine Shell	Unidentifiable	1.5	2	
T-7	16.2	Area B	Block G	Surface	-	-	Marine Shell	*Cypraea* sp.	0.3	1	
T-7	16.3	Area B	Block G	Surface	-	-	Marine Shell	*Cypraea* sp.	3.7	3	
T-7	17.1	Area B	Block G	Surface	-	-	Flake	Basalt	-	6	
T-7	18.1	Area B	Block G	Surface	-	-	Glass Sherd	Colorless	-	2	
T-7	18.2	Area B	Block G	Surface	-	-	Pot Sherd	Bisque	-	1	While Glaze
T-7	19.1	Area B	Block H	Surface	-	-	Marine Shell	*Cypraea* sp.	1.3	1	
T-7	19.2	Area B	Block H	Surface	-	-	Marine Shell	Unidentifiable	2.7	4	
T-7	19.3	Area B	Block H	Surface	-	-	Marine Shell	*Cypraea* sp.	3.4	1	
T-7	19.4	Area B	Block H	Surface	-	-	Coral	-	43.0	3	
T-7	20.1	Area B	Block H	Surface	-	-	Flake	Basalt	-	6	
T-7	20.2	Area B	Block H	Surface	-	-	Flake	Slag	-	5	
T-7	21.1	Area B	Block H	Surface	-	-	Historic	Alluminum	1.4	1	
T-7	21.2	Area B	Block H	Surface	-	-	Glass Sherd	Pink Transluscent	-	1	
T-7	21.3	Area B	Block H	Surface	-	-	Glass Sherd	Green Transluscent	-	2	
T-7	22.1	Area A	-	Surface	-	-	Coral		555.7	111	
T-7	22.2	Area A	-	Surface	-	-					
T-7	22.3	Area A	-	Surface	-	-					
T-7	22.4	Area A	-	Surface	-	-					
T-7	22.5	Area A	-	Surface	-	-					
T-7	22.6	Area A	-	Surface	-	-					
T-7	23.1	Area A	-	Surface	-	-	Marine Shell	*Conus* sp.	233.6	14	
T-7	23.2	Area A	-	Surface	-	-	Marine Shell	*Cypraea* sp.	7.1	37	
T-7	23.3	Area A	-	Surface	-	-	Marine Shell	*Cassis cornuta*?	14.2	1	
T-7	23.4	Area A	-	Surface	-	-	Marine Shell	*Conus* sp.	39.8	13	
T-7	23.5	Area A	-	Surface	-	-	Marine Shell	Unidentifiable	77.0	100+	

SCS PROJECT 652 TRADITIONAL ARTIFACT INVENTORY											
Site	Field Bag #	Fea.	Unit	Layer	Depth (cmbd)	Depth (cmbs)	Artifact Type	Material/Species	Weight (grams)	Count	Remarks
T-7	23.6	Area A	-	Surface	-	-	Marine Shell	*Drupa ricina*	16.9	3	
T-7	23.7	Area A	-	Surface	-	-	Marine Shell	*Cypraea* sp.	9.9	2	
T-7	23.8	Area A	-	Surface	-	-	Operculum	-	0.4	1	
T-7	23.9	Area A	-	Surface	-	-	Marine Shell	*Nerita neglecta* & *Nerita picea*	2.5	15	
T-7	23.10	Area A	-	Surface	-	-	Marine Shell	*Littorina* sp.	1.0	6	
T-7	23.11	Area A	-	Surface	-	-	Marine Shell	*Conus* sp.	1.9	2	
T-7	23.12	Area A	-	Surface	-	-	Marine Shell	*Conus* sp.	2.8	1	
T-7	23.13	Area A	-	Surface	-	-	Marine Shell	*Anachis miser*	0.0	1	
T-7	23.14	Area A	-	Surface	-	-	Coral	-	2.9	11	
T-7	24.1	Area A	-	Surface	-	-	Historic	Ferrous	451.5	3	Railroad Spikes
T-7	25.1	Area A	-	Surface	-	-	Glass Sherd	Green Opaque	-	2	
T-7	25.2	Area A	-	Surface	-	-	Glass Sherd	Colorless	-	3	
T-7	25.3	Area A	-	Surface	-	-	Glass Sherd	Blue Transluscent	-	1	
T-7	25.4	Area A	-	Surface	-	-	Glass Sherd	Amathyst	-	1	
T-4	19	-	-	Surface	-	-	Marine Shell	*Purpura aperta?*	41.0	1	
T-3	26.1	-	TU-1	I	-	0–28	Charcoal	-	-	-	
T-3	26.2	-	TU-1	I	-	0–28	Seeds	-	-	3	
T-3	26.3	-	TU-1	I	-	0–28	Seeds	Burned	-	6	
T-3	27.1	-	ST-1	I	-	0–24	Historic	Wire Nail	-	1	
T-3	27.2	-	ST-1	I	-	0–24	Coral	-	21.3	4	
T-3	27.3	-	ST-1	I	-	0–24	Charcoal	-	0.1	-	
T-3	27.4	-	ST-1	I	-	0–24		Slag	-	4	
T-3	28.1	-	ST-2	I	-	0–25	Land Snail	-	-	5	
T-3	28.2	-	ST-2	I	-	0–25	Historic	Cement	-	1	
T-3	28.3	-	ST-2	I	-	0–25		Slag	-	11	
T-3	29.1	-	ST-3	II	32	-	Charcoal	-	1.0	-	
T-3	30.1	-	ST-5	I	40–46	-	Glass Sherd	Irridescent/Colorless	-	3	
T-3	31.1	-	ST-5	II	41	-	Charcoal	-	0.0	-	
T-3	32.1	-	ST-5	II	45	-	Charcoal	-	0.0	-	

SCS PROJECT 652 TRADITIONAL ARTIFACT INVENTORY											
Site	**Field Bag #**	**Fea.**	**Unit**	**Layer**	**Depth (cmbd)**	**Depth (cmbs)**	**Artifact Type**	**Material/Species**	**Weight (grams)**	**Count**	**Remarks**
T-3	33.1	-	Backhoe Trench 6	I	-	7–17	Soil Sample	-	-	-	
T-3	34.1	-	Backhoe Trench 6	II	-	33–43	Soil Sample	-	-	-	
T-3	35.1	-	Backhoe Trench 6	III	-	60-70	Soil Sample	-	-	-	
T-3	36.1	-	Backhoe Trench 6	I	-	3-13	Soil Sample	-	-	-	
T-3	37.1	-	Backhoe Trench 6	II	-	33-43	Soil Sample	-	-	-	
T-3	38.1	-	Backhoe Trench 6	III	-	67-72	Soil Sample	-	-	-	
T-3	39.1	-	Backhoe Trench 7	I	-	0-10	Soil Sample	-	-	-	
T-3	40.1	-	Backhoe Trench 7	IIA	-	18-28	Soil Sample	-	-	-	
T-3	41.1	-	Backhoe Trench 7	IIB	-	46-56	Soil Sample	-	-	-	
T-3	42.1	-	Backhoe Trench 7	III	-	60-70	Soil Sample	-	-	-	
T-3	43.1	-	Backhoe Trench 7	I	-	8-14	Soil Sample	-	-	-	
T-3	44.1	-	Backhoe Trench 7	IIA	-	30-38	Soil Sample	-	-	-	
T-3	45.1	-	Backhoe Trench 7	III	-	50-55	Soil Sample	-	-	-	
T-3	46.1	-	Backhoe Trench 7	IV	-	60-65	Soil Sample	-	-	-	

APPENDIX E-1.

State Historic Preservation Letter Accepting Paraso and Dega Archaeological Inventory Survey

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR - LAND

DEAN NAKANO
ACTING DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

November 13, 2006

Dr. Michael Dega
Scientific Consultant Services, Inc.
711 Kapiolani Boulevard, Suite 975
Honolulu, Hawaii 96813

LOG NO: 2006.3593
DOC NO: 0611MK07
Archaeology

Dear Dr. Dega:

SUBJECT: Chapter 6E-42 Historic Preservation Review – Revised Archaeological Inventory Survey for 633 Acres in the Launiupoko Large Lot Subdivision Numbers 3, 4, and 7 Launiupoko and Polanui Ahupuaa, Lahaina District, Island TMK (2) 4-7-001: por. 2

Thank you for the opportunity to review this revised report which our staff received on August 24, 2006 (Paraso and Dega 2006, *An Archaeological Inventory Survey of 633 acres in the Launiupoko [Large Lot] Subdivision NOS 3, 4, and 7, Launiupoko and Polanui Ahupuaa, District of Lahaina [Formerly Kaanapali] Island of Maui, Hawaii [TMK (2) 4-7-01:2 por.]*...Scientific Consultant Services, Inc., ms). We previously provided comments and requested some revisions (LOG NO: 2006.2835/DOC NO: 0608MK27) including the insertion of permanent SIHP site numbers throughout the report. We indicated that the background section was acceptable.

The survey has adequately covered the project area documenting ten historic properties, two of which were previously identified during previous archaeological inventory survey. Previously identified SIHP 50-50-03-2665 consists of two historic ranching wall segments, and 50-50-03-4787 consists of an historic irrigation ditch. Newly identified sites 50-50-03-5950 through -5957 consist of plantation and ranching activity sites including rock mounds, irrigation systems, terraces, slag scatter, modified rock deposit, lithic/midden scatter, and wall segments. These sites represent historic plantation activities related to sugar production or ranching activities.

We agree with the significance assessments that all of the sites are significant under Criterion "D" for their information content. No further work is necessary for SIHP 50-50-03-5951 through 5957, -2665, and -4787.

We previously concurred with the preliminary mitigation recommendations for SIHP 50-50-03-5930, which consists of the large plantation era clearing mounds, and has been discussed within the community from a cultural perspective. Oral documentation by former plantation workers suggests that the mounds may be both constructed upon existing stone structures, and that cultural materials were periodically placed within the mounds during the field clearing process. We believe that archaeological monitoring during any deconstruction of these mounds is appropriate. We will await a monitoring plan detailing the proposed scope of monitoring.

We find this report to be acceptable. As always, if you disagree with our comments or have questions, please contact Dr. Melissa Kirkendall at (808) 243-5169 as soon as possible to resolve these concerns.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

MK:kf

c: Bert Ratte, DPWEM, County of Maui, FAX 270-7972
Michael Foley, Director, Dept. of Planning, FAX 270-7634
Maui Cultural Resources Commission, Dept. of Planning, 250 S. High Street, Wailuku, HI 96793

APPENDIX F.

Archaeological Field Inspection Letter

SCIENTIFIC CONSULTANT SERVICES, Inc.

711 Kapiolani Blvd., Suite 975 Honolulu, Hawai`i 96813

Ms. Jenny Pickett
SHPD-Maui
130 Mahalani Street
Wailuku, HI 96793

August 9, 2007

Re: Field Inspection of Proposed Southerly/*Mauka* Extension of the Lahaina Bypass, Launiupoko and Polanui Ahupua`a, Lahaina District, Island of Maui, Hawai`i [TMK:(2) 4-7-01:por. various]

Dear Ms. Pickett:

At the request of Makila Land Company, LLC (Makila), Scientific Consultant Services, Inc. (SCS) conducted an Archaeological Field Inspection of the proposed Southerly/*Mauka* Extension of the Lahaina Bypass, Launiupoko and Polanui Ahupua`a, Lahaina District, Island of Maui, Hawai`i [TMK:(2) 4-7-01:por. various]. The Field Inspection was conducted by SCS staff on October 31 and November 1, 2006, mostly within abandoned agricultural fields. The area surveyed covered a 2.5 mile, 160 ft. wide corridor that extends toward Lahaina from the former Olowalu Landfill northwest to Puamana (Figures 1 and 2). The request for Field Inspection was made by Makila to satisfy historic preservation review requirements, as part of an Environmental Assessment. An Archaeological Cultural Impact Assessment (underway) is another component of that Environmental Assessment. Although this entire section of bypass corridor falls within lands already subjected to archaeological survey (see below), Makila and SCS agreed that a follow up field inspection would focus attention exclusively on the proposed corridor, and ensure that no undocumented archaeological sites would be impacted during bypass construction.

Previous Archaeology within Bypass Corridor

SCS conducted Archaeological Inventory Survey on 633 acres of undeveloped land known as Launiupoko (Large Lot) Subdivision No. 3, 4, & 7, located in Launiupoko and Polanui Ahupua`a, Lahaina District, Maui Island, Hawai`i [TMK (2) 4-7-01:2 por.] (Paraso and Dega 2006). This project involved full systematic survey of the entire parcel, mapping and recording of identified sites and features, and limited testing. Most importantly, Paraso and Dega's study covered 100 percent of the current project area (Figures 3). This former SCS work is particularly relevant to the current field inspection, as no new sites were found in the current project area. All archaeological sites within a 30 ft. radius of the proposed bypass were previously documented by Paraso and Dega (2006) (Figure 4). The following three paragraphs were taken directly from Paraso and Dega (2006):

> A total of ten sites were identified, the majority of which were assessed as historic. Five of the ten sites are associated with the sugarcane plantation era. These sites include large rock mounds, terraces, and irrigation ditches. One of the irrigation ditches was previously recorded by PHRI (2000) as State Site Number 50-50-03-4787 Feature D and is referred to as Lahaina Pump Ditch No. 1. Site 50-50-03-5950 is composed of 17 linear, large rock mounds scattered throughout the project area. Site 50-50-03-5951 consists of an irrigation ditch, water pipes, reservoir, and flume. Site 50-50-03-5952 is a terrace complex associated with the manual cultivation of sugarcane. Site 50-50-03-5957 is also a terrace associated with sugarcane cultivation.

Two of the ten sites are rock walls associated with the cattle ranching era, one of which was previously recorded by Graves *et al.* (1998) and Haun *et al.* (2001) as State Site Number 50-50-03-2665. The other rock wall is designated Site 50-50-03-5954. One of the ten sites (Site 50-50-03-5953) is a scatter of slag fragments and cores interpreted to be a historic work area. As slag is a mill by-product, the slag scatter is historic in age. The function and age of Sites 50-50-03-5955 and 50-50-03-5956 are indeterminate but are simply referred to as activity areas. Site 50-50-03-5955 is a modestly modified rock deposit/bedrock area containing a small cache of coral fragments. This is site is simply interpreted as a modified area as disturbance, erosion, and lack of cohesiveness renders interpretations difficult. Site 50-50-03-5956 is a midden and lithic scatter that also contains historic material such as glass and metal fragments. Material was sampled during surface collection. No cultural materials were observed during subsurface testing.

All of the sites identified during [Paraso and Dega's 2006] Inventory Survey are significant under Criterion D. All the sites have been thoroughly mapped and recorded. No further work is recommended for nine of these ten sites. SIHP 50-50-03-5950, the large plantation era clearing mounds, have been discussed within the community from a cultural perspective. Oral documentation by former plantation employees suggests that the mounds may have been constructed upon existing stone structures, and cultural materials were periodically placed within the mounds during field clearing (Kirkendall 2006), personal communication). If development of the area requires any deconstruction of these mounds (*i.e.*, the features of Site 5950) a qualified archaeologist should monitor these activities.

In general, the project area has been tremendously altered by sugarcane cultivation; Paraso and Dega's (2006) subsurface testing yielded negative results. The presence of any intact subsurface cultural deposits is very unlikely. Almost all views across this landscape portray the extent of historic and modern agricultural activity (Figure 5). A modern dirt road currently exists for roughly 80 percent of the length of the proposed bypass section subject to this field inspection (Figure 6).

Sites located within Bypass Corridor

Three sites documented by Paraso and Dega (2006) are contained within the proposed Lahaina bypass corridor: Sites 5954, 5955, and 5950. Sites 5954 (rock wall) and 5955 (activity area) have been documented fully and no further work has been recommended. However, five features of the clearing mound site (Site 5950) will be altered by the proposed bypass. Each of the 17 large mounds has been given an individual feature number, and numbers 3, 12, 13, 15, and 16 fall within the current project area (see Figure 4).

Conclusions

No new archaeological sites were documented during this Field Inspection of the proposed Lahaina bypass. Of the three previously recorded sites within the project area, two have been fully documented as Criterion D sites (Paraso and Dega 2006), and no further work has been recommended. This assessment was agreed with as the report was accepted by the SHPD (Log No.:2006.3593; Doc No.: 0611MK07). The monitoring required at Site 50-50-03-5950 (Features 3, 12, 13, 15, and/or 16) will be the responsibility of Makila or the developer first in need of deconstructing these features. If, by the time earth-moving procedures on the Lahaina bypass begin, several other mound features have been Monitored with negative results, SHPD may be consulted to determine the possibility of not Monitoring some or all of the mounds that fall within the Lahaina bypass corridor.

Although the Inventory Survey Report (Paraso and Dega 2006) alludes to oral histories pointing to possible site and/or artifacts within the historic plantation-era mounds, none have

been empirically shown to contain sites and/or artifacts. The hypothesis of archeological material occurring within the Site 5950 mounds amounts to non-empirically substantiated notions. However, this is not one that should be readily dismissed. SCS archaeologists believe that if the large clearing mounds do contain items of archaeological interest, their value to the community and archaeological record would be significantly reduced due to their current provenience. Artifacts or sites found within the mounds today would have been pushed there, or been the base of literally tons of surrounding boulder deposit, and would therefore yield little intact objects or information. Questions remain as to whether significant sites occur under the larger mounds, whether the context of any finds would be secondary or even tertiary.

For this reason, Makila, SCS, and SHPD will communicate during mound deconstruction to determine an appropriate sample size for Archaeological Monitoring. SCS recommends that if the first four of 17 mounds Monitored within the Launiupoko lands produce entirely negative results, Site 5950 mound Monitoring may be discontinued for the duration of the development project.

Thank you again for reviewing this document and your advice on Monitoring during future ground altering activities in the Launiupoko area related to this project. Please call (597-1182) if you have any questions or concerns about this letter.

Best regards,

Jon Wilson, B.A.
Michael Dega, Ph.D.
Senior Archaeologists
Scientific Consultant Services, Inc.

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FIGURE 1: HIGHLIGHTED AREA SUBJECT TO FIELD INSPECTION (SURVEYOR'S MAP)

FIGURE 2: HIGHLIGHTED AREA OF FIELD INSPECTION (AERIAL PHOTOGRAPH)

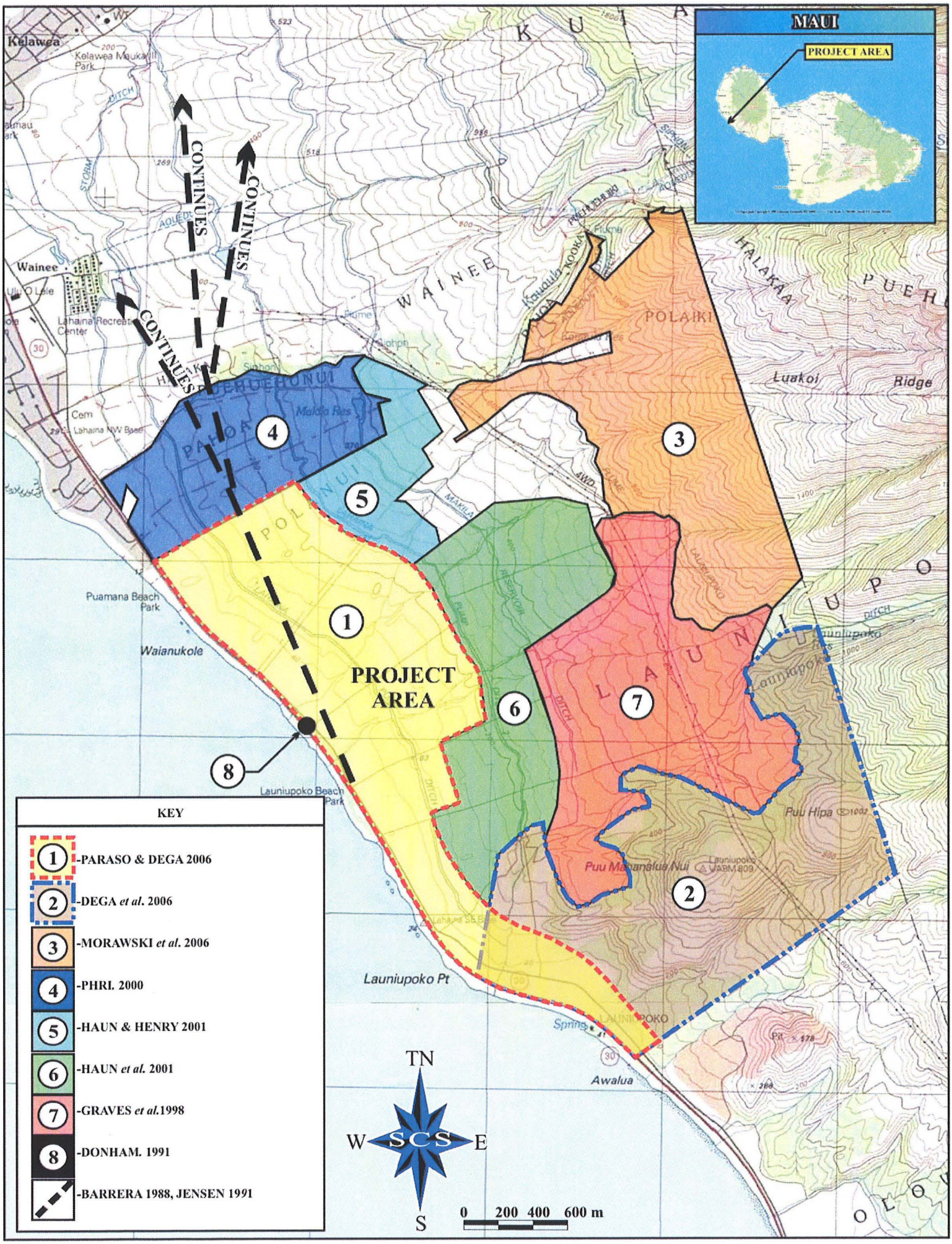

Figure 3: Previous archaeology near the project area

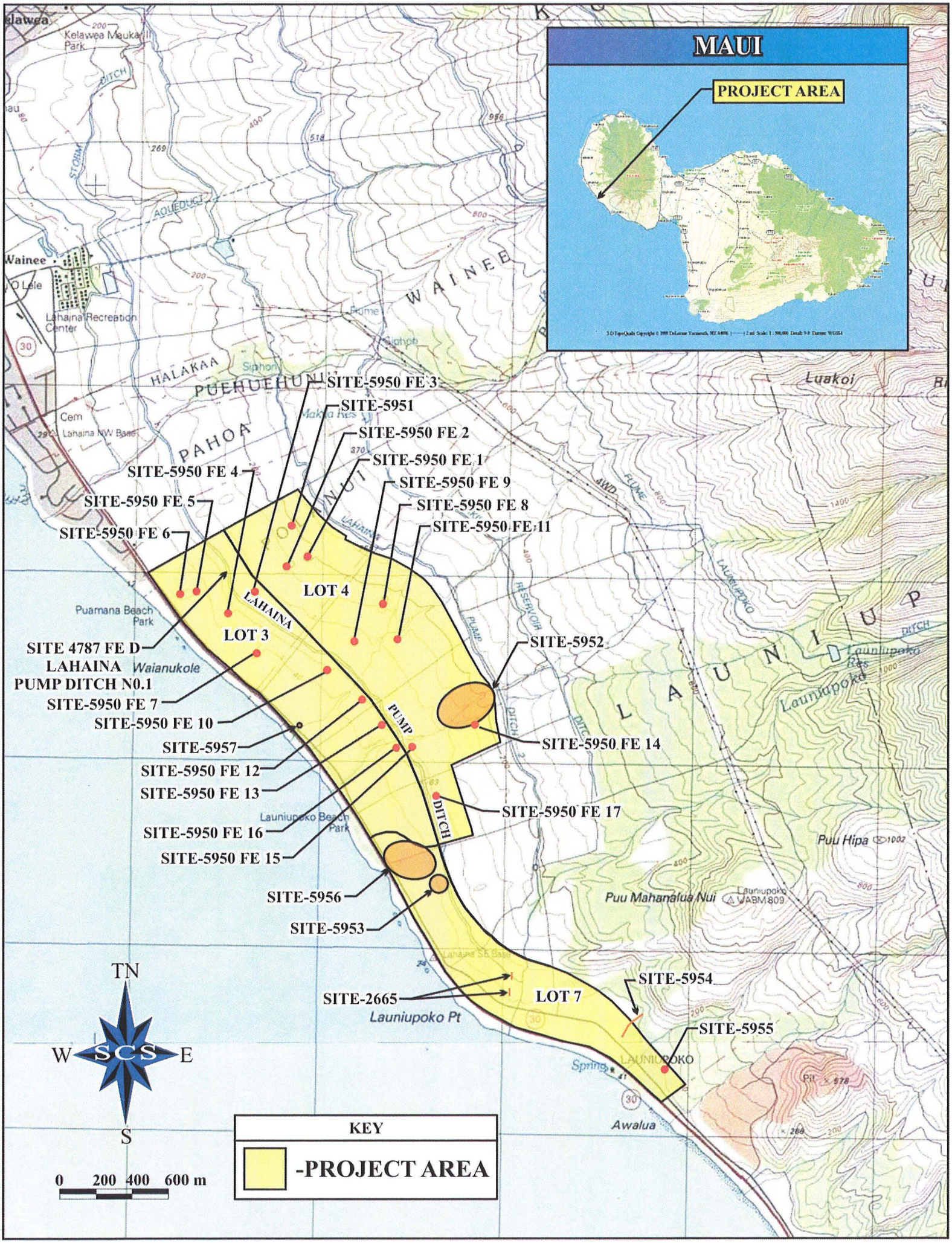
MAUI
PROJECT AREA
SITE-5950 FE 3
SITE-5951
SITE-5950 FE 2
SITE-5950 FE 1
SITE-5950 FE 4
SITE-5950 FE 9
SITE-5950 FE 5
SITE-5950 FE 8
SITE-5950 FE 6
SITE-5950 FE 11
LOT 4
LOT 3
SITE 4787 FE D
LAHAINA
PUMP DITCH N0.1
SITE-5952
SITE-5950 FE 7
SITE-5950 FE 10
SITE-5957
SITE-5950 FE 14
SITE-5950 FE 12
SITE-5950 FE 13
SITE-5950 FE 17
SITE-5950 FE 16
SITE-5950 FE 15
SITE-5956
SITE-5953
SITE-5954
SITE-2665
LOT 7
SITE-5955
TN
W
E
S
SCS
0 200 400 600 m
KEY
-PROJECT AREA
Kelawea Mauka Park
Wainee
Lahaina Recreation Center
HALAKAA
PUEHUEHUNE
PAHOA
Puamana Beach Park
Launiupoko Beach Park
Launiupoko Pt
Puu Hipa
Puu Mahanalua Nui
Launiupoko
Awalua
Luakoi

FIGURE 5: AREA OF PROPOSED SOUTHERLY/MAUKA EXTENSION OF THE LAHAINA BYPASS. VIEW TO SOUTHEAST.

FIGURE 6: AREA OF PROPOSED SOUTHERLY/MAUKA EXTENSION OF THE LAHAINA BYPASS. NOTE TWO MOUND FEATURES OF SITE 5950. VIEW TO NORTHWEST.

APPENDIX G.

Cultural Impact Assessment Report

SCS Project Number 763-CIA-1

A CULTURAL IMPACT ASSESSMENT OF THE PROPOSED SOUTHERN/MAUKA EXTENSION OF THE LAHAINA BYPASS IN LAUNIUPOKO SUBDIVISION NOS 3, 4, AND 7 LAUNIUPOKO AND POLANUI AHUPUA`A DISTRICT OF LAHAINA (FORMERLY KĀ`ANAPALI) ISLAND OF MAUI, HAWAI`I [TMK (2) 4-7-01:2 POR.]

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February 2007

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INTRODUCTION

Scientific Consultant Services, Inc. (SCS) has been contracted by the Makila Land Company, LLC, to conduct a Cultural Impact Assessment on a portion of Parcels 3, 4, and 7 of the Laniupoko Subdivision, Laniupoko and Polanui Ahupua`a (TMK:4-7-01:2 por). The area assessed is the proposed southern/mauka extension of the Lahaina Bypass (Figures 1and 2).

The Constitution of the State of Hawai`i clearly states the duty of the State and its agencies is to preserve, protect, and prevent interference with the traditional and customary rights of native Hawaiians. Article XII, Section 7 requires the State to "protect all rights, customarily and traditionally exercised for subsistence, cultural and religious purposes and possessed by *ahupua`a* tenants who are descendants of native Hawaiians who inhabited the Hawaiian Islands prior to 1778" (2000). In spite of the establishment of the foreign concept of private ownership and western-style government, Kamehameha III (Kauikeaouli) preserved the peoples traditional right to subsistence. As a result in 1850, the Hawaiian Government confirmed the traditional access rights to native Hawaiian *ahupua`a* tenants to gather specific natural resources for customary uses from undeveloped private property and waterways under the Hawaiian Revised Statutes (HRS) 7-1. In 1992, the State of Hawai`i Supreme Court, reaffirmed HRS 7-1 and expanded it to include, "native Hawaiian rights...may extend beyond the *ahupua`a* in which a native Hawaiian resides where such rights have been customarily and traditionally exercised in this manner" (Pele Defense Fund v. Paty, 73 Haw.578, 1992).

Act 50, enacted by the Legislature of the State of Hawai`i (2000) with House Bill 2895, relating to Environmental Impact Statements, proposes that:

> ...there is a need to clarify that the preparation of environmental assessments or environmental impact statements should identify and address effects on Hawaii's culture, and traditional and customary rights...[H.B. NO. 2895].

Act 50 requires state agencies and other developers to assess the effects of proposed land use or shore line developments on the "cultural practices of the community and State" as part of the HRS Chapter 343 environmental review process (2001). Its purpose has broadened, "to promote and protect cultural beliefs, practices and resources of native Hawaiians [and] other

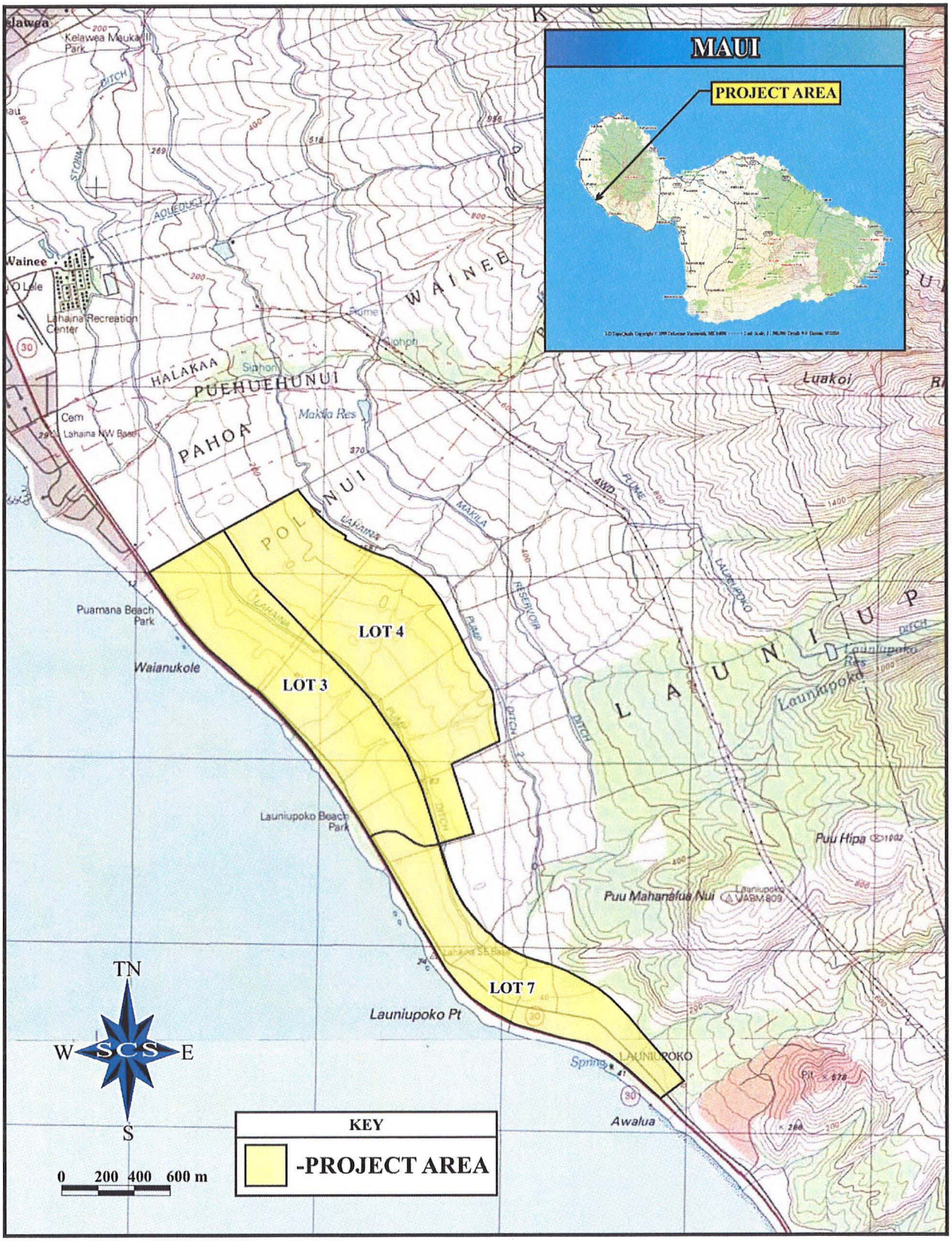

Figure 1: USGS Quadrangle Map Showing Project Area.

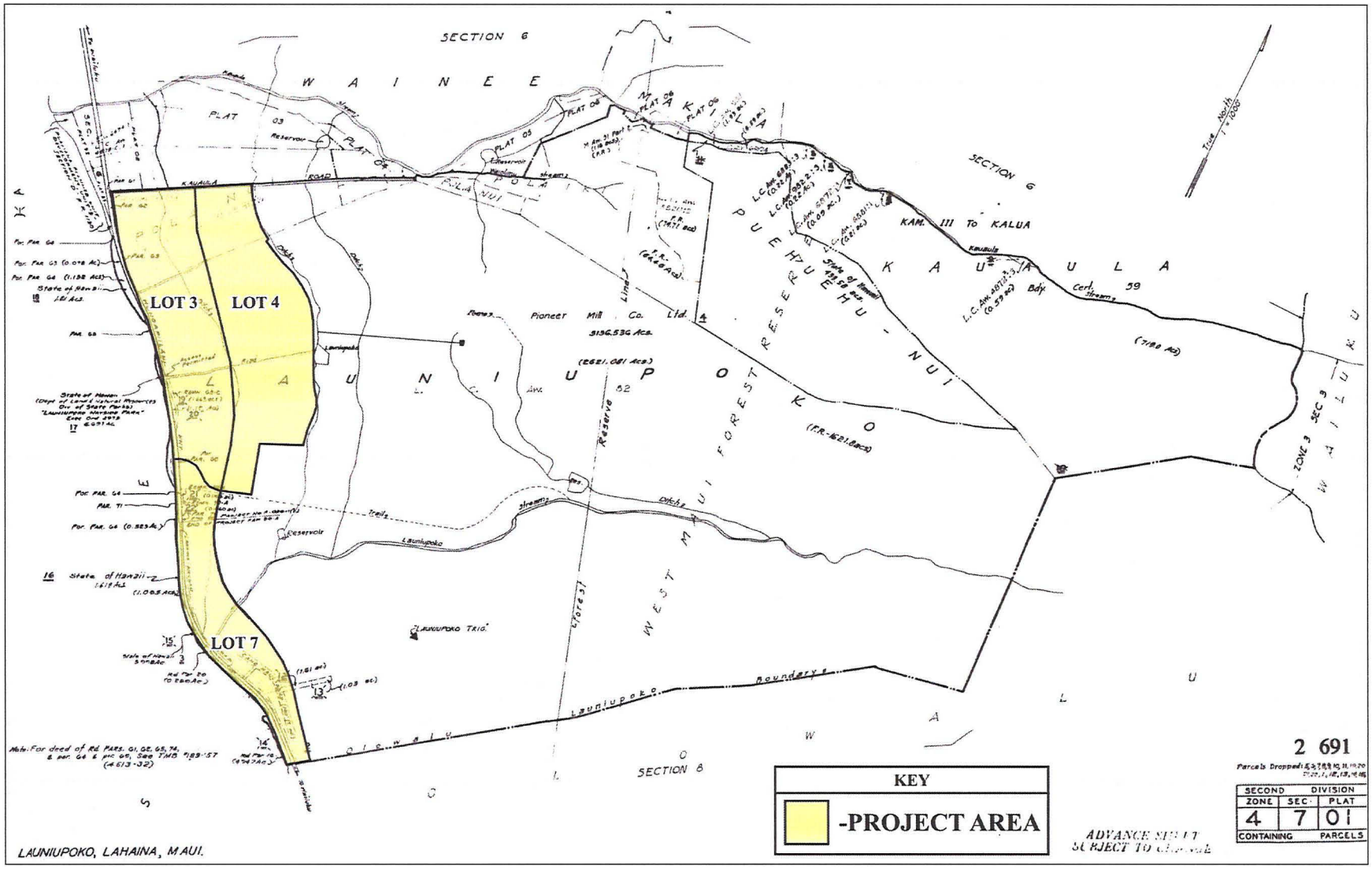

Figure 2: Tax Map Key [TMK] Showing Project Area.

ethnic groups. Cultural resources include a broad range of often overlapping categories, including places behaviors, values, beliefs, objects, records, stories, etc. (H.B. 2895, Act 40, 2000).

Act 50 also amended the definition of 'significant effect' to be re-defined as "the sum of effects on the quality of the environment including actions that are...contrary to the State's environmental policies...or adversely affect the economic welfare, social welfare, or cultural practices of the community and State" (H.B. 2895, Act 50, 2000). Thus, not only are native Hawaiian cultural resources evaluated, but those of other ethnic groups as well.

Act 50 requires that an assessment of cultural practices be included in the Environmental Assessments and the Environmental Impact Statements, and to be taken into consideration during the planning process. The concept of geographical expansion is recognized by using, as an example, "the broad geographical area, e.g. district or *ahupua`a*" (OEQC 1997). It was decided that the process should identify 'anthropological' cultural practices, rather than 'social' cultural practices. For example, *limu* (edible seaweed) gathering would be considered an anthropological cultural practice, while a modern-day marathon would be considered a social cultural practice.

According to the Guidelines for Assessing Cultural Impacts established by the Hawaii State Office of Environmental Quality Control (OEQC 1997):

> The types of cultural practices and beliefs subject to assessment may include subsistence, commercial, residential, agricultural, access-related, recreational, and religions and spiritual customs. The types of cultural resources subject to assessment may include traditional cultural properties or other types of historic sites, both manmade and natural which support such cultural beliefs.

This Cultural Impact Assessment involves evaluating the probability of impacts on identified cultural resources, including values, rights, beliefs, objects, properties, records, and stories occurring within the project area and its vicinity (H.B. 2895, Act 50, 2000).

METHODOLOGY

This Cultural Impact Assessment was prepared in accordance with the methodology and content protocol provided in the Guidelines for Assessing Cultural Impacts (OEQC 1997). In outlining the "Cultural Impact Assessment Methodology", the OEQC states: that "...information

may be obtained through scoping, community meetings, ethnographic interviews and oral histories…" (1997).

This report contains archival and documentary research, as well as communication with organizations having knowledge of the project area, its cultural resources, and its practices and beliefs. This Cultural Impact Assessment was prepared in accordance with the methodology and content protocol provided in the Guidelines for Assessing Cultural Impacts (OEQC 1997). The assessment concerning cultural impacts should address, but not be limited to, the following matters:

(1) a discussion of the methods applied and results of consultation with individuals and organizations identified by the preparer as being familiar with cultural practices and features associated with the project area, including any constraints of limitations which might have affected the quality of the information obtained;

(2) a description of methods adopted by the preparer to identify, locate, and select the persons interviewed, including a discussion of the level of effort undertaken;

(3) ethnographic and oral history interview procedures, including the circumstances under which the interviews were conducted, and any constraints or limitations which might have affected the quality of the information obtained;

(4) biographical information concerning the individuals and organizations consulted, their particular expertise, and their historical and genealogical relationship to the project area, as well as information concerning the persons submitting information or being interviewed, their particular knowledge and cultural expertise, if any, and their historical and genealogical relationship to the project area;

(5) a discussion concerning historical and cultural source materials consulted, the institutions and repositories searched, and the level of effort undertaken, as well as the particular perspective of the authors, if appropriate, any opposing views, and any other relevant constraints, limitations or biases;

(6) a discussion concerning the cultural resources, practices and beliefs identified, and for the resources and practices, their location within the broad geographical area in which the proposed action is located, as well as their direct or indirect significance or connection to the project site;

(7) a discussion concerning the nature of the cultural practices and beliefs, and the significance of the cultural resources within the project area, affected directly or indirectly by the proposed project;

(8) an explanation of confidential information that has been withheld from public disclosure in the assessment;

(9) a discussion concerning any conflicting information in regard to identified cultural resources, practices and beliefs;

(10) an analysis of the potential effect of any proposed physical alteration on cultural resources, practices, or beliefs; the potential of the proposed action to isolate cultural resources, practices, or beliefs from their setting; and the potential of the proposed action to introduce elements which may alter the setting in which cultural practices take place, and;

(11) the inclusion of bibliography of references, and attached records of interviews which were allowed to be disclosed.

Based on the inclusion of the above information, assessments of the potential effects on cultural resources in the project area and recommendations for mitigation of these effects can be proposed.

ARCHIVAL RESEARCH

Archival research focused on a historical documentary study involving both published and unpublished sources. These included legendary accounts of native and early foreign writers; early historical journals and narratives; historic maps and land records such as Land Commission Awards, Royal Patent Grants, and Boundary Commission records; historic accounts; and previous archaeological project reports.

INTERVIEW METHODOLOGY

Interviews are conducted in accordance with Federal and State laws and guidelines. Individuals and/or groups who have knowledge of traditional practices and beliefs associated with a project area or who know of historical properties within a project area are sought for consultation. Individuals who have particular knowledge of traditions passed down from preceding generations and a personal familiarity with the project area are invited to share their relevant information. Often people are recommended for their expertise, and indeed, organizations, such as Hawaiian Civic Clubs, the Island Branch of Office of Hawaiian Affairs, historical societies, Island Trail clubs, and Planning Commissions are depended upon for their recommendations of suitable informants. These groups are invited to contribute their input, and suggest further avenues of inquiry, as well as specific individuals to interview.

If knowledgeable individuals are identified, personal interviews are sometimes taped and then transcribed. These draft transcripts are returned to each of the participants for their review and comments. After corrections are made, each individual signs a release form, making the information available for this study. When telephone interviews occur, a summary of the information is often sent for correction and approval, or dictated by the informant and then incorporated into the document. Key topics discussed with the interviewees vary from project to project, but usually include: personal association to the *ahupua`a*; land use in the project's vicinity; knowledge of traditional trails, gathering areas, water sources, religious sites; place names and their meanings; stories that were handed down concerning special places or events in the project area; or any evidence of previous activities identified while in the project vicinity.

In this case, initial letters, briefly outlining the development plans along with maps of the project area, were sent to organizations whose jurisdiction should include knowledge of the area with an invitation for consultation. Consultation was sought from the Maui Office of Hawaiian Affairs, Community Resource Coordinator, Maui (Thelma Shimaoka); the Office of Hawaiian Affairs, O`ahu (Lance Foster); Planning Director for the Maui Planning Department (Michael Foley); the Lahaina Chapter of the Hawaiian Civic Club (Holuamoku Ralar); the Cultural Historian with the State Historic Preservation Division (SHPD, Hinano Rodrigues), Maui Office (SHPD); and Nā Kupuna O Maui (Patsy Nishiyama). If cultural resources are identified based on the information received from these organizations and additional informants, an assessment of the potential effects on the identified cultural resources in the project area and recommendations for mitigation of these effects can be conducted.

PROJECT AREA AND VICINITY

Launiupoko Ahupua`a is bordered from north to northeast by Polanui, Polaiki, and Pūehuehunui Ahupua`a on the north and Olowalu Ahupua`a on the south. Literally translated Launiupoko means "short coconut leaf" (Pukui *et al.* 1974:130). The project area consists of "undeveloped" land located on the western slopes of the West Maui range situated between coastal areas to the west and mountainous terrain to the east. The land is "undeveloped" per current housing but has been formerly developed through sugar cane cultivation. The majority of the project area falls within the bounds of Launiupoko Ahupua`a. The northern portion of the project area extends into the southern half of Polanui Ahupua`a.

Mostly within abandoned agricultural fields, the project area was a 2.5 mile, 160 ft. wide corridor that extended toward Lahaina from the former Olowalu Landfill northwest to Puamana (Figures 3 and 4). Although this entire section of bypass corridor falls within lands already subjected to an archaeological survey, Makila and SCS agreed that a follow-up field inspection (conducted in October 2006) would focus on the proposed corridor, and ensure that no undocumented archaeological sites would be present or impacted during bypass construction.

A previous Archaeological Inventory Survey was conducted by SCS on 633 acres of undeveloped Launiupoko (Large Lot) Subdivision No. 3, 4, & 7, (Paraso and Dega 2006). This project involved full systematic survey of the entire parcel, mapping and recording of identified sites and features, and limited testing. Most importantly, Paraso and Dega's study covered 100 percent of the current project area (Figure 3). This former SCS work is particularly relevant to

the follow-up field inspection, as no new sites were found and all archaeological sites within a 30 ft. radius of the proposed bypass were previously documented by Paraso and Dega (2006).

Of the three previously recorded sites within the project area, two have been fully documented as Criterion D sites (Paraso and Dega 2006), and no further work has been recommended. This assessment was agreed with as the report was accepted by the SHPD (Log No.:2006.3593; Doc No.: 0611MK07). The monitoring required at Site 50-50-03-5950 (Features 1, 12, 13, 15, and/or 16) will be the responsibility of Makila or the developer first in need of deconstructing these features. If, by the time earth-moving procedures on the Lahaina bypass begin, several other mound features have been monitored with negative results, SHPD may be consulted to determine the possibility of not monitoring some or all of the mounds that fall within the Lahaina bypass corridor.

