ALAN M. ARAKAWA
Mayor

DAVID C. GOODE
Director

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Deputy Director

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COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
ENGINEERING DIVISION
200 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

RALPH NAGAMINE, L.S., P.E.
Development Services Administration

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

June 5, 2013

Mr. Gary Gill, Acting Director
State of Hawaii
Office of Environmental Quality Control
235 South Beretania Street, Suite 702
Honolulu, Hawaii 96813

Subject: Draft Environmental Assessment for
Kūlanihāko'i Bridge Replacement
Wailuku, Maui, Hawaii
Project No. BR-3100(015)

Dear Mr. Gill:

The County of Maui Department of Public Works (DPW) has reviewed the Draft Environmental Assessment (DEA) for the subject project and anticipates a Finding of No Significant Impact. The DEA has been prepared pursuant to Chapter 343, Hawaii Revised Statutes and Chapter 11-200, Hawaii Administrative Rules. Please publish notice of this DEA in the June 23, 2013 issue of OEQC's *The Environmental Notice*.

One (1) each the following items will be mailed under separate transmittal:

- Hardcopy of the OEQC publication form and DEA; and
- CD including the DEA and OEQC publication form in pdf format.

Please contact Ms. Wendy Kobashigawa of our Engineering Division at (808) 270-7435 or Wendy.Kobashigawa@co.maui.