Launiupoko is known to be rocky and dry, as rainfall is scarce. In *The Hawaiian Planter*, Handy states that:

> Although there is a sizable stream bed and a deep valley here, there is no visible evidence of wet taro cultivation, and the Hawaiian planters at Olowalu say that *lo`i* never existed in Launiupoko. It is possible that there may have been a few terraces on the level land at the base of the valley, but this is wholly arid land now and covered with dense brush [Handy 1940:103].

According to Handy and Handy (1972:272), the Lahaina District is "flanked by excellent fishing grounds." Although there appears to be few legends pertaining to the Launiupoko area, a search of the literature reveals several references indicating the importance of fishing in Launiupoko Ahupua`a. In *Sites of Maui,* Sterling (1998:27) quotes A.D. Kahaulelio from an article titled "Fishing Lore," *Ka Nupepa Kuokoa*, May 30, 1902, as saying "[t]he schools of *nehu* [*Stolephorus Purpureus,* an important bait fish used to catch tuna] were accustomed to coming in to Launiupoko and Keonepoko in the District of Lahaina, and sometimes at Mala." Kahaulelio also wrote the following about shark fishing in the area:

> Hoomoemoe Fishing for Sharks—It was much practiced by old timers of this ahupua`a of Makila, and also by the people of the upland of Kauaula since we were children...The kinds of sharks caught by the hoomoemoe method were lalakea and hammerheads...the place where hoomoemoe fishing was done was at Pahee, in Launiupoko, Lahaina. When you arrive at the little cape of Keahuiki and down the small incline, the first stretch you come to extending over to the rocky beach and adjoining with the sand on the left side, that is the place where the nets were laid [Sterling 1998:27].

CULTURAL AND HISTORICAL CONTEXT

The island of Maui ranks second in size of the eight main islands in the Hawaiian Archipelago. Pu`u Kukui, forming the west end of the island (1,215 m amsl), is composed of large, heavily eroded amphitheater valleys that contain well-developed, permanent stream systems that water fertile agricultural lands extending to the coast. The deep valleys of West Maui and their associated coastal regions have been witness to many battles in ancient times and were coveted productive landscapes.

PAST POLITICAL BOUNDARIES

Traditionally, the division of Maui's lands into districts (*moku*) and sub-districts was performed by a *kahuna* (priest, expert) named Kalaiha`ōhia, during the time of the *ali`i* Kaka`alaneo (Beckwith 1940:383; Fornander places Kaka`alaneo at the end of the 15th century or the beginning of the 16th century [Fornander 1919-20, Vol. 6:248]). Land was considered the property of the king or *ali`i `ai moku* (the *ali`i* who eats the island/district), which he held in trust for the gods. The title of *ali`i `ai moku* ensured rights and responsibilities to the land, but did not confer absolute ownership. The king kept the parcels he wanted, his higher chiefs received large parcels from him and, in turn, distributed smaller parcels to lesser chiefs. The *maka`āinana* (commoners) worked the individual plots of land.

In general, several terms, such as *moku*, *ahupua`a*, *`ili* or *`ili`* ā*ina* were used to delineate various land sections. A district (*moku*) contained smaller land divisions (*ahupua`a*) which customarily continued inland from the ocean and upland into the mountains. Extended household groups living within the *ahupua`a* were therefore, able to harvest from both the land and the sea. Ideally, this situation allowed each *ahupua`a* to be self-sufficient by supplying needed resources from different environmental zones (Lyons 1875:111). The *`ili `āina*, or *`ili*, were smaller land divisions and were next to importance to the *ahupua`a*. They were administered by the chief who controlled the *ahupua`a* in which it was located (*ibid*: 33; Lucas 1995:40). The *mo`o`āina* were narrow strips of land within an *`ili*. The land holding of a tenant or *hoa `āina* residing in an *ahupua`a* was called a *kuleana* (Lucas 1995:61). The project area is located in the *ahupua`a* of Olowalu, meaning literally "many hills" (Pukui *et al.* 1974:170).

TRADITIONAL SETTLEMENT PATTERNS

Archaeological settlement pattern data indicates that initial colonization and occupation of the Hawaiian Islands first occurred on the windward shoreline areas of the

main islands between the A.D. 4th and 11th centuries, with populations eventually settling in drier leeward areas during later periods (Kirch 1985). Although coastal settlement was dominant native Hawaiians began cultivating and living in the upland *kula* zones. Greater population expansion to inland areas began between A.D. 11th and 12th centuries and continued through the 16th century. Large scale or intensive agriculture was implemented in association with habitation, religious, and ceremonial activities.

The Hawaiian economy was based on agricultural production and marine exploitation, as well as raising livestock and collecting wild plants and birds. Extended household groups settled in various *ahupua`a*. During pre-Contact times, there were primarily two types of agriculture, wetland and dry land, both of which were dependent upon geography and physiography. River valleys provided ideal conditions for wetland *kalo* (*Colocasia esculenta*) agriculture that incorporated pond fields and irrigation canals. Other cultigens, such as *kō* (sugar cane, *Saccharum officinaruma*) and *mai`a* (banana, *Musa* sp.), were also grown and, where appropriate, such crops as *`uala* (sweet potato, *Ipomoea batatas*) were cultivated. This was the typical agricultural pattern seen during traditional times on all the Hawaiian Islands (Kirch and Sahlins 1992, Vol. 1:5, 119; Kirch 1985). Agricultural development on the leeward side of Maui was likely to have begun early in what is known as the Expansion Period (A.D. 1200-1400, Kirch 1985).

Most of the *ahupua`a* on the southern coast have been overshadowed by the famous roadstead and village of Lāhainā which served as the capitol of the Hawaiian Kingdom after the conquest of Kamehameha until 1855. The ethnographic and historic literature, often our only link to the past, reveals that the lands around Lāhainā were rich agricultural areas irrigated by aqueducts originating in well-watered valleys with permanent occupation predominately on the coast. A number of traditional activities took place in this district from fishing and cultivation by early Hawaiians to residential and recreational use by the *ali`i* (ruling) class. The district served as an important center both politically and socially during the late prehistoric and early historic period. It was the royal chiefly center for centuries (Thrum 1908, 1916, 1917; Walker 1981; Kirch 1985; Kamakau 1992; Sterling 1998) and played a key role in the intra-island warfare associated with island unification. By the late 1700s, Kamehameha I had firmly established his presence on Maui with the invasion of Lāhainā. By the early 1800s, Kamehameha I designated Lāhainā the capital of the Hawaiian Kingdom.

The District of Lāhainā extended from Honokohau Ahupua`a on the north to Ukumehame Ahupua`a on the south. Handy and Handy have stated the space cultivated by the natives of Lāhainā District at about "...three leagues [9 miles] in length, and one in its greatest breadth. Beyond this all is dry and barren; everything recalls the image of desolation" (1972:593). Crops cultivated included coconut, breadfruit, paper mulberry, banana, taro, sweet potato, sugar cane, and gourds.

Lāhainā served as the capital until 1850 when it was moved to Honolulu. In 1819, the first whaling ship Bellina arrived in what would later be known as Lāhainā Harbor. Lāhainā served as the center of commercial whaling in the Pacific until the mid-1800s. After the decline of the whaling industry, Lāhainā and surrounding areas became a base for sugarcane plantations. Most recently tourism is the main industry in Lāhainā.

THE GREAT MĀHELE

In the 1840s, traditional land tenure shifted drastically with the introduction of private land ownership based on western law. While it is a complex issue, many scholars believe that in order to protect Hawaiian sovereignty from foreign powers, Kauikeaouli (Kamehameha III) was forced to establish laws changing the traditional Hawaiian economy to that of a market economy (Kame`eleihiwa 1992:169-70, 176; Kelly 1983:45, 1998:4; Daws 1968:111; Kuykendall 1938 Vol. I: 145). The Great Māhele of 1848 divided Hawaiian lands between the king, the chiefs, the government, and began the process of private ownership of lands. The subsequently awarded parcels were called Land Commission Awards (LCAs). Once lands were made available and private ownership was instituted, the *maka`āinana*, if they had been made aware of the procedures, were able to claim the plots on which they had been cultivating and living. These claims did not include any previously cultivated but presently fallow land, *`okipū* (on O`ahu), stream fisheries, or many other resources necessary for traditional survival (Kelly 1983; Kame`eleihiwa 1992:295; Kirch and Sahlins 1992). If occupation could be established through the testimony of two witnesses, the petitioners were awarded the claimed LCA and issued a Royal Patent after which they could take possession of the property (Chinen 1961:16).

Launiupoko Ahupua`a is bordered from north to northeast by Polanui, Polaiki, and Pūehuehunui Ahupua`a on the north and Olowalu Ahupua`a on the south. Literally translated Launiupoko means "short coconut leaf" (Pukui *et al.* 1974:130).

The Waihona `Aina database (2006) compiles land ownership data from the Indices of Awards (Indices 1929), Native Register (NR n.d.), Native Testimony (NT n.d.), Foreign Register (FR n.d.), and Foreign Testimony (FT n.d.). The database lists only one claim for Launiupoko. The entire *ahupua`a* of Launiupoko consisting of 3,778 acres was awarded to Thomas Phillips (Royal Patent 1358 LCA 82); no *kuleana* lands were awarded within the *ahupua`a*. This LCA proved to be somewhat controversial as Kekauluohi (Kamehameha III) made a stipulation that "this land shall not be conveyed to a *haole* and one who does not reside in Hawai`i." With the exception of 66 acres of *kuleana* parcels, all 377 acres of Polanui (large Pola) Ahupua`a was awarded to William C. Lunalilo (Royal Patent 8395 LCA 8559-B, Apana 25). None of the awarded land was in the present project area.

Sugar was to be the economic future of Hawai`i and as early as 1828, two Chinese brothers, Ahung and Atai, of Honolulu's Hungtai Company arrived in Wailuku to explore the possibility of setting up one of its earliest sugar mills. Atai soon created a plant that processed sugar cane cultivated by Hawaiians, named the Hungtai Sugar Works (Dorrance and Morgan 2000:15–16). Ahung later joined Kamehameha III's sugar producing enterprise, although by 1844 both operations had ceased. The Wailuku Sugar Company was the next to follow, in 1862, and would expand sugar production over the next 126 years of its existence—4,450 acres by 1939. Land use in Launiupoko Ahupua`a in the mid 19th and early 20th century was largely devoted to the sugar industry. The Pioneer Mill Company was founded in 1860 by James Campbell, Henry Thurton, and James Dunbar. In 1864, Benjamin Pittman acquired lands in Launiupoko which he deeded to Campbell, Thurton, and Dunbar. In 1885, Thurton constructed a railroad system to transport sugarcane from the fields to the mill in Lahaina (Condé and Best 1973). One railroad line crosses through the northeast portion of Laniupoko and the other follows the coastline.

Between 1885 and 1895 the mill changed hands three times before finally falling under the control of Homer and Isenberg who incorporated the mill in 1895 (Goodwin and Leineweber 1997). Homer and Isenberg's agent was H. Hackfield Co. which later became Amfac, Inc.

In 1900, when the Pioneer Mill Company was reorganized, the plantation controlled a total of 12,500 acres. Although the land was believed to be "...the rockiest of the irrigated plantations in Hawaii..." the Pioneer Mill Company developed an

extensive and powerful irrigation and water collection system, consisting of tunnels, ditches, and flumes that extended into the valleys of the West Maui Mountains, including Launiupoko (Graves *et al.* 1998). The terrains rockiness required that the land be cultivated by hand (Gilmore 1936). The cleared rocks were used to construct walls that formed banks of the cane row and the areas between the walls were softened and planted. The soil beneath the rocks was very fertile and produced good yields. However, by 1930, the fields at Launiupoko were no longer used for sugarcane cultivation due to labor shortages and the difficulty associated with working such rocky fields (Graves *et al.* 1998). Thereafter, the fields were used for cattle grazing by the Pioneer Mill Company. A 1939 Pioneer Mill Company map of Launiupoko shows the old field designations, as well as, the ditches and reservoirs, including Lahaina Pump Ditch No. 1 which traverses the project area.

SUMMARY

The "level of effort undertaken" to identify potential effect by a project to cultural resources, places or beliefs (OEQC 1997) has not been officially defined and is left up to the investigator. A good faith effort can mean contacting agencies by letter, interviewing people who may be affected by the project or who know its history, research identifying sensitive areas and previous land use, holding meetings in which the public is invited to testify, notifying the community through the media, and other appropriate strategies based on the type of project being proposed and its impact potential. Sending inquiring letters to organizations concerning development of a piece of property that has already been totally impacted by previous activity and is located in an already developed industrial area may be a "good faith effort". However, when many factors need to be considered, such as in coastal or mountain development, a good faith effort would undoubtedly mean an entirely different level of research activity.

In the case of the present parcel, letters of inquiry were sent to organizations whose expertise would include the project area. Consultation was sought from the Maui Office of Hawaiian Affairs, Community Resource Coordinator, Maui (Thelma Shimaoka); the Office of Hawaiian Affairs, O`ahu (Lance Foster); Planning Director for the Maui Planning Department; the Lahaina Chapter of the Hawaiian Civic Club (Holuamoku Ralar); the Cultural Historian with the State Historic Preservation Division (Hinano Rodrigues), Maui Office (SHPD); and Nā Kupuna O Maui (Patsy Nishiyama). Additional individuals familiar with the Lahaina and Laniupoko region were

recommended and then contacted by phone for an informal interview concerning the possibility of cultural activities within the project area. These individuals included, Ke`eaumoku and U`ilani Kapu with Kuleana Ku`ikāhi, LLC; and Clifford Nae`ole, Cultural Advisor for the Ritz Carlton Kapalua.

Historical and cultural source materials were extensively used and can be found listed in the References Cited portion of the report. Such scholars as I`i, Kamakau, Beckwith, Chinen, Kame`eleihiwa, Fornander, Kuykendall, Kelly, Handy and Handy, Puku`i and Elbert, Thrum, Sterling, and Cordy have contributed, and continue to contribute to our knowledge and understanding of Hawai`i, past and present. The works of these and other authors were consulted and incorporated in the report where appropriate. Land use document research was supplied by the Waihona `Aina 2005 Data base.

CIA INQUIREY RESPONSE

As suggested in the "Guidelines for Accessing Cultural Impacts" (OEQC 1997), CIAs incorporating personal interviews should include ethnographic and oral history interview procedures, circumstances attending the interviews, as well as the results of the consultation. It is also permissible to include organizations with individuals familiar with cultural practices and features associated with the project area.

Analysis of the potential effect of the project on cultural resources, practices or beliefs, its potential to isolate cultural resources, practices or beliefs from their setting, and the potential of the project to introduce elements which may alter the setting in which cultural practices take place is a requirement of the OEQC (No. 10, 1997). It does not appear that the project area has been used for traditional cultural purposes within recent times.

As stated above, consultation was sought from the Maui Office of Hawaiian Affairs, Community Resource Coordinator, Maui; the Office of Hawaiian Affairs, O`ahu; Planning Director for the Maui Planning Department; the Lahaina Chapter of the Hawaiian Civic Club; the Cultural Historian with the State Historic Preservation Division, Maui Office (SHPD); and Nā Kupuna O Maui. Attempts were made to contact other individuals familiar with the Laniupoko region concerning the possibility of cultural activities within the project area. These individuals included, Ke`eaumoku and U`ilani Kapu with Kuleana Ku`ikāhi, LLC and Clifford Nae`ole, Cultural Advisor for the Ritz Carlton Kapalua.

From a total of nine contacts, five responses were received. These included the Office of Hawaiian Affairs, O`ahu Branch; SHPD Cultural Historian (both suggesting additional contacts); the Hawaiian Civic Club, Lahaina Chapter; Nā Kupuna O Maui and Cultural Advisor, Cifford Nae`ole.

Nā Kupuna O Maui and Cifford Nae`ole were not aware of any cultural activities associated with the proposed Southerly/Mauka Extension. Representatives from the Lahaina Hawaiian Civic Club met twice with Mr. Rory Frampton, Land Planner for Makila Land Co., LLC to discuss the proposed project and for a site inspection. As a result, the Lahaina Civic Club stated they were not aware of any sensitive cultural sites or activity areas . . . within the proposed corridor" (pers. Comm.. February 1, 2007). They stated:

> Overall we are supportive of the proposed extension since it could lead to an opening up or expansion of coastal areas. The shoreline between Launiupoko and Awalua contains many resources which are critical for the continuance of traditional and customary native Hawaiian practices (pole fishing, diving, collecting limu, camping, etc.).[*Ibid.*]

Howevever, they also felt that the proposed Bypass ". . . has the potential to inhibit opportunities for mauka/makai access. The Bypass should be designed to allow for safe mauka/makai access to the Valleys or upland areas" (*Ibid.*). The Lahaina Hawaiian Civic Club suggested incorporating pedestrian underpasses at major drainage crossings and streams since those areas would have been used as traditional *mauka/makai* access by native Hawaiians. They also noted the following concerns/recommendations pertaining to coastal use and access:

1. The current road provides continuous access and is also very scenic. The visual plain is a cultural resource often overlooked and needs to be preserved. Design plans should continue to allow vehicle access to this section of the shoreline.

2. It is important to preserve a continuous coastal road (in addition to the Bypass) as an alternative route in case of emergencies.

3. There are concerns about private control of new coastal accesses or roadways. Legal mechanisms should be in place which allows for public use in perpetuity.

CULTURAL ASSESSMENT AND RECOMMENDATIONS

Based on historical research and those responses received from the Hawaiian Civic Club, Lahaina Chapter; Nā Kupuna O Maui; and Cultural Advisor, Cifford Nae`ole, it is reasonable to conclude that pursuant to Act 50, the exercise of native Hawaiian rights, or any ethnic group, related to gathering, access, or other customary activities, will not be affected by development activities along the proposed southern/mauka bypass extension. . Because there were no specific cultural activities identified within the project area, there are no adverse effects

However, it is recommended that comments and suggestions offered by the Lahaina Chapter of the Hawaiian Civic Club be seriously considered and steps taken to mitigate their concerns for underpasses for *mauka* and *makai* access, preservation of visual plain and old coastal road, as well as legal assurance for public use in perpetuity.

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APPENDIX H.

Traffic Impact Assessment Report

TRAFFIC IMPACT ANALYSIS REPORT

for

The Proposed Relocation of the Southern Terminus of the Lahaina Bypass Highway

Prepared for:

Makila Land Company, LLC.

November 2009

Prepared By

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TRAFFIC IMPACT ANALYSIS REPORT

FOR

THE PROPOSED RELOCATION OF THE SOUTHERN TERMINUS OF THE LAHAINA BYPASS HIGHWAY

LAHAINA, HAWAI'I

November 2009

PREPARED FOR:

Makila Land Company, LLC.

PREPARED BY:

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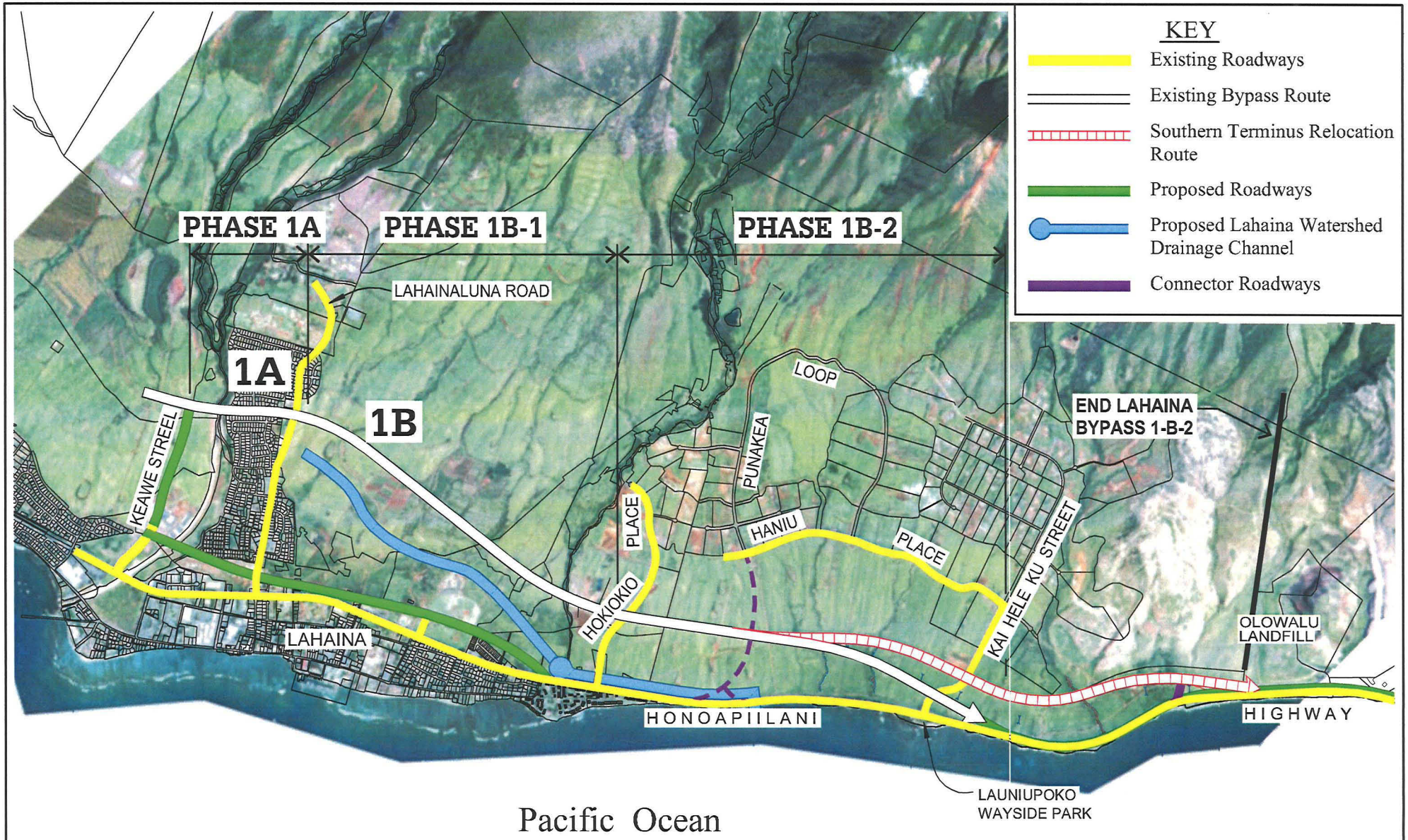
TRAFFIC IMPACT ANALYSIS REPORT
FOR THE PROPOSED RELOCATION OF THE SOUTHERN TERMINUS OF THE LAHAINA BYPASS HIGHWAY

I. PURPOSE AND METHODOLOGY OF STUDY

The State of Hawaii Department of Transportation (HDOT), in coordination with the Federal Highway Administration (FHWA), is proposing the relocation of the southern terminus of the Lahaina Bypass from its currently approved location south of Launiupoko Beach Park to the vicinity of the former Olowalu Landfill site. The proposed terminus would be shifted to the south by approximately 4,800 feet as shown on Figure 1. The basic configuration of the Lahaina Bypass in terms of functional traffic flow would not change. Two alternative routes have been proposed whose routes would terminate at the same location, just north of the former Olowalu Landfill.

This study was conducted to analyze the traffic impacts of the proposed project in the planning years 2020 and 2035 and recommend conceptual designs for five intersections. Traffic forecasts were developed for both planning years and assigned to the study networks. A level of service analysis was conducted on the conceptual designs to identify traffic impacts and develop mitigating measures. The study area limits were the proposed Puamana Connector as the northern boundary and the southern terminus of the bypass highway with Honoapi'ilani Highway near Olowalu.



Source: Warren S. Unemori Engineering, Inc.

FIGURE 1

Proposed Lahaina Bypass Southern Terminus Relocation

Intial Construction Phases for the Lahaina Bypass

SCALE: 1 IN. = 3000 FT.

Prepared For: State of Hawaii, Department of Transportation

II. PROJECT BACKGROUND

The HDOT has been planning and implementing a wide range of transportation projects to mitigate the current and forecast traffic congestion on West Maui. They have used the recommendations of the Maui Long-Range Land Transportation Plan (February 1997) as a guide in implementing improvements. Two key components of the plan include the widening of Honoapli'ilani Highway and the implementation of the Lahaina Bypass Highway. The HDOT has completed the widening of Honoapli'ilani Highway from Kaanapali Parkway to Honokowai Stream and the modernization and synchronization of nine traffic signals from Leiali'i Parkway to Shaw Street. They have completed the final design for widening the highway from Dickenson Street to Aholo Road and construction was initiated in October, 2009

The HDOT initially proposed a Lahaina Bypass route between Puamana and Kaanapali. The widening of Honoapli'ilani Highway from Kaanapali to Honokowai was part of this action. The Record of Decision (ROD) for the Environmental Impact Statement (EIS) of this initial project was approved by the FHWA in June, 1991.

The HDOT subsequently modified the project to extend the northern terminus for the bypass route from Kaanapali to Honokowai and to extend the southern terminus from Puamana to Launiupoko. The amended project included several connector and access roadways, and was referred to as the Lahaina Bypass Modified Project in the Supplemental EIS. The ROD for the Final Supplemental EIS was approved by the FHWA in October 2003. The HDOT is now implementing the Lahaina Bypass Highway in phases. The design-build contract for Phase 1A from Keawe Street Extension to Lahainaluna Road was awarded in January 2007 and the two year construction phase began in January 2009. The design contract for Phase 1B-1 from Lahainaluna Road to Hokiokio Place is estimated for completion in late 2009, with the three year construction phase expected to begin in mid 2010. Design and construction of later phases will follow.

A long range goal of HDOT is to provide additional corridor capacity in West Maui to meet the region's rapid population growth. The Lahaina Bypass Highway is a key project to reaching this goal. Since completion of the ROD in 2003, the HDOT in coordination with the FHWA, is proposing the relocation of the southern terminus of the Lahaina Bypass from Launiupoko to the vicinity of the Olowalu Landfill about 4,800 feet to the south. The proposed action complements the HDOT's ongoing Honoapi'ilani Highway Widening/ Realignment, Maalaea to Launiupoko project, which is studying options for providing needed highway capacity between these two points. The project objectives could be achieved either via widening or realignment of the highway, including a new inland alignment between the Pali and Launiupoko. The proposed relocation of the southern terminus advances the objectives of the current study by establishing a viable point of connection for the next phase of work.

III. PROPOSED ALTERNATIVES

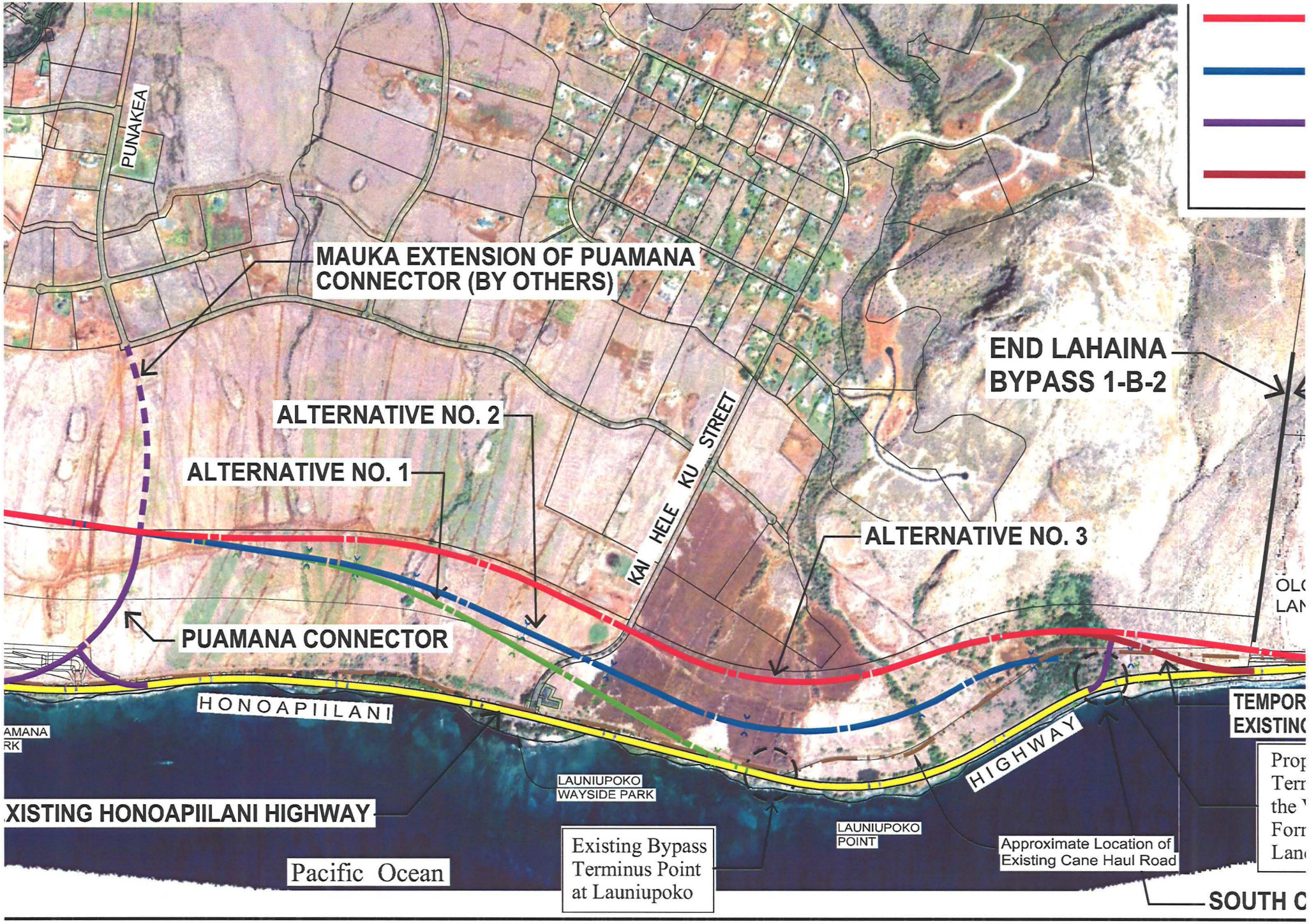
Three alternative alignments for the southern terminus of the Lahaina Bypass Highway have been proposed:

1. The approved alignment intersects Honoapi'ilani Highway south of the Launiupoko Wayside Park.

2. The County proposed Pali to Puamana (P2P) alignment is approximately midway between the mauka alignment and existing highway and continues south on a mauka alignment to Ma'alaea. For the purposes of this study, it would intersect Honoapi'ilani Highway north of the former Olowalu landfill.

3. The preferred mauka alignment intersects Honoapi'ilani Highway in the vicinity of the former Olowalu Landfill in the same location as alternative number 2.

The three alternative alignments are shown on Figure 2. Alternative numbers 2 and 3 would require relocating the southern terminus of the Lahaina Bypass Highway from its currently approved location by Launiupoko Beach Park to about 4,800 feet south. This relocation would result in a more inland alignment for the southerly segment of roadway. There would be no additional intersections or connector roads with the proposed relocation, and no changes in terms of functional traffic flow. The mauka alignment of alternative number 3 would intersect with Kai Hele Ku Street at a location that provides better design features with Kai Hele Ku Street compared to the first two alternative alignments.



Proposed Lahaina Bypass Southern Terminus Relocation

IV. HIGHWAY NETWORK DESCRIPTION

The entire Lahaina Bypass Highway would be completed as a two-lane highway from its northern terminus in Honokowai to its southern terminus by year 2020. The bypass highway would be widened to four lanes by year 2035. It should be noted that the 2003 ROD stated, "A four (4) lane wide Lahaina Bypass Road between Launiupoko and Honokowai, will be required to accommodate the Year 2020 Traffic Projections with the planned roadway projects and the known developments." The ideal (maximum) capacity of a two-lane highway is about 1700 vehicles per lane each way and 3200 vehicles per hour for both lanes, per the Highway Capacity Manual (2000) published by Transportation Research Board. These highway lane capacities were assumed for the 2020 study network.

This study indicated the need for four highway lanes in the study area in 2020. Two assumptions were made in order to provide four lanes of highway capacity in 2020. First, it was assumed that the existing section of Honoapiilani Highway between the Puamana Connector and the southern terminus would remain in operation. Also, it was assumed that the section of Honoapi'ilani Highway south of the southern terminus would have four lanes. These assumptions are discussed in further detail below.

The HDOT and County of Maui had planned to convert the current section of Honoapi'ilani Highway between the Puamana Connector and the south terminus of the bypass highway into a local recreational roadway when the bypass highway is completed and not allow through traffic. This was to enhance coastal recreational opportunities and to mitigate coastal erosion problems. For the purposes of this study, this section of highway was assumed to remain in operation until the bypass highway was expanded to four lanes in 2035 to provide four highway lanes in the study area.

The section of Honoapi'ilani Highway south of the bypass highway southern terminus is planned as having two lanes in 2020. This study assumed that a portion of the current highway immediately south of bypass highway intersection would be widened to four lanes by 2020 to accommodate the traffic volumes forecast for this study. If the highway were not widened, there would be long periods of congested traffic flows through the day. The volume of northbound traffic reaching the bypass highway would be constrained by the capacity of the two lane highway and would be lower than the volumes shown in these forecasts. Similarly, southbound traffic would back up from the two lane section into the bypass highway and create lower traffic volumes than forecast.

The current Honoapi'ilani Highway Widening/ Realignment, Maalaea to Launiupoko project, is indicating the need for six highway lanes passing through mountainous terrain within their study area in 2035. This capacity could be provided with one six-lane facility or two or more separate facilities. This finding also implies that the two-lane section of Honoapi'ilani Highway between the Puamana Connector and the southern terminus would need to remain open. This study found that the four lane bypass highway passing through rolling terrain would provide sufficient capacity within this study area. Two alternative highway networks were developed for 2035 to account for this difference

of findings. The baseline network assumed four highway lanes in the study area while the alternative provided six lanes of highway north of the southern terminus, which assumed that Honoapi'ilani Highway would remain open between the Puamana Connector and the southern terminus. It was assumed that the section of the Lahaina Bypass Highway between the Puamana Connector and southern terminus would have a 55 mile per hour (mph) design speed, the same as for Phase 1B-1 of the bypass.

The Puamana Connector would be a new mauka-makai roadway providing access between the bypass highway and the portion of Honoapi'ilani Highway entering Lahaina town from the south. The general location of the makai intersection of this new roadway would be in the vicinity of the Puamana Beach Park. The Puamana Connector would be extended mauka of the bypass highway to provide access to existing and proposed mauka development. The 2003 ROD indicated that this roadway "would be constructed by others." It was assumed that the section of the Puamana Connector below the bypass and the section of Honoapi'ilani Highway north to Lahaina would also have a 55 mph design speed.

The two alternative routes which are being considered for the Puamana Connector are identified on Figure 2. The north alternative would align with Hokiokio Place that serves a mauka community of about 25 parcels. Punakea Loop would have to be extended makai to connect with Honoapi'ilani Highway to provide access for new residential units planned for that mauka area. From Honoapiilani Highway vehicles from Punakea Loop could access the Puamana Connector at Hokiokio Place. Punakea Loop would pass beneath the bypass highway and not intersect with it. The second alternative would align the connector road with Punakea Loop and serve most of the new proposed housing in the mauka area. A connector roadway would have to be built between Hokiokio Place and Punakea Loop mauka of the bypass highway so that the residents in the former subdivision could reach the connector roadway. Only one of the alternatives can intersect the access-controlled bypass highway due to their proximity to each other.

This study prepared network-wide traffic forecasts assuming the Punakea Loop alignment for the Puamana Connector since it is forecast to handle the higher volume of traffic. A supplemental analysis included only the two intersections of the Pumana Connector with the Hokiokio Place alignment. Although both alternative networks would have different volumes at each intersection, the differences would be greatest at these two intersections. The supplemental analysis limited its scope to the year 2020 forecast and year 2035 forecast with 33% diversion for comparison purposes.

Kai Hele Ku Street currently intersects Honoapi'ilani Highway as a signalized intersection. The mauka segment of this private roadway serves several mauka communities while the segment makai of Honoapi'ilani Highway serves the Launiupoko Wayside Park. The proposed bypass highway would create a new intersection on the mauka segment of Kai Hele Ku Street for all 2020 and 2035 alternatives. The mauka alignment (Alternative 3) of the bypass roadway would intersect with Kai Hele Ku Street at a location that provides for better design features with Kai Hele Ku Street compared to the approved (Alternative 1) or the P2P (Alternative 2) alignments.

The five study intersections of the preferred mauka alternative are identified on Figure 2:

1. Lahaina Bypass Highway and Honoapi'ilani Highway (south)
2. Lahaina Bypass Highway and Kai Hele Ku Road
3. Lahaina Bypass Highway and Puamana Connector
4. Honoapi'ilani Highway (north) and Puamana Connector
5. Honoapi'ilani Highway and Kai Hele Ku Street

V. TRAFFIC FORECASTING METHODOLOGY

Traffic forecasts were prepared for the preferred mauka alignment for the morning and afternoon peak hours of the years 2020 and 2035. The first study year is the expected completion of the entire bypass highway as a two-lane highway and the second year is its completion as a four-lane highway. A single set of traffic assignment forecasts was made for the preferred mauka alternative. A subsequent analysis indicated that all three alternatives would have very similar traffic forecasts and that one set of forecasts was sufficient.

Austin, Tsutsumi and Associates, Inc. (ATA), who prepared the traffic forecasts for the bypass highway in the ROD, prepared baseline AM and PM peak hour forecasts at the Lahaina Bypass Highway/Puamana Connector intersection for the 2035 forecast year. These traffic forecasts are for the baseline bypass highway alignment without the existing Honoapi'ilani Highway alignment between the Puamana Connector and southern terminus intersections. The year 2035 traffic assignment forecasts were based on the "Honoapiilani Highway Widening/Realignment Maalaea to Launiupoko" Draft Traffic Technical Memorandum (April 28, 2008) by CH2MHill. These AM and PM peak hour traffic forecasts assumed there were no capacity restraints on the highway system. More than half of the forecast traffic volumes would utilize the Puamana Connector to access the makai route to Lahaina town.

The year 2035 traffic forecasts were converted to year 2030 forecasts as an intermediate step to obtaining the year 2020 traffic forecasts. The year 2035 forecasts were reduced by the 5.5% to 6% factors CH2MHill had used to convert the original 2030 forecasts prepared by ATA to obtain the 2035 forecasts for their study. The year 2030 traffic forecasts were based on the 2030 population forecasts and distributions from the "Draft Maui Island Plan" (March 2008). The 2030 peak hour forecasts were then converted to year 2020 forecasts by the ratio of 2020 to 2030 West Maui population forecasts from the draft plan.

The rate of population/traffic growth in West Maui per the draft island plan is summarized below:

YEAR	WEST MAUI POPULATION	GROWTH RATIO FROM PREVIOUS YEARS
2035	--------	1.055 to 1.06
2030	28,903	1.15
2020	25,096	1.40
2000	17,967	-----

The draft island plan does not include population forecasts for 2035. CH2MHill derived the 5.5% to 6% growth rates for 2030 to 2035 based on the growth rate from 2020 to 2030. Most of the traffic growth in the West Maui area is forecast to occur by 2020. Only a relatively slight increase in traffic would occur between 2020 and 2035 as most of the available lands would be developed by 2020.

Two additions were made to the ATA baseline forecasts for this study. First, the future traffic from proposed residential units in the Makila area was included. An additional 400 units could be located in the area of Makila mauka of the bypass highway. An additional 36 units could be located in the makai area bounded by the Puamana Connector and preferred mauka bypass highway alignment. Then the highway volumes were adjusted for capacity restraints.

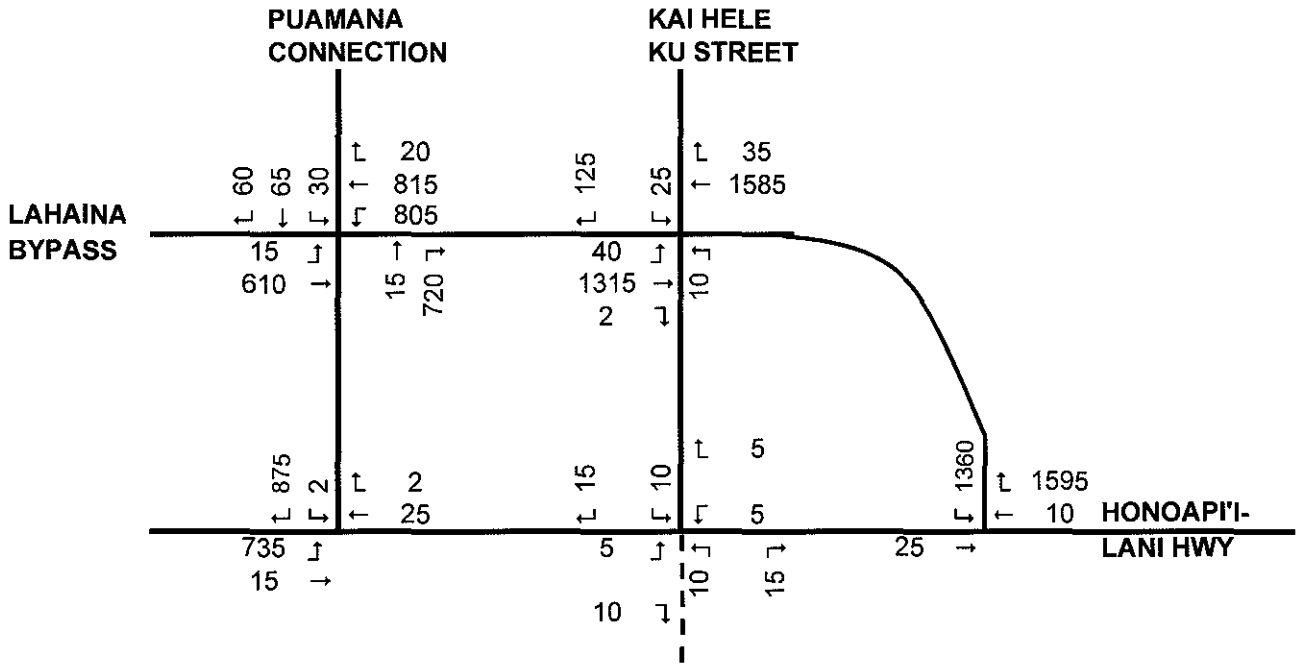
The additional trips generated by these 436 new homes were forecast using the trip generation equations for single family dwelling units from the Institute of Transportation Engineers Trip Generation Report (7th Edition, 2003). Trip distribution factors were derived from the Kai Hele Ku Street intersection turning volumes and the 2035 forecasts. It was assumed that 70% of the new mauka trips would enter the roadway system via the Puamana Connector, while the remaining 30% of trips would use Kai Hele Ku Street. These additional units were assumed to be in place by 2020 and would not increase by 2035.

Figures 3 to 7 are not-to-scale schematic maps of the proposed highway network intended to show the traffic forecast volumes. The turning movements shown at each intersection are not indicative of the proposed design of the intersection, but are used to show the hourly traffic demand volumes at each intersection. The final intersection designs would be based on the volumes of these through and turning movements.

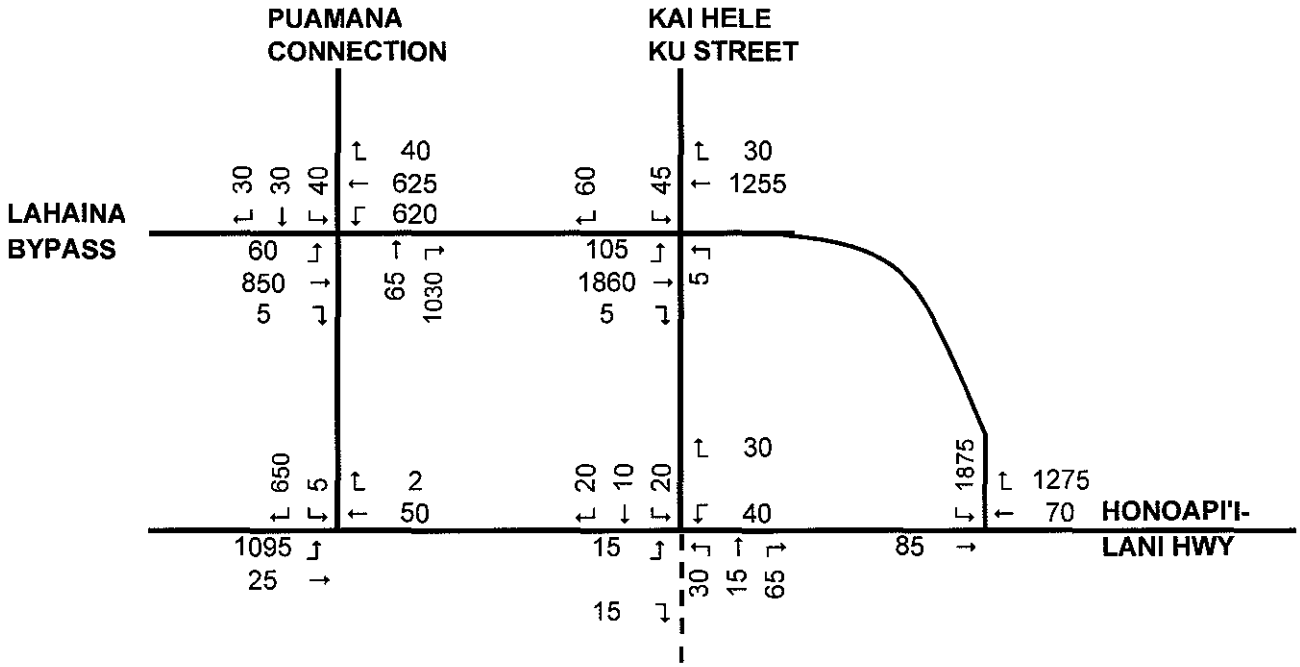
The modified baseline traffic assignments with the Makila development and without the existing highway between the Puamana Connector and southern terminus are shown on Figures 3 and 4 for years 2020 and 2035, respectively.

These modified 2020 forecasts at the Lahaina Bypass Highway and Puamana Connector intersection are compared to the peak hour volumes in the ROD as shown below:

	AM PEAK HOUR		PM PEAK HOUR	
MOVEMENT	ROD	NEW	ROD	NEW
Northbound through	1105	815	945	625
Northbound left turn	830	805	525	620
Southbound through	485	610	900	850
Eastbound right turn	855	720	1330	1030



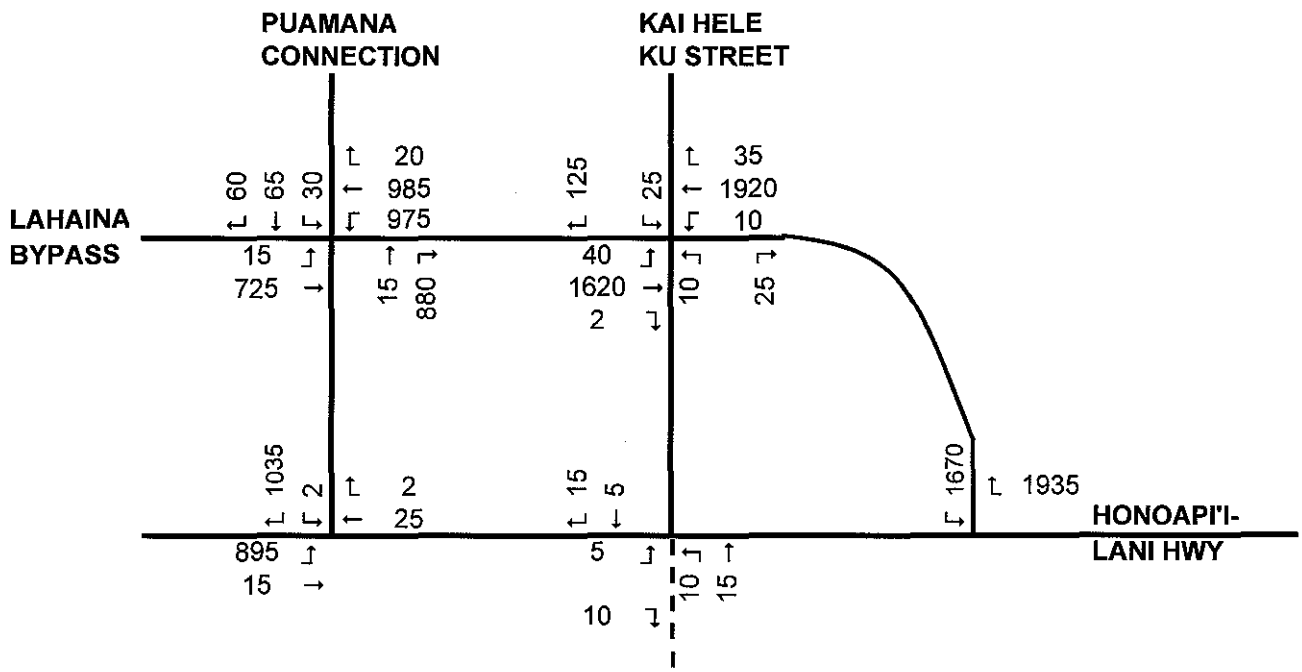
AM PEAK HOUR



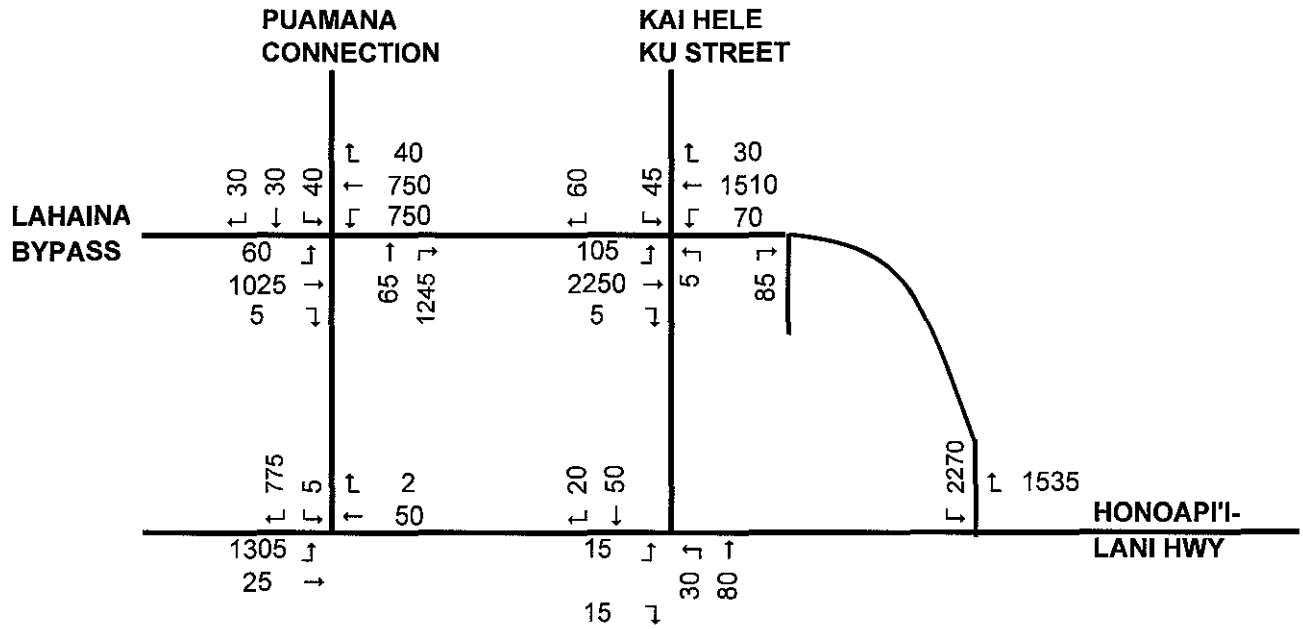
PM PEAK HOUR

NOT TO SCALE

2020 BASELINE TRAFFIC FORECAST W/ MAKILA DEVELOPMENT
FIGURE 3



AM PEAK HOUR



PM PEAK HOUR

NOT TO SCALE

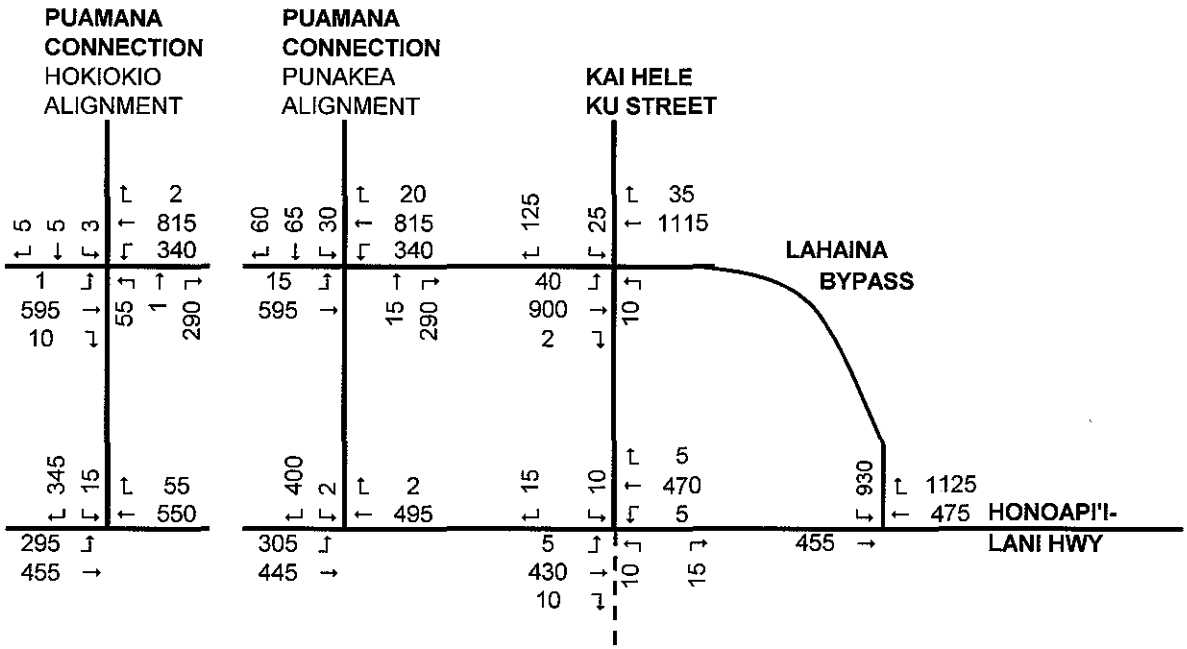
2035 BASELINE TRAFFIC FORECAST W/ MAKILA DEVELOPMENT
FIGURE 4

The new AM peak hour northbound volumes are lower than the equivalent ROD volumes, while the southbound/eastbound volumes are about equal. Both the new northbound and south/eastbound volumes in the PM peak hour are also lower than their equivalent ROD volumes.

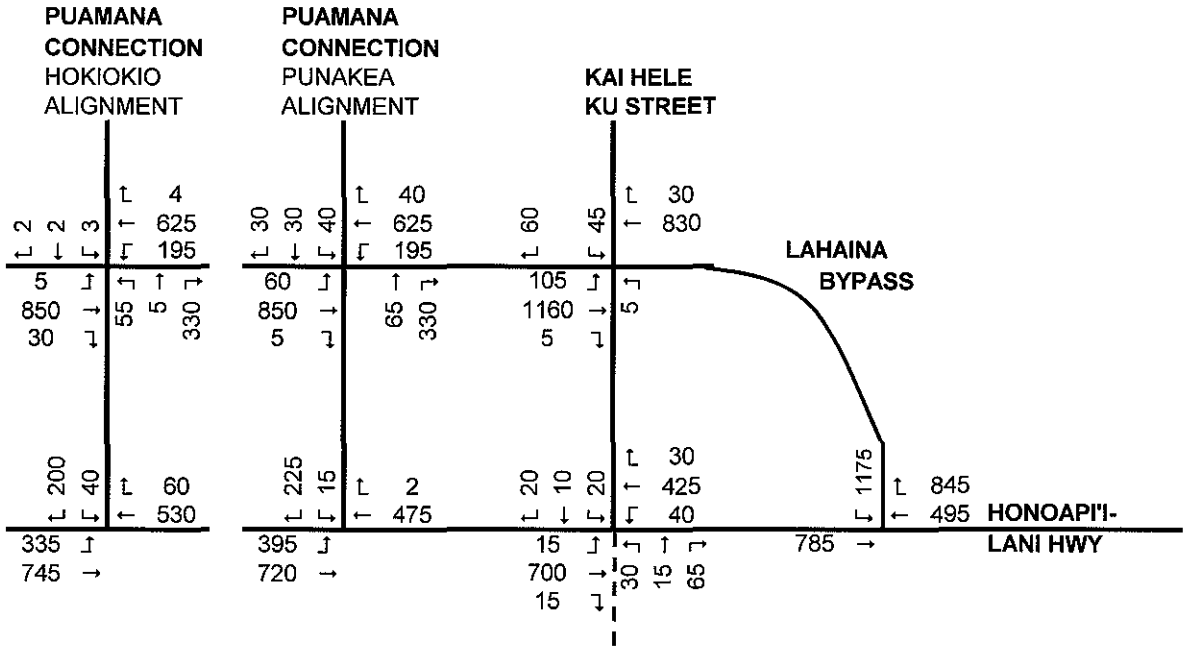
The 2020 baseline traffic forecasts exceed the two-lane bypass highway capacity between the Puamana Connector and southern terminus. Therefore, it was assumed that most of those trips that utilize the Puamana Connector (presumedly Lahaina-oriented trips) would divert to the existing Honoapi'ilani Highway alignment between these two points. It is estimated that 60 percent of these morning peak hour trips and 70 percent of the afternoon peak hour trips would need to divert to maintain similar levels of traffic operations on both the bypass highway and Honoapi'ilani Highway. The year 2020 traffic assignment forecasts constrained by highway capacity are shown on Figure 5.

The traffic forecast for the Puamana Connector along the Hokiokio Place alignment is also shown on Figure 5 to the left of the network-wide forecasts. Comparing the two sets of forecasts, the major volumes at the bypass intersection do not change while those volumes entering and leaving the mauka roadway are much smaller with the Hokiokio Place alignment. At the Honoapi'ilani Highway intersection, the traffic volumes entering and leaving the south highway leg are slightly higher with the Hokiokio Place alignment while the through (traveling between Honoapi'ilani Highway and Puamana Connector) volumes are slightly lower.

Two highway network scenarios were assumed for the year 2035. The first scenario assumed the baseline network with the section of Honoapi'ilani Highway between the Puamana Connector and southern terminus restricted to local recreational traffic. The traffic volumes for this scenario would be as shown on Figure 4, the baseline 2035 traffic forecast. The second scenario assumed that the existing section of Honoapi'ilani Highway between the Puamana Connector and the southern terminus would continue to be in service to maintain six lanes of highway capacity through this study area. Two levels of diversion, upper and lower bounds, were estimated regarding the percentage of trips that would use the makai route . It was estimated that 20 percent and 33 percent of the peak hour trips would divert to the Honoapi'ilani Highway. These low levels of diversion assume that the highway network would be designed to encourage most of the trips to utilize the bypass highway route. The year 2035 traffic assignment forecasts with 20% diversion are shown on Figure 6. The year 2035 traffic assignment forecasts with 33% diversion are shown on Figure 7. As with the year 2020 forecasts, the traffic forecast for the Puamana Connector aligned with the Hokiokio Place are also shown on Figure 7 to the left of network-wide forecasts.



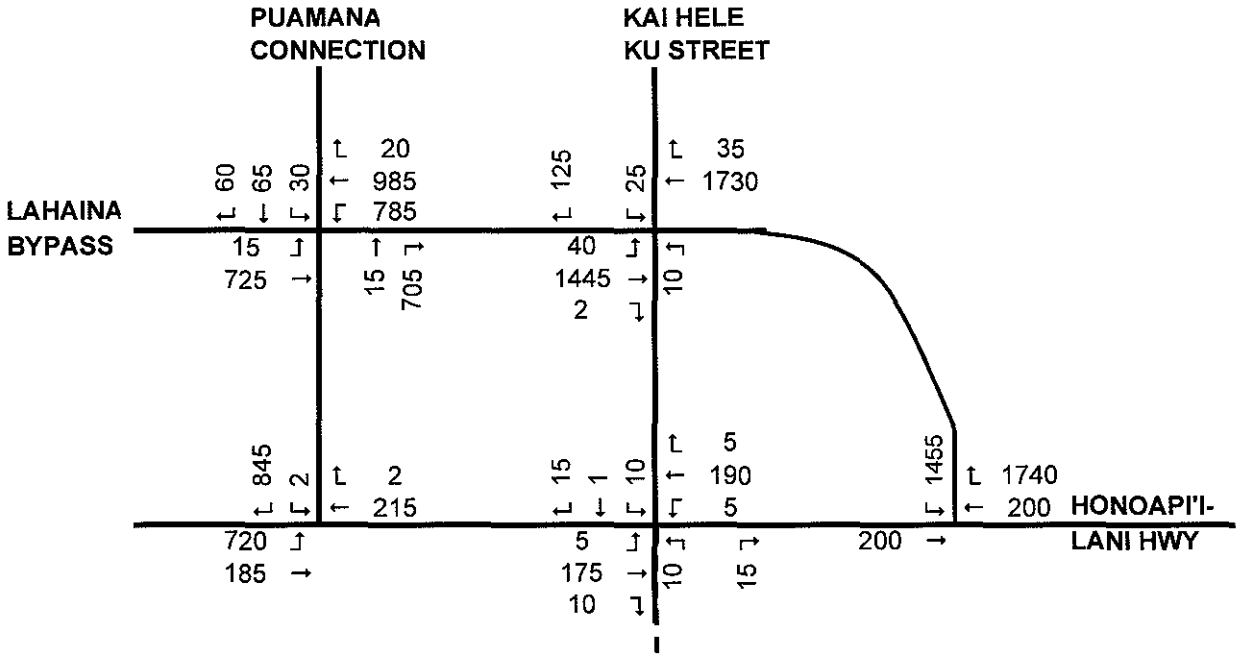
AM PEAK HOUR



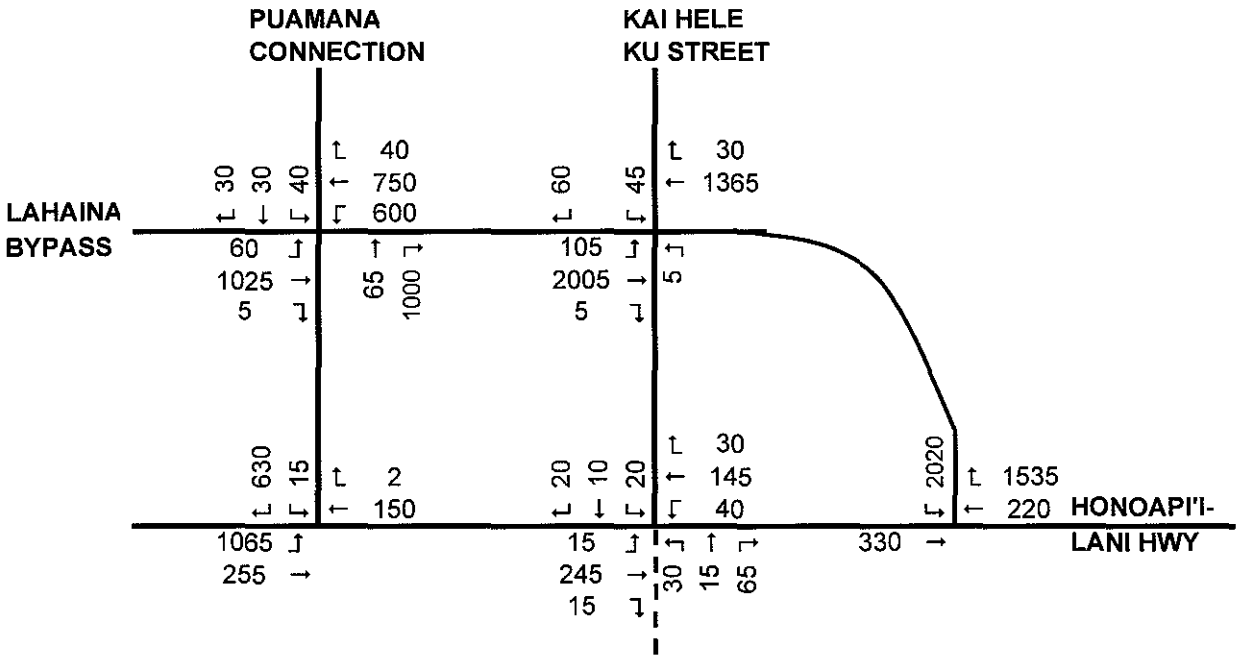
PM PEAK HOUR

NOT TO SCALE

2020 TRAFFIC ASSIGNMENT ADJUSTED FOR CAPACITY
FIGURE 5



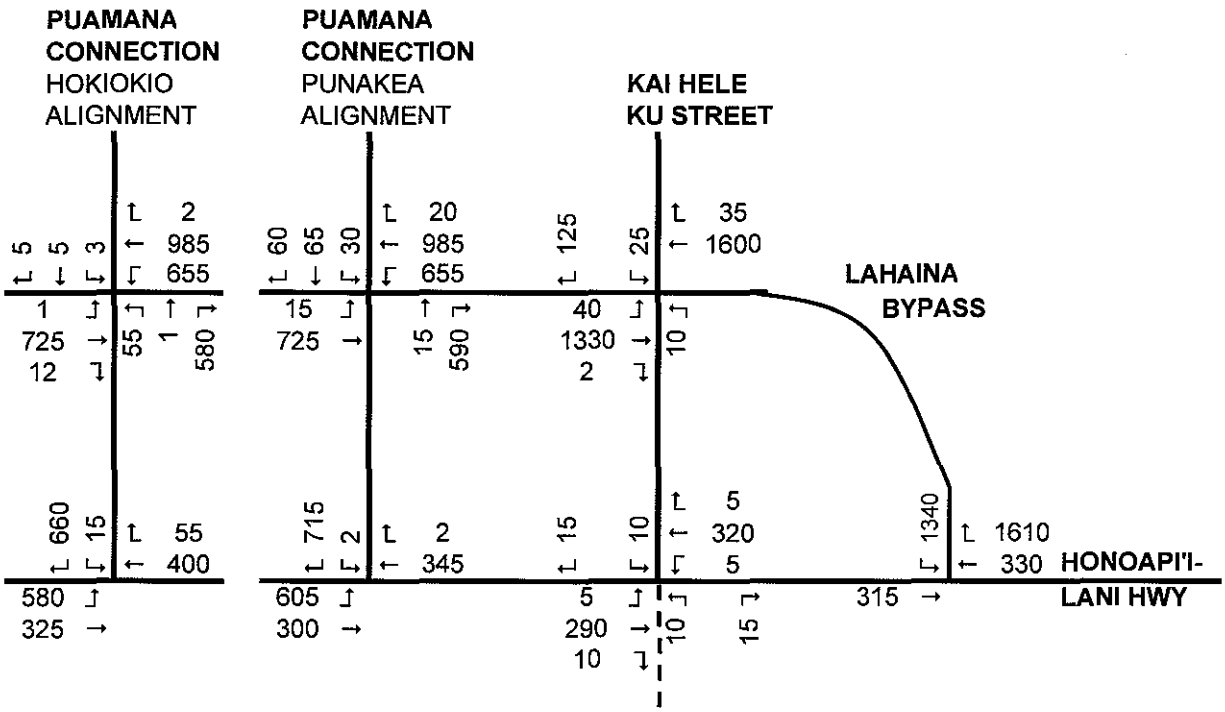
AM PEAK HOUR



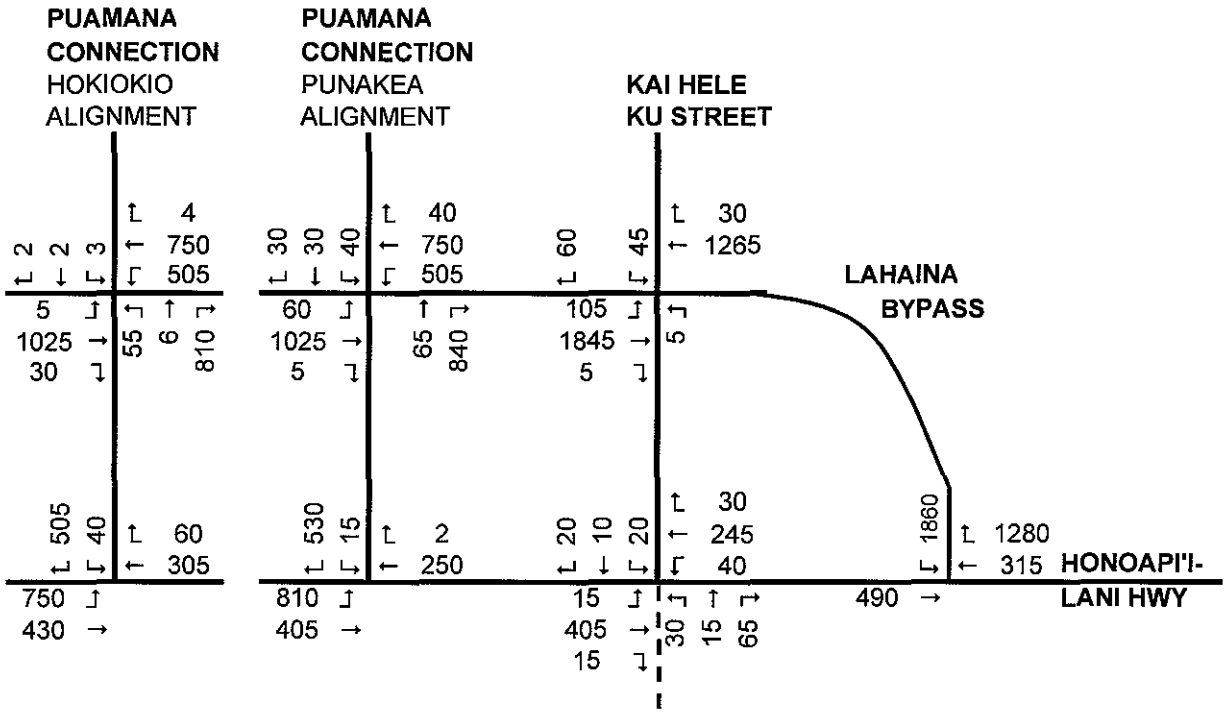
PM PEAK HOUR

NOT TO SCALE

2035 TRAFFIC ASSIGNMENT WITH 20% DIVERSION
FIGURE 6



AM PEAK HOUR



PM PEAK HOUR

NOT TO SCALE

2035 TRAFFIC ASSIGNMENT WITH 33% DIVERSION
FIGURE 7

VI. DEVELOPMENT OF CONCEPTUAL INTERSECTION DESIGNS

Four sets of traffic forecast assignments were analyzed as the basis for developing conceptual designs for the study intersections:

- 2020 capacity constrained forecast (Figure 5)
- 2035 baseline traffic forecast (Figure 4)
- 2035 traffic forecast with 20% diversion (Figure 6)
- 2035 traffic forecast with 33% diversion (Figure 7)

For each study intersection, a level of service analysis was used to analyze the operations of an initial design. The design was then improved to mitigate unacceptable traffic conditions. The conceptual designs developed for the preferred mauka alternative would also be applicable to the other two alternative alignments since their traffic operations would not be different. In considering alternative intersection designs, roundabouts were not considered feasible since they do not conform to several guidelines set forth in the Hawaii DOT's memo on Modern Roundabouts Policy Guideline dated December 19, 2008. These non-conforming items include:

- The capacity of a single lane roundabout of 1,100 vehicles per hour is insufficient to handle the forecast volumes.
- Operating speeds through roundabouts should not exceed 35 miles per hour while the design speed of the roadways are 55 miles per hour.
- Roundabouts need not be considered when less that 10% of the traffic enters the intersection from a minor street, which is the case for several intersections.
- Roundabouts are best suited for level terrain while the bypass highway alignment is in rolling terrain.

The concept of level of service is used to quantify the quality of traffic flow on roadway facilities. The Transportation Research Board (TRB) has developed procedures to calculate level of service value(s) by measuring traffic volumes against the capacities of different types of roadway facilities. The TRB Highway Capacity Manual 2000 (HCM2000) describes the various procedures developed for freeways, highways, signalized and unsignalized intersections, etc.

Each of the five study intersections are expected to be signalized in the year 2020. The methodology for analyzing signalized intersections calculates the levels of service for individual movements, approaches and the intersection as a whole based on the average stopped delay per vehicle. The results range from level of service A (best with average delays less than ten seconds) to F (worst with average delays longer than 80 seconds). The definitions for level of service for signalized intersections are summarized below:

LEVEL OF SERVICE	SIGNALIZED INTERSECTION CONTROL DELAY (Seconds/Vehicle)
A	< 10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	> 80.1

Many jurisdictions consider levels of service A to C as acceptable for areas like Maui, with levels of service E and F indicating the need for mitigating measures. For signalized intersections, the major streets can be designed to have a higher level of service than the side streets or major street turning lanes. Lower levels of service on the latter approaches can be tolerated if they permit the major street approaches to have acceptable levels of service. In many areas of the state, the traffic signal cycle lengths are increased to improve traffic flow on the main street while increasing delays and reducing levels of service on the minor side streets and movements. The results of the level of service analysis for the signalized intersections are shown on Table 1. The table shows the level of service, delay (seconds per vehicle), and volume/capacity ratio (V/C) for the morning and afternoon peak periods for both planning years. The results for each study intersection are discussed in the following paragraphs.

Several traffic movements are proposed to be made as on-ramp movements that would not be controlled by traffic signals. The HCM2000 does not have a procedure for analyzing this specific type of traffic movement. Therefore, the HCM2000 procedure for analyzing freeway on-ramp merges was utilized, realizing that the upstream traffic would be controlled by traffic signals that would leave gaps in the traffic. Hence; the actual results for the on-ramp movement can be expected to be better than calculated. The methodology for analyzing ramp merges calculates a level of service based on the density of vehicles at the merge as shown below:

LEVEL OF SERVICE	DENSITY (Pass. cars/mile/lane)
A	< 10
B	> 10 - 20
C	> 20 - 28
D	> 28 – 35
E	> 35

No density is shown for level of service F which exists when the total flow departing the merge area exceeds the capacity of the downstream segment. The procedure assumes at least two through lanes on the main highway link, which would not be the case in 2020. The results of the on-ramp level of service analysis are shown on Table 2.

The results of the level of service analyses for the signalized intersection and on-ramps are graphically summarized on Figures 8 to 12. The results for the 2020 traffic forecast are graphically summarized on Figure 8. The results for the 2035 baseline traffic forecast are shown on Figure 9. The results for the 2035 with 20% diversion traffic forecast are shown on Figure 10. The results for the 2035 with 33% diversion traffic forecast are shown on Figure 11. Figure 12 shows the levels of service for the 2035 baseline network with the recommended alternative traffic controls at two locations.

The capacity of a highway with signalized intersections is generally governed by the through capacity of the signalized intersection. For this study, the level of service for the 2035 four lane highway was also calculated using the HCM2000 procedure for multi-lane highways. The methodology for analyzing multi-lane highways calculates levels of service for different free flow speeds based on maximum density (pass. cars/mile/lane), maximum service flow rate (pass. cars/hr/lane), average speed (miles/hr) and maximum volume to capacity ratio (v/c). The HCM2000 defines levels of service for 55 miles per hour free flow speed and rolling terrain as shown below:

LEVEL OF SERVICE	AVERAGE SPEED	MAXIMUM DENSITY	MAX FLOW RATE
A	60.0	11	660
B	60.0	18	1080
C	59.4	26	1550
D	56.7	35	1980
E	55.0	40	2200

The multi-lane highway levels of service calculated for the 2035 AM and PM peak hour volumes forecast on the four lane bypass highway between the southern terminus and Kai Helu Ku Street is summarized below for several of the parameters:

	AM PEAK HOUR			PM PEAK HOUR		
SCENARIO SPEED	LOS	MAX FLOW	AVE. SPEED	LOS	MAX FLOW	AVE. SPEED
Baseline	C	1163	54.8	C	1357	54.8
20% diversion	B	1038	54.8	C	1207	54.8
33% diversion	B	959	54.8	C	1107	54.8

These results indicate that the four lane bypass highway proposed in 2035 would be adequate to handle the forecasted traffic volumes. Also, the highway operations should improve as more traffic is diverted to the makai section of Honoapi'ilani Highway.

The relationship between these results and the proposed intersection design are discussed below. It is noted that the design schematics presented in this report are conceptual. Detailed design including appropriate striping and signage will occur at later stages in the project. Detailed design also will provide for safe pedestrian and bicycle movements at all of the intersections.

TABLE 1
SIGNALIZED INTERSECTION LEVEL OF SERVICE SUMMARY

Intersection Movement	YEAR 2020						YEAR 2035														
							WITH NO DIVERSION						WITH 20% DIVERSION						WITH 33% DIVERSION		
	AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR		
	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C
Lahaina Bypass and Honoapiilani Highway																								
Intersection	C	22.4	0.63	C	25.5	0.72	NOT APPLICABLE						C	29.8	0.62	C	34.8	0.81	C	22.3	0.67	C	32.8	0.82
Bypass SB thru	B	19.4	0.62	C	23.7	0.79							C	31.3	0.94	C	34.7	0.99	C	21.4	0.81	C	31.6	0.96
Hon. Hwy NB "left"	C	28.5	0.75	C	30.2	0.79							B	19.8	0.34	D	37.0	0.57	C	26.2	0.60	D	40.3	0.71
Lahaina Bypass and Kai Hele Ku Street																								
Intersection	C	22.4	0.77	B	19.0	0.75	C	23.3	0.73	D	40.5	0.85	B	19.8	0.66	C	27.2	0.76	B	18.4	0.62	C	24.1	0.70
KHK St. EB	E	72.4	0.08	F	83.8	0.04	D	53.4	0.15	E	76.4	0.42	D	52.6	0.06	E	72.0	0.04	D	52.6	0.06	E	72.0	0.04
KHK St. WB	E	66.0		E	75.2		D	45.8		E	63.9		D	45.8		E	63.3		D	45.8		E	63.3	
Bypass NB	C	25.5		B	15.2		C	24.6		C	21.0		B	19.6		B	16.7		B	17.4		B	15.7	
Bypass SB	B	11.5		B	16.8		B	19.1		D	51.5		B	17.1		C	32.3		B	16.2		C	27.5	
left	F	91.2	0.49	F	97.4	0.65	E	67.5	0.39	F	86.5	0.60	E	67.5	0.39	F	86.5	0.60	E	67.5	0.39	F	86.5	0.60
through	A	7.8	0.64	A	9.7	0.79	B	17.8	0.74	D	50.0	1.00	B	15.6	0.66	C	29.6	0.90	B	14.6	0.61	C	24.3	0.83
Lahaina Bypass and Kai Hele Ku Street Eastbound Approach Eliminated																								
Intersection	C	21.5	0.77	B	19.9	0.75							B	16.2	0.66	B	16.8	0.69	B	15.1	0.62	B	15.9	0.64
KHK St. WB	E	66.4		E	73.9								D	44.2		E	60.7		D	45.8		E	60.7	
Bypass NB	C	25.5		B	17.5								B	19.5		B	19.5		B	17.4		B	18.4	
Bypass SB	A	10.0		B	17.3								A	9.3		B	12.9		A	8.9		B	11.8	
left	F	84.9	0.38	F	93.1	0.58							E	67.5	0.39	E	77.9	0.48	E	67.5	0.39	E	77.9	0.48
through	A	6.5	0.63	B	10.6	0.80							A	7.6	0.58	A	9.6	0.75	A	7.1	0.53	A	8.1	0.70

LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound

TABLE 1
SIGNALIZED INTERSECTION LEVEL OF SERVICE SUMMARY

Intersection Movement	YEAR 2020 AM PEAK HOUR LOS	Delay	V/C	YEAR 2020 PM PEAK HOUR LOS	Delay	V/C	YEAR 2035 WITH NO DIVERSION AM PEAK HOUR LOS	Delay	V/C	YEAR 2035 WITH NO DIVERSION PM PEAK HOUR LOS	Delay	V/C	YEAR 2035 WITH 20% DIVERSION AM PEAK HOUR LOS	Delay	V/C	YEAR 2035 WITH 20% DIVERSION PM PEAK HOUR LOS	Delay	V/C	YEAR 2035 WITH 33% DIVERSION AM PEAK HOUR LOS	Delay	V/C	YEAR 2035 WITH 33% DIVERSION PM PEAK HOUR LOS	Delay	V/C
Lahaina Bypass and Puamana Connector (with Punakea Loop alignment)																								
	(with single north bound left turn lane)						(with double northbound left turn lanes)						(with double northbound left turn lanes)						(with double northbound left turn lanes)					
Intersection	D	42.1	0.68	D	35.6	0.75	D	45.5	0.62	D	46.6	0.63	D	40.9	0.56	D	42.2	0.58	D	37.3	0.52	D	39.3	0.55
Puamana C EB	D	48.9	0.05	D	48.0	0.26	E	69.5	0.05	E	78.4	0.24	E	69.5	0.05	E	70.8	0.22	E	59.8	0.05	E	63.3	0.21
Puamana C WB	D	48.3		D	44.7		E	72.5		E	79.0		E	72.5		E	71.3		E	62.3		E	63.6	
left/through	D	51.4	0.27	D	48.4	0.31	E	73.1	0.31	E	79.4	0.31	E	73.1	0.31	E	71.6	0.29	E	62.9	0.28	E	63.9	0.26
right	D	41.3	0.10	C	34.1	0.06	E	71.1	0.17	E	75.8	0.04	E	71.1	0.17	E	68.5	0.04	E	61.2	0.15	E	61.2	0.03
Bypass NB	D	39.7		C	25.7		D	40.5		D	40.3		C	33.1		C	34.8		C	29.2		C	31.4	
left	F	89.9	0.94	E	62.5	0.75	E	69.4	0.86	E	68.7	0.75	E	59.4	0.70	E	61.8	0.63	D	52.8	0.61	E	56.7	0.55
through	B	19.4	0.73	B	15.0	0.59	B	12.4	0.42	B	13.2	0.33	B	12.4	0.42	B	14.1	0.34	B	13.7	0.44	B	15.3	0.36
Bypass SB	D	45.1		D	43.2		D	53.2		D	51.2		D	53.2		D	47.9		D	50.3		D	45.3	
left	E	75.2	0.28	E	59.4	0.49	F	101.0	0.36	F	98.4	0.50	F	101.0	0.36	F	89.6	0.46	F	90.8	0.33	F	81.0	0.43
through	D	44.4	0.80	D	42.2	0.93	D	52.3	0.58	D	48.5	0.70	D	52.3	0.58	D	45.5	0.70	D	49.5	0.60	D	43.3	0.71
Lahaina Bypass and Puamana Connector (with Punakea Loop alignment and northbound left turn ramp)																								
Intersection							B	16.4	0.40	B	17.3	0.39	SAME RESULTS FOR ALL 2035 ALTERNATIVES											
Puamana C EB							C	32.7	0.04	D	45.9	0.17												
Puamana C WB							C	34.1		D	46.1													
left/through							C	34.4	0.21	D	46.3	0.21												
right							C	33.3	0.10	D	44.4	0.03												
Bypass NB through							B	17.6	0.54	B	18.1	0.41												
Bypass SB							B	11.3		B	12.9													
left							E	58.1	0.22	E	63.2	0.40												
through							B	10.4	0.35	A	9.9	0.45												

LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound

TABLE 1
SIGNALIZED INTERSECTION LEVEL OF SERVICE SUMMARY

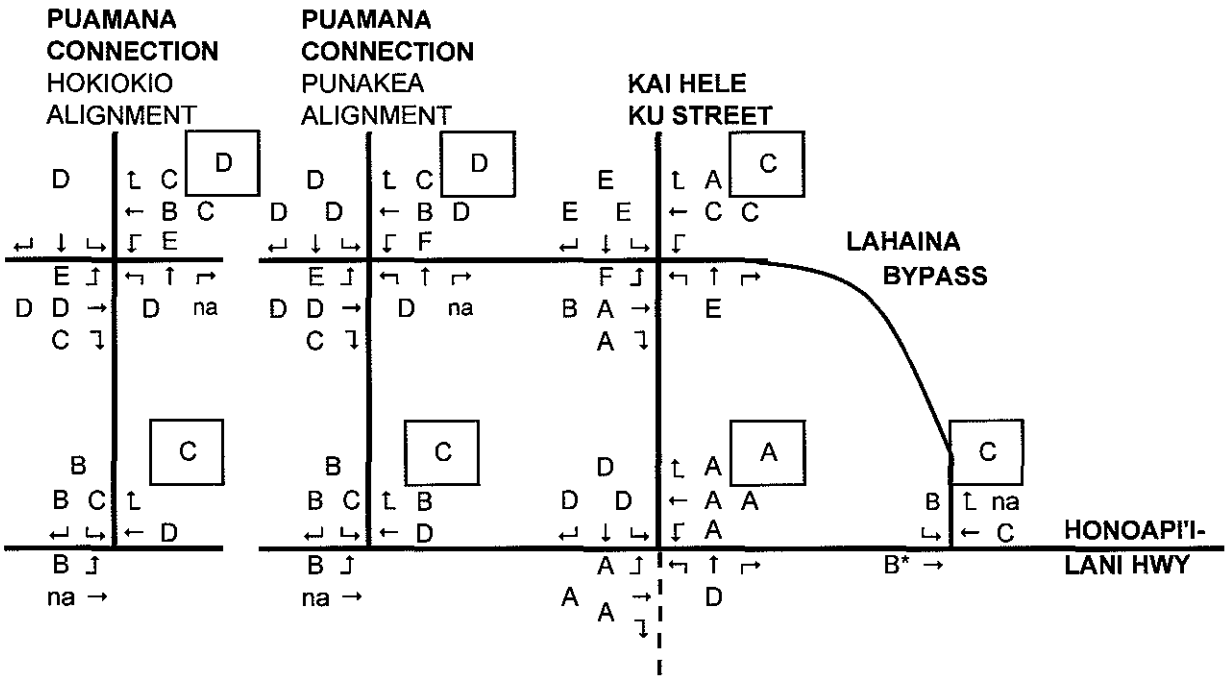
Intersection	YEAR 2020						YEAR 2035																	
							WITH NO DIVERSION						WITH 20% DIVERSION						WITH 33% DIVERSION					
	AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR			AM PEAK HOUR			PM PEAK HOUR		
Movement	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C	LOS	Delay	V/C
Lahaina Bypass and Puamana Connector (with Hokiokio Place alignment)																								
	(with single north bound left turn lane)																		(with double northbound left turn lanes)					
Intersection	D	37.4	0.67	C	34.6	0.75													C	34.1	0.5	D	35.3	0.55
Puamana C EB	D	53.3	0.24	D	48.5	0.32													E	63.7	0.24	E	65.7	0.29
Puamana C WB	D	44.0		D	42.6														E	61.4		E	62.7	
Bypass NB	C	29.8		C	26.3														C	27.0		C	29.6	
left	E	59.3	0.77	E	62.5	0.75													D	49.9	0.59	D	53.9	0.54
through	B	17.6	0.71	B	15.0	0.59													B	11.8	0.43	B	13.4	0.35
Bypass SB	D	49.5		D	41.3														D	46.5		D	40	
left	E	71.2	0.01	E	55.1	0.04													F	87.6	0.03	E	74.9	0.04
through	D	49.5	0.85	D	42.2	0.93													D	46.6	0.59	D	40.2	0.69
LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound																								
Honoapiilani Highway and Puamana Connector (with Punakea Loop alignment)																								
Intersection	C	24.6	0.59	C	33.5	0.59	B	11.8	0.68	C	34.4	0.87	B	18.0	0.68	C	29.5	0.79	C	23.1	0.68	C	27	0.75
Hon. Hwy SB	B	19.1	0.53	B	19.9	0.51	B	14.6	0.82	D	51.7	1.05	B	17.6	0.77	D	39.4	0.97	C	21.7	0.74	C	30.8	0.9
Puamana Con WB	B	13.3		B	14.5		A	8.9		A	4.1		B	12.3		A	8.5		B	16.0		B	10.2	
left	C	30.7	0.02	D	48.6	0.21	C	33.2	0.02	D	54.8	0.09	D	38.2	0.02	E	56.2	0.25	D	40.7	0.02	D	53.7	0.24
through	B	13.2	0.50	B	12.1	0.24	A	8.8	0.81	A	3.7	0.57	B	12.3	0.76	A	7.2	0.52	B	15.9	0.73	A	8.9	0.47
Hon. Hwy NB left	D	37.3	0.89	D	54.4	0.92	C	33.7	0.24	E	56	0.47	D	41.7	0.74	D	49.8	0.59	D	40.3	0.8	D	50.2	0.74
Honoapiilani Highway and Puamana Connector (with Hokiokio Place alignment)																								
Intersection	C	27.0	0.59	C	35.9	0.60													C	30.2	0.72	C	30.5	0.71
Hon. Hwy SB	C	21.2	0.53	C	29.4	0.51													C	24.7	0.75	C	33.3	0.85
Puamana Con WB	B	15.2		C	23.8														B	18.3		B	15.9	
left	C	33.0	0.13	D	54.9	0.34													D	43.5	0.17	E	57.4	0.35
through	B	14.5	0.46	B	17.4	0.24													B	17.7	0.71	B	12.5	0.48
Hon. Hwy NB left	D	37.8	0.90	D	45.1	0.85													D	55.0	0.93	D	49.6	0.73
Honoapiilani Highway and Kai Hele Ku Street																								
Intersection	A	7.9	0.34	B	11.9	0.61	NOT APPLICABLE						NOT APPLICABLE						A	8.7	0.25	B	10.8	0.42
Kai Hele Ku St EB	D	38.3		D	43.2														C	31.0		C	27.1	
Kai Hele Ku St WB	D	38.4		D	38.9														C	31.0		C	26.6	
Hon. Hwy NB	A	6.6		A	6.1														A	6.9		A	6.9	
Hon. Hwy SB	A	6.4		A	9.1														A	6.8		A	8.6	

LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound

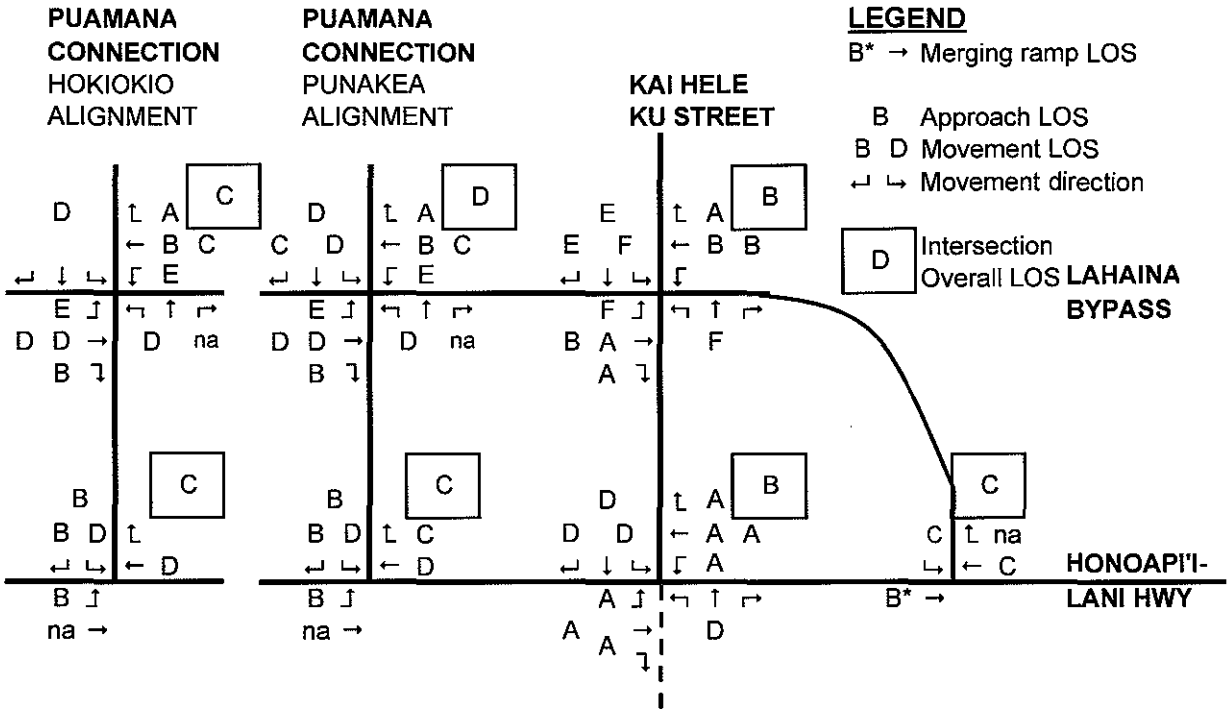
TABLE 2
ON-RAMP LEVEL OF SERVICE SUMMARY

Intersection Movement	YEAR 2020				YEAR 2035											
					WITH NO DIVERSION				WITH 20% DIVERSION				WITH 33% DIVERSION			
	AM PEAK		PM PEAK		AM PEAK		PM PEAK		AM PEAK		PM PEAK		AM PEAK		PM PEAK	
	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.	LOS	Dens.
Lahaina Bypass and Honoapiilani Highway																
Hon. Hwy SB on-ramp	B	14.4	B	19.4	B	17.4	C	25.5	B	16.9	C	23.0	B	16.9	C	23.0
Lahaina Bypass and Kai Hele Ku Street Michigan U turn																
Kai Helu Ku WB on-ramp	NOT APPLICABLE				C	22	B	18.3	C	20.2	B	16.3	B	19.0	B	15.4
Left turn ramp to LBH SB	NOT APPLICABLE				B	19.7	C	26.6	B	18.1	C	23.8	B	17.0	C	22.3
Lahaina Bypass and Puamana Connector																
Puamana Conn EB on-ramp	NOT APPLICABLE				B	17.1	C	23.1	B	15.5	C	21.0	B	14.5	B	19.6

LEGEND: EB = eastbound; WB = westbound; SB = southbound; NB = northbound



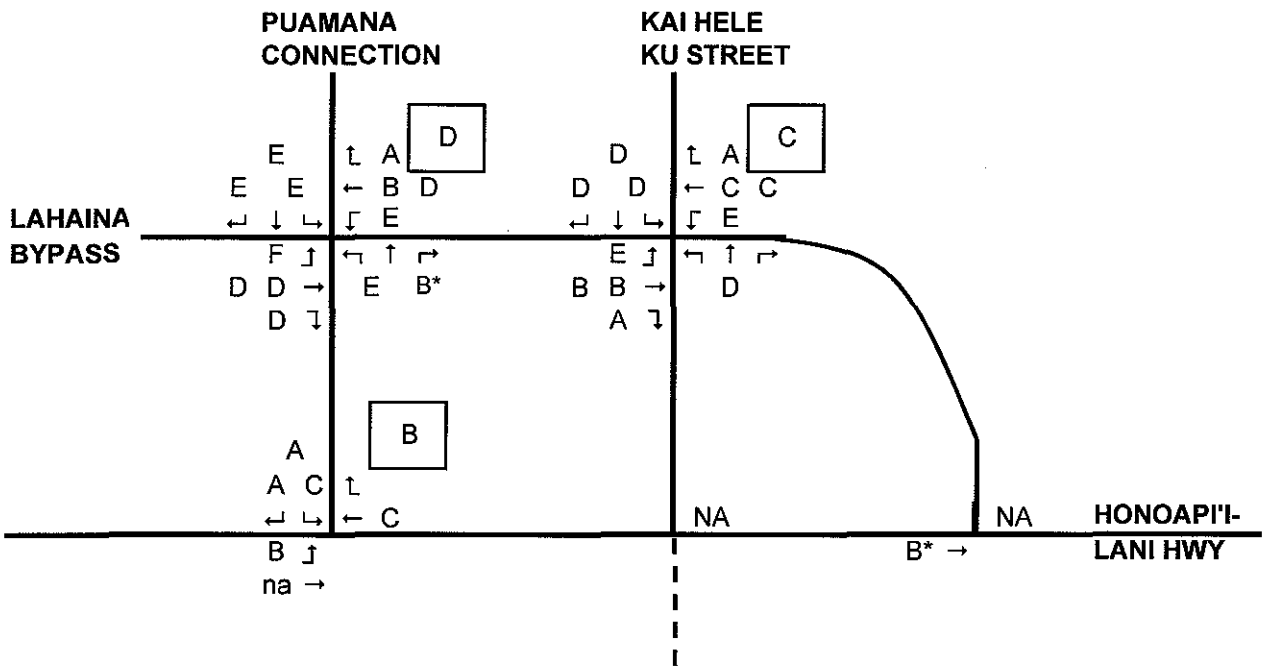
AM PEAK HOUR



PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2020 ADJUSTED TRAFFIC ASSIGNMENT
FIGURE 8



AM PEAK HOUR

LEGEND

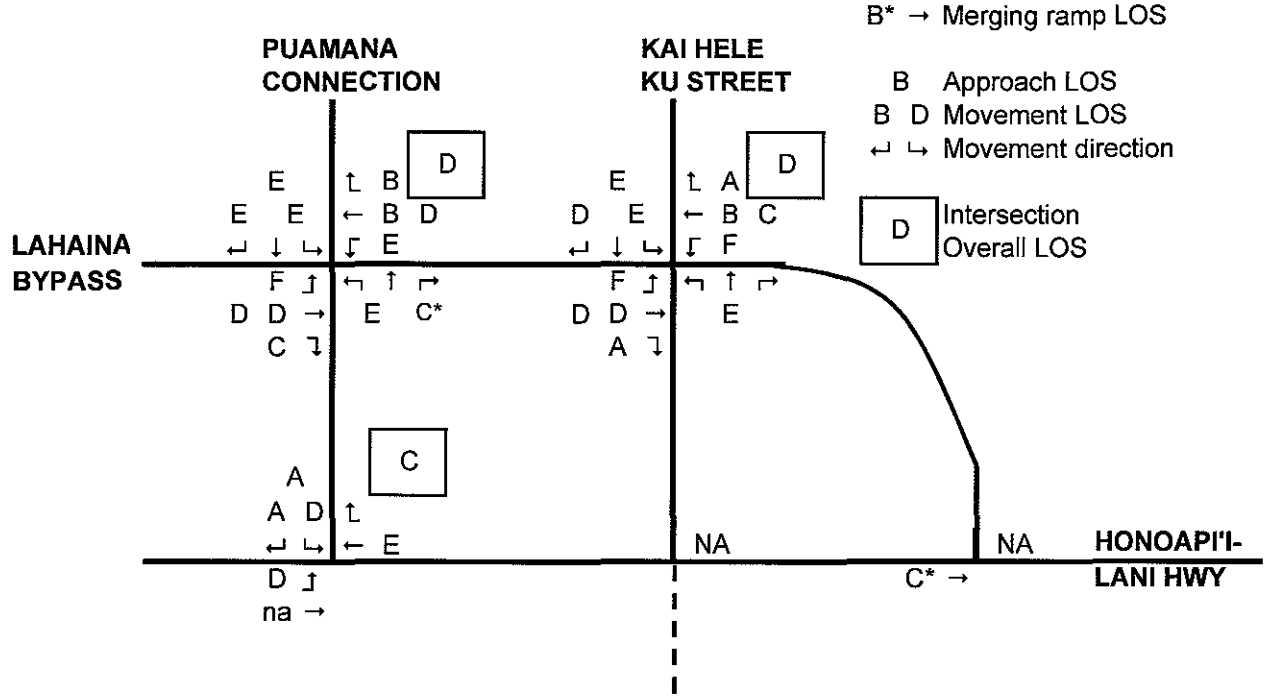
B* → Merging ramp LOS

B Approach LOS

B D Movement LOS

↵ ↳ Movement direction

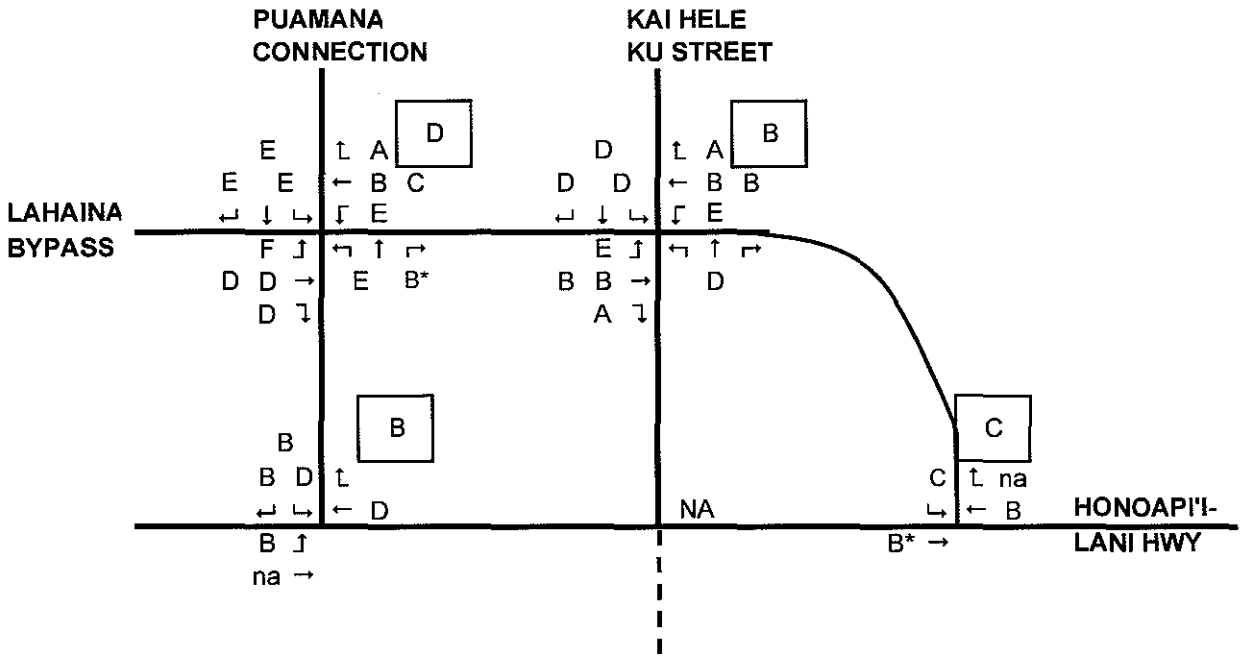
D Intersection Overall LOS



PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2035 BASE TRAFFIC ASSIGNMENT
FIGURE 9



AM PEAK HOUR

LEGEND

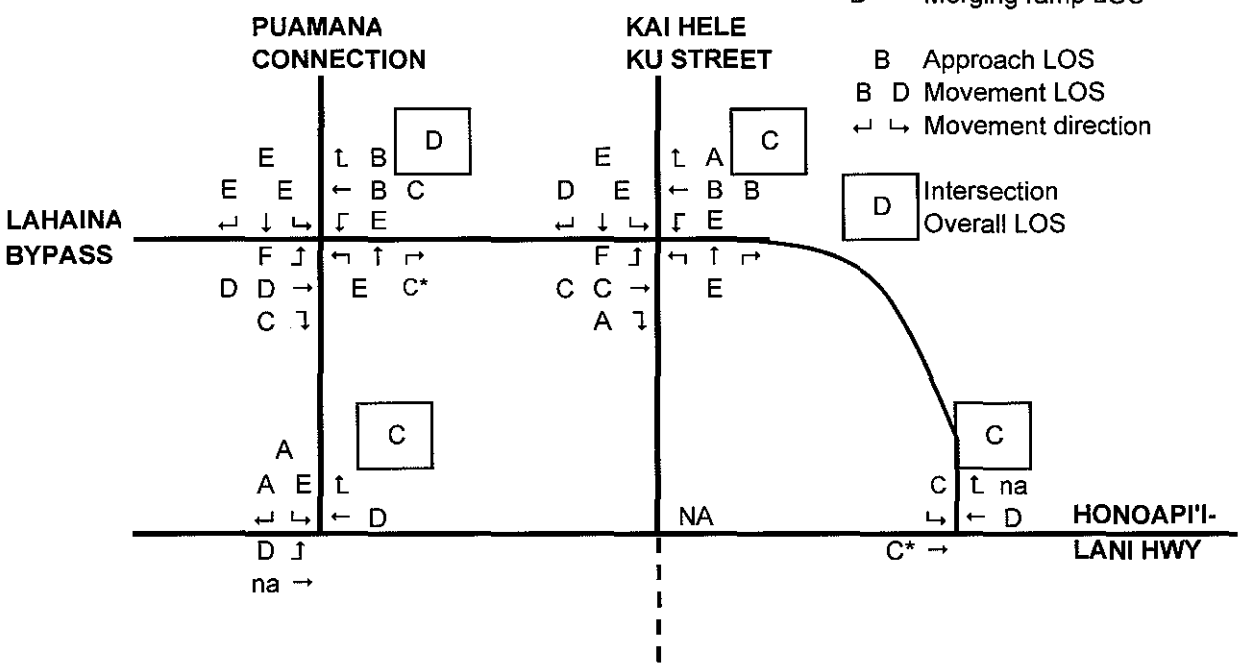
B* → Merging ramp LOS

B Approach LOS

B D Movement LOS

↵ ↳ Movement direction

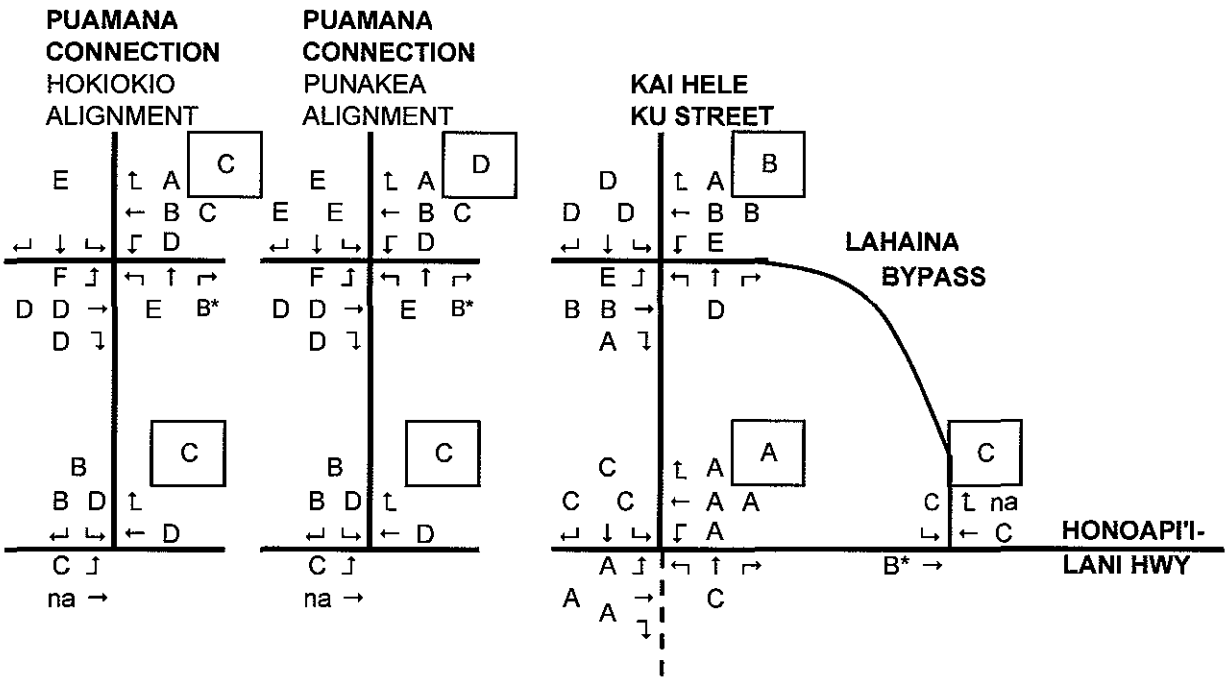
D Intersection Overall LOS



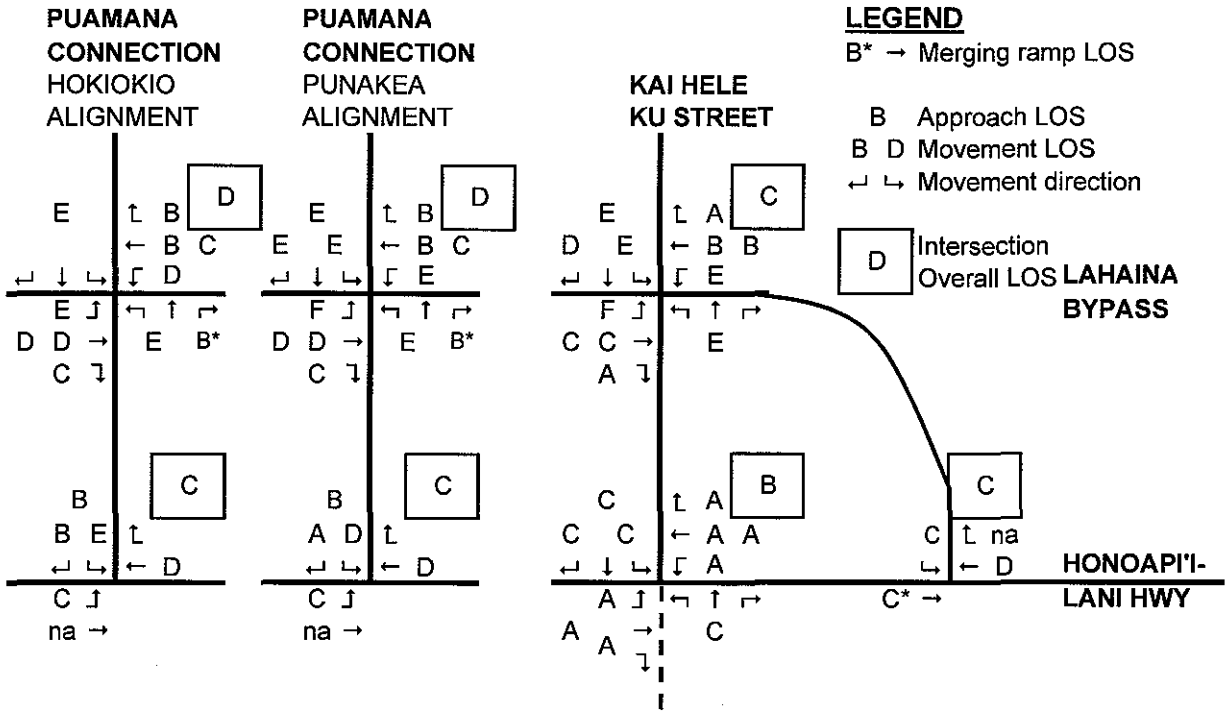
PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2035 TRAFFIC ASSIGNMENT WITH 20% DIVERSION
FIGURE 10



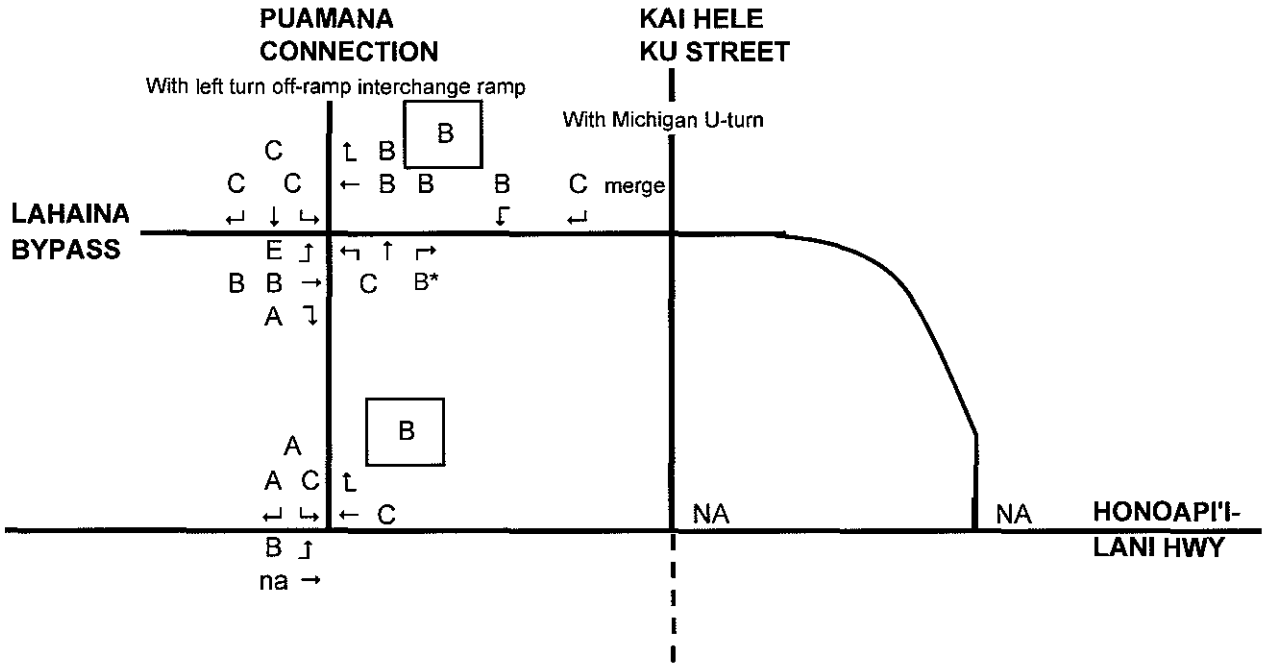
AM PEAK HOUR



PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2035 TRAFFIC ASSIGNMENT WITH 33% DIVERSION
FIGURE 11



AM PEAK HOUR

LEGEND

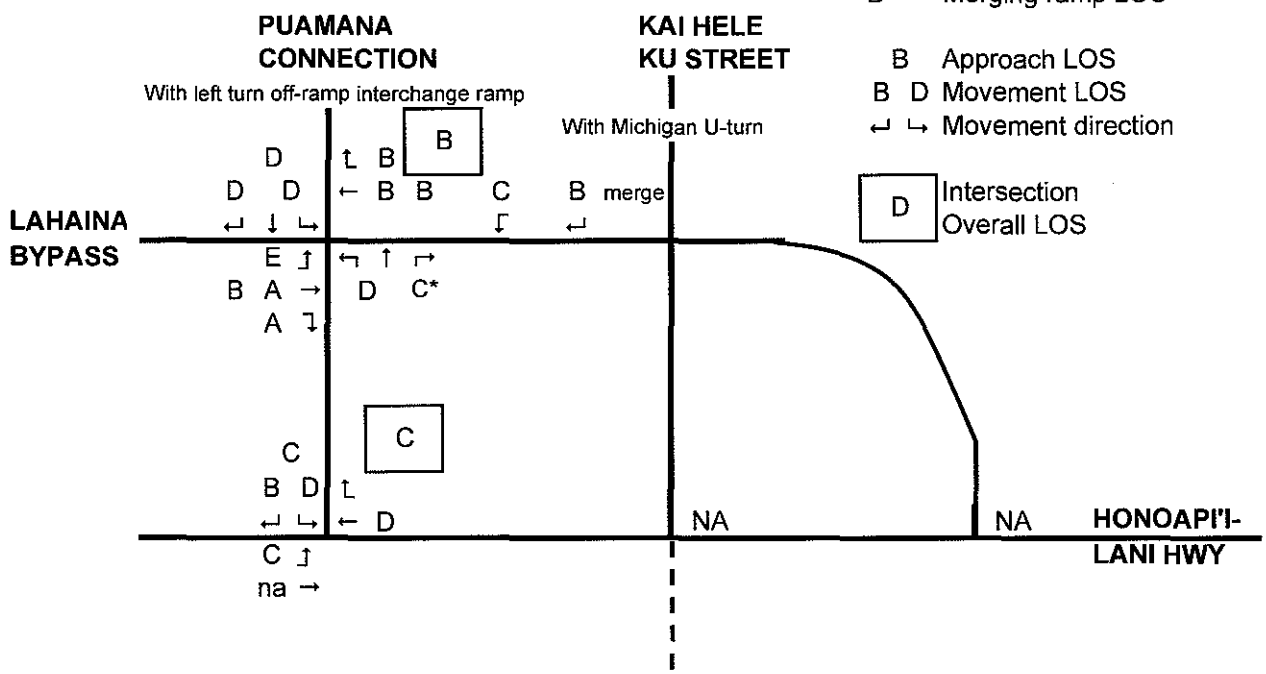
B* → Merging ramp LOS

B Approach LOS

B D Movement LOS

↵ ↳ Movement direction

D Intersection Overall LOS



PM PEAK HOUR

NOT TO SCALE

LEVEL OF SERVICE SUMMARY
2035 BASE TRAFFIC WITH ALTERNATE TRAFFIC DESIGNS
FIGURE 12

Lahaina Bypass Highway and Honoapi'ilani Highway (south)

The primary movements at this intersection are between the Lahaina Bypass Highway and the south leg of Honoapi'ilani Highway. The former roadway has one through lane in each direction while the latter was assumed to have two lanes in each direction in year 2020. The section of Honoapi'ilani Highway between the Puamana Connector and the north leg of this intersection would retain its current two lane design, but could be modified at either intersection.

The following design features are recommended for 2020:

- Honoapi'ilani Highway northbound "through lane" approach to Lahaina Bypass northbound – only one lane would be required since it would not be stopped by the traffic signal. The northbound right lane of the four-lane highway section south of the terminus would continue as the single northbound through lane of the bypass highway.
- Honoapi'ilani Highway northbound "left turn" approach –one lane with 450 feet of storage required. The left northbound lane of the four-lane highway section south of the terminus would become the "left turn" lane.
- Lahaina Bypass Highway southbound "through lane" approach to southbound Honoapi'ilani Highway – the single southbound through lane would expand to include an auxiliary through lane with 550 feet of storage, creating a two through lane approach.
- Honoapi'ilani Highway southbound "through lane" approach - the single southbound through lane would be designed as an on-ramp that would not be controlled by traffic signals and merge with the southbound highway lanes south of the terminus.

The recommended design is shown on Figure D-1. With this design, the proposed intersection would be operating at level of service C in both peak periods. The Honoapi'ilani Highway northbound "left turn" approach would be operating at level of service C in the PM peak hour. The Honoapi'ilani Highway southbound "on-ramp" approach would be operating at level of service B or better in both peak hours.

The year 2035 baseline network would not require an intersection at the southern terminus and would force traffic from East and Central Maui to enter the makai area via Kai Hele Ku Street. However, the southbound through lane from Honoapi'ilani Highway should be retained as an "on-ramp" approach as in the previous design. This would provide a convenient travel path for residents/ beach goers within the study area to travel south without having to travel mauka first to enter the highway network and minimize disrupting the major traffic flow on the bypass highway. This concept is schematically shown on Figure D-2. This "on-ramp" would operate at levels of service B and C in the morning and afternoon peak hours, respectively.

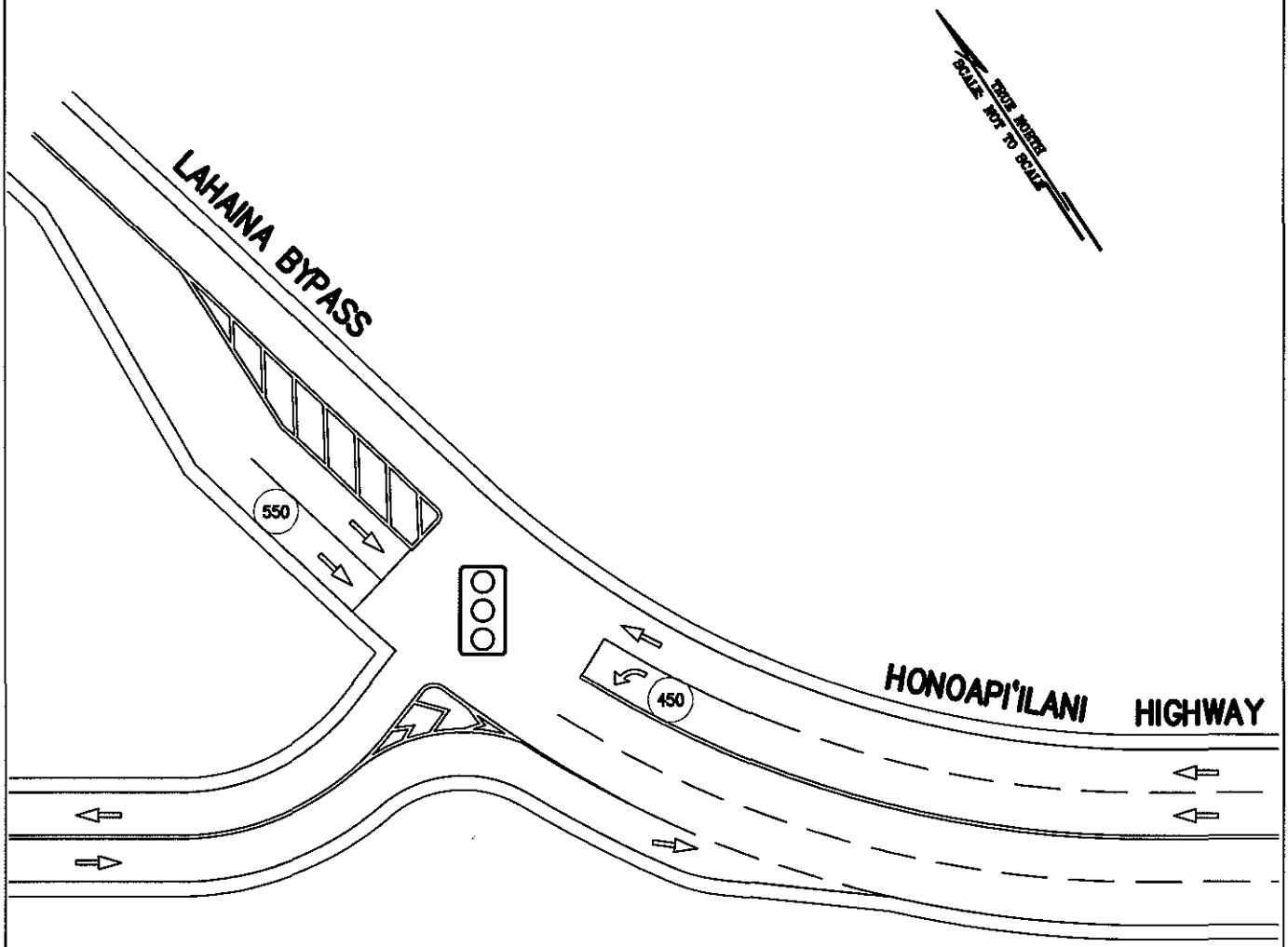
Figure D-3 shows the recommended intersection design for the year 2035 if Honoapi'ilani Highway were kept open between Puamana Connector and the southern

teminus intersections. The following design features are recommended for 2035 based on the 33% diversion:

- Honoapi'ilani Highway northbound "through lane" approach to Lahaina Bypass northbound - the two northbound lanes of the four-lane highway section would continue as the two northbound through lanes of the bypass highway and would not be stopped by the traffic signal.
- Honoapi'ilani Highway northbound "left turn" lane – one lane with 275 feet of storage required. Traffic from the left northbound through lane of Honoapi'ilani Highway would merge into the "left turn" lane.
- Lahaina Bypass Highway southbound "through lane" approach to southbound Honoapi'ilani Highway –the two through lanes of the bypass highway would be controlled by the traffic signal.
- Honoapi'ilani Highway southbound "through lane" approach - the single southbound through lane would be designed as an on-ramp that would not be controlled by traffic signals and merge with the southbound highway lanes south of the terminus.

The recommended design intersection as shown on Figure D-3 would be operating at level of service C in both the morning and afternoon peaks. The Honoapi'ilani Highway northbound "left turn" approach and would be operating at level of service D in the PM peak hour. The Honoapi'ilani Highway southbound "on-ramp" approach would be operating at level of service B or better in the morning peak hour and at level of service C or better in the afternoon peaks.

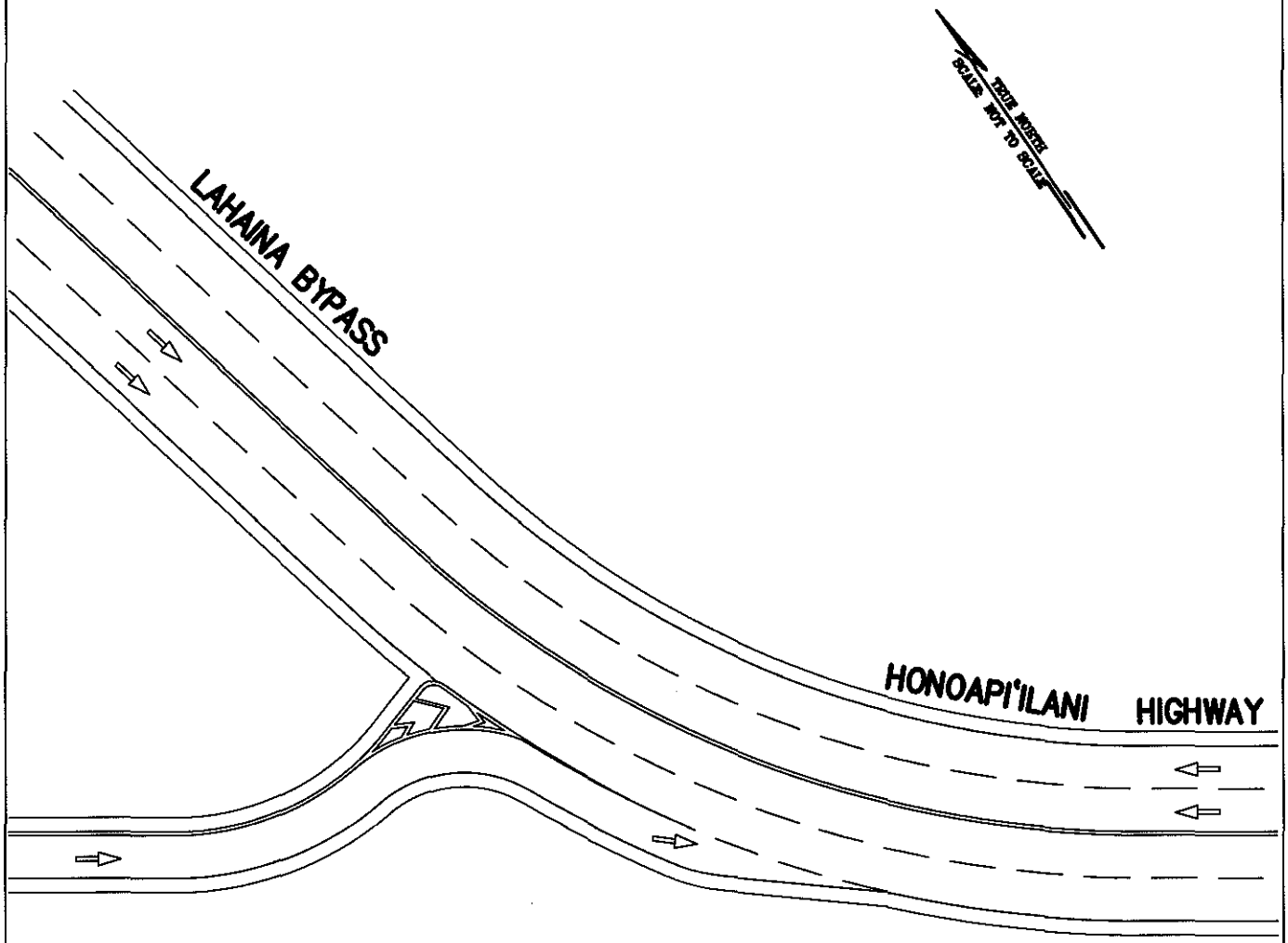
None of the three recommended design alternatives permit left turns from Honoapi'ilani Highway southbound to Lahaina Bypass Highway northbound. It is recommended that some form of median or raised barrier should be designed and constructed on the bypass highway to prohibit illegal left turns.



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	T–INTERSECTION AT LAHAINA BYPASS HIGHWAY AND HONOAPI'ILANI HIGHWAY 2020	FIGURE D–1
	NOT TO SCALE — DATE: NOVEMBER 2009	



SSFM INTERNATIONAL

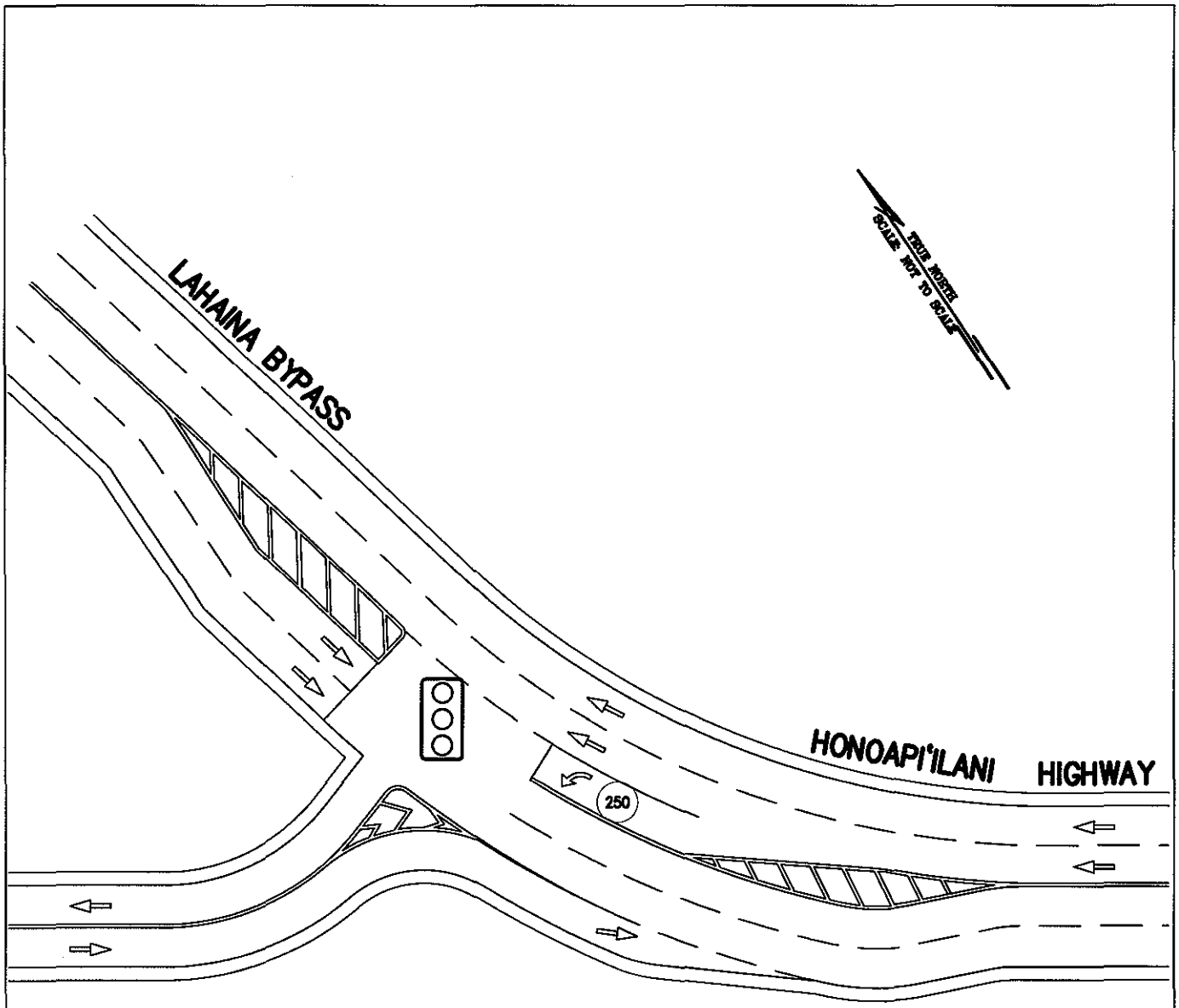
SSFM International, Inc.
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

T–INTERSECTION AT LAHAINA BYPASS HIGHWAY AND HONOAPI'ILANI HIGHWAY 2035 WITH BASELINE HIGHWAY NETWORK

NOT TO SCALE

DATE: NOVEMBER 2009

FIGURE D–2



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	T–INTERSECTION AT LAHAINA BYPASS HIGHWAY AND HONOAPI'ILANI HIGHWAY 2035	FIGURE D–3
	NOT TO SCALE / DATE: NOVEMBER 2009	

Lahaina Bypass Highway and Kai Hele Ku Street

The Lahaina Bypass Highway would intersect Kai Hele Ku Street with one through lane in each direction in 2020 and with two through lanes in 2035. The proposed designs for the Kai Hele Ku Street approaches as a traditional signalized intersection are similar for both years:

- Lahaina Bypass Highway approaches would have separate left and right turn lanes with the storage length of the southbound left turn lane at 175 feet.
- Kai Hele Ku Street eastbound approach would be a single lane for all movements.
- Kai Hele Ku Street westbound approach would include a right turn lane and a shared left turn/through lane.

The recommended designs for the 2020 and 2035 signalized intersections are shown on Figures D-4 and D-5, respectively. Traffic at this intersection in 2020 is forecast to operate at levels of service C and B in the morning and afternoon peak hours, respectively. Traffic performance at this intersection in 2035 would improve as more vehicles are diverted to the makai route. With no diversion the intersection is forecast to operate at levels of service C and D in the morning and afternoon peak hours, respectively. With diversion the intersection is forecast to improve one level of service to B and C in the morning and afternoon peak hours, respectively. Many of the minor movements would be operating at levels of service E and F due to the long traffic signal cycle lengths and not capacity problems.

Due to the low volumes forecast on the eastbound approach for all but the 2035 baseline network and the availability of alternate routes, it is recommended that elimination of the west leg (eastbound approach) of Kai Hele Ku Street be considered. In this case, the northbound approach left turn lane would also not be required. Traffic to the makai areas would have to utilize the north or south intersections of Honoapi'ilani Highway, which is not expected to be a large inconvenience. If this approach were not connected to the intersection, the intersection levels of service would remain about the same for 2020 but show considerable improvements for 2035, especially in the PM peak hour. The PM intersection levels of service would improve one step from C to B and the southbound approach levels of service would improve by one level for both peak hours. The 2035 baseline network was not analyzed without the eastbound connection since the eastbound approach would be needed to allow access into the makai area.

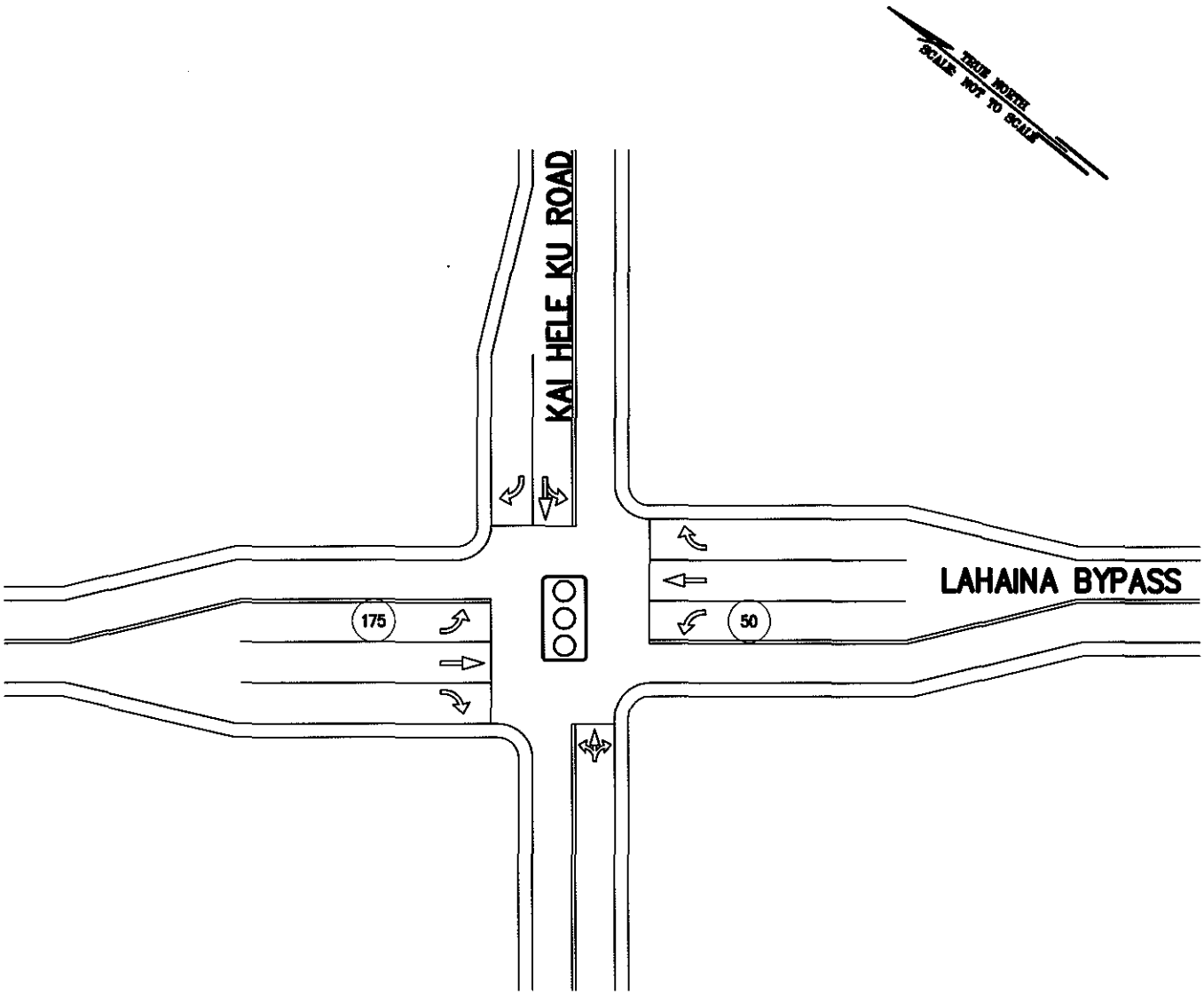
A Michigan U-turn design would be an alternative to the signalized intersection design in 2035. The Michigan U-turn attempts to improve traffic operations and safety by permitting only right turn movements. The design eliminates inbound and outbound left turns and through movements with the placement of a median through the intersection. All outbound vehicles are forced to make a right turn onto the main roadway and the left turn/through movements make a U-turn upstream and merge onto the opposing traffic roadway. Inbound left turn vehicles continue past the intersection, make a U-turn upstream, and make a right turn into their original destination roadway. This design is

intended for situations where there are high through volumes and low minor street volumes that do not warrant traffic signals or in lieu of traffic signals.

This alternative would require the north and south bound lanes of the bypass highway to be separated sufficiently to include a U-turn lane between the two roadways. A conceptual design on this alternative is shown on Figure D-6. With this design, the traffic on the highway would not experience delays while the westbound on-ramp traffic would operate at improved levels of service B and C in the morning and afternoon peak hours, respectively. This analysis indicates that the Michigan U-turn would be a feasible alternative at the Kai Hele Ku Street intersection in 2035 with all three scenarios. As with the signalized intersection design, it is recommended that elimination of the west leg (eastbound approach) be considered for the non-baseline networks.

The Michigan U-turn design could not be used with the 2020 network since the opposing lanes of traffic are assumed not to be separated in the two lane design. Although a formal traffic signal warrant analysis was not made, this intersection may warrant a traffic signal system by 2020 with the additional traffic from the mauka development. Another alternative that could be pursued if traffic signals are not warranted is not to provide a connection between the Lahaina Bypass Highway and Kai Hele Ku Road. The two roadways would be grade separated so that users of Kai Hele Ku Road would drive to Honoapi'ilani Highway to access the highway system. It would increase their travel times and increase traffic volumes at the two Honoapi'ilani Highway intersections. This alternative was not analyzed in this study but should be given future consideration. This alternative would afford better pedestrian and bicycle routes between the mauka communities and the coastal areas.

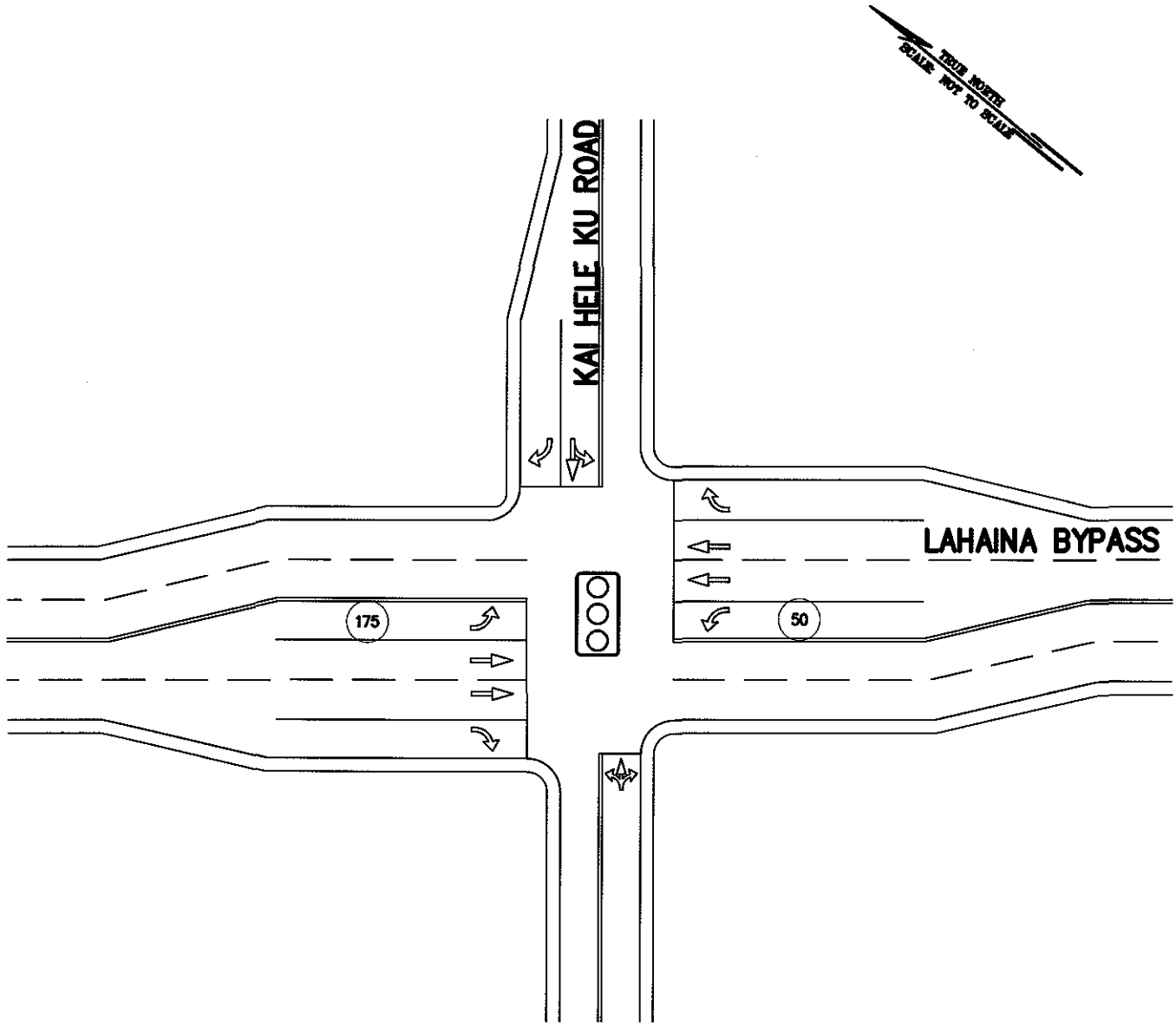
An implementation strategy may be to initially install traffic signals when the two lane highway is completed in about 2020 and convert to a Michigan U-turn when the four lane highway is built.



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

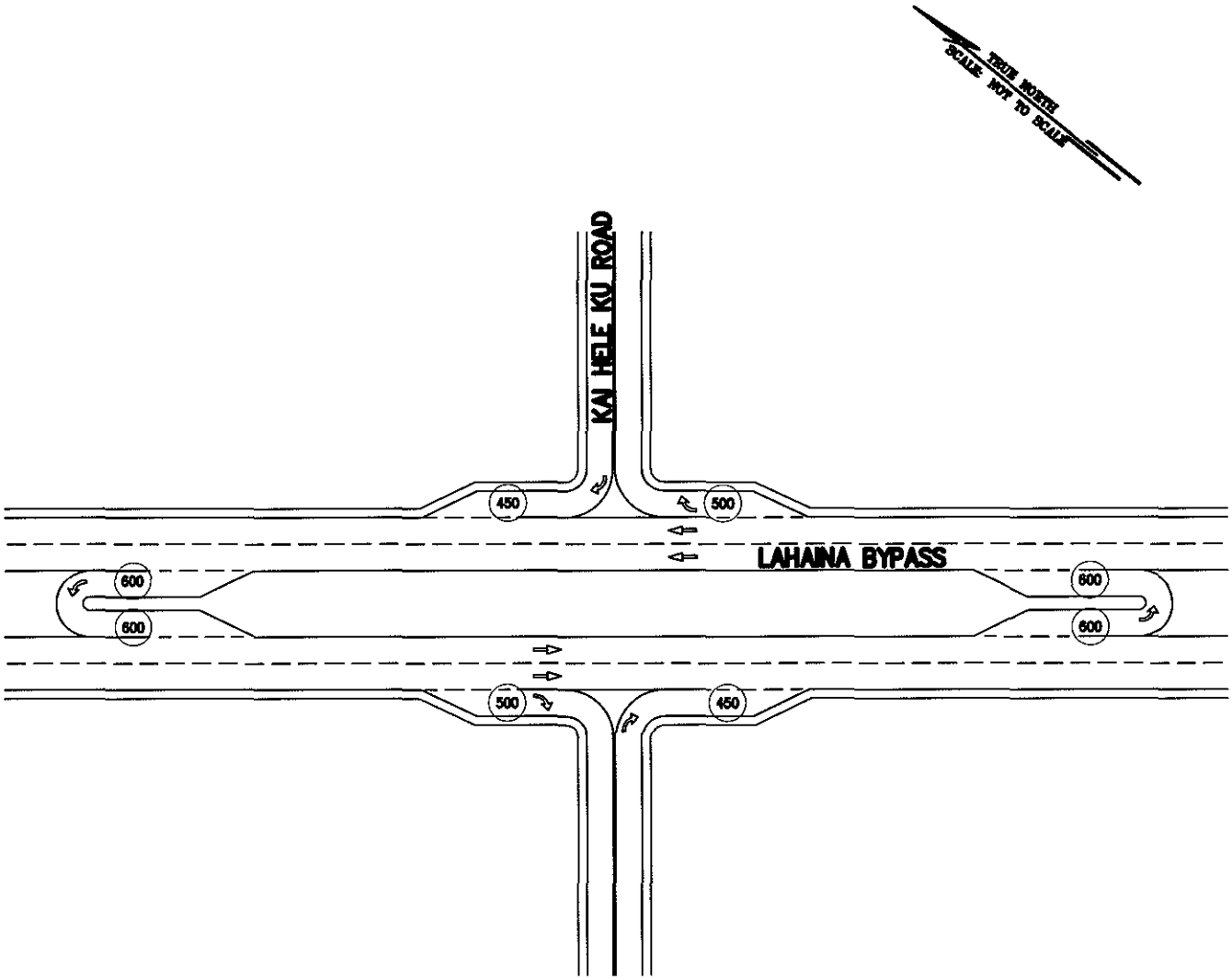
SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	TRADITIONAL INTERSECTION AT LAHAINA BYPASS HIGHWAY AND KAI HELE KU ROAD 2020	FIGURE D-4
	NOT TO SCALE — DATE: NOVEMBER 2009	



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	TRADITIONAL INTERSECTION AT LAHAINA BYPASS HIGHWAY AND KAI HELE KU ROAD 2035	FIGURE D-5
	NOT TO SCALE — DATE: NOVEMBER 2009	



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	MICHIGAN U-TURN AT LAHAINA BYPASS HIGHWAY AND KAI HELE KU ROAD 2035	FIGURE D-6
	NOT TO SCALE / DATE: NOVEMBER 2009	

Lahaina Bypass Highway and Puamana Connector

As at the Kai Hele Ku intersection, the Lahaina Bypass Highway would intersect the Puamana Connector with one through lane in each direction in 2020 and with two through lanes in 2035. The 2020 signalized intersection design would include:

- Lahaina Bypass Highway northbound approach – separate right turn lane and separate left turn lane with 500 feet storage length.
- Lahaina Bypass Highway southbound approach – separate right turn lane and separate left turn lane with 75 feet storage length.
- Puamana Connector eastbound approach - shared left turn and through lane.
- Puamana Connector eastbound right turn - would be designed as an on-ramp that would not be controlled by traffic signals and merge with the southbound highway lanes south of the Puamana Connector.
- Puamana Connector westbound approach - shared left turn/through lane and separate right turn lane for the Punakea Loop alignment, single shared lane for the Hokiokio Place alignment.

The recommended design as shown on Figure D-7 would be appropriate for both alignments of the Puamana Connector except as noted above. With this design for the Punakea Loop alignment, the proposed intersection would be operating at level of service D in both peak periods of 2020. The bypass highway northbound left turn lane would be operating at levels of service F and E in the morning and afternoon peak hours, respectively. The Puamana Connector eastbound "on-ramp" approach level of service could not be calculated for 2020 since the level of service calculation procedure assumes two (southbound) through lanes. Traffic operations would be slightly better with the Hokiokio Place alignment due to a slightly shorter cycle length. The intersection level of service would improve from D to C in the PM peak and the northbound left turn lane level of service would improve from F to E in the AM peak.

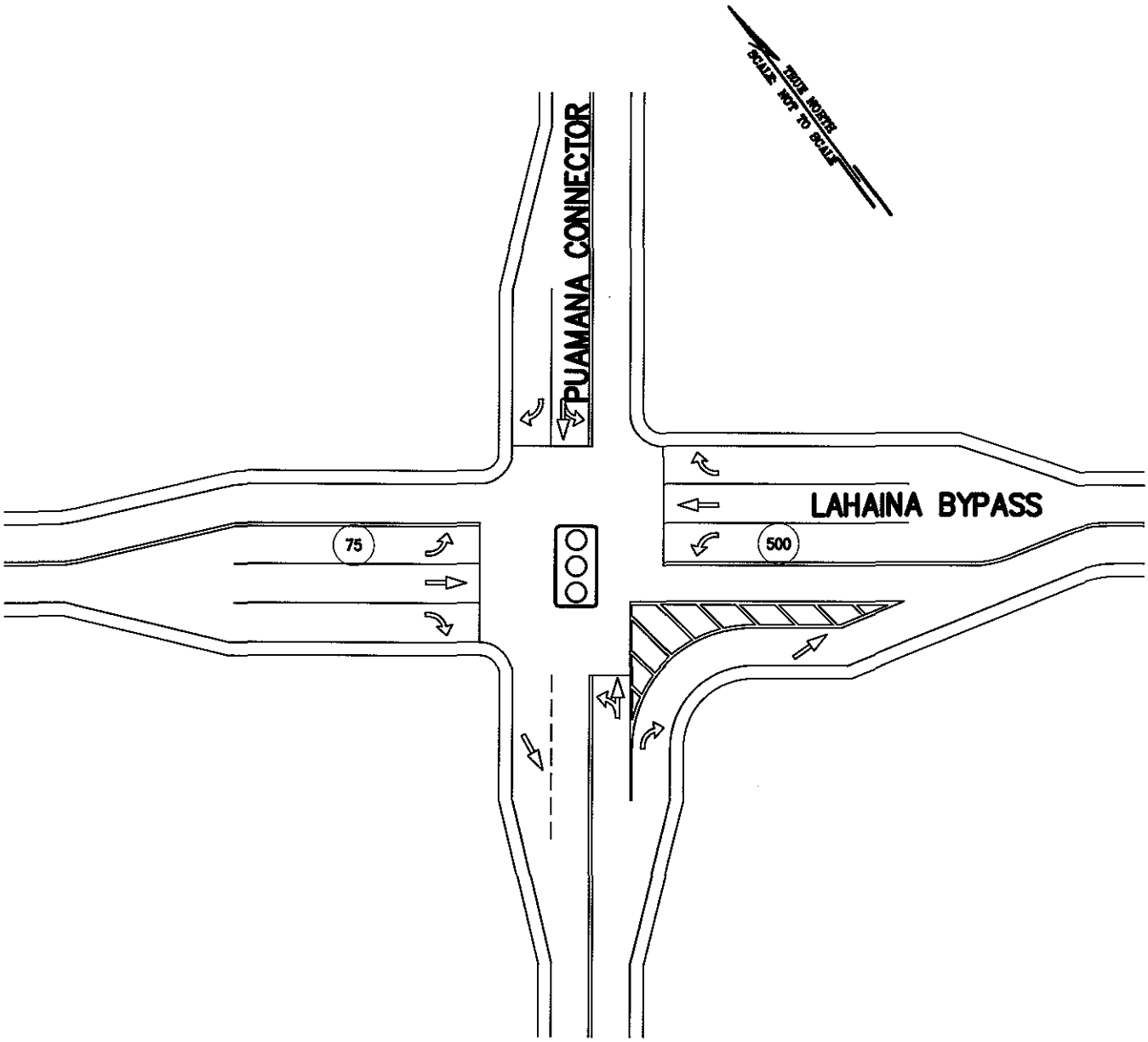
The design for 2035 is similar to 2020 except that there would be two through lanes in each direction of highway and double left turn lanes on the northbound approach as shown on Figure D-8. The storage length for these lanes would range from 850 feet with the baseline network to 450 feet with 33% diversion network. The storage length of the southbound left turn lane would also increase to 100 feet. With this design for the Punakea Loop alignment, the proposed intersection would be operating at level of service D in both peak periods for all alternatives although several approaches and movements would be operating at lower levels of service. The bypass highway northbound left turn lane would be operating at levels of service E in the afternoon peak hour (D in the AM peak hour with the 33% diversion network since the volume of opposing traffic would be less). Both Puamana Connector approaches would be operating at level of service E in both peak periods due to the long delays caused by the long cycle lengths required and not by capacity problems. Similarly, the bypass highway southbound left turn lane would be operating at level of service F due to the long delays caused by long cycle lengths and

not capacity problems. The Puamana Connector eastbound "on-ramp" approach would be operating at acceptable levels of service B and C or better. As with the year 2020, traffic operations would improve slightly with the Hokiokio Place alignment of Puamana Connector.

The very high volumes of left turns from the northbound approach of the Lahaina Bypass Highway to the Puamana Connector require much of the traffic signal cycle time in both peak periods. Traffic operations would improve considerably if this movement were made on an interchange ramp that bypassed the traffic signal. An underpass rather than overpass ramp is initially proposed to minimize the aesthetic impacts. The specific ramp design would need to be studied further. If such a ramp were built, the peak hour intersection level of service would improve from D to B. The levels of service on all the other approaches also improve due to the shorter delays made possible with shorter traffic signal cycle lengths. A schematic of this proposal is shown on Figure D-9.

Another reason in favor of the interchange ramp is the much lower traffic signal cycle length that would be possible. This traffic signal would be in close proximity to the traffic signal at the Honoapiilani Highway/Puamana Connector intersection, which is forecast to have a much shorter traffic signal cycle length. Traffic signals in close proximity to one another should be operating at the same cycle length for maximum efficiency.

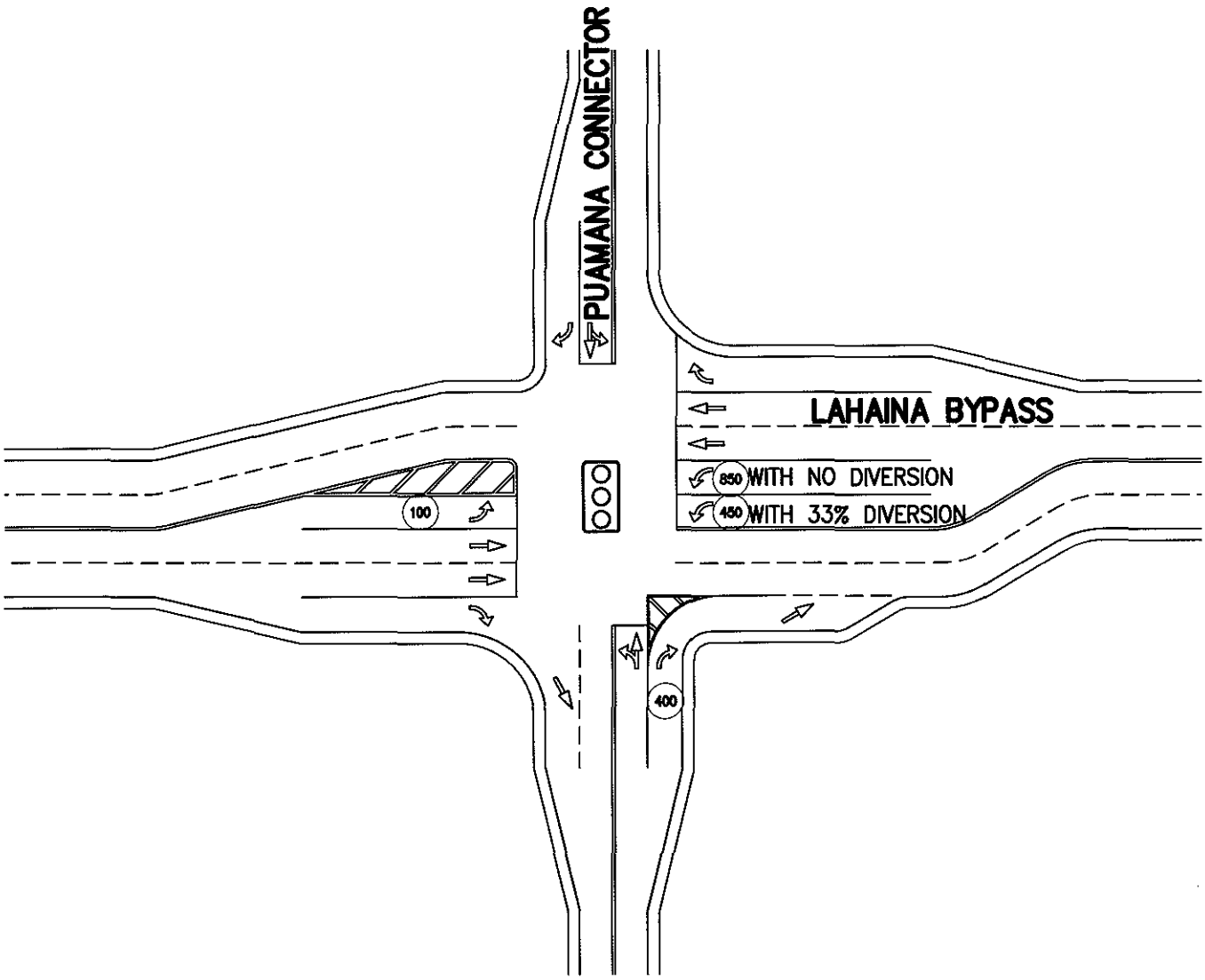
A partial cloverleaf design would represent the next level of design but was not analyzed in this study and should be given future consideration. A partial cloverleaf design would establish grade separation between the Lahaina Bypass Highway and Puamana Connector roadways and should reduce delays considerably. The partial cloverleaf would provide free flow movement for the northbound left turn movements. The grade separation would also afford better pedestrian and bicycle routes between the mauka communities and the coastline.



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

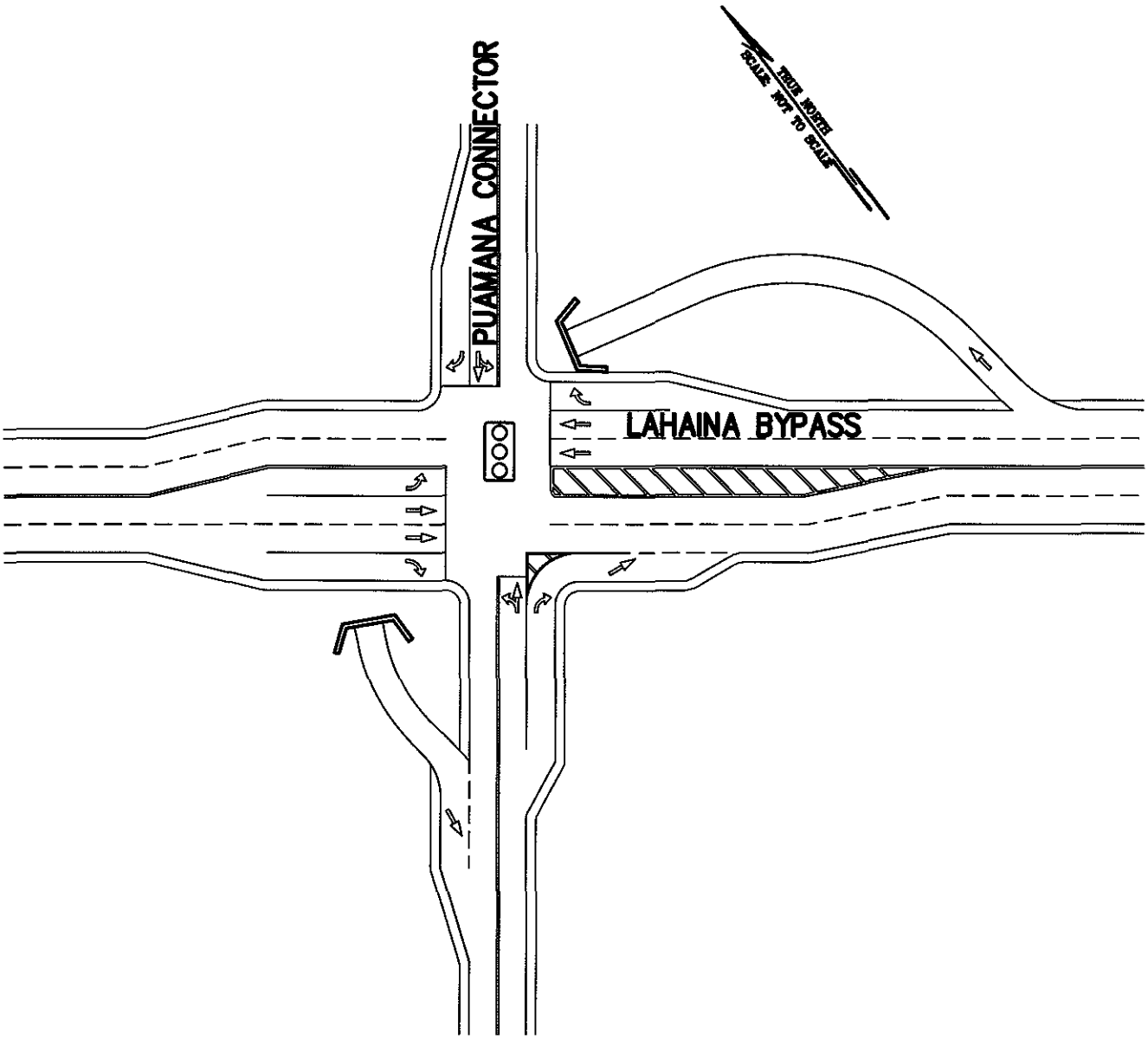
SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	TRADITIONAL INTERSECTION AT LAHAINA BYPASS HIGHWAY AND PUAMANA CONNECTOR 2020	FIGURE D-7
	NOT TO SCALE — DATE: NOVEMBER 2009	



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	TRADITIONAL INTERSECTION AT LAHAINA BYPASS HIGHWAY AND PUAMANA CONNECTOR 2035	FIGURE D-8
	NOT TO SCALE / DATE: FEBRUARY 2009	



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	PARTIAL INTERCHANGE AT LAHAINA BYPASS HIGHWAY AND PUAMANA CONNECTOR 2035	FIGURE D-9
	NOT TO SCALE / DATE: NOVEMBER 2009	

Honoapi'ilani Highway (north) and Puamana Connector

This intersection is expected to retain the same design for 2020 and 2035 (with diversion) networks since both Honoap'ilani Highway and the Puamana Connector are expected to remain at two lanes. The same design would also be appropriate for both Punakea Loop and Hokiokio Place alignments of the Puamana Connector:

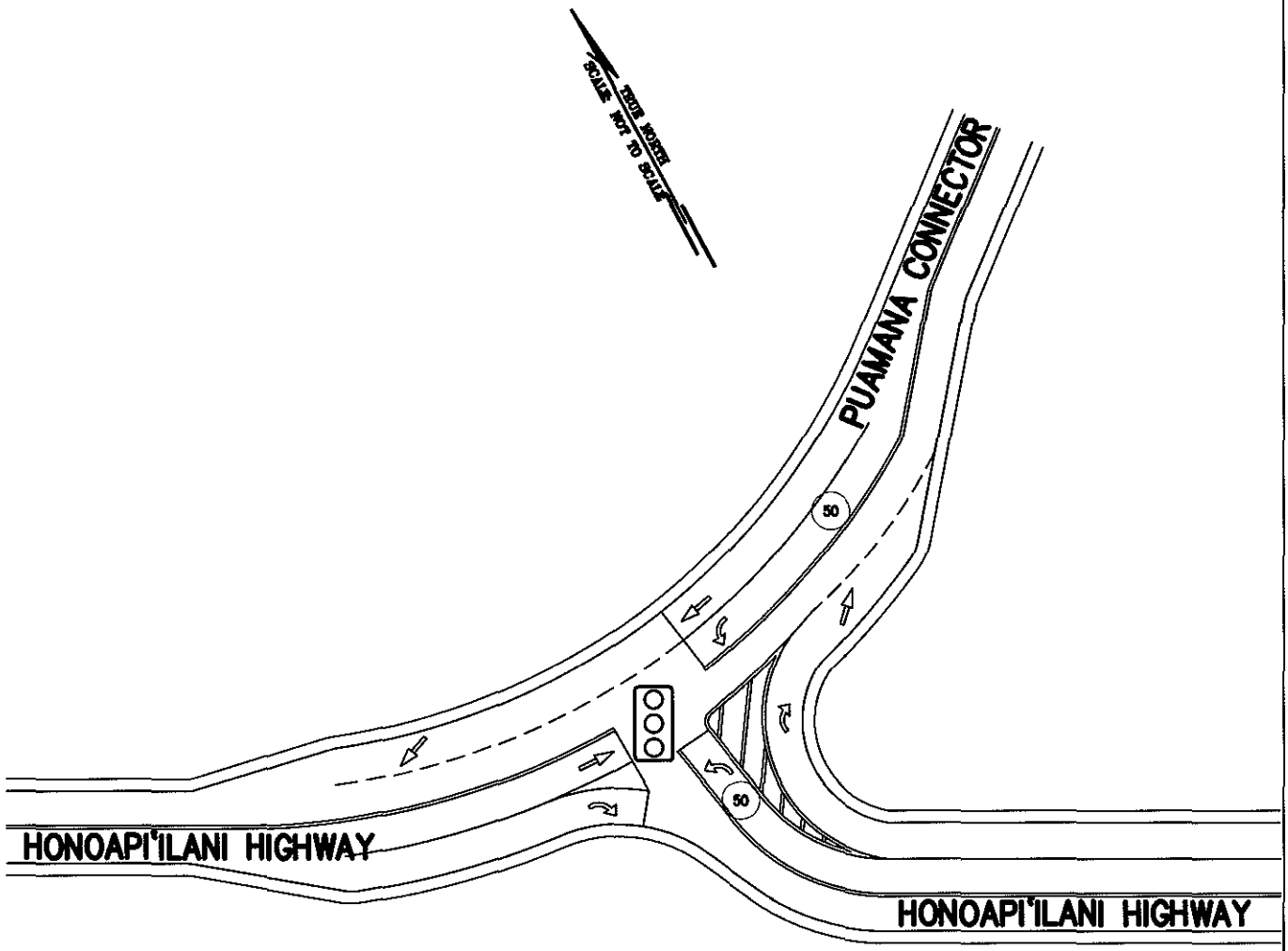
- Honoapi'ilani Highway southbound "through lane" to Puamana Connector eastbound – this one lane movement would be controlled by the traffic signal.
- Honoapi'ilani Highway southbound "right turn lane" to Honoapi'ilani Highway southbound- the single southbound through lane would be designed as an on-ramp that would not be controlled by traffic signals and merge with the southbound highway lanes south of the intersection.
- Honoapi'ilani Highway northbound "left turn" lane to Honoapi'ilani Highway northbound – one lane would be the major movement on the approach.
- Honoapi'ilani Highway northbound right turn lane to Puamana Connector eastbound – the right turn lane would be designed as an on-ramp that would not be controlled by traffic signals and merge with the eastbound highway lanes east of the intersection.
- Puamana Connector westbound "through lane" to Honoapi'ilani Highway northbound – this one lane movement would be controlled by the traffic signal.
- Puamana Connector westbound left turn lane to Honoapi'ilani Highway southbound - one lane with the minimum 50 feet storage length.

The recommended design is shown on Figure D-10. With this design for the Punakea Loop alignment, the proposed intersection would be operating at level of service C in both peak periods of 2020, when traffic volumes on the makai highway are forecast to be the highest. The intersection level of service would improve to B or remain at C for the 2035 alternatives when traffic volumes on the makai highway are forecast to decrease from the 2020 levels. The northbound approach is forecast to operate at level of service D in both forecast years in both AM and PM peak hours. The level of service for the Honoapi'ilani Highway northbound right turn lane could not be calculated since the level of service calculation procedure assumes two (eastbound) through lanes.

The traffic operations measures for the Hokiokio Place alignment are shown on Table 1 and discussed below in relative terms to those for the Punakea Loop alignment. The intersection levels of service would remain at C in both forecast years and both peak hours but the delay would increase by several seconds. The Honoapi'ilani Highway southbound approach level of service would change from B to C in 2020 but remain at C in 2035. The level of service for the Puamana Connector left turn lane would remain unchanged from 2020 but worsen from D to E in the 2035 PM peak hour.

Two alternate routes are being considered for the Puamana Connector: Hokiokio Place or Punakea Loop. The above level of service analysis did not indicate that either alternative was infeasible or that one alternative was "better" than the other. Other considerations will dictate which alternative would be selected. The Punakea Loop alignment provides a better opportunity for grade separation between the bypass highway and connector that could accommodate the interchange ramp. Another consideration in favor of the Punakea Loop alternative is the much larger number of residences that could be directly served. The Hokiokio Place route serves a landlocked area with a limited number of residences. With the Hokiokio Place alignment, residents using Punakea Loop would have to travel via an underpass from mauka to a new intersection with Honoapi'ilani Highway to access the highway system. This intersection would operate acceptably as an unsignalized intersection.

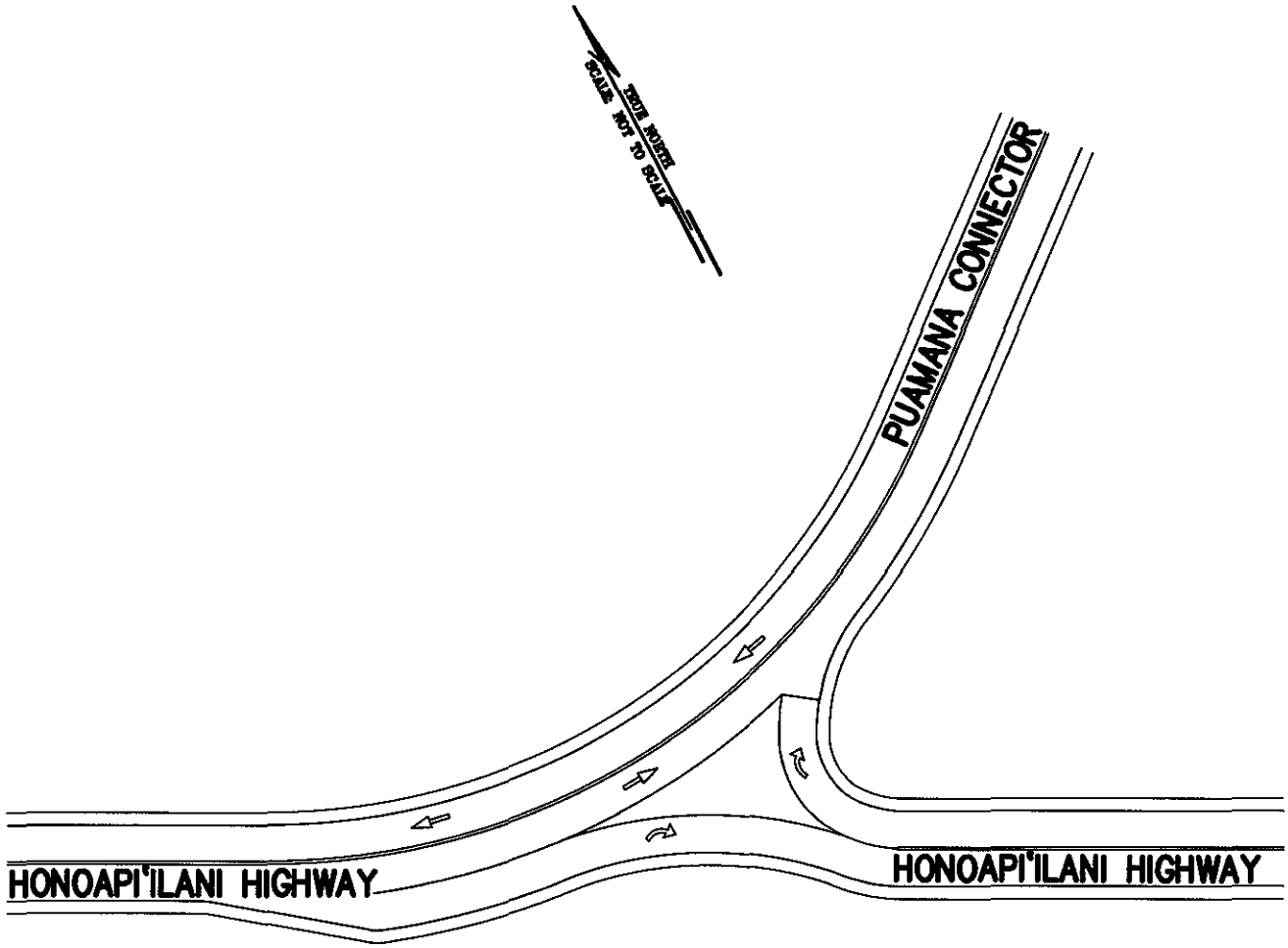
As discussed for the Honoapi'ilani Highway (south) and Lahaina Bypass Highway intersection, the baseline highway network could be implemented by 2035 if there is a desire to reduce traffic on Honoapi'ilani Highway between Puamana Connection and the southern terminus so that it could be made into a local recreational roadway. Traffic signals would not be required since only right turn in, right turn out movements would be permitted to the local recreation road. Several alternate entry and egress routes should be provided as a convenience for makai area residents and beach goers, without encouraging through traffic. A conceptual design of the baseline intersection is shown on Figure D - 11. There is no level of service calculations for these movements.



LEGEND

(100) LENGTH OF STORAGE LANE IN FEET

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	T–INTERSECTION AT HONOAPI'ILANI HIGHWAY AND PUAMANA CONNECTOR 2020 AND 2035	FIGURE D–10
	NOT TO SCALE — DATE: NOVEMBER 2009	

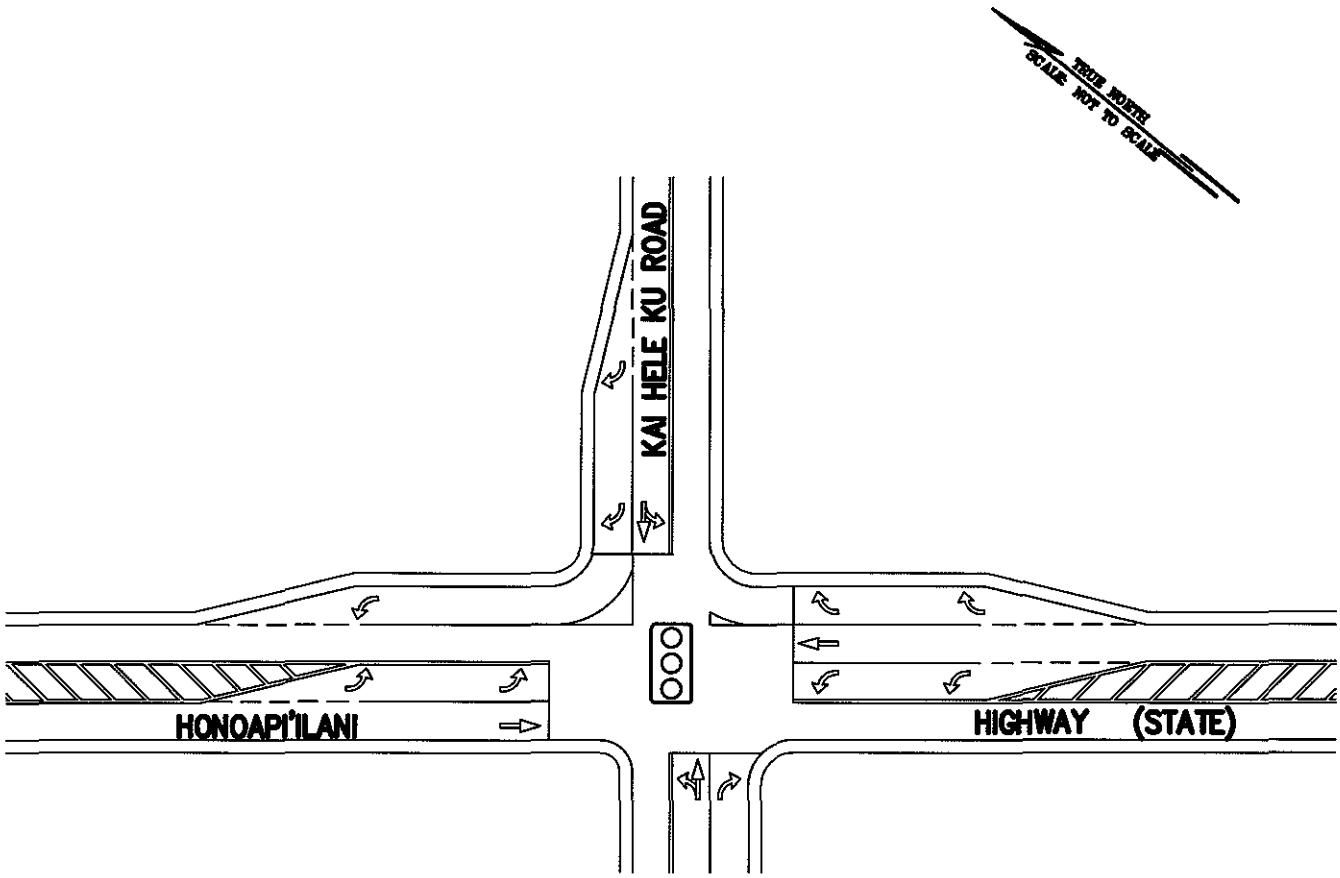


ALTERNATIVE 1

SSFM INTERNATIONAL SSFM International, Inc. 501 Sumner Street, Suite 620 Honolulu, Hawaii 96817	T-INTERSECTION AT HONOAPI'ILANI HIGHWAY AND PUAMANA CONNECTOR 2035 WITH BASELINE HIGHWAY NETWORK	FIGURE D-11
	NOT TO SCALE — DATE: NOVEMBER 2009	

Honoapi'ilani Highway and Kai Hele Ku Street

The current design of the intersection is shown on Figure D-12. The mauka approach of Kai Hele Ku Street serves residential communities while the makai approach provides access to the Launiupoko Wayside Park. Although not warranted, traffic signals were installed at this intersection for pedestrian safety. Honoapi'ilani Highway would continue to have heavy traffic with the 2020 network and traffic forecast and the 2035 network with 33% diverted traffic forecast. It is expected that the traffic signals would need to remain in place for pedestrian safety and that the existing roadway design could be retained.



SSFM INTERNATIONAL

SSFM International, Inc.
501 Sumner Street, Suite 620
Honolulu, Hawaii 96817

CURRENT INTERSECTION AT HONOAPI'ILANI HIGHWAY AND KAI HELE KU ROAD

NOT TO SCALE

DATE: NOVEMBER 2009

FIGURE D-12

VII. CONCLUSIONS

The proposed relocation of the southern terminus of the Lahaina Bypass Highway with Honoapi'ilani Highway would not adversely affect future traffic operations relative to the approved alignment. The proposed relocation is considered appropriate in the context of current planning, policy and environmental considerations.

The proposed roadway network for the southern terminus of the Lahaina Bypass Highway is forecast to be operating over capacity by the year 2020 due to the high demand for travel forecast in northwest Maui. The proposed two-lane bypass highway would not be adequate to meet the forecast travel demand between its southern terminus and the Puamana Connector. The existing section of Honoapi'ilani Highway in this area would need to be maintained in service to provide sufficient roadway capacity. Expansion of this section of the bypass highway to four lanes should be facilitated. Also, Honoapi'ilani Highway would have to be widened to four lanes south of the southern terminus to meet the 2020 travel forecasts. All of the five study intersections would need to be signalized by 2020. The specific conceptual design recommendations are shown on Figures D-1, -4, -7, -10 and -12.

The baseline network with four lane bypass highway assumed for 2035 would have adequate capacity to handle all north-south traffic. The section of Honoapi'ilani Highway between the southern terminus and Puamana Conector could be made into a local recreational roadway. The intersections at the two ends of the Honoapiilani Highway would not permit cross traffic movements and would not have to be signalized. Implementing a Michigan U-turn at the Lahaina Bypass Highway/Kai Hele Ku Street intersection and a left turn interchange ramp at the Lahaina Bypass Highway/ Puamana Connector intersection would improve traffic operations on the bypass highway. The specific conceptual design recommendations are shown on Figures D-2, -6, -9, and -11.

Retaining the section of Honoapi'ilani Highway between the southern terminus and Puamana Connector in operation in 2035 would provide six highway lanes of capacity and improve traffic operations on the bypass highway. The intersections at the two ends of the Honoapiilani Highway would need to be signalized to allow cross traffic to enter the highway section. The other design features discussed above would also pertain to this scenario. The present design of the Honoapi'ilani Highway/ Kai Hele Ku Street intersection could be retained but the traffic signals might be removed depending on the amount of traffic remaining on the highway. The specific conceptual design recommendations are shown on Figures D-3, -6, -9, -10 and -12.

VIII. REFERENCES

1. Kaku and Associates, Maui Long-Range Land Transportation Plan, February 1997
2. FHWA, Record of Decision for the Lahaina Bypass Final Supplemental EIS, Exhibit "C-1" Traffic Analysis, September 2003
3. Transportation Research Board, National Research Council, Highway Capacity Manual, 2000 Edition.
4. CH2MHill, Honoapiilani Highway Widening/Realignment Maalaea to Launiupoko, Draft Traffic Technical Memorandum, April 28, 2008
5. Draft Maui Island Plan, March 2008
6. Institute of Transportation Engineers, Trip Generation, Seventh Edition, 2003.

Appendix A
Level of Service Worksheets

Signalized Intersection

Level of Service Worksheets

CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM DIV MIT 2020
Comment: 2020 AM W/60% DIV & 2 SB LANES

Site Information

Jurisdiction/Date: 1/13/2009
EB/WB Street: HONOAPIILA
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							477				928	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	35	41						
Yellow + All red (s)	7	7						

Cycle (s): 90 Lost time per cycle (s): 7 Critical v/c Ratio: .626

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	1			2	1
Flow rate (veh/h)							518				1009	11
Capacity (veh/h)							688				1616	716
Adjusted saturation flow (veh/h)							1770	1848			3547	1571
v/c ratio							.753				.624	.015
g/C ratio							.389				.456	.456
Average back of queue (veh)							12.8				11.1	.2
Uniform delay (s)							23.8				18.6	13.4
Incremental delay (s)							4.7				.8	0
Initial queue delay (s)							0				0	0
Delay (s)							28.5				19.4	13.4
LOS							C				B	B
Approach delay (s)/LOS		/			/		28.5	/	C	19.4	/	B
Intersection delay (s)/ LOS		22.4			/				C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM DIV MIT 2020
Comment: 2020 PM W/70% DIV & 2 SB LANES

Site Information

Jurisdiction/Date: 1/13/2009
EB/WB Street: HONOAPIILA
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							497				1177	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	35	41						
Yellow + All red (s)	7	7						

Cycle (s): 90 Lost time per cycle (s): 7 Critical v/c Ratio: .722

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	1			2	1
Flow rate (veh/h)							540				1279	11
Capacity (veh/h)							688				1616	716
Adjusted saturation flow (veh/h)							1770	1848			3547	1571
v/c ratio							.785				.792	.015
g/C ratio							.389				.456	.456
Average back of queue (veh)							13.7				16.5	.2
Uniform delay (s)							24.2				20.9	13.4
Incremental delay (s)							6				2.8	0
Initial queue delay (s)							0				0	0
Delay (s)							30.2				23.7	13.4
LOS							C				C	B
Approach delay (s)/LOS		/			/		30.2	/	C	23.6	/	C
Intersection delay (s)/ LOS		25.5			/				C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 20% DIV 2035
Comment: 2035 AM W/20% DIV & 4 LANES

Site Information

Jurisdiction/Date: 1/13/2009
EB/WB Street: HONOAPIILA
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							199				1456	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	30	40						
Yellow + All red (s)	7	7						

Cycle (s): 84 Lost time per cycle (s): 7 Critical v/c Ratio: .62

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	1			2	1
Flow rate (veh/h)							216				1583	11
Capacity (veh/h)							632				1689	748
Adjusted saturation flow (veh/h)							1770	1848			3547	1571
v/c ratio							.342				.937	.015
g/C ratio							.357				.476	.476
Average back of queue (veh)							4				23.6	.1
Uniform delay (s)							19.8				20.8	11.6
Incremental delay (s)							0				10.5	0
Initial queue delay (s)							0				0	0
Delay (s)							19.8				31.3	11.6
LOS							B				C	B
Approach delay (s)/LOS		/			/		19.8	/	B	31.2	/	C
Intersection delay (s)/ LOS	29.8 / C											

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 20% DIV 2035
Comment: 2035 PM W/20% DIV & 4 LANES

Site Information

Jurisdiction/Date: 1/13/2009
EB/WB Street: HONOAPIILA
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							219				2021	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)								50			50	
Approach bicycle volume (bic/h)								0			0	
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	25	66						
Yellow + All red (s)	7	7						

Cycle (s): 105 Lost time per cycle (s): 7 Critical v/c Ratio: .808

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	2			2	1
Flow rate (veh/h)							238				2197	11
Capacity (veh/h)							421				2229	987
Adjusted saturation flow (veh/h)							1770	3533			3547	1571
v/c ratio							.565				.985	.011
g/C ratio							.238				.629	.629
Average back of queue (veh)							6.7				42.8	.1
Uniform delay (s)							35.2				19	7.3
Incremental delay (s)							1.8				15.7	0
Initial queue delay (s)							0				0	0
Delay (s)							37				34.7	7.3
LOS							D				C	A
Approach delay (s)/LOS		/			/		37	/	D	34.6	/	C
Intersection delay (s)/ LOS	34.8 / C											

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 33% DIV 2035
Comment: 2035 AM W/33% DIV & 4 LANES

Site Information

Jurisdiction/Date: 1/13/2009
EB/WB Street: HONOAPIILA
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							329				1341	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)							50			50		
Approach bicycle volume (bic/h)							0			0		
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	30	45						
Yellow + All red (s)	7	7						

Cycle (s): 89 Lost time per cycle (s): 7 Critical v/c Ratio: .665

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	1			2	1
Flow rate (veh/h)							358				1458	11
Capacity (veh/h)							596				1793	794
Adjusted saturation flow (veh/h)							1770	1848			3547	1571
v/c ratio							.6				.813	.014
g/C ratio							.337				.506	.506
Average back of queue (veh)							8.1				18.5	.1
Uniform delay (s)							24.5				18.5	11
Incremental delay (s)							1.7				3	0
Initial queue delay (s)							0				0	0
Delay (s)							26.2				21.5	11
LOS							C				C	B
Approach delay (s)/LOS		/			/		26.2	/	C	21.4	/	C
Intersection delay (s)/ LOS		22.3					/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 33% DIV 2035
Comment: 2035 PM W/33% DIV & 4 LANES

Site Information

Jurisdiction/Date: 1/13/2009
EB/WB Street: HONOAPIILA
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)							317				1859	10
RTOR volume (veh/h)									0			0
Peak-hour factor							.92	.92			.92	.92
Heavy vehicles (%)							2	2			2	2
Start-up lost time, l_1 (s)							2	2			2	2
Extension of effective green, e (s)							2	2			2	2
Arrival type, AT							3	3			3	3
Approach pedestrian volume (p/h)							50			50		
Approach bicycle volume (bic/h)							0			0		
Left/right parking (Y or N)		/			/		N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB								
NB	L							
SB		TR						
Green (s)	30	65						
Yellow + All red (s)	7	7						

Cycle (s): 109 Lost time per cycle (s): 7 Critical v/c Ratio: .817

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration							L	T			T	R
No. of lanes							1	2			2	1
Flow rate (veh/h)							345				2021	11
Capacity (veh/h)							487				2115	937
Adjusted saturation flow (veh/h)							1770	3533			3547	1571
v/c ratio							.707				.955	.012
g/C ratio							.275				.596	.596
Average back of queue (veh)							10.5				38	.1
Uniform delay (s)							35.6				20.6	8.9
Incremental delay (s)							4.7				11	0
Initial queue delay (s)							0				0	0
Delay (s)							40.3				31.6	8.9
LOS							D				C	A
Approach delay (s)/LOS		/			/		40.3	/	D	31.5	/	C
Intersection delay (s)/ LOS		32.8					/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM SIG 2020
Comment: 2020 AM W/60% DIVERSION

Site Information

Jurisdiction/Date: 11/10/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	10	2	2	27	1	127	0	1117	35	42	901	2
RTOR volume (veh/h)			0			15			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB		TR						
SB	LT	TR						
Green (s)	10	140	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 190 Lost time per cycle (s): 10 Critical v/c Ratio: .77

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	1	1	1	1	1
Flow rate (veh/h)		15			30	122	0	1214	38	46	979	2
Capacity (veh/h)		202			185	331		1373	1158	93	1520	1158
Adjusted saturation flow (veh/h)		1538			1409	1571	1770	1863	1571	1770	1863	1571
v/c ratio		.075			.164	.368		.885	.033	.49	.644	.002
g/C ratio		.132			.132	.211		.737	.737	.053	.816	.737
Average back of queue (veh)		.7			1.5	5.8		55.7	.6	2.6	22.5	0
Uniform delay (s)		72.4			73.2	64.2		18.9	6.7	87.5	6.8	6.6
Incremental delay (s)		0			0	0		7.2	0	3.7	1	0
Initial queue delay (s)		0			0	0		0	0	0	0	0
Delay (s)		72.4			73.2	64.2		26.1	6.7	91.2	7.8	6.6
LOS		E			E	E		C	A	F	A	A
Approach delay (s)/LOS	72.4	/	E	66	/	E	25.5	/	C	11.5	/	B
Intersection delay (s)/ LOS	22.4				/				C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM SIG 2020
Comment: 2020 PM W/60% DIVERSION

Site Information

Jurisdiction/Date: 11/10/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	4	1	0	46	1	60	0	830	32	103	1161	5
RTOR volume (veh/h)			0			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB		TR						
SB	LT	TR						
Green (s)	20	150	20					
Yellow + All red (s)	5	5	5					

Cycle (s): 205 Lost time per cycle (s): 10 Critical v/c Ratio: .752

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	1	1	1	1	1
Flow rate (veh/h)		5			51	60	0	902	35	112	1262	5
Capacity (veh/h)		154			132	345		1363	1150	173	1590	1150
Adjusted saturation flow (veh/h)		1578			1355	1571	1770	1863	1571	1770	1863	1571
v/c ratio		.035			.387	.173		.662	.03	.648	.794	.005
g/C ratio		.098			.098	.22		.732	.732	.098	.854	.732
Average back of queue (veh)		.3			2.9	2.9		29.3	.6	6.8	37.7	.1
Uniform delay (s)		83.8			86.7	64.9		14.3	7.5	89.1	6.8	7.4
Incremental delay (s)		0			.4	0		1.2	0	8.3	2.9	0
Initial queue delay (s)		0			0	0		0	0	0	0	0
Delay (s)		83.8			87.1	64.9		15.5	7.5	97.4	9.7	7.4
LOS		F			F	E		B	A	F	A	A
Approach delay (s)/LOS	83.8	/	F	75.2	/	E	15.2	/	B	16.8	/	B
Intersection delay (s)/ LOS	19				/				B			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 0 DIV 2035
Comment: 2035 AM W/NO DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	10	1	25	27	1	127	9	1922	35	42	1619	2
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 150 Lost time per cycle (s): 10 Critical v/c Ratio: .725

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		39			30	138	10	2089	38	46	1760	2
Capacity (veh/h)		261			235	419	118	2364	1047	118	2364	1047
Adjusted saturation flow (veh/h)		1569			1410	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.15			.129	.33	.083	.884	.036	.387	.744	.002
g/C ratio		.167			.167	.267	.067	.667	.667	.067	.667	.667
Average back of queue (veh)		1.5			1.1	4.9	.4	43.1	.6	2	28.4	0
Uniform delay (s)		53.4			53.2	44.2	65.7	20.3	8.5	67.1	16.5	8.3
Incremental delay (s)		0			0	0	0	4.4	0	.4	1.3	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		53.4			53.2	44.2	65.7	24.7	8.5	67.5	17.8	8.3
LOS		D			D	D	E	C	A	E	B	A
Approach delay (s)/LOS	53.4	/	D	45.8	/	D	24.6	/	C	19.1	/	B
Intersection delay (s)/ LOS	23.3					/			C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 0 DIV 2035
Comment: 2035 W/NO DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	4	1	86	46	1	60	72	1510	32	103	2248	5
RTOR volume (veh/h)			10			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB	R		LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	20	130	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 190 Lost time per cycle (s): 10 Critical v/c Ratio: .852

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		88			51	60	78	1641	35	112	2443	5
Capacity (veh/h)		210			131	413	186	2427	1075	186	2427	1075
Adjusted saturation flow (veh/h)		1597			994	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.419			.391	.145	.42	.676	.032	.601	1.007	.005
g/C ratio		.132			.132	.263	.105	.684	.684	.105	.684	.684
Average back of queue (veh)		4.6			2.7	2.5	4.1	29.2	.6	6.2	82.5	.1
Uniform delay (s)		75.8			75.5	53.6	79.6	17.6	9.7	81.2	30	9.5
Incremental delay (s)		.6			.4	0	.7	.8	0	5.3	20	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		76.4			75.9	53.6	80.3	18.4	9.7	86.5	50	9.5
LOS		E			E	D	F	B	A	F	D	A
Approach delay (s)/LOS	76.4	/	E	63.9	/	E	21	/	C	51.5	/	D
Intersection delay (s)/ LOS	40.5					/			D			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 20% DIV 2035
Comment: 2035 AM W/20% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	10	1	2	27	1	127	1	1732	35	42	1444	2
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 150 Lost time per cycle (s): 10 Critical v/c Ratio: .663

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		14			30	138	1	1883	38	46	1570	2
Capacity (veh/h)		257			240	419	118	2364	1047	118	2364	1047
Adjusted saturation flow (veh/h)		1541			1439	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.055			.127	.33	.009	.796	.036	.387	.664	.002
g/C ratio		.167			.167	.267	.067	.667	.667	.067	.667	.667
Average back of queue (veh)		.5			1.1	4.9	0	33	.6	2	22.6	0
Uniform delay (s)		52.6			53.2	44.2	65.4	17.8	8.5	67.1	14.9	8.3
Incremental delay (s)		0			0	0	0	2	0	.4	.7	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		52.6			53.2	44.2	65.4	19.8	8.5	67.5	15.6	8.3
LOS		D			D	D	E	B	A	E	B	A
Approach delay (s)/LOS	52.6	/	D	45.8	/	D	19.6	/	B	17.1	/	B
Intersection delay (s)/ LOS	19.8				/					B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 20% DIV 2035
Comment: 2035 W/20% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	4	1	2	46	2	60	1	1363	32	103	2005	5
RTOR volume (veh/h)			0			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB	R		LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	20	130	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 190 Lost time per cycle (s): 10 Critical v/c Ratio: .756

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		8			52	60	1	1482	35	112	2179	5
Capacity (veh/h)		210			179	413	186	2427	1075	186	2427	1075
Adjusted saturation flow (veh/h)		1598			1362	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.036			.291	.145	.006	.611	.032	.601	.898	.005
g/C ratio		.132			.132	.263	.105	.684	.684	.105	.684	.684
Average back of queue (veh)		.4			2.6	2.5	.1	24.2	.6	6.2	57	.1
Uniform delay (s)		72			74.5	53.6	76.1	16.3	9.7	81.2	24.6	9.5
Incremental delay (s)		0			0	0	0	.5	0	5.3	5	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		72			74.5	53.6	76.1	16.8	9.7	86.5	29.6	9.5
LOS		E			E	D	E	B	A	F	C	A
Approach delay (s)/LOS	72	/	E	63.3	/	E	16.7	/	B	32.3	/	C
Intersection delay (s)/ LOS	27.2				/					C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 33% DIV 2035
Comment: 2035 AM 33% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	10	1	2	27	1	127	1	1602	35	42	1329	2
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 150 Lost time per cycle (s): 10 Critical v/c Ratio: .62

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		14			30	138	1	1741	38	46	1445	2
Capacity (veh/h)		257			240	419	118	2364	1047	118	2364	1047
Adjusted saturation flow (veh/h)		1541			1439	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.055			.127	.33	.009	.736	.036	.387	.611	.002
g/C ratio		.167			.167	.267	.067	.667	.667	.067	.667	.667
Average back of queue (veh)		.5			1.1	4.9	0	27.7	.6	2	19.4	0
Uniform delay (s)		52.6			53.2	44.2	65.4	16.4	8.5	67.1	14.1	8.3
Incremental delay (s)		0			0	0	0	1.2	0	.4	.5	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		52.6			53.2	44.2	65.4	17.6	8.5	67.5	14.6	8.3
LOS		D			D	D	E	B	A	E	B	A
Approach delay (s)/LOS	52.6	/	D	45.8	/	D	17.4	/	B	16.2	/	B
Intersection delay (s)/ LOS	18.4				/					B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 33% DIV 2035
Comment: 2035 33% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	4	1	2	46	2	60	1	1265	32	103	1843	5
RTOR volume (veh/h)			0			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB	R		LTR					
WB	R		LTR					
NB	L	TR						
SB	L	TR						
Green (s)	20	130	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 190 Lost time per cycle (s): 10 Critical v/c Ratio: .703

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LTR			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	2	1	1	2	1
Flow rate (veh/h)		8			52	60	1	1375	35	112	2003	5
Capacity (veh/h)		210			179	413	186	2427	1075	186	2427	1075
Adjusted saturation flow (veh/h)		1598			1362	1571	1770	3547	1571	1770	3547	1571
v/c ratio		.036			.291	.145	.006	.567	.032	.601	.826	.005
g/C ratio		.132			.132	.263	.105	.684	.684	.105	.684	.684
Average back of queue (veh)		.4			2.6	2.5	.1	21.3	.6	6.2	45.3	.1
Uniform delay (s)		72			74.5	53.6	76.1	15.5	9.7	81.2	21.8	9.5
Incremental delay (s)		0			0	0	0	.3	0	5.3	2.5	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		72			74.5	53.6	76.1	15.8	9.7	86.5	24.3	9.5
LOS		E			E	D	E	B	A	F	C	A
Approach delay (s)/LOS	72	/	E	63.3	/	E	15.7	/	B	27.5	/	C
Intersection delay (s)/ LOS	24.1				/					C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM SIG NO EB 2020
Comment: 2020 AM W/60% DIV & NO EB APPROACH

Site Information

Jurisdiction/Date: 12/14/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	27	0	127	0	1117	35	42	901	2
RTOR volume (veh/h)						15			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)					0			0			0	
Approach bicycle volume (bic/h)					0			0			0	
Left/right parking (Y or N)		/		N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	13	140	22					
Yellow + All red (s)	5	5	5					

Cycle (s): 190 Lost time per cycle (s): 10 Critical v/c Ratio: .77

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	R
No. of lanes				1		1		1	1	1	1	1
Flow rate (veh/h)				29		122		1214	38	46	979	2
Capacity (veh/h)				205		331		1373	1158	121	1549	
Adjusted saturation flow (veh/h)				1770		1571		1863	1571	1770	1863	1571
v/c ratio				.143		.368		.885	.033	.377	.632	
g/C ratio				.116		.211		.737	.737	.068	.832	
Average back of queue (veh)				1.5		5.8		55.7	.6	2.5	20.7	
Uniform delay (s)				75.5		64.2		18.9	6.7	84.6	5.7	
Incremental delay (s)				0		0		7.2	0	.3	.8	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				75.5		64.2		26.1	6.7	84.9	6.5	
LOS				E		E		C	A	F	A	
Approach delay (s)/LOS		/		66.4	/	E	25.5	/	C	10	/	A
Intersection delay (s)/ LOS			21.5			/				C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM SIG NO EB 2020
Comment: 2020 PM W/60% DIV & NO EB APPROACH

Site Information

Jurisdiction/Date: 12/14/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)			0	46		60	0	830	32	103	1161	5
RTOR volume (veh/h)						5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)					0			0			0	
Approach bicycle volume (bic/h)					0			0			0	
Left/right parking (Y or N)		/		N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR	R					
SB	LT	T						
Green (s)	23	150	22					
Yellow + All red (s)	5	5	5					

Cycle (s): 210 Lost time per cycle (s): 10 Critical v/c Ratio: .751

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	R
No. of lanes				1		1		1	1	1	1	1
Flow rate (veh/h)				50		60		902	35	112	1262	5
Capacity (veh/h)				185		374		1331	1324	194	1579	
Adjusted saturation flow (veh/h)				1770		1571		1863	1571	1770	1863	1571
v/c ratio				.27		.16		.678	.026	.578	.799	
g/C ratio				.105		.238		.714	.843	.11	.848	
Average back of queue (veh)				2.8		2.9		31.9	.4	6.8	40.1	
Uniform delay (s)				86.6		63.4		16.6	2.7	88.9	7.6	
Incremental delay (s)				0		0		1.4	0	4.2	3	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				86.6		63.4		18	2.7	93.1	10.6	
LOS				F		E		B	A	F	B	
Approach delay (s)/LOS		/		73.9	/	E	17.5	/	B	17.3	/	B
Intersection delay (s)/ LOS			19.9			/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 20% DIV 2035
Comment: 2035 AM W/20% DIV & NO EB APPRAOCH

Site Information

Jurisdiction/Date: 12/14/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	27	0	127	0	1732	35	42	1444	2
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 150 Lost time per cycle (s): 10 Critical v/c Ratio: .663

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration					LT	R		T	R	L	T	R
No. of lanes					1	1		2	1	1	2	1
Flow rate (veh/h)					30	138		1883	38	46	1570	2
Capacity (veh/h)						419		2364	1047	118	2719	
Adjusted saturation flow (veh/h)					1777	1571		3547	1571	1770	3547	1571
v/c ratio						.33		.796	.036	.387	.577	
g/C ratio						.267		.667	.667	.067	.767	
Average back of queue (veh)						4.9		33	.6	2	15.9	
Uniform delay (s)						44.2		17.8	8.5	67.1	7.3	
Incremental delay (s)						0		2	0	.4	.3	
Initial queue delay (s)						0		0	0	0	0	
Delay (s)						44.2		19.8	8.5	67.5	7.6	
LOS						D		B	A	E	A	
Approach delay (s)/LOS		/		44.2	/	D	19.5	/	B	9.3	/	A
Intersection delay (s)/ LOS		16.2				/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 20% DIV 2035
Comment: 2035 W/20% DIV & NO EBAPPRAOCH

Site Information

Jurisdiction/Date: 12/14/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	46	0	60	0	1363	32	103	2005	5
RTOR volume (veh/h)						5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)					0			0			0	
Approach bicycle volume (bic/h)					0			0			0	
Left/right parking (Y or N)		/		N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	25	125	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 190 Lost time per cycle (s): 10 Critical v/c Ratio: .689

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	R
No. of lanes				1		1		2	1	1	2	1
Flow rate (veh/h)				50		60		1482	35	112	2179	5
Capacity (veh/h)				233		455		2333	1034	233	2893	
Adjusted saturation flow (veh/h)				1770		1571		3547	1571	1770	3547	1571
v/c ratio				.215		.131		.635	.034	.481	.753	
g/C ratio				.132		.289		.658	.658	.132	.816	
Average back of queue (veh)				2.5		2.4		26.2	.7	5.9	32.8	
Uniform delay (s)				73.7		49.9		19.1	11.4	76.5	8.4	
Incremental delay (s)				0		0		.6	0	1.4	1.2	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				73.7		49.9		19.7	11.4	77.9	9.6	
LOS				E		D		B	B	E	A	
Approach delay (s)/LOS		/		60.7	/	E	19.5	/	B	12.9	/	B
Intersection delay (s)/ LOS		16.8				/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 33% DIV 2035
Comment: 2035 AM 33% DIV & NO EB APPROACH

Site Information

Jurisdiction/Date: 12/14/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	27	0	127	0	1602	35	42	1329	0
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	10	100	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 150 Lost time per cycle (s): 10 Critical v/c Ratio: .62

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	R
No. of lanes				1		1		2	1	1	2	1
Flow rate (veh/h)				29		138		1741	38	46	1445	0
Capacity (veh/h)				295		419		2364	1047	118	2719	
Adjusted saturation flow (veh/h)				1770		1571		3547	1571	1770	3547	1571
v/c ratio				.1		.33		.736	.036	.387	.531	
g/C ratio				.167		.267		.667	.667	.067	.767	
Average back of queue (veh)				1.1		4.9		27.7	.6	2	13.7	
Uniform delay (s)				53		44.2		16.4	8.5	67.1	6.9	
Incremental delay (s)				0		0		1.2	0	.4	.2	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				53		44.2		17.6	8.5	67.5	7.1	
LOS				D		D		B	A	E	A	
Approach delay (s)/LOS		/		45.8	/	D	17.4	/	B	8.9	/	A
Intersection delay (s)/ LOS		15.1				/			B			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 33% DIV 2035
Comment: 2035 33% DIV & NO EB APPROACH

Site Information

Jurisdiction/Date: 12/14/2008
EB/WB Street: KAI HELE K
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	0	0	0	46	0	60	0	1265	32	103	1843	5
RTOR volume (veh/h)			0			5			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB								
WB	R		LR					
NB		TR						
SB	LT	T						
Green (s)	25	125	25					
Yellow + All red (s)	5	5	5					

Cycle (s): 190 Lost time per cycle (s): 10 Critical v/c Ratio: .639

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration				L		R		T	R	L	T	
No. of lanes				1		1		2	1	1	2	
Flow rate (veh/h)				50		60		1375	35	112	2003	
Capacity (veh/h)				233		455		2333	1034	233	2882	
Adjusted saturation flow (veh/h)				1770		1571		3547	1571	1770	3533	
v/c ratio				.215		.131		.589	.034	.481	.695	
g/C ratio				.132		.289		.658	.658	.132	.816	
Average back of queue (veh)				2.5		2.4		23	.7	5.9	26.6	
Uniform delay (s)				73.7		49.9		18.2	11.4	76.5	7.4	
Incremental delay (s)				0		0		.4	0	1.4	.7	
Initial queue delay (s)				0		0		0	0	0	0	
Delay (s)				73.7		49.9		18.6	11.4	77.9	8.1	
LOS				E		D		B	B	E	A	
Approach delay (s)/LOS		/		60.7	/	E	18.4	/	B	11.8	/	B
Intersection delay (s)/ LOS		15.9				/			B			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM DIV 2020
Comment: 2020 AM W/60% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	292	29	63	61	338	816	22	14	594	2
RTOR volume (veh/h)			70			20			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	4	4	4	2	2	2	4	4	4	4	4	4
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB	R			LTR				
NB	L	LT	TR					
SB	L		TR					
Green (s)	5	30	70	35				
Yellow + All red (s)	1	6	6	6				

Cycle (s): 159 Lost time per cycle (s): 12 Critical v/c Ratio: .675

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	1	1	1	1	1
Flow rate (veh/h)		18			100	45	367	887	24	15	646	2
Capacity (veh/h)		394			372	455	393	1218	684	55	804	684
Adjusted saturation flow (veh/h)		1789			1690	1571	1736	1827	1553	1736	1827	1553
v/c ratio		.047			.269	.098	.935	.728	.035	.279	.803	.003
g/C ratio		.22			.22	.289	.226	.667	.44	.031	.44	.44
Average back of queue (veh)		.7			3.9	1.5	19.6	28.1	.6	.7	27.7	.1
Uniform delay (s)		48.9			51.4	41.3	60.4	17.2	25.3	75.2	38.5	24.9
Incremental delay (s)		0			0	0	29.5	2.2	0	0	5.9	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		48.9			51.4	41.3	89.9	19.4	25.3	75.2	44.4	24.9
LOS		D			D	D	F	B	C	E	D	C
Approach delay (s)/LOS	48.9	/	D	48.3	/	D	39.7	/	D	45.1	/	D
Intersection delay (s)/ LOS			42.1				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM DIV 2020
Comment: 2020 PM W/70% DIVERSION

Site Information

Jurisdiction/Date: 11/10/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	65	331	38	30	29	196	624	40	60	850	5
RTOR volume (veh/h)			75			5			5			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	4	4	4	2	2	2	4	4	4	4	4	4
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB	R			LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	10	5	70	20				
Yellow + All red (s)	6	6	6	6				

Cycle (s): 129 Lost time per cycle (s): 12 Critical v/c Ratio: .747

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	1	1	1	1	1	1
Flow rate (veh/h)		73			74	26	213	678	38	65	924	5
Capacity (veh/h)		281			235	438	283	1147	975	135	991	843
Adjusted saturation flow (veh/h)		1815			1516	1571	1736	1827	1553	1736	1827	1553
v/c ratio		.259			.314	.06	.754	.591	.039	.485	.932	.006
g/C ratio		.155			.155	.279	.163	.628	.628	.078	.543	.543
Average back of queue (veh)		2.4			2.5	.7	8.4	15.7	.6	2.5	37.2	.1
Uniform delay (s)		48			48.4	34.1	51.5	14.2	9.2	57	27.3	13.5
Incremental delay (s)		0			0	0	11	.8	0	2.4	14.9	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		48			48.4	34.1	62.5	15	9.2	59.4	42.2	13.5
LOS		D			D	C	E	B	A	E	D	B
Approach delay (s)/LOS	48	/	D	44.7	/	D	25.7	/	C	43.2	/	D
Intersection delay (s)/ LOS			35.6				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM W/NO DIV 2035
Comment: 2035 AM W/ NO DIVERSION, 2 LT LANES

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	881	29	63	61	976	986	22	14	723	1
RTOR volume (veh/h)			0			15			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	5	65	80	40				
Yellow + All red (s)	5	5	5	5				

Cycle (s): 210 Lost time per cycle (s): 10 Critical v/c Ratio: .619

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		18			100	50	1061	1072	13	15	786	1
Capacity (veh/h)		345			321	299	1227	2533	1122	42	1351	598
Adjusted saturation flow (veh/h)		1812			1686	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.054			.311	.167	.864	.423	.012	.361	.582	.002
g/C ratio		.19			.19	.19	.357	.714	.714	.024	.381	.381
Average back of queue (veh)		.9			5.3	2.5	33.7	14.4	.2	1	20.4	0
Uniform delay (s)		69.5			73.1	71.1	62.8	12.3	8.6	100.9	51.7	40.3
Incremental delay (s)		0			0	0	6.6	.1	0	.1	.6	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		69.5			73.1	71.1	69.4	12.4	8.6	101	52.3	40.3
LOS		E			E	E	E	B	A	F	D	D
Approach delay (s)/LOS	69.5	/	E	72.5	/	E	40.5	/	D	53.2	/	D
Intersection delay (s)/ LOS	45.5	/	D									

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM W/NO DIV 2035
Comment: 2035 PM W/ NO DIV, 2 LT LANES

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	1	65	1243	38	30	29	748	751	40	60	1025	5
RTOR volume (veh/h)			100			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	0			0			0			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	16	47	97	35				
Yellow + All red (s)	5	5	5	5				

Cycle (s): 215 Lost time per cycle (s): 10 Critical v/c Ratio: .631

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		72			74	10	813	816	33	65	1114	5
Capacity (veh/h)		300			238	256	1087	2458	1089	132	1600	709
Adjusted saturation flow (veh/h)		1844			1460	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.239			.311	.038	.748	.332	.03	.495	.696	.008
g/C ratio		.163			.163	.163	.316	.693	.693	.074	.451	.451
Average back of queue (veh)		3.9			4.1	.5	24.6	10.9	.6	4.1	30.2	.2
Uniform delay (s)		78.4			79.4	75.8	65.8	13.2	10.3	95.6	47.2	32.5
Incremental delay (s)		0			0	0	2.9	0	0	2.8	1.3	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		78.4			79.4	75.8	68.7	13.2	10.3	98.4	48.5	32.5
LOS		E			E	E	E	B	B	F	D	C
Approach delay (s)/LOS	78.4	/	E	79	/	E	40.3	/	D	51.2	/	D
Intersection delay (s)/ LOS	46.6	/	D									

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM W/20% DIV 2035
Comment: 2035 AM W/20% DIVERSION, 2 LT LANES

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	706	29	63	61	786	986	22	14	723	1
RTOR volume (veh/h)			0			15			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	5	65	80	40				
Yellow + All red (s)	5	5	5	5				

Cycle (s): 210 Lost time per cycle (s): 10 Critical v/c Ratio: .556

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		18			100	50	854	1072	13	15	786	1
Capacity (veh/h)		345			321	299	1227	2533	1122	42	1351	598
Adjusted saturation flow (veh/h)		1812			1686	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.054			.311	.167	.696	.423	.012	.361	.582	.002
g/C ratio		.19			.19	.19	.357	.714	.714	.024	.381	.381
Average back of queue (veh)		.9			5.3	2.5	23.8	14.4	.2	1	20.4	0
Uniform delay (s)		69.5			73.1	71.1	57.7	12.3	8.6	100.9	51.7	40.3
Incremental delay (s)		0			0	0	1.7	.1	0	.1	.6	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		69.5			73.1	71.1	59.4	12.4	8.6	101	52.3	40.3
LOS		E			E	E	E	B	A	F	D	D
Approach delay (s)/LOS	69.5	/	E	72.5	/	E	33.1	/	C	53.2	/	D
Intersection delay (s)/ LOS			40.9				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM W/20% DIV 2035
Comment: 2035 PM W/ 20% DIV, 2 LT LANES

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	1	65	1000	38	30	29	601	751	40	60	1025	5
RTOR volume (veh/h)			0			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	16	39	90	35				
Yellow + All red (s)	5	5	5	5				

Cycle (s): 200 Lost time per cycle (s): 10 Critical v/c Ratio: .583

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		72			74	10	653	816	33	65	1114	5
Capacity (veh/h)		323			258	275	1031	2376	1053	142	1596	707
Adjusted saturation flow (veh/h)		1844			1477	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.222			.286	.036	.634	.344	.031	.461	.698	.008
g/C ratio		.175			.175	.175	.3	.67	.67	.08	.45	.45
Average back of queue (veh)		3.6			3.8	.5	17.4	10.9	.6	3.7	28.2	.2
Uniform delay (s)		70.8			71.6	68.5	60.5	14.1	11.1	87.9	44.1	30.4
Incremental delay (s)		0			0	0	1.3	0	0	1.7	1.4	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		70.8			71.6	68.5	61.8	14.1	11.1	89.6	45.5	30.4
LOS		E			E	E	E	B	B	F	D	C
Approach delay (s)/LOS	70.8	/	E	71.3	/	E	34.8	/	C	47.9	/	D
Intersection delay (s)/ LOS			42.2				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM W/33% DIV 2035
Comment: 2035 AM W/33% DIVERSION, 2 LT LANES

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	591	29	63	61	656	986	22	14	723	1
RTOR volume (veh/h)			0			15			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	5	55	70	40				
Yellow + All red (s)	5	5	5	5				

Cycle (s): 190 Lost time per cycle (s): 10 Critical v/c Ratio: .515

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		18			100	50	713	1072	13	15	786	1
Capacity (veh/h)		382			356	331	1176	2427	1075	47	1307	579
Adjusted saturation flow (veh/h)		1813			1691	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.048			.281	.151	.606	.442	.012	.327	.601	.002
g/C ratio		.211			.211	.211	.342	.684	.684	.026	.368	.368
Average back of queue (veh)		.8			4.7	2.3	17.3	14.4	.2	.9	18.9	0
Uniform delay (s)		59.8			62.9	61.2	51.9	13.6	9.6	90.8	48.7	37.9
Incremental delay (s)		0			0	0	.9	.1	0	0	.8	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		59.8			62.9	61.2	52.8	13.7	9.6	90.8	49.5	37.9
LOS		E			E	E	D	B	A	F	D	D
Approach delay (s)/LOS	59.8	/	E	62.3	/	E	29.2	/	C	50.3	/	D
Intersection delay (s)/ LOS	37.3				/					D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM W/33% DIV 2035
Comment: 2035 PM W/ 33% DIV, 2 LT LANES

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	1	65	838	38	30	29	503	751	40	60	1025	5
RTOR volume (veh/h)			0			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	16	32	82	35				
Yellow + All red (s)	5	5	5	5				

Cycle (s): 185 Lost time per cycle (s): 10 Critical v/c Ratio: .551

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R	L	T	R	L	T	R
No. of lanes		1			1	1	2	2	1	1	2	1
Flow rate (veh/h)		72			74	10	547	816	33	65	1114	5
Capacity (veh/h)		349			290	297	985	2281	1011	153	1572	696
Adjusted saturation flow (veh/h)		1845			1530	1571	3437	3547	1571	1770	3547	1571
v/c ratio		.206			.255	.033	.555	.358	.032	.426	.709	.008
g/C ratio		.189			.189	.189	.286	.643	.643	.086	.443	.443
Average back of queue (veh)		3.3			3.4	.4	13.1	10.9	.6	3.4	26.6	.2
Uniform delay (s)		63.3			63.9	61.2	56	15.3	12	80.1	41.8	28.8
Incremental delay (s)		0			0	0	.7	0	0	.9	1.5	0
Initial queue delay (s)		0			0	0	0	0	0	0	0	0
Delay (s)		63.3			63.9	61.2	56.7	15.3	12	81	43.3	28.8
LOS		E			E	E	E	B	B	F	D	C
Approach delay (s)/LOS	63.3	/	E	63.6	/	E	31.4	/	C	45.3	/	D
Intersection delay (s)/ LOS	39.3				/					D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM NO DIV W/IC 2035
Comment: 2035 AM NO DIV W/INTERCHANGE

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	2	15	881	29	63	61	765	986	22	14	723	1
RTOR volume (veh/h)			0			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LT					
WB			LTR					
NB		TR						
SB	LTR	TR						
Green (s)	5	70	35					
Yellow + All red (s)	5	5	5					

Cycle (s): 125 Lost time per cycle (s): 10 Critical v/c Ratio: .401

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R		T	R	L	T	R
No. of lanes		1			1	1		2	1	1	2	1
Flow rate (veh/h)		18			100	45		1072	13	15	786	1
Capacity (veh/h)		508			478	440		1986	880	71	2270	1005
Adjusted saturation flow (veh/h)		1816			1707	1571		3547	1571	1770	3547	1571
v/c ratio		.036			.209	.101		.54	.015	.215	.346	.001
g/C ratio		.28			.28	.28		.56	.56	.04	.64	.64
Average back of queue (veh)		.5			2.8	1.2		13.3	.2	.6	7.1	0
Uniform delay (s)		32.7			34.4	33.3		17.3	12.2	58.1	10.4	8.1
Incremental delay (s)		0			0	0		.3	0	0	0	0
Initial queue delay (s)		0			0	0		0	0	0	0	0
Delay (s)		32.7			34.4	33.3		17.6	12.2	58.1	10.4	8.1
LOS		C			C	C		B	B	E	B	A
Approach delay (s)/LOS	32.7	/	C	34.1	/	C	17.6	/	B	11.3	/	B
Intersection delay (s)/ LOS			16.4			/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM NODIV W/IC 2035
Comment: 2035 PM NO DIV W/INTERCHANGE

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	1	65	1243	38	30	29	785	751	40	60	1025	5
RTOR volume (veh/h)			100			20			10			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LT					
WB			LTR					
NB		TR						
SB	LTR	TR						
Green (s)	15	85	35					
Yellow + All red (s)	5	5	5					

Cycle (s): 150 Lost time per cycle (s): 10 Critical v/c Ratio: .388

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LT	R		T	R	L	T	R
No. of lanes		1			1	1		2	1	1	2	1
Flow rate (veh/h)		72			74	10		816	33	65	1114	5
Capacity (veh/h)		430			356	367		2010	890	177	2483	1100
Adjusted saturation flow (veh/h)		1845			1527	1571		3547	1571	1770	3547	1571
v/c ratio		.167			.207	.027		.406	.037	.369	.449	.005
g/C ratio		.233			.233	.233		.567	.567	.1	.7	.7
Average back of queue (veh)		2.5			2.6	.3		10.7	.6	2.7	11.6	.1
Uniform delay (s)		45.9			46.3	44.4		18.3	14.4	63.1	9.8	6.8
Incremental delay (s)		0			0	0		0	0	.1	.1	0
Initial queue delay (s)		0			0	0		0	0	0	0	0
Delay (s)		45.9			46.3	44.4		18.3	14.4	63.2	9.9	6.8
LOS		D			D	D		B	B	E	A	A
Approach delay (s)/LOS	45.9	/	D	46.1	/	D	18.1	/	B	12.9	/	B
Intersection delay (s)/ LOS			17.3			/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM DIV HOK 2020
Comment: 2020 AM W/60% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date: 1/13/2009
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	55	1	292	3	6	5	338	816	2	1	594	12
RTOR volume (veh/h)			70			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	4	4	4	2	2	2	4	4	4	4	4	4
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB	R			LTR				
NB	L	LT	TR					
SB	L		TR					
Green (s)	7	35	65	30				
Yellow + All red (s)	1	6	6	6				

Cycle (s): 156 Lost time per cycle (s): 12 Critical v/c Ratio: .662

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LTR		L	T	R	L	T	R
No. of lanes		1			1		1	1	1	1	1	1
Flow rate (veh/h)		61			10		367	887	2	1	646	13
Capacity (veh/h)		255			335		478	1241	647	78	761	647
Adjusted saturation flow (veh/h)		1326			1743		1736	1827	1553	1736	1827	1553
v/c ratio		.239			.029		.768	.714	.003	.014	.848	.02
g/C ratio		.192			.192		.276	.679	.417	.045	.417	.417
Average back of queue (veh)		2.4			.4		16.4	26.5	.1	0	28.9	.3
Uniform delay (s)		53.3			51.2		51.9	15.6	26.6	71.2	41	26.8
Incremental delay (s)		0			0		7.4	2	0	0	8.9	0
Initial queue delay (s)		0			0		0	0	0	0	0	0
Delay (s)		53.3			51.2		59.3	17.6	26.6	71.2	49.9	26.8
LOS		D			D		E	B	C	E	D	C
Approach delay (s)/LOS	53.3	/	D	51.2	/	D	29.8	/	C	49.5	/	D
Intersection delay (s)/ LOS			37.2				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM DIV HOK 2020
Comment: 2020 PM W/70% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date: 1/13/2009
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	56	6	331	3	2	2	196	624	5	5	850	31
RTOR volume (veh/h)			75			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	4	4	4	2	2	2	4	4	4	4	4	4
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB	R			LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	10	5	70	20				
Yellow + All red (s)	6	6	6	6				

Cycle (s): 129 Lost time per cycle (s): 12 Critical v/c Ratio: .748

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LTR		L	T	R	L	T	R
No. of lanes		1			1		1	1	1	1	1	1
Flow rate (veh/h)		67			5		213	678	5	5	924	34
Capacity (veh/h)		210			255		283	1147	975	135	991	843
Adjusted saturation flow (veh/h)		1357			1642		1736	1827	1553	1736	1827	1553
v/c ratio		.32			.021		.754	.591	.006	.04	.932	.04
g/C ratio		.155			.155		.163	.628	.628	.078	.543	.543
Average back of queue (veh)		2.3			.2		8.4	15.7	.1	.2	37.2	.6
Uniform delay (s)		48.5			46.2		51.5	14.2	9	55.1	27.3	13.8
Incremental delay (s)		0			0		11	.8	0	0	14.9	0
Initial queue delay (s)		0			0		0	0	0	0	0	0
Delay (s)		48.5			46.2		62.5	15	9	55.1	42.2	13.8
LOS		D			D		E	B	A	E	D	B
Approach delay (s)/LOS	48.5	/	D	46.2	/	D	26.3	/	C	41.3	/	D
Intersection delay (s)/ LOS			34.6				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM W/33% HOK 2035
Comment: 2035 AM W/33% DIVERSION, HOKIOKIO

Site Information

Jurisdiction/Date: 1/19/2009
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	55	1	591	3	6	5	656	986	2	1	723	12
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	5	55	70	35				
Yellow + All red (s)	5	5	5	5				

Cycle (s): 185 Lost time per cycle (s): 10 Critical v/c Ratio: .501

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LTR		L	T	R	L	T	R
No. of lanes		1			1		2	2	1	1	2	1
Flow rate (veh/h)		61			15		713	1072	2	1	786	13
Capacity (veh/h)		255			321		1207	2492	1104	48	1342	594
Adjusted saturation flow (veh/h)		1346			1697		3437	3547	1571	1770	3547	1571
v/c ratio		.239			.047		.591	.43	.002	.023	.586	.022
g/C ratio		.189			.189		.351	.703	.703	.027	.378	.378
Average back of queue (veh)		2.8			.7		16.6	13.3	0	.1	18.1	.4
Uniform delay (s)		63.7			61.4		49.1	11.7	8.2	87.6	45.9	36
Incremental delay (s)		0			0		.8	.1	0	0	.7	0
Initial queue delay (s)		0			0		0	0	0	0	0	0
Delay (s)		63.7			61.4		49.9	11.8	8.2	87.6	46.6	36
LOS		E			E		D	B	A	F	D	D
Approach delay (s)/LOS	63.7	/	E	61.4	/	E	27	/	C	46.5	/	D
Intersection delay (s)/ LOS			33.9				/			C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM W/33% HOK 2035
Comment: 2035 PM W/ 33% DIV, HOKIOKIO

Site Information

Jurisdiction/Date: 1/19/2009
EB/WB Street: PUAMANA CO
NB/SB Street: LAHAINA BY

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	56	6	838	3	3	2	503	751	4	5	1025	31
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	2	2	2	2	2	2
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)		0			0			0			0	
Approach bicycle volume (bic/h)		0			0			0			0	
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB				LT				
WB				LTR				
NB	L	LTR	TR					
SB	L		TR					
Green (s)	16	32	82	30				
Yellow + All red (s)	5	5	5	5				

Cycle (s): 180 Lost time per cycle (s): 10 Critical v/c Ratio: .553

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT			LTR		L	T	R	L	T	R
No. of lanes		1			1		2	2	1	1	2	1
Flow rate (veh/h)		67			7		547	816	4	5	1114	34
Capacity (veh/h)		229			284		1012	2345	1039	157	1616	716
Adjusted saturation flow (veh/h)		1377			1703		3437	3547	1571	1770	3547	1571
v/c ratio		.294			.023		.54	.348	.004	.035	.69	.047
g/C ratio		.167			.167		.294	.661	.661	.089	.456	.456
Average back of queue (veh)		3.1			.3		12.6	10.1	.1	.3	25.2	1
Uniform delay (s)		65.7			62.7		53.3	13.4	10.4	74.9	38.9	27.3
Incremental delay (s)		0			0		.6	0	0	0	1.3	0
Initial queue delay (s)		0			0		0	0	0	0	0	0
Delay (s)		65.7			62.7		53.9	13.4	10.4	74.9	40.2	27.3
LOS		E			E		D	B	B	E	D	C
Approach delay (s)/LOS	65.7	/	E	62.7	/	E	29.6	/	C	40	/	D
Intersection delay (s)/ LOS			35.2				/			D		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM DIV 2020
Comment: 2020 AM W/60% DIVERSION

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		306	443	2	399		493		2			
RTOR volume (veh/h)			100			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	25	25					
Yellow + All red (s)	4	6	6					

Cycle (s): 71 Lost time per cycle (s): 4 Critical v/c Ratio: .589

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		333		2	434		536					
Capacity (veh/h)		632		121	860		601					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.526		.018	.504		.892					
g/C ratio		.352		.07	.479		.352					
Average back of queue (veh)		5.7		0	6.4		12.7					
Uniform delay (s)		18.3		30.7	12.7		21.7					
Incremental delay (s)		.8		0	.5		15.6					
Initial queue delay (s)		0		0	0		0					
Delay (s)		19.1		30.7	13.2		37.3					
LOS		B		C	B		D					
Approach delay (s)/LOS	19.1	/	B	13.3	/	B	37.3	/	D		/	
Intersection delay (s)/ LOS	24.6			/					C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM DIV 2020
Comment: 2020 PM W/70% DIVERSION

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		394	719	16	225		476		0			
RTOR volume (veh/h)			100			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	50	35					
Yellow + All red (s)	4	6	6					

Cycle (s): 106 Lost time per cycle (s): 6 Critical v/c Ratio: .585

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		428		17	245		517					
Capacity (veh/h)		847		81	999		563					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.506		.214	.245		.919					
g/C ratio		.472		.047	.557		.33					
Average back of queue (veh)		9.4		.5	3.9		18.3					
Uniform delay (s)		19.4		48.6	12.1		34.1					
Incremental delay (s)		.5		0	0		20.3					
Initial queue delay (s)		0		0	0		0					
Delay (s)		19.9		48.6	12.1		54.4					
LOS		B		D	B		D					
Approach delay (s)/LOS	19.9	/	B	14.5	/	B	54.4	/	D		/	
Intersection delay (s)/ LOS	33.5			/					C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM NO DIV 2035
Comment: 2035 AM W/NO DIVERSION

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		895	13	2	1037		25		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	50	5					
Yellow + All red (s)	4	6	6					

Cycle (s): 76 Lost time per cycle (s): 4 Critical v/c Ratio: .679

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		973		2	1127		27					
Capacity (veh/h)		1181		113	1394		112					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.824		.019	.809		.242					
g/C ratio		.658		.066	.776		.066					
Average back of queue (veh)		18.2		0	17.3		.6					
Uniform delay (s)		9.7		33.2	5.1		33.7					
Incremental delay (s)		4.9		0	3.7		0					
Initial queue delay (s)		0		0	0		0					
Delay (s)		14.6		33.2	8.8		33.7					
LOS		B		C	A		C					
Approach delay (s)/LOS	14.6	/	B	8.9	/	A	33.7	/	C		/	
Intersection delay (s)/ LOS	11.8				/				B			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM NO DIV 2035
Comment: 2035 PM W/NO DIVERSION

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		1306	25	6	777		50		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	90	8					
Yellow + All red (s)	4	6	6					

Cycle (s): 119 Lost time per cycle (s): 6 Critical v/c Ratio: .87

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		1420		7	845		54					
Capacity (veh/h)		1358		72	1494		115					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		1.045		.09	.565		.474					
g/C ratio		.756		.042	.832		.067					
Average back of queue (veh)		64.5		.2	10.2		1.9					
Uniform delay (s)		14.5		54.8	3.2		53.5					
Incremental delay (s)		37.2		0	.5		2.5					
Initial queue delay (s)		0		0	0		0					
Delay (s)		51.7		54.8	3.7		56					
LOS		D		D	A		E					
Approach delay (s)/LOS	51.7	/	D	4.1	/	A	56	/	E		/	
Intersection delay (s)/ LOS	34.4				/				C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 20% DIV 2035
Comment: 2035 AM W/20% DIVERSION

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		720	186	2	847		215		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		50			50			50				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	49	16					
Yellow + All red (s)	4	6	6					

Cycle (s): 86 Lost time per cycle (s): 4 Critical v/c Ratio: .681

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		783		2	921		234					
Capacity (veh/h)		1023		100	1211		317					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.765		.022	.76		.736					
g/C ratio		.57		.058	.674		.186					
Average back of queue (veh)		16.3		.1	16.9		6.1					
Uniform delay (s)		14.1		38.2	9.4		33					
Incremental delay (s)		3.5		0	2.9		8.7					
Initial queue delay (s)		0		0	0		0					
Delay (s)		17.6		38.2	12.3		41.7					
LOS		B		D	B		D					
Approach delay (s)/LOS	17.6	/	B	12.3	/	B	41.7	/	D		/	
Intersection delay (s)/ LOS	18				/				B			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 20% DIV 2035
Comment: 2035 PM W/20% DIVERSION

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		1063	253	16	630		152		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	80	20					
Yellow + All red (s)	4	6	6					

Cycle (s): 121 Lost time per cycle (s): 6 Critical v/c Ratio: .79

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		1155		17	685		165					
Capacity (veh/h)		1187		71	1321		282					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.973		.245	.519		.586					
g/C ratio		.661		.041	.736		.165					
Average back of queue (veh)		46.6		.6	10.9		5.7					
Uniform delay (s)		19.5		56.2	6.8		46.7					
Incremental delay (s)		19.9		0	.4		3.1					
Initial queue delay (s)		0		0	0		0					
Delay (s)		39.4		56.2	7.2		49.8					
LOS		D		E	A		D					
Approach delay (s)/LOS	39.4	/	D	8.5	/	A	49.8	/	D		/	
Intersection delay (s)/ LOS	29.5				/				C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 33% DIV 2035
Comment: 2035 AM W/33% DIVERSION

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		605	301	2	717		345		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		50			50			50				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	45	25					
Yellow + All red (s)	4	6	6					

Cycle (s): 91 Lost time per cycle (s): 4 Critical v/c Ratio: .684

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		658		2	779		375					
Capacity (veh/h)		888		94	1065		469					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.741		.023	.731		.8					
g/C ratio		.495		.055	.593		.275					
Average back of queue (veh)		15		.1	16		10.4					
Uniform delay (s)		18.3		40.7	13.3		30.7					
Incremental delay (s)		3.4		0	2.6		9.6					
Initial queue delay (s)		0		0	0		0					
Delay (s)		21.7		40.7	15.9		40.3					
LOS		C		D	B		D					
Approach delay (s)/LOS	21.7	/	C	16	/	B	40.3	/	D		/	
Intersection delay (s)/ LOS		23.1			/					C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 33% DIV 2035
Comment: 2035 PM W/33% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		901	430	16	532		250		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	70	25					
Yellow + All red (s)	4	6	6					

Cycle (s): 116 Lost time per cycle (s): 6 Critical v/c Ratio: .754

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		979		17	578		272					
Capacity (veh/h)		1083		74	1223		368					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.904		.235	.473		.739					
g/C ratio		.603		.043	.681		.216					
Average back of queue (veh)		33.1		.6	9.6		9.3					
Uniform delay (s)		20.1		53.7	8.7		42.5					
Incremental delay (s)		10.7		0	.2		7.7					
Initial queue delay (s)		0		0	0		0					
Delay (s)		30.8		53.7	8.9		50.2					
LOS		C		D	A		D					
Approach delay (s)/LOS	30.8	/	C	10.2	/	B	50.2	/	D		/	
Intersection delay (s)/ LOS		27			/					C		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM DIV HOK 2020
Comment: 2020 AM W/60% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		294	443	14	344		549		0			
RTOR volume (veh/h)			100			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	25	29					
Yellow + All red (s)	4	6	6					

Cycle (s): 75 Lost time per cycle (s): 4 Critical v/c Ratio: .59

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		320		15	374		597					
Capacity (veh/h)		598		115	814		660					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.534		.133	.459		.905					
g/C ratio		.333		.067	.453		.387					
Average back of queue (veh)		5.9		.3	5.8		15					
Uniform delay (s)		20.3		33	14.2		21.7					
Incremental delay (s)		.9		0	.3		16.1					
Initial queue delay (s)		0		0	0		0					
Delay (s)		21.2		33	14.5		37.8					
LOS		C		C	B		D					
Approach delay (s)/LOS	21.2	/	C	15.2	/	B	37.8	/	D		/	
Intersection delay (s)/ LOS	27				/				C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM DIV HOK 2020
Comment: 2020 PM W/70% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		335	719	42	201		532		0			
RTOR volume (veh/h)			100			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	10	50	50					
Yellow + All red (s)	4	6	6					

Cycle (s): 126 Lost time per cycle (s): 6 Critical v/c Ratio: .597

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		364		46	218		578					
Capacity (veh/h)		712		136	912		677					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.511		.335	.24		.854					
g/C ratio		.397		.079	.508		.397					
Average back of queue (veh)		10.4		1.6	4.5		21.6					
Uniform delay (s)		28.8		54.9	17.4		34.7					
Incremental delay (s)		.6		0	0		10.4					
Initial queue delay (s)		0		0	0		0					
Delay (s)		29.4		54.9	17.4		45.1					
LOS		C		D	B		D					
Approach delay (s)/LOS	29.4	/	C	23.8	/	C	45.1	/	D		/	
Intersection delay (s)/ LOS	35.7				/				D			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 33% DIVHOK 2035
Comment: 2035 AM W/33% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		580	301	14	662		456		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB			LR					
SB								
Green (s)	5	45	30					
Yellow + All red (s)	4	6	6					

Cycle (s): 96 Lost time per cycle (s): 4 Critical v/c Ratio: .721

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		630		15	720		496					
Capacity (veh/h)		842		90	1010		533					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.749		.17	.712		.93					
g/C ratio		.469		.052	.563		.313					
Average back of queue (veh)		15.6		.4	15.7		16.5					
Uniform delay (s)		20.9		43.5	15.3		32					
Incremental delay (s)		3.8		0	2.4		23					
Initial queue delay (s)		0		0	0		0					
Delay (s)		24.7		43.5	17.7		55					
LOS		C		D	B		D					
Approach delay (s)/LOS	24.7	/	C	18.3	/	B	55	/	D		/	
Intersection delay (s)/ LOS	30.2				/				C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 33% DIVHOK 2035
Comment: 2035 PM W/33% DIVERSION & HOKIOKIO

Site Information

Jurisdiction/Date: 1/16/2009
EB/WB Street: PUAMANA CO
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)		750	430	42	506		306		0			
RTOR volume (veh/h)			0			0			0			
Peak-hour factor		.92	.92	.92	.92		.92		.92			
Heavy vehicles (%)	5	5	5	5	5	5	5	5	5			
Start-up lost time, l_1 (s)		2	2	2	2		2		2			
Extension of effective green, e (s)		2	2	2	2		2		2			
Arrival type, AT		3	3	3	3		3		3			
Approach pedestrian volume (p/h)		0			0			0				
Approach bicycle volume (bic/h)		0			0			0				
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N		/	

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB		T						
WB	LT	T						
NB	R		LR					
SB								
Green (s)	10	70	35					
Yellow + All red (s)	4	6	6					

Cycle (s): 131 Lost time per cycle (s): 6 Critical v/c Ratio: .708

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		T		L	T		L					
No. of lanes		1		1	1		1					
Flow rate (veh/h)		815		46	550		333					
Capacity (veh/h)		959		131	1151		456					
Adjusted saturation flow (veh/h)		1795		1719	1795		1706					
v/c ratio		.85		.348	.478		.73					
g/C ratio		.534		.076	.641		.267					
Average back of queue (veh)		29.2		1.7	11.2		12.4					
Uniform delay (s)		26		57.4	12.2		43.7					
Incremental delay (s)		7.3		0	.3		5.9					
Initial queue delay (s)		0		0	0		0					
Delay (s)		33.3		57.4	12.5		49.6					
LOS		C		E	B		D					
Approach delay (s)/LOS	33.3	/	C	15.9	/	B	49.6	/	D		/	
Intersection delay (s)/ LOS	30.5				/				C			

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM DIV 2020
Comment: 2020 AM W/60% DIVERSION

Site Information

Jurisdiction/Date: 11/12/2008
EB/WB Street: KAI HELE K
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	11	0	5	10	1	16	5	468	4	3	430	10
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	3	3	3	3	3	3
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	50			0			50			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTRP					
WB			LTR					
NB	L	LTRP						
SB	L	LTR						
Green (s)	5	65	10					
Yellow + All red (s)	5	5	5					

Cycle (s): 95 Lost time per cycle (s): 15 Critical v/c Ratio: .344

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration	Def		R		LT	R	L	T	R	L	TR	
No. of lanes	1		1		1	1	1	1	1	1	1	
Flow rate (veh/h)	12		5		12	17	5	509	4	3	478	
Capacity (veh/h)	147		126		120	165	655	1262	1064	630	1248	
Adjusted saturation flow (veh/h)	1397		1198		1144	1571	1752	1845	1556	1752	1824	
v/c ratio	.081		.043		.099	.105	.008	.403	.004	.005	.383	
g/C ratio	.105		.105		.105	.105	.789	.684	.684	.789	.684	
Average back of queue (veh)	.3		.1		.3	.4	0	6.4	0	0	5.9	
Uniform delay (s)	38.4		38.2		38.4	38.5	2.7	6.5	4.8	2.8	6.4	
Incremental delay (s)	0		0		0	0	0	.1	0	0	0	
Initial queue delay (s)	0		0		0	0	0	0	0	0	0	
Delay (s)	38.4		38.2		38.4	38.5	2.7	6.6	4.8	2.8	6.4	
LOS	D		D		D	D	A	A	A	A	A	
Approach delay (s)/LOS	38.3	/	D	38.4	/	D	6.6	/	A	6.4	/	A
Intersection delay (s)/ LOS	7.9					/				A		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM DIV 2020
Comment: 2020 PM W/70% DIVERSION

Site Information

Jurisdiction/Date: 11/12/2008
EB/WB Street: KAI HELE K
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	32	15	65	21	10	20	40	426	32	15	700	15
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	3	3	3	3	3	3
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	50			0			50			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTRP					
WB			LTR					
NB	L	LTRP						
SB	L	LTR						
Green (s)	5	65	10					
Yellow + All red (s)	5	5	5					

Cycle (s): 95 Lost time per cycle (s): 15 Critical v/c Ratio: .605

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration		LT	R		LT	R	L	T	R	L	TR	
No. of lanes		1	1		1	1	1	1	1	1	1	
Flow rate (veh/h)		51	71		34	22	43	463	35	16	777	
Capacity (veh/h)		152	126		127	165	433	1262	1026	663	1248	
Adjusted saturation flow (veh/h)		1444	1198		1211	1571	1752	1845	1499	1752	1825	
v/c ratio		.336	.56		.264	.131	.101	.367	.034	.025	.623	
g/C ratio		.105	.105		.105	.105	.789	.684	.684	.789	.684	
Average back of queue (veh)		1.4	2		.9	.6	.3	5.6	.3	.1	12.6	
Uniform delay (s)		39.4	40.4		39.1	38.6	5.1	6.3	4.8	2.7	8.3	
Incremental delay (s)		0	5.6		0	0	0	0	0	0	1	
Initial queue delay (s)		0	0		0	0	0	0	0	0	0	
Delay (s)		39.4	46		39.1	38.6	5.1	6.3	4.8	2.7	9.3	
LOS		D	D		D	D	A	A	A	A	A	
Approach delay (s)/LOS	43.2	/	D	38.9	/	D	6.1	/	A	9.1	/	A
Intersection delay (s)/ LOS	11.9					/				B		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 33 DIV 2035
Comment: 2035 AM W/ 33% DIVERSION

Site Information

Jurisdiction/Date: 11/12/2008
EB/WB Street: KAI HELE K
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	11	0	15	10	1	16	5	320	4	3	290	10
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	3	3	3	3	3	3
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	50			0			50			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTRP					
WB			LTR					
NB	L	LTRP						
SB	L	LTR						
Green (s)	5	50	10					
Yellow + All red (s)	5	5	5					

Cycle (s): 80 Lost time per cycle (s): 15 Critical v/c Ratio: .252

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration	Def		R		LT	R	L	T	R	L	TR	
No. of lanes	1		1		1	1	1	1	1	1	1	
Flow rate (veh/h)	12		16		12	17	5	348	4	3	326	
Capacity (veh/h)	175		157		151	196	738	1153	972	718	1138	
Adjusted saturation flow (veh/h)	1397		1257		1205	1571	1752	1845	1556	1752	1821	
v/c ratio	.068		.104		.079	.089	.007	.302	.004	.005	.286	
g/C ratio	.125		.125		.125	.125	.75	.625	.625	.75	.625	
Average back of queue (veh)	.3		.3		.3	.4	0	3.9	0	0	3.6	
Uniform delay (s)	30.9		31		30.9	31	2.8	6.9	5.6	2.8	6.9	
Incremental delay (s)	0		0		0	0	0	0	0	0	0	
Initial queue delay (s)	0		0		0	0	0	0	0	0	0	
Delay (s)	30.9		31		30.9	31	2.8	6.9	5.6	2.8	6.9	
LOS	C		C		C	C	A	A	A	A	A	
Approach delay (s)/LOS	31	/	C	31	/	C	6.9	/	A	6.8	/	A
Intersection delay (s)/ LOS	8.7						/			A		

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CHAPTER 16 - OPERATIONAL ANALYSIS - SUMMARY WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 33 DIV 2035
Comment: 2035 PM W/33% DIVERSION

Site Information

Jurisdiction/Date: 11/12/2008
EB/WB Street: KAI HELE K
NB/SB Street: HONOAPIILA

Intersection Data

Area type: Other Analysis period: .25 h Signal type: Actuated-Field % Back of queue: 95

	EB			WB			NB			SB		
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
Volume (veh/h)	32		65	21	10	20	40	245	32	15	405	15
RTOR volume (veh/h)			0			0			0			0
Peak-hour factor	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92	.92
Heavy vehicles (%)	2	2	2	2	2	2	3	3	3	3	3	3
Start-up lost time, l_1 (s)	2	2	2	2	2	2	2	2	2	2	2	2
Extension of effective green, e (s)	2	2	2	2	2	2	2	2	2	2	2	2
Arrival type, AT	3	3	3	3	3	3	3	3	3	3	3	3
Approach pedestrian volume (p/h)	50			0			50			0		
Approach bicycle volume (bic/h)	0			0			0			0		
Left/right parking (Y or N)	N	/	N	N	/	N	N	/	N	N	/	N

Signal Phasing Plan

L: LT T: TH R: RT P: Peds

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8
EB			LTRP					
WB			LTR					
NB	L	LTRP						
SB	L	LTR						
Green (s)	5	40	10					
Yellow + All red (s)	5	5	5					

Cycle (s): 70 Lost time per cycle (s): 15 Critical v/c Ratio: .42

Intersection Performance

	EB			WB			NB			SB		
Lane group configuration	Def		R		LT	R	L	T	R	L	TR	
No. of lanes	1		1		1	1	1	1	1	1	1	
Flow rate (veh/h)	35		71		34	22	43	266	35	16	457	
Capacity (veh/h)	196		185		103	224	584	1054	889	749	1040	
Adjusted saturation flow (veh/h)	1369		1296		-1093:	1571	1752	1845	1556	1752	1821	
v/c ratio	.178		.382		.328	.097	.074	.253	.039	.022	.439	
g/C ratio	.143		.143		.143	.143	.714	.571	.571	.714	.571	
Average back of queue (veh)	.6		1.4			.4	.3	2.8	.3	.1	5.5	
Uniform delay (s)	26.4		27.2		27	26.1	3.7	7.5	6.6	3.1	8.6	
Incremental delay (s)	0		.2		0	0	0	0	0	0	.2	
Initial queue delay (s)	0		0		0	0	0	0	0	0	0	
Delay (s)	26.4		27.4		27	26.1	3.7	7.5	6.6	3.1	8.8	
LOS	C		C		C	C	A	A	A	A	A	
Approach delay (s)/LOS	27.1	/	C	26.6	/	C	6.9	/	A	8.6	/	A
Intersection delay (s)/ LOS	10.8						/			B		

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Unsignalized Intersection

Level of Service Worksheets

CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information		Site Information	
Analyst	WY	Jurisdiction/Date	1/13/2009
Agency or Company	SSFM	Major Street	HONOAPIILANI HWY
Analysis Period/Year	AMDIVHOK 2020	Minor Street	PUNAKEA CONNECTOR
Comment	2020 AM WITH HOKIOKIO PUAMAN CONNEC		

Input Data

Lane Configuration	SB	NB	EB	WB
Lane 1 (curb)	LT	TR		LR
Lane 2				
Lane 3				

	SB			NB			EB			WB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	25	443			493	20				27		111
PHF	.9	.9			.9	.9				.9		.9
Proportion of heavy vehicles, HV	3	3			3	3				3		3
Flow rate	28	492			548	22				30		123
Flare storage (# of vehs)												0
Median storage (# of vehs)										0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
EB	1								
	2								
	3								
WB	1	LR	153	417	.367	2	18.5	C	18.5
	2								
	3								C
		①	28	997	.028	<1	8.7	A	
		④							

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information		Site Information	
Analyst	WY	Jurisdiction/Date	1/13/2009
Agency or Company	SSFM	Major Street	HONOAPIILANI HWY
Analysis Period/Year	PMDIVHOK 2020	Minor Street	PUNAKEA CONNECTOR
Comment	2020 PM WITH HOKIOKIO PUAMAN CONNEC		

Input Data

Lane Configuration	SB	NB	EB	WB
Lane 1 (curb)	LT	TR		LR
Lane 2				
Lane 3				

	SB			NB			EB			WB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	53	735			476	37				37		112
PHF	.9	.9			.9	.9				.9		.9
Proportion of heavy vehicles, HV	3	3			3	3				3		3
Flow rate	59	817			529	41				41		124
Flare storage (# of vehs)												0
Median storage (# of vehs)							0			0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
EB	1								
	2								
	3								
WB	1	LR	165	299	.551	3	30.8	D	30.8
	2								
	3								D
		①	59	997	.059	<1	8.8	A	
		④							

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst	WY
Agency or Company	SSFM
Analysis Period/Year	AMDIVHOK 2035
Comment	2035 AM WITH HOKIOKIO PUAMAN CONNEC

Site Information

Jurisdiction/Date	1/13/2009
Major Street	HONOAPIILANI HWY
Minor Street	PUNAKEA CONNECTOR

Input Data

Lane Configuration	SB	NB	EB	WB
Lane 1 (curb)	LT	TR		LR
Lane 2				
Lane 3				

	SB			NB			EB			WB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	25	302			345	20				27		111
PHF	.9	.9			.9	.9				.9		.9
Proportion of heavy vehicles, HV	3	3			3	3				3		3
Flow rate	28	336			383	22				30		123
Flare storage (# of vehs)												1
Median storage (# of vehs)										0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
EB	1								
	2								
	3								
WB	1	LR	153	1003	.152	1	9.2	A	9.2
	2								
	3								A
		①	28	1148	.024	<1	8.2	A	
		④							

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CHAPTER 17 - TWSC - UNSIGNALIZED INTERSECTIONS WORKSHEET

Analysis Summary

General Information

Analyst	WY
Agency or Company	SSFM
Analysis Period/Year	PMDIVHOK 2035
Comment	2035 PM WITH HOKIOKIO PUAMANA CONN

Site Information

Jurisdiction/Date	1/13/2009
Major Street	HONOAPIILANI HWY
Minor Street	PUNAKEA CONNECTOR

Input Data

Lane Configuration	SB	NB	EB	WB
Lane 1 (curb)	LT	TR		LR
Lane 2				
Lane 3				

	SB			NB			EB			WB		
Movement	1 (LT)	2 (TH)	3 (RT)	4 (LT)	5 (TH)	6 (RT)	7 (LT)	8 (TH)	9 (RT)	10 (LT)	11 (TH)	12 (RT)
Volume (veh/h)	53	446			250	37				37		112
PHF	.9	.9			.9	.9				.9		.9
Proportion of heavy vehicles, HV	3	3			3	3				3		3
Flow rate	59	496			278	41				41		124
Flare storage (# of vehs)												0
Median storage (# of vehs)										0		

Signal upstream of Movement 2 _____ ft Movement 5 _____ ft

Length of study period (h) .25

Output Data

	Lane	Movement	Flow Rate (veh/h)	Capacity (veh/h)	v/c	Queue Length (veh)	Control Delay (s)	LOS	Approach Delay and LOS
EB	1								
	2								
	3								
WB	1	LR	165	532	.31	1	14.8	B	14.8
	2								
	3								B
		①	59	1235	.048	<1	8.1	A	
		④							

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On Ramp Merge

Level of Service Worksheets

CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM DIV 2020
Comment: 2020 AM W/60% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date: 11/16/2008
Freeway/Direction of Travel: LAHAINA BYPASS WB
Junction: HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = _____ ft
V_u = _____ veh/h

Freeway terrain: Level
Ramp terrain: Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = _____ ft
V_D = _____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	10310	.09	1	928	.9	5	.976	1	1057
v_R	5060	.09		455	.9	5	.976	1	519
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F + P_{FM}$

L_{EQ} = _____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation _____ (Exhibit 25-5)
v_{12} = 1057 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{F0}	1575	See Exhibit 25-7	
v_{R12}	1575	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 14.4 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = 305 (Exhibit 25-19)
S_R = 61.5 mi/h (Exhibit 25-19)
S_O = _____ mi/h (Exhibit 25-19)
S = 61.5 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = _____ (Equation 25-8 or 25-9)
P_{FD} = _____ using Equation _____ (Exhibit 25-12)
v_{12} = _____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{F0} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = _____ pc/mi/ln
LOS = _____ (Exhibit 25-4)

Speed Estimation

D_s = _____ (Exhibit 25-19)
S_R = _____ mi/h (Exhibit 25-19)
S_O = _____ mi/h (Exhibit 25-19)
S = _____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM DIV 2020
Comment: 2020 PM W/70%DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date: 11/16/2008
Freeway/Direction of Travel: LAHAINA BYPASS WB
Junction: HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp
☑ Yes ☐ On
☐ No ☐ Off
L_{up} = _____ ft
V_u = _____ veh/h

Freeway terrain: Level
Ramp terrain: Level
Ramp Type
☑ Merge ☐ Diverge
☑ Right side ☐ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp
☐ Yes ☐ On
☑ No ☐ Off
L_{down} = _____ ft
V_D = _____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	13100	.09	1	1179	.9	5	.976	1	1343
v_R	8750	.09		788	.9	5	.976	1	897
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F + P_{FM}$

L_{EQ} = _____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation _____ (Exhibit 25-5)
v_{12} = 1343 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{F0}	2240	See Exhibit 25-7	
v_{R12}	2240	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 19.4 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = 323 (Exhibit 25-19)
S_R = 61 mi/h (Exhibit 25-19)
S_O = _____ mi/h (Exhibit 25-19)
S = 61 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = _____ (Equation 25-8 or 25-9)
P_{FD} = _____ using Equation _____ (Exhibit 25-12)
v_{12} = _____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{F0} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = _____ pc/mi/ln
LOS = _____ (Exhibit 25-4)

Speed Estimation

D_s = _____ (Exhibit 25-19)
S_R = _____ mi/h (Exhibit 25-19)
S_O = _____ mi/h (Exhibit 25-19)
S = _____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM BASE 2035
Comment: 2035 AM BASELINE CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date: 12/17/2008
Freeway/Direction of Travel: LAHAINA BYPASS WB
Junction: HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Level; Ramp terrain: Level

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	18555	.09	1	1670	.9	5	.976	1	1902
v_R	300	.09		27	.9	5	.976	1	31
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1902 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1933	See Exhibit 25-7	
v_{R12}	1933	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 17.4 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .313 (Exhibit 25-19)
S_R = 61.2 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 61.2 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM BASE 2035
Comment: 2035 PM BASELINE CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date: 12/17/2008
Freeway/Direction of Travel: LAHAINA BYPASS WB
Junction: HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Level; Ramp terrain: Level

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 140 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	25222	.09	1	2270	.9	5	.976	1	2585
v_R	950	.09		86	.9	5	.976	1	97
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2585 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2683	See Exhibit 25-7	
v_{R12}	2683	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$
D_R = 25.5 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .368 (Exhibit 25-19)
S_R = 59.7 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 59.7 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 20 DIV 2035
Comment: 2035 AM W/20% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date: 11/16/2008
Freeway/Direction of Travel: LAHAINA BYPASS WB
Junction: HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Level; Ramp terrain: Level

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	16180	.09	1	1456	.9	5	.976	1	1658
v_R	2222	.09		200	.9	5	.976	1	228
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1658 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1886	See Exhibit 25-7	
v_{R12}	1886	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 16.9 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .312 (Exhibit 25-19)
S_R = 61.3 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 61.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 20 DIV 2035
Comment: 2035 PM W/20% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date: 11/16/2008
Freeway/Direction of Travel: LAHAINA BYPASS WB
Junction: HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Level; Ramp terrain: Level

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	22444	.09	1	2020	.9	5	.976	1	2301
v_R	3655	.09		329	.9	5	.976	1	375
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2301 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2675	See Exhibit 25-7	
v_{R12}	2675	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 23 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .343 (Exhibit 25-19)
S_R = 60.4 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 60.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM 33 DIV 2035
Comment: 2035 AM W/33% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date: 11/16/2008
Freeway/Direction of Travel: LAHAINA BYPASS WB
Junction: HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Level; Ramp terrain: Level

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	14900	.09	1	1341	.9	5	.976	1	1527
v_R	3500	.09		315	.9	5	.976	1	359
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1527 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1886	See Exhibit 25-7	
v_{R12}	1886	4600: All	

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 16.9 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .312 (Exhibit 25-19)
S_R = 61.3 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 61.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM 33 DIV 2035
Comment: 2035 PM W/33% DIV CONTINUOUS ONRAMP

Site Information

Jurisdiction/Date: 11/16/2008
Freeway/Direction of Travel: LAHAINA BYPASS WB
Junction: HONOAPIILANI HWY SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Level; Ramp terrain: Level

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	20655	.09	1	1859	.9	5	.976	1	2117
v_R	5460	.09		491	.9	5	.976	1	560
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2117 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2677	See Exhibit 25-7	
v_{R12}	2677	4600: All	

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 23 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .343 (Exhibit 25-19)
S_R = 60.4 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 60.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM PK 0 DIV 2035
Comment: 2035 AM PEAK MICH U-TURN NO DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BYPASS NB
Junction: KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Rolling; Ramp terrain: Rolling

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 60 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	21840	.09	1	1966	.9	5	.93	1	2348
v_R	1722	.09		155	.9	5	.93	1	185
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2348 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2533	See Exhibit 25-7	
v_{R12}	2533	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 22 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .335 (Exhibit 25-19)
S_R = 54 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 54 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM PK 0 DIV 2035
Comment: 2035 PM PEAK MICH U-TURN 0% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BYPASS NB
Junction: KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☑ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Rolling; Ramp terrain: Rolling

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 60 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	17900	.09	1	1611	.9	5	.93	1	1924
v_R	1180	.09		106	.9	5	.93	1	127
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1924 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2051	See Exhibit 25-7	
v_{R12}	2051	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 18.3 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .316 (Exhibit 25-19)
S_R = 54.3 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 54.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM PK 20% DIV 2035
Comment: 2035 AM PEAK MICH U-TURN 20% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BYPASS NB
Junction: KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Rolling
Ramp terrain: Rolling
Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft
S_{FF} = 60 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	19640	.09	1	1768	.9	5	.93	1	2111
v_R	1722	.09		155	.9	5	.93	1	185
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2111 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2296	See Exhibit 25-7	
v_{R12}	2296	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 20.2 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = 325 (Exhibit 25-19)
S_R = 54.2 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 54.2 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM PK 20% DIV 2035
Comment: 2035 PM PEAK MICH U-TURN 20% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BYPASS NB
Junction: KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☑ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Rolling
Ramp terrain: Rolling
Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft
S_{FF} = 60 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	15500	.09	1	1395	.9	5	.93	1	1666
v_R	1180	.09		106	.9	5	.93	1	127
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1666 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1793	See Exhibit 25-7	
v_{R12}	1793	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 16.3 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = 309 (Exhibit 25-19)
S_R = 54.4 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 54.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM PK 33% DIV 2035
Comment: 2035 AM PEAK MICH U-TURN 33% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BYPASS NB
Junction: KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Rolling
Ramp terrain: Rolling
Ramp Type: ☑ Merge ☐ Diverge ☑ Right side ☐ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft
S_{FF} = 60 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	18200	.09	1	1638	.9	5	.93	1	1957
v_R	1722	.09		155	.9	5	.93	1	185
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1957 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{F0}	2142	See Exhibit 25-7	
v_{R12}	2142	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 19 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .319 (Exhibit 25-19)
S_R = 54.3 mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = 54.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM PK 33% DIV 2035
Comment: 2035 PM PEAK MICH U-TURN 33% DIVERSION

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BYPASS NB
Junction: KAI HELE KU ST

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☑ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Rolling
Ramp terrain: Rolling
Ramp Type: ☑ Merge ☐ Diverge ☑ Right side ☐ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft
S_{FF} = 60 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	14410	.09	1	1297	.9	5	.93	1	1549
v_R	1180	.09		106	.9	5	.93	1	127
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1549 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{F0}	1676	See Exhibit 25-7	
v_{R12}	1676	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 15.4 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .307 (Exhibit 25-19)
S_R = 54.5 mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = 54.5 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_0 = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM PK 0 DIV 2035
Comment: 2035 AM PEAK MICH U-TURN 0% DIVERSION

Site Information

Jurisdiction/Date: 12/14/2008
Freeway/Direction of Travel: LAHAINA BYPASS SB
Junction: LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☑ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Level
Ramp terrain: Level
Ramp Type: ☑ Merge ☐ Diverge ☐ Right side ☑ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 140 ft
S_{FF} = 60 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	18500	.09	1	1665	.9	5	.976	1	1896
v_R	400	.09		36	.9	5	.976	1	41
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1896 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{F0}	1937	See Exhibit 25-7	
v_{R12}	1937	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 19.7 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .338 (Exhibit 25-19)
S_R = 53.9 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 53.9 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{F0} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM PK 0 DIV 2035
Comment: 2035 PM PEAK MICH U-TURN 0% DIVERSION

Site Information

Jurisdiction/Date: 12/14/2008
Freeway/Direction of Travel: LAHAINA BYPASS SB
Junction: LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Level
Ramp terrain: Level
Ramp Type: ☑ Merge ☐ Diverge ☐ Right side ☑ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 140 ft
S_{FF} = 60 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	26180	.09	1	2356	.9	5	.976	1	2683
v_R	1470	.09		132	.9	5	.976	1	151
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2683 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{F0}	2834	See Exhibit 25-7	
v_{R12}	2834	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 26.6 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .378 (Exhibit 25-19)
S_R = 53.2 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 53.2 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{F0} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM PK 20% DIV 2035
Comment: 2035 AM PEAK MICH U-TURN 20% DIVERSION

Site Information

Jurisdiction/Date: 12/14/2008
Freeway/Direction of Travel: LAHAINA BYPASS SB
Junction: LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On; ☐ No ☑ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Level; Ramp terrain: Level

Ramp Type: ☑ Merge ☐ Diverge; ☐ Right side ☑ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 140 ft

S_{FF} = 60 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On; ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	16550	.09	1	1490	.9	5	.976	1	1696
v_R	300	.09		27	.9	5	.976	1	31
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1696 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1727	See Exhibit 25-7	
v_{R12}	1727	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 18.1 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .333 (Exhibit 25-19)
S_R = 54 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 54 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FF} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM PK 20% DIV 2035
Comment: 2035 PM PEAK MICH U-TURN 20% DIVERSION

Site Information

Jurisdiction/Date: 12/14/2008
Freeway/Direction of Travel: LAHAINA BYPASS SB
Junction: LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On; ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Level; Ramp terrain: Level

Ramp Type: ☑ Merge ☐ Diverge; ☐ Right side ☑ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 140 ft

S_{FF} = 60 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On; ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	23500	.09	1	2115	.9	5	.976	1	2409
v_R	522	.09		47	.9	5	.976	1	54
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2409 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2462	See Exhibit 25-7	
v_{R12}	2462	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$

D_R = 23.8 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .357 (Exhibit 25-19)
S_R = 53.6 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 53.6 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FF} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM PK 33% DIV 2035
Comment: 2035 AM PEAK MICH U-TURN 33% DIVERSION

Site Information

Jurisdiction/Date: 12/14/2008
Freeway/Direction of Travel: LAHAINA BYPASS SB
Junction: LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☑ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Level
Ramp terrain: Level
Ramp Type: ☑ Merge ☐ Diverge ☐ Right side ☑ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 140 ft
S_{FF} = 60 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	15250	.09	1	1373	.9	5	.976	1	1563
v_R	300	.09		27	.9	5	.976	1	31
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1563 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{f0}	1594	See Exhibit 25-7	
v_{R12}	1594	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 17 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .33 (Exhibit 25-19)
S_R = 54.1 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 54.1 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{f1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{f0} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM PK 33% DIV 2035
Comment: 2035 PM PEAK MICH U-TURN 33% DIVERSION

Site Information

Jurisdiction/Date: 12/14/2008
Freeway/Direction of Travel: LAHAINA BYPASS SB
Junction: LEFT TURN MERGE TO SB

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Level
Ramp terrain: Level
Ramp Type: ☑ Merge ☐ Diverge ☐ Right side ☑ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 140 ft
S_{FF} = 60 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	21680	.09	1	1951	.9	5	.976	1	2222
v_R	515	.09		46	.9	5	.976	1	53
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 2222 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{f0}	2275	See Exhibit 25-7	
v_{R12}	2275	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 22.3 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .349 (Exhibit 25-19)
S_R = 53.7 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 53.7 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{f1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{f0} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM W/NO DIV 2035
Comment: 2035 AM W/NO DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BP SB
Junction: PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Rolling; Ramp terrain: Rolling

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	8350	.09	1	752	.9	5	.93	1	898
v_R	9800	.09		882	.9	5	.93	1	1054
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 898 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1951	See Exhibit 25-7	
v_{R12}	1951	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 17.1 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_S = 313 (Exhibit 25-19)
S_R = 61.2 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 61.2 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_S = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM W/NO DIV 2035
Comment: 2035 PM W/NO DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BP SB
Junction: PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Rolling; Ramp terrain: Rolling

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\, f_{HV}\, f_p}$
v_F	11810	.09	1	1063	.9	5	.93	1	1270
v_R	13800	.09		1242	.9	5	.93	1	1484
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1270 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2753	See Exhibit 25-7	
v_{R12}	2753	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$
D_R = 23.1 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_S = 347 (Exhibit 25-19)
S_R = 60.3 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 60.3 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$
D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_S = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM W/20% DIV 2035
Comment: 2035 AM W/20% DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BP SB
Junction: PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Rolling
Ramp terrain: Rolling
Ramp Type: ☑ Merge ☐ Diverge ☑ Right side ☐ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft
S_{FF} = 70 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	8350	.09	1	752	.9	5	.93	1	898
v_R	7850	.09		707	.9	5	.93	1	844
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 898 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1742	See Exhibit 25-7	
v_{R12}	1742	4600: All	

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 15.5 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .308 (Exhibit 25-19)
S_R = 61.4 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 61.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM W/20% DIV 2035
Comment: 2035 PM W/20% DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BP SB
Junction: PUAMANA CONNECTOR RIGI

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On ☐ No ☐ Off
L_{up} = ____ ft
V_u = ____ veh/h

Freeway terrain: Rolling
Ramp terrain: Rolling
Ramp Type: ☑ Merge ☐ Diverge ☑ Right side ☐ Left side
Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft
S_{FF} = 70 mi/h S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On ☑ No ☐ Off
L_{down} = ____ ft
V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	11810	.09	1	1063	.9	5	.93	1	1270
v_R	11111	.09		1000	.9	5	.93	1	1194
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1270 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2464	See Exhibit 25-7	
v_{R12}	2464	4600: All	

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 21 pc/mi/ln
LOS = C (Exhibit 25-4)

Speed Estimation

M_s = .332 (Exhibit 25-19)
S_R = 60.7 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 60.7 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{FI} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{FO} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: AM W/33% DIV 2035
Comment: 2035 AM W/33% DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BP SB
Junction: PUAMANA CONNECTOR RIGH

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On; ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Rolling; Ramp terrain: Rolling

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On; ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	8350	.09	1	752	.9	5	.93	1	898
v_R	6570	.09		591	.9	5	.93	1	706
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 898 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{F0}	1604	See Exhibit 25-7	
v_{R12}	1604	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 14.5 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .305 (Exhibit 25-19)
S_R = 61.4 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 61.4 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{F0} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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CHAPTER 25 - RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information

Analyst: WY
Agency or Company: SSFM
Analysis Period/Year: PM W/33% DIV 2035
Comment: 2035 PM W/33% DIV, PUAMANA CONN. RIGHT TURN RAMP

Site Information

Jurisdiction/Date: 11/11/2008
Freeway/Direction of Travel: LAHAINA BP SB
Junction: PUAMANA CONNECTOR RIGH

☐ Operational (LOS) ☐ Design (L_A, L_D, or N) ☑ Planning (LOS) ☐ Planning (L_A, L_D, or N)

Inputs

Upstream Adjacent Ramp: ☑ Yes ☐ On; ☐ No ☐ Off; L_{up} = ____ ft; V_u = ____ veh/h

Freeway terrain: Rolling; Ramp terrain: Rolling

Ramp Type: ☑ Merge ☐ Diverge; ☑ Right side ☐ Left side

Number of freeway lanes: 2
Number of ramp lanes: 1
Length of ramp roadway: 500 ft

S_{FF} = 70 mi/h; S_{FR} = 35 mi/h

Downstream Adjacent Ramp: ☐ Yes ☐ On; ☑ No ☐ Off; L_{down} = ____ ft; V_D = ____ veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	AADT (veh/day)	K	D	V (veh/h)	PHF	% HV	f_{HV}	f_p	$v = \frac{V}{PHF\ f_{HV}\ f_p}$
v_F	11810	.09	1	1063	.9	5	.93	1	1270
v_R	9310	.09		838	.9	5	.93	1	1001
v_U								1	
v_D								1	

Merge Areas

Estimation of v_{12}

$v_{12} = v_F * P_{FM}$

L_{EQ} = ____ (Equation 25-2 or 25-3)
P_{FM} = 1 using Equation ____ (Exhibit 25-5)
v_{12} = 1270 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{F0}	2270	See Exhibit 25-7	
v_{R12}	2270	4600: All	

Level-of-Service Determination (if not F)

$D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$

D_R = 19.6 pc/mi/ln
LOS = B (Exhibit 25-4)

Speed Estimation

M_s = .324 (Exhibit 25-19)
S_R = 60.9 mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = 60.9 mi/h (Equation 25-14)

Diverge Areas

Estimation of v_{12}

$v_{12} = v_R + (v_F - v_R)P_{FD}$

L_{EQ} = ____ (Equation 25-8 or 25-9)
P_{FD} = ____ using Equation ____ (Exhibit 25-12)
v_{12} = ____ pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{F1} = v_F$		See Exhibit 25-14	
v_{12}		4400: All	
$v_{F0} = v_F - v_R$		See Exhibit 25-14	
v_R		See Exhibit 25-3	

Level-of-Service Determination (if not F)

$D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$

D_R = ____ pc/mi/ln
LOS = ____ (Exhibit 25-4)

Speed Estimation

D_s = ____ (Exhibit 25-19)
S_R = ____ mi/h (Exhibit 25-19)
S_O = ____ mi/h (Exhibit 25-19)
S = ____ mi/h (Equation 25-15)

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APPENDIX I.

Preliminary Engineering Report

Established 1969

Engineering Assessment for

The Proposed Lahaina Bypass Southern Terminus Relocation Project

Prepared For: Makila Land Company
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Kahului, Hawaii 96732

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Date: Jaunary 2007

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2 Southern Terminus Relocation
3 Drainage Map

APPENDIX

A Drainage Calculation

PROPOSED LAHAINA BYPASS
Southern Terminus Relocation

A. INTRODUCTION AND BACKGROUND

The Lahaina Bypass Project which extends from Honokowai to Launiupoko obtained its Final EIS Approval on April 2002. Design and construction of Phase I-A between Lahainaluna Road and Keawe Street is currently underway. The design contract for Phase I-B-1 between Lahainaluna Road and Hoki'oki'o Place has also been awarded and in progress. Design of Phase I-B-2, Hoki`oki`o Place to Honoapiilani Highway, is projected to begin in the 4th quarter of 2008 with construction projected to occur between 2011 and 2015. (See Figure 1.)

B. PROPOSED ACTION

The shoreline along the existing Honoapiilani Highway in the vicinity of the Southern terminus is being undermined by erosion. Numerous other sections of the existing highway are experiencing similar problems. Several sections of the highway have already been realigned and relocated further inland.

In order to avoid this recurring problem, the project proposes to move the southern terminus further inland away from the shoreline to higher ground. The elevation of the proposed alignment will range between 40 to 120 feet above mean sea level and 800 to 1500 feet mauka or inland of the existing highway. (See Figure 2.)

HDOT has recently commissioned a planning study for a new highway between Launiuapoko and Maalaea. It is logical to assume that the new alignment will follow a more

inland route for reasons mentioned previously. Should this be the case, approximately one mile of currently approved interim right-of-way for the southern terminus to Launiuapoko will have to be abandoned whereas under the proposed alignment only around 2,500 feet of the right-of-way for the temporary connector will need to be abandoned. Furthermore, the length of the new Launiuapoko to Maalaea highway will be shortened by one mile.

There are other advantages to a mauka alignment. By keeping through-traffic away from the coastal area, safer coastal recreational opportunities will become available to the public. By working in collaboration with the landowners, HDOT and FHWA can establish a mutually acceptable highway corridor at least cost to the public.

C. ENGINEERING ASSESSMENT

1. Roadway

Based on the most current study completed by the Traffic Division of SSFM and other previous studies conducted by HDOT, a four lane divided highway for the Lahaina Bypass is warranted and long overdue.

The bypass is classified as a rural arterial. The topography through Launiuapoko is fairly level. Therefore, design speed for the southern terminus extension will be for 60 m.p.h. Maximum grade in this section will be under 3%. Typical section will consist of a minimum right-of-way of 160-feet, with two 12-feet wide lanes in each direction, a 10-feet wide paved shoulder on the right and a 6-foot paved shoulder on the median. The median, including the paved shoulder, will have a minimum width of 34 feet. Most of the roadway prism will be raised a few feet

above the existing grade to accommodate drainage interceptor ditches and drainage structures. Slopes of cuts and fills will range between 4:1 and 2:1 depending on height.

2. Infrastructure

a. Water System

The water system in Launiupoko is owned and operated by Makila Water Company. There are no water lines within the proposed project corridor except for a line along Kai Hele Kuu Drive which is being used primarily for irrigation. Since the crossing at the new Kai Hele Kuu intersection will be fairly close to present grade, the existing waterline will not be affected.

The existing, source, storage and water distribution systems are located mauka and east of the proposed highway corridor. Therefore, new pipe line sleeve or lines will be installed across the right-of-way to service lands on the makai side before or in conjunction with the highway project.

b. Wastewater System

Since the County sewer system does not extend to Launiupoko, individual wastewater system in the form of septic tanks with leach fields or seepage pits are being used for wastewater disposal in the area. Currently there are no dwellings in the vicinity of the proposed highway corridor.

Therefore, no wastewater facility will be impacted by the relocated highway.

c. Electricity

MECO's main high voltage line that provides power to Lahaina from Central Maui runs along the foot of the West Maui Mountains approximately one mile east, or mauka, of the proposed project corridor. Therefore, this transmission line will not be impacted by the highway realignment project.

There is also an overhead distribution system along Kai Hele Kuu Drive. This line will be undergrounded across the realigned highway corridor.

d. Drainage

There are eight (8) contributory drainage areas situated upland (mauka) of the proposed Lahaina Bypass Extension corridor. Seven (7) of these are over 100 acres. Only one is less than 100 acres. (See Figure 3.)

These drainage areas are comprised of the westerly slopes of the West Maui Mountains which are fairly steep and flatter lands that were formulated by the erosion of these steeper slopes. Most of the flatter land were previously used for cultivation of sugar cane. More recently they have been subdivided into smaller agricultural lots with houses built on them.

The drainage concept used and approved by the County to develop the agricultural subdivisions were to maintain the surface runoff to pre-

development rates and volumes by retaining the additional runoff generated by the development onsite in retention basins and/or subsurface storage systems. Consequently, the curve numbers and coefficient of permeability used for the highway drainage is based on pre-development conditions. In accordance with the County's "Rules for the Design of Storm Drainage Facilities", for drainage areas greater than 100 acres, and all streams, the NRCS hydrograph method was used. For drainage areas of less than 100 acres, 50-year 1-hour storm and the Rational Method was used to size the drainage structures at all roadway crossings.

Table 1 shows the runoff rates and approximate size of drainage structures required at the road crossing.

Table 1

Drainage Area	Q_{100} cfs	Q_{50} cfs	Size of Drainage Structure
1.	1654		Twin 12' x 8' Box Culvert
2.	2650		Twin 12' x 12' Box Culvert
3.	1568		Twin 12' x 8' Box Culvert
4.	638		Single 8' x 6' Box Culvert
5.	233		72" CAP
6.	281		78" CAP
7.	148		60" CAP
8.		67	48" CAP

D. PROPOSED IMPROVEMENTS

According to the TIAR prepared by the traffic engineering consultant, SSFM, four travel lanes will be required to handle the projected traffic demand by year 2020. They have presented two options, first to build two lanes of Lahaina Bypass at the outset and keep the existing Honoapiilani Highway open. In order to utilize the existing highway, traffic signals and additional turn lanes will have to be added at four intersections namely, at the Honoapiilani Highway/Lahaina Bypass south connector at the southern terminus of the Bypass, at Kai Hele Kuu intersection, at the Lahaina Bypass/Puamana Connector and finally at the Honoapiilani/Puamana Connector intersection. The existing traffic signal at the Honoapiilani/Kai Hele kuu intersection would remain. The beach erosion now occurring near the south connector and north of the Launiupoko Beach Park would have to be mitigated.

The second option would be to install four travel lanes between the Lahaina Bypass/Puamana connector and the Lahaina Bypass/Honoapiilani south connector, from the outset and limit the existing Honoapiilani Highway for beach access and parking.

E. SUMMARY AND CONCLUSION

In reviewing the two options, it is our professional opinion that constructing four lanes at the outset will preclude the need for traffic signals and additional intersection improvements at the Honoapiilani/Lahaina Bypass south connector and also at the Honoapiilani/Puamana connector. It will also forestall construction of temporary laneage improvements at the Lahaina Bypass/Kai Hele Kuu and Lahaina Bypass/Puamana Connector

intersections.

Keeping the existing highway open as required in option 1 will forestall the full utilization of coastal recreational amenities in the interim. It will also mean additional expenditures on erosion mitigative measures.

Based on the projected traffic demand for 2030, the Puamana Connector/Lahaina Bypass intersection will require a grade separated structure. If funding constraints prevent construction of a grade separated structure at the outset, at the very least, ample right-of-way should be set aside to facilitate installation of the structure in the future. In the interim, traffic signals with adequate left turn storage lanes and accel and decel lanes will be required at this intersection to minimize the length of vehicular queues. A grade separated structure, such as an underpass, will enable mauka-makai pedestrian, bicycle and vehicular traffic to cross without disrupting flow on the main highway.

The proposed corridor is comprised of land that was previously used for sugar cane cultivation, and cattle grazing. Although part of the land is now being developed into smaller agricultural lots, there are no residential settlement in the immediate vicinity of the proposed corridor. The grade of the proposed corridor is fairly flat except for the area south of Launiupoko Stream immediately before the temporary reconnection to the existing highway. Fill material to construct a raised roadway prism is readily available nearby in the form of existing manmade rock mounds.

It is our professional opinion that with appropriate design considerations the proposed realignment project will not have any adverse impact on existing public facilities, downstream properties or the coastal environment. Moving the highway further inland as

proposed will provide greater opportunities for coastal recreational activities for public enjoyment. Removing through traffic from the coastal recreational areas will also enhance public safety and accessibility to these coastal recreational resources.

On the contrary, option 1 will adversely impact the public's ability to fully enjoy the coastal amenities. Additional short-term expenditures for interim intersection improvements and corrective beach erosion measures could better be utilized to complete four lanes of the Bypass from the outset.

V:\Projdata\06proj\06058\Reports\Eng Assessment\Eng Assessment.wpd

F. REFERENCES

1. *Lahaina Transportation Design Workshop.* January 2007.

2. *Traffic Study by SSFM.*

3. *Soil Survey of Islands of Kauai, Oahu, Molokai, and Lanai, State of Hawaii.* August 1972. United States Department of Agriculture, Soil Conservation Service.

4. *Rules for the Design of Storm Drainage Facilities in the County of Maui.* July 1995. Department of Public Works and Waste Management, County of Maui.

5. *SCS National Engineering Handbook, Section 4 - Hydrology.* 1969. Soil Conservation Service, U.S. Department of Agriculture.

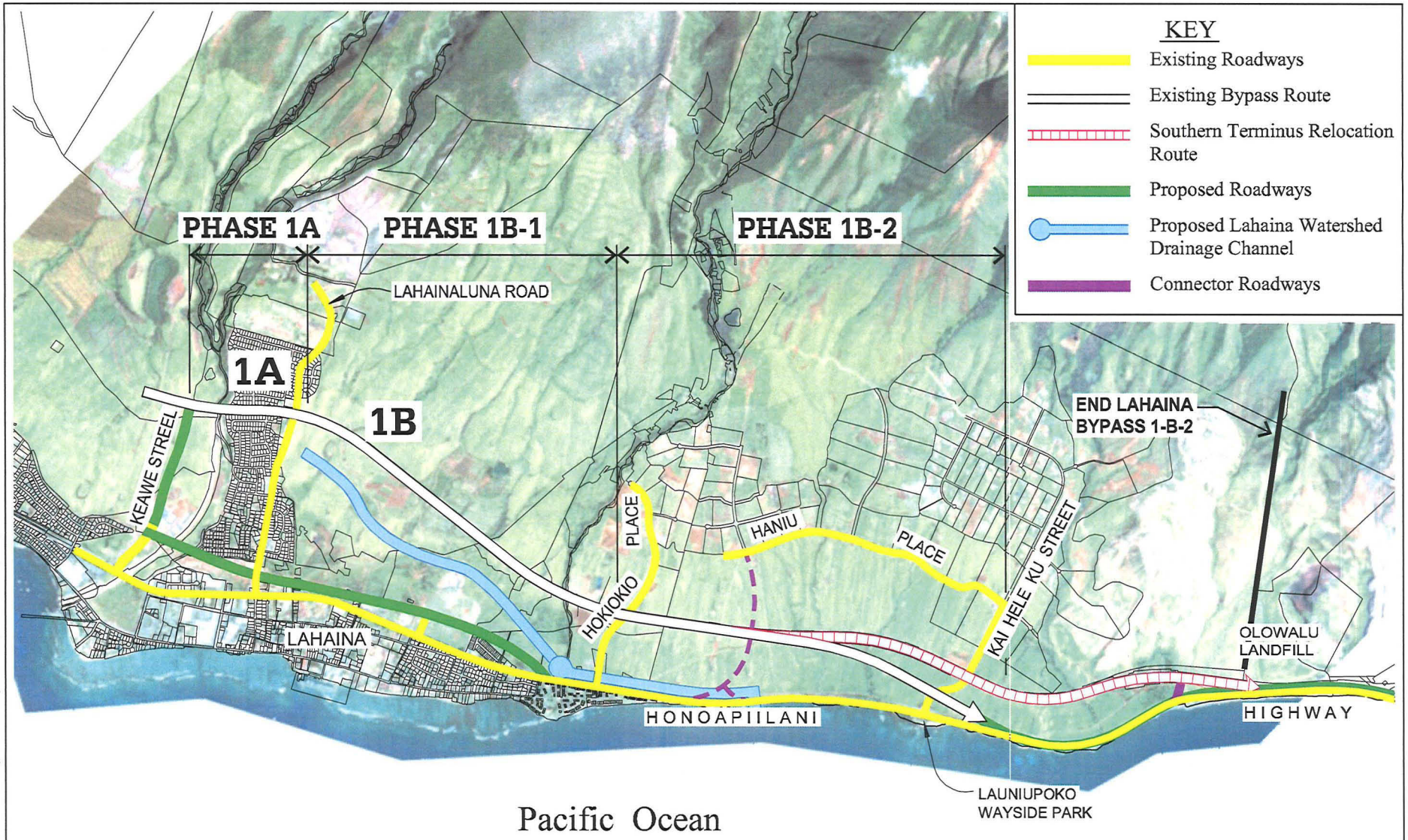
6. *Rainfall Frequency Atlas of the Hawaiian Islands, Technical Paper No. 43.* 1962. U.S. Department of Commerce, Weather Bureau.

FIGURES

1. Lahaina Bypass Project Limits

2. Southern Terminus Relocation

3. Drainage Map



Source: Warren S. Unemori Engineering, Inc.

Proposed Lahaina Bypass Southern Terminus Relocation

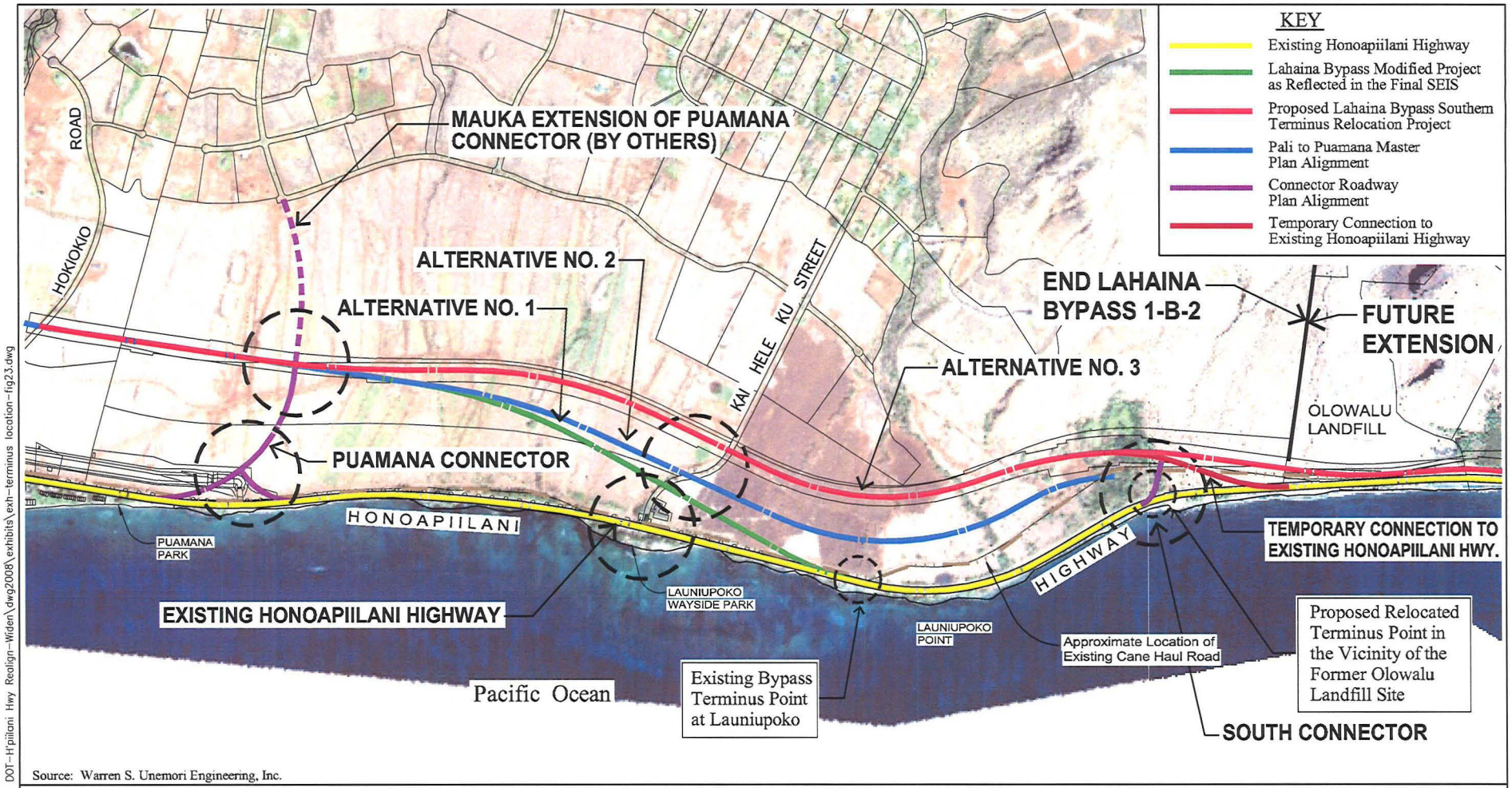
Intial Construction Phases for the Lahaina Bypass

SCALE: 1 IN. = 3000 FT.

Prepared For: State of Hawaii, Department of Transportation

FIGURE 1

V:\Projdata\04PROJ\04044 - DOT-H'piilani Hwy Realign-Widen\dwg2008\exhibits\exh-terminus location-fig4-5.dwg



Source: Warren S. Unemori Engineering, Inc.

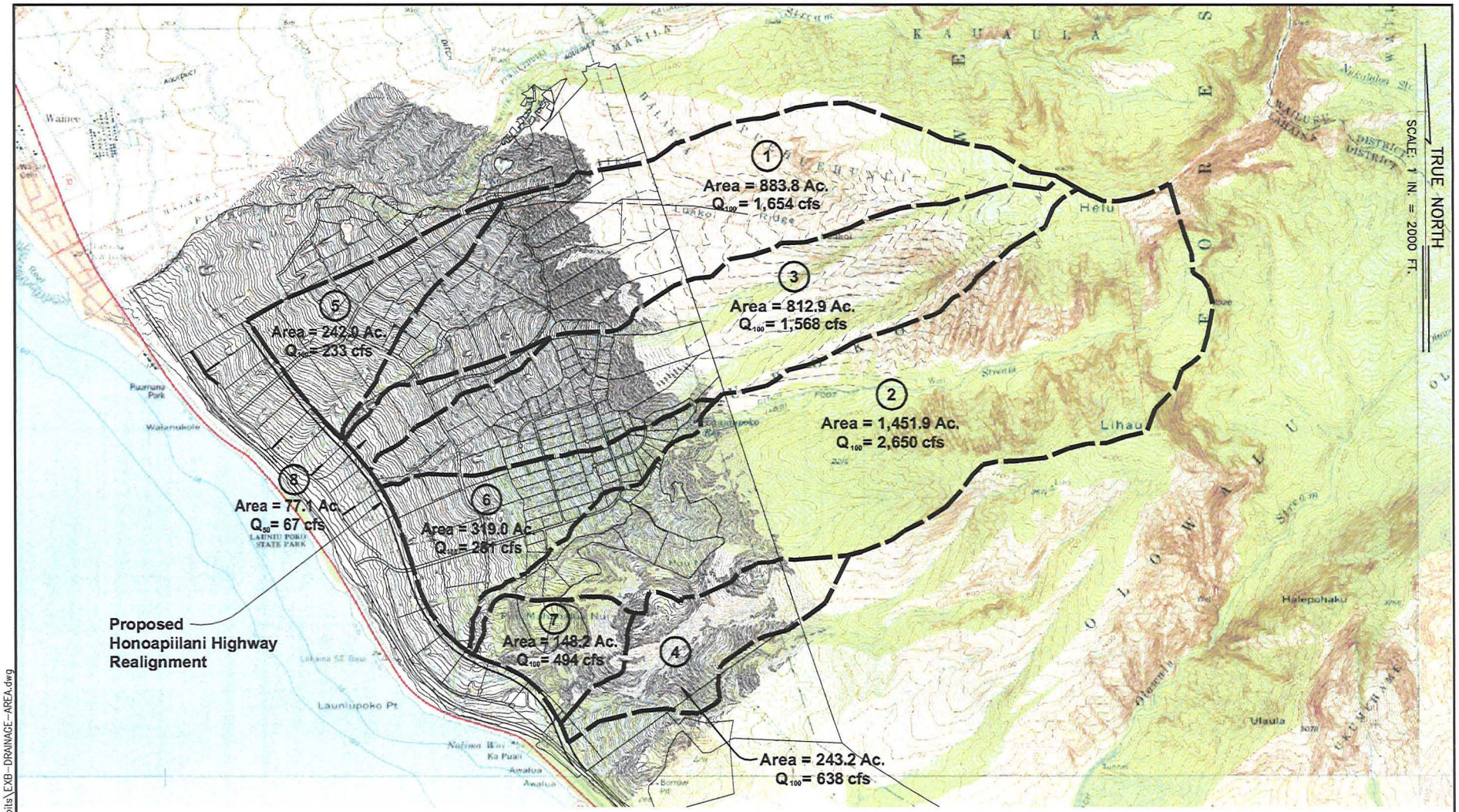
Scale: 1 in. = 1000 ft.

Prepared For: State of Hawaii, Department of Transportation

Proposed Lahaina Bypass Southern Terminus Relocation
Alignment Comparison: Pali to Puamana Master Plan vs. Proposed Action

FIGURE 2

V:\Projdata\04PROJ\04044 – DOT–H'piilani Hwy Realign–Widen\dwg2008\exhibits\exh–terminus location–fig23.dwg



DRAIN AREA MAP

0 2000 4000 6000 8000

SCALE: 1 IN. = 2000 FT.

FIGURE 3

WARREN S. UNEMORI ENGINEERING, INC.

January 2, 2008

03098\dwg2004\exhibits\EXB-DRAINAGE-AREA.dwg

APPENDIX A

DRAINAGE CALCULATIONS

LAHAINA BYPASS DRAINAGE AREA CALCULATIONS

Project Site Surface Runoff (100 Yr. - 24 Hr. = varies)

Watershed No.	Total Drainage Area (acs.)	Soil Group B Area (acs.)	Soil Group C Area (acs.)	Soil Group D Area (acs.)	Curve Number	Runoff Coeff't	Approx. 100-yr, 24-hr Rainfall (in)	50-yr, 1-hr. Rainfall Intensity	Longest Run (ft)	Elevation Change (ft)	Average Slope (%)	Pre-Development Runoff (cfs)
1	883.8	221.8	238.3	423.7	69.8	n/a	12.1	n/a	19670.0	4300.0	21.86	**1654**
2	1451.9	307.6	0.0	1144.3	72.6	n/a	12.0	n/a	22800.0	4300.0	18.86	**2650**
3	812.9	265.6	106.9	440.4	69.2	n/a	11.8	n/a	17800.0	4375.0	24.58	**1568**
4	243.2	27.1	0.0	216.1	74.7	n/a	10.0	n/a	7950.0	1588.0	19.97	**638**
5	242.0	242.0	0.0	0.0	56.0	n/a	10.0	n/a	6620.0	630.0	9.52	**233**
6	319.0	319.0	0.0	0.0	56.0	n/a	10.0	n/a	8310.0	860.0	10.35	**281**
7	148.2	27.3	0.0	120.9	73.1	n/a	10.0	n/a	3450.0	645.0	18.70	**494**
8*	77.1	77.1	0.0	0.0	n/a	0.3	n/a	2.9	5110.0	510.0	9.98	**67**

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyCounty

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	12.1000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
AREA 1		AREA	100	599.474		11.0000	1653.87		
*OUT 10		JCT	100	599.474		11.0000	1653.87		
POND 10	IN	POND	100	599.474		11.0000	1653.87		
POND 10	OUT	POND	100	599.474		11.0000	1653.87		

```
SCS UNIT HYDROGRAPH METHOD
Calc.Method Option =  2
STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 12.1000 in
Rain Dir      = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
Rain File -ID =  - TypeI   24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
HYG File - ID = work_pad.hyg - AREA 1 Pre100
Tc            = 1.6472 hrs
Drainage Area = 883.800 acres  Runoff CN= 70

=========================================
Computational Time Increment   =   .04991 hrs
Computed Peak Time             =  11.0307 hrs
Computed Peak Flow             =  1655.08 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.0000 hrs
Peak Flow, Interpolated Output =  1653.87 cfs
=========================================

                 DRAINAGE AREA
               -------------------
               ID:AREA 1
               CN    =   70
               Area =     883.800 acres
               S     =   4.2857 in
               0.2S =    .8571 in

                Cumulative Runoff
               -------------------
                       8.1400 in
                      599.508 ac-ft

HYG Volume...        599.474 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =  1.64716 hrs (ID: AREA 1)
Computational Incr, Tm =   .04991 hrs = 0.04545 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   607.96 cfs
Unit peak time      Tp =  1.09808 hrs
Unit receding limb, Tr =  4.39232 hrs
Total unit time,    Tb =  5.49040 hrs
```

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyCounty

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	12.0000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
AREA 2		AREA	100	1025.512		11.1500	2649.70		
*OUT 10		JCT	100	1025.512		11.1500	2649.70		
POND 10	IN	POND	100	1025.512		11.1500	2649.70		
POND 10	OUT	POND	100	1025.512		11.1500	2649.70		

```
SCS UNIT HYDROGRAPH METHOD
Calc.Method Option =  2
STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 12.0000 in
Rain Dir      = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
Rain File -ID =  - TypeI   24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
HYG File - ID = work_pad.hyg - AREA 2 Pre100
Tc            = 1.8484 hrs
Drainage Area = 1451.900 acres  Runoff CN= 73

=============================================
Computational Time Increment   =   .04929 hrs
Computed Peak Time             =  11.1395 hrs
Computed Peak Flow             =  2649.87 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.1500 hrs
Peak Flow, Interpolated Output =  2649.70 cfs
=============================================

                 DRAINAGE AREA
              -------------------
              ID:AREA 2
              CN   =   73
              Area =    1451.900 acres
              S    =   3.6986 in
              0.2S =    .7397 in

               Cumulative Runoff
              -------------------
                      8.4761 in
                    1025.542 ac-ft

HYG Volume...       1025.512 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =  1.84842 hrs (ID: AREA 2)
Computational Incr, Tm =   .04929 hrs = 0.04000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   890.01 cfs
Unit peak time      Tp =  1.23225 hrs
Unit receding limb, Tr =  4.92900 hrs
Total unit time,    Tb =  6.16125 hrs
```

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyCounty

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	11.8000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
AREA 3		AREA	100	528.776		10.9000	1567.59		
*OUT 10		JCT	100	528.776		10.9000	1567.59		
POND 10	IN	POND	100	528.776		10.9000	1567.59		
POND 10	OUT	POND	100	528.776		10.9000	1567.59		

```
SCS UNIT HYDROGRAPH METHOD
Calc.Method Option =  2
STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 11.8000 in
Rain Dir      = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
Rain File -ID =  - TypeI   24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
HYG File - ID = work_pad.hyg - AREA 3 Pre100
Tc            = 1.4574 hrs
Drainage Area = 821.900 acres  Runoff CN= 69

==========================================
Computational Time Increment   =   .05113 hrs
Computed Peak Time             =  10.8917 hrs
Computed Peak Flow             =  1568.66 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  10.9000 hrs
Peak Flow, Interpolated Output =  1567.59 cfs
==========================================

                 DRAINAGE AREA
               -------------------
               ID:AREA 3
               CN   =   69
               Area =     821.900 acres
               S    =   4.4928 in
               0.2S =    .8986 in

                Cumulative Runoff
               -------------------
                       7.7199 in
                      528.748 ac-ft

HYG Volume...        528.776 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =  1.45737 hrs (ID: AREA 3)
Computational Incr, Tm =   .05113 hrs = 0.05263 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   639.01 cfs
Unit peak time      Tp =   .97156 hrs
Unit receding limb, Tr =  3.88623 hrs
Total unit time,    Tb =  4.85779 hrs
```

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyCounty

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	10.1000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
AREA 4		AREA	100	141.297		10.3500	637.80		
*OUT 10		JCT	100	141.297		10.3500	637.80		
POND 10	IN	POND	100	141.297		10.3500	637.80		
POND 10	OUT	POND	100	141.297		10.3500	637.80		

```
SCS UNIT HYDROGRAPH METHOD
Calc.Method Option =  2
STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 10.1000 in
Rain Dir      = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
Rain File -ID =  - TypeI   24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
HYG File - ID = work_pad.hyg - AREA 4 Pre100
Tc            = .7288 hrs
Drainage Area = 243.200 acres  Runoff CN= 75

==========================================
Computational Time Increment   =   .04859 hrs
Computed Peak Time             =  10.3488 hrs
Computed Peak Flow             =   637.97 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  10.3500 hrs
Peak Flow, Interpolated Output =   637.80 cfs
==========================================

                 DRAINAGE AREA
               -------------------
               ID:AREA 4
               CN    =   75
               Area =     243.200 acres
               S     =   3.3333 in
               0.2S =    .6667 in

                Cumulative Runoff
               -------------------
                       6.9703 in
                      141.265 ac-ft

HYG Volume...        141.297 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .72881 hrs (ID: AREA 4)
Computational Incr, Tm =   .04859 hrs = 0.10000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   378.10 cfs
Unit peak time      Tp =   .48586 hrs
Unit receding limb, Tr =  1.94344 hrs
Total unit time,    Tb =  2.42930 hrs
```

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyCounty

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	10.0000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
AREA 5		AREA	100	87.969		10.9500	232.54		
*OUT 10		JCT	100	87.969		10.9500	232.54		
POND 10	IN	POND	100	87.969		10.9500	232.54		
POND 10	OUT	POND	100	87.969		10.9500	232.54		

```
SCS UNIT HYDROGRAPH METHOD
Calc.Method Option =  2
STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 10.0000 in
Rain Dir      = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
Rain File -ID =  - TypeI   24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
HYG File - ID = work_pad.hyg - AREA 5 Pre100
Tc            = 1.4910 hrs
Drainage Area = 242.000 acres  Runoff CN= 56

==========================================
Computational Time Increment   =   .04970 hrs
Computed Peak Time             =  10.9833 hrs
Computed Peak Flow             =   232.75 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  10.9500 hrs
Peak Flow, Interpolated Output =   232.54 cfs
==========================================

                DRAINAGE AREA
              -------------------
              ID:AREA 5
              CN    =   56
              Area =     242.000 acres
              S     =   7.8571 in
              0.2S =   1.5714 in

               Cumulative Runoff
              -------------------
                      4.3622 in
                      87.970 ac-ft

HYG Volume...         87.969 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =  1.49098 hrs (ID: AREA 5)
Computational Incr, Tm =   .04970 hrs = 0.05000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   183.91 cfs
Unit peak time      Tp =   .99396 hrs
Unit receding limb, Tr =  3.97586 hrs
Total unit time,    Tb =  4.96982 hrs
```

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyCounty

Return Event	Total Depth in	Rainfall Type	RNF ID
Pre100	10.0000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
AREA 6		AREA	100	115.953		11.1500	281.03		
*OUT 10		JCT	100	115.953		11.1500	281.03		
POND 10	IN	POND	100	115.953		11.1500	281.03		
POND 10	OUT	POND	100	115.953		11.1500	281.03		

```
SCS UNIT HYDROGRAPH METHOD
Calc.Method Option =  2
STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 10.0000 in
Rain Dir      = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
Rain File -ID =  - TypeI   24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
HYG File - ID = work_pad.hyg - AREA 6 Pre100
Tc            = 1.7152 hrs
Drainage Area = 319.000 acres  Runoff CN= 56

==========================================
Computational Time Increment   =   .04971 hrs
Computed Peak Time             =  11.1361 hrs
Computed Peak Flow             =   281.09 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  11.1500 hrs
Peak Flow, Interpolated Output =   281.03 cfs
==========================================

                 DRAINAGE AREA
               -------------------
               ID:AREA 6
               CN    =   56
               Area =     319.000 acres
               S     =   7.8571 in
               0.2S =   1.5714 in

                Cumulative Runoff
               -------------------
                       4.3622 in
                      115.961 ac-ft

HYG Volume...        115.953 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =  1.71520 hrs (ID: AREA 6)
Computational Incr, Tm =   .04971 hrs = 0.04348 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   210.73 cfs
Unit peak time      Tp =  1.14344 hrs
Unit receding limb, Tr =  4.57376 hrs
Total unit time,    Tb =  5.71720 hrs
```

MASTER DESIGN STORM SUMMARY

Network Storm Collection: MyCounty

Return Event	Total Depth in	Rainfall Type	RNF ID
100	10.0000	Synthetic Curve	TypeI 24hr

MASTER NETWORK SUMMARY
SCS Unit Hydrograph Method

(*Node=Outfall; +Node=Diversion;)
(Trun= HYG Truncation: Blank=None; L=Left; R=Rt; LR=Left&Rt)

Node ID		Type	Return Event	HYG Vol ac-ft	Trun	Qpeak hrs	Qpeak cfs	Max WSEL ft	Max Pond Storage ac-ft
AREA 7		AREA	100	81.627		10.1500	493.80		
*OUT 10		JCT	100	81.627		10.1500	493.80		
POND 10	IN	POND	100	81.627		10.1500	493.80		
POND 10	OUT	POND	100	81.627		10.1500	493.80		

```
SCS UNIT HYDROGRAPH METHOD
Calc.Method Option =  2
STORM EVENT: 100 year storm
Duration      = 24.0000 hrs     Rain Depth = 10.0000 in
Rain Dir      = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
Rain File -ID =  - TypeI   24hr
Unit Hyd Type = Default Curvilinear
HYG Dir       = V:\Projdata\06proj\06058\Calcs\Drainage Area Calcs (dtt-revi
HYG File - ID = work_pad.hyg - AREA 7 100
Tc            = .4041 hrs
Drainage Area = 148.200 acres  Runoff CN= 73

==========================================
Computational Time Increment   =   .05388 hrs
Computed Peak Time             =  10.1294 hrs
Computed Peak Flow             =   501.39 cfs

Time Increment for HYG File    =    .0500 hrs
Peak Time, Interpolated Output =  10.1500 hrs
Peak Flow, Interpolated Output =   493.80 cfs
WARNING: The difference between calculated peak flow
and interpolated peak flow is greater than 1.50%
==========================================

                DRAINAGE AREA
              -------------------
              ID:AREA 7
              CN    =   73
              Area =     148.200 acres
              S     =   3.6986 in
              0.2S =    .7397 in

               Cumulative Runoff
              -------------------
                      6.6173 in
                      81.723 ac-ft

HYG Volume...         81.627 ac-ft (area under HYG curve)

***** SCS UNIT HYDROGRAPH PARAMETERS *****

Time Concentration, Tc =   .40411 hrs (ID: AREA 7)
Computational Incr, Tm =   .05388 hrs = 0.20000 Tp

Unit Hyd. Shape Factor =  483.432 (37.46% under rising limb)
K =  483.43/645.333,  K =    .7491 (also, K = 2/(1+(Tr/Tp))
Receding/Rising, Tr/Tp =   1.6698 (solved from K =   .7491)

Unit peak,          qp =   415.53 cfs
Unit peak time      Tp =   .26940 hrs
Unit receding limb, Tr =  1.07760 hrs
Total unit time,    Tb =  1.34700 hrs
```

Warren S. Unemori Engineering, Inc.
Wells Street Professional Center
2145 Wells Street , Suite 403
Wailuku, Maui , Hawaii 96793

Date: December 28, 2006

HYDROLOGIC CALCULATIONS: DRAIN AREA 8

Objective: To determine the runoff from the contributory Drainage Area No. 8, mauka of the Honoapiilani Highway realignment.

I. 50-Yr. - 1 Hr. Rainfall:

From "Rainfall Frequency Atlas of the Hawaiian Islands", for Lahaina, Maui,
R(50 Yr.-1Hr.) = 2.75 inches

2. Total Area:

Area (Ac.):		77.10

3. Runoff Coefficents:

Infiltration:	Medium	0.07
Relief:	Rolling (5-15%)	0.03
Vegetal Cover:	Good (10-50%)	0.03
Development Type:	Agricultural	0.15
Runoff Coeff't., C:		0.28
Min. Runoff Coeff't for Undeveloped Areas		0.30

4. Time of Concentration:

Approx. Elev. Diff'l. (ft.):		510
Higher Elev. (ft.):	600	
Lower Elev. (ft.):	90	
Approx. Runoff Length (ft.):		5,110
Average Slope:		9.98%
Time of Concentration (min.):		55

5. Intensity:

Intensity (in./hr.):		2.9

6. Total Runoff:

Q = C x I x A (cfs):		**67.08**

APPENDIX J.

Comments Received at the April 26, 2007 Public Scoping Meeting

Public Scoping Meeting
for
Proposed Relocation of Lahaina Bypass Southern Terminus

April 26, 2007
Lahaina Civic Center

SUMMARY OF COMMENTS RECEIVED

A public scoping meeting on the proposed relocation of Lahaina Bypass Southern Terminus was held for the purpose of receiving input for the preparation of the Draft Environmental Assessment for the project. Representing the Department of Transportation were Brennon Morioka, Deputy Director; Fred Cajigal, Maui District Highway Engineer; and Wayne Kawahara, Project Civil Engineer. The list of attendees is attached to this summary.

The following is a summary of questions and comments offered and responses provided.

1. **Bob Pure**:

   a. Comment concerning timing of phases
   Brennan Morioka:
   - Explained phasing of Bypass
   - General design and construction time frame is 2 years for Phase IA
   - Phase IB-2 to follow immediately after construction of Phase IB-1 is completed

2. **Joe Pluta, West Maui Taxpayers Association, West Maui Improvement Foundation**:

   a. Noted that implementation timing is critical

   b. Asked about recent legislation pertaining to SDOT being exempted for certain regulatory requirements
   Brennan Morioka: Legislation is being considered to allow SDOT to be exempt from SMA permitting requirements in the event of an emergency (acts of Mother Nature). Example, if shoreline erosion requires roadway relocation, SDOT would be exempt from SMA process as long as project improvements remain in the right-of-way. If Federal monies are involved, federal legislation governs.

   c. How can we get FEMA involved to facilitate implementation of the Bypass?
   B. Morioka: SDOT does not typically work with FEMA in terms of facilitating project implementation. SDOT's cooperating federal agency is FHWA.

   d. Is FHWA involved in these discussions (regarding this project)?
   B. Morioka: Meetings are held every other week with FHWA.

e. Asked whether there would be further delays in conjunction with this proposal.
B. Morioka: No further delays. The point of this proposal is to move forward. This project in no way will change the (original Lahaina Bypass) Record of Decision causing delay. It will not impact the schedule, except to possibly accelerate the implementation of the broader regional highway planning effort.

f. Inquired about the possibility of extending the Bypass further south to Ma`alaea.
B. Morioka: Explained the permitting process and that Ma`alaea to Launiupoko venture would be a larger project. Explained the EA versus EIS process. SDOT understands that the Ma`alaea extension encompasses broader issues which requires the preparation of an EIS. SDOT will be working to establish a task force for the Ma`alaea to Launiupoko segment in the EIS process.

g. Expressed belief that getting stuck at the Pali and the back up will be a problem. The problem is getting passed that portion of the highway "bottleneck".

3. **Norm Bezane**:

a. Questioned representations made by SDOT regarding start of construction dates for Phase IA.
B. Morioka: Explained the awarding of contracts and further explained the Bypass timeline.

b. Explained his familiarity with RFPs and indicated his understanding is that the Bypass was planned to start in January. Noted last month's DOT representations regarding construction starting in July. At this meeting, it is being represented that construction will start in August. Wants to emphasize that SDOT should meet deadlines and dates.
B. Morioka: After summarizing the project schedule, explained that this is the reason for public involvement. That is to keep the public apprised of status and to keep SDOT accountable.

4. **Fred Schwettmann**:

a. Requested comment on specific issues for consensus building and building in a timely fashion.
B. Morioka: With respect to the Ma`alaea to Launiupoko study, explained EIS process and that EIS process takes longer (5 years) than the EA process. Must ensure that SDOT is providing what the community wants. When conflicting views are received, it is difficult for government to move forward because it is unclear what the community wants. This leads to further delays. Further explained the vulnerability of a project because it is subject to challenge in the courts, which results in the judge making a decision about whether to proceed or not. Once the project is challenged in court, the 5-year timeframe is no longer applicable. Public's questions and comments become part of a formal document to justify the project. If

there is only opposition to a project (at public forums), it is difficult to move a project forward. Building consensus to get people to support a project is the most important thing the community can do to help the process. This is the third meeting (on the Bypass) in the past week and there has been good turn out for these meetings. Engaging the public is part of the consensus building process.

b. Explained his understanding of consensus building, however, inquired whether there are any contingency plans in case of problems. Asked what SDOT thought the potential problems might be; particularly those that would end up in court.
B. Morioka: Some issues which may be a source of concern include cultural sensitivity, environmental impacts (flora, fauna), different routes having community impacts, and impacts on view planes. Explained that this is what the environmental review process is for; it is meant to identify alternatives and options so that when questions are raised, they can be responded to. The project is opened to litigation when questions are not addressed properly.

5. **Joe Pluta**:
   a. Expressed support for this project (southern terminus relocation) and commended everyone. Questioned the need to use federal monies. Inquired about the possibility of using State funds and getting reimbursed by the federal government later, or seeking use of private funds. Questioned the economic loss of a road closure should delays be caused an emergency. Wondered about the economic impact due to such an event.
   B. Morioka: There are limitations to funding. Federal appropriations end in 2010. In addition, there are limited State funds. SDOT does advance construction monies in a few instances; however, there are limitations because it is difficult to leverage future monies for federal projects.

   b. Expressed that we have to start thinking "outside of the box".
   B. Morioka: Explained that by 2009 the State will start running out of federal highway funds. Cannot solely rely on federal monies and existing state funding. Public-private partnerships is an avenue which needs to be explored. SDOT will be entering into a number of public-private partnerships and some private entities are being asked to pay for some of it now.

6. **George Laverson**:
   a. Has a different perspective from everyone else. Current drive is breathtaking and world class. Hate to see it ruined. He understands the Bypass project, but why Bypass the coast? Can we fix the shore instead of moving the whole highway?
   B. Morioka: Explained that this is the type of comments SDOT needs to hear. With respect to the Ma`alaea to Launiupoko project, the EIS process will look at different routes and alternatives. There has been a determination of capacity need 25 years out. How it will be met is not determined (roadway, bikeway, employee subsidized shuttles). Thus, roadways are not the only alternatives being looked at. There is

also the "no-build" scenario to be considered.

7. **Mike Foley**:

a. Supports the project, but wants to caution everyone that the County and State have the lands zoned for Agriculture in the project vicinity. Moving the highway as proposed would provide opportunity for other development (residential and commercial) instead of recreation and open space. Six months ago the property owner applied for subdivision (into approximately twenty 15-acre lots). Would like to know the status of the subdivision and whether or not the properties are for sale or will be for sale.

B. Morioka: Explained right-of-way acquisition objectives of the SDOT and that the State tries to acquire property with the least amount of money as possible, or have the lands dedicated to the DOT.

Rory Frampton, Makila Land Co.: Makila Land owns parcels of land affected by the southern terminus relocation. The subdivision would not increase the cost of the land. Preliminary subdivision approval has been secured, with final subdivision approval being worked on. The alignment recommended has been set aside as a "no build" zone on the subdivision map so it can be transferred to SDOT. Makila wants to work with SDOT and provide the land to the State at no cost.

8. **Hans Michel**:

a. Thinks the idea of the southern terminus relocation is excellent and public has been ready for regional improvements for many months and years. Questioned the location of the alignment in relation to the "proposed storm drainage channel" (blue line on map exhibit board) and rubbish dump. Expressed concern about drainage.

B. Morioka: Explained that 2 culvert structures are to be addressed in the design of the southern terminus relocation.

b. Asked what happens to existing road after the Bypass is completed; does it get turned over to the County and when will that take place?

B. Morioka: It is typical that the older portion of the road is turned over to the County in a progressive manner, once the Bypass is built.

c. Requested clarification of funding for Phase IB.

B. Morioka: $40 million is appropriated for Phase IB (includes Phases IB-1 and IB-2). The $40 million takes us to the end of Phase IB. This proposed southern terminus relocation project is important because it adds significant mileage to the Bypass, gives us more road in a shorter period of time, and saves money. Phase IB-1 will start construction in beginning of 2009.

d. Commented on the relationship between the drainage channel and the alignment. If there is a big flood the Bypass will be damaged. He would like to see the flood channel mauka of the Bypass but now understands that the monies have lapsed for

the flood channel.

9. **Gene Moore**:
   a. Questioned communication between other agencies during construction of multiple projects. Is there coordination between the project managers?
   B. Morioka: Yes. Coordination will be undertaken between multiple projects. All traffic controls will be working in concert with each other.

10. **Hans Michel**:
   a. Expressed concern at the Lahainaluna Road-Honoapi`ilani Highway intersection and the problems of large trucks and semi-trailers navigating the turns.
   B. Morioka: Lahainaluna Road intersection will be improved as part of the Honoapi`ilani Highway widening project to allow for safe turning movements.

   b. Asked about mass transit from Kapalua to the Pali and beyond. Can government acquire land now for future transportation plans. Expressed need that some kind of easement be set aside now for future mass transit.
   B. Morioka: This kind of issue can be addressed through the General Plan and Community Plans. These are the things that need to be addressed before you can reserve lands. In addition to the County General Plan and Community Plans, the SDOT is working on a long-range plan for Maui County (transportation specific).

The meeting was adjourned with no further questions or comments.

LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION SCOPING MEETING

Date: **Thursday, April 26, 2007**
Time: **6:00 p.m. - 8:00 p.m.**
Location: **Lahaina Civic Center - Social Hall**

SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
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Rory Frampton	Makila Land Co.	33 Lono Ave, Suite 450 Kahului, 96790	Ph: 298-4956 FAX: Email: rorymakilaland.com
Claudine Sean Nicolas	MAUI NEWS	100 Mahalani St Wailuku HI 96793	Ph: 242-6341 FAX: Email: claudine@mauinews.com
Bob Pure BOB PURE	LBN	2560 Keka'a Drive, Unit C303 Lahaina HI 96761	Ph: 661-3307 FAX: Email: bobdi@hawaii.rr.com
William Soares	ME	37 Kua Place	Ph: 667-9140 FAX: Email:
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NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
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Joshua Dean (Dean)	West Maui Land Co.	808 Olowalu Village Rd Lahaina	Ph: FAX: Email: joshua@westmauiland.com
Pete Martin		540 A STABLE RD PAIA, HI 96779	Ph: FAX: Email: pkm@maui.net

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LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION SCOPING MEETING

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SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
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Donna Sorrey		P.O. Box 817 Lahaina 96767	Ph: 661-8748 FAX: 661-5871 Email:
Norm Bezaire			Ph: FAX: Email:
Mac Lowson		PO Box 613 Lahaina 96767	Ph: FAX: Email:
Theo Morrison	Lahainabypassnow	505 Front St. #202 Lahaina, HI 96761	Ph: 667-5150 FAX: Email: theo@lahainabypass
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LAHAINA BYPASS SOUTHERN TERMINUS RELOCATION SCOPING MEETING

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SIGN-IN SHEET

NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
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Heidi Bigelow	West Maui Land Co.	33 Lono Ave. Suite 450 Kahului, HI 96732	Ph: 808 877 4202 FAX: Email:
Mona Stevenson	Maui Community College	310 Kaahumanu Kahului, HI 96732	Ph: FAX: Email: monaste@hawaii.edu
MIKE WHITE	KAANAPALI BEACH HOTEL	2525 KAANAPALI PKWY LAHAINA, HI 96761	Ph: FAX: Email: MWHITE@KBHMAUI.com
John Seibert		c/o KHYC 380 YACHT CLUB WAY REDONDO BCH CA 90277	Ph: FAX: Email: jseibert@PO BOX.com
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CLAIRE PARISSON		52 PUAKUKU PL LAHAINA 96761	Ph: 667-7022 FAX: — Email: —
Debbie Martin		590 Old Stable Rd Paia HI 96779	Ph: 871-5924 FAX: Email:
[illegible]	Maui Chamber of Commerce	313 Ano St Makawao HI 96768	Ph: 871-7711 FAX: Email: DANIEL@MAUICHAMBER.COM
MIKE FOLEY		128 PUALU PLACE NAPILI	Ph: 669-8184 FAX: Email: PETE155@AOL.COM

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NAME	ORGANIZATION	MAILING ADDRESS	PHONE, FAX NO. & E-MAIL
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Laurie Lowson	Resident	POB 11494 96761 6494	Ph: FAX: Email: Laurie@Lowson.com
KIRK HUNT	HUNT CONSTRUCTION	1328 KAHOMA ST	Ph: 808 385-8395 FAX: 808 661-8079 Email: KIRKHUNTES@HAWAII.RR.COM
			Ph: FAX: Email:

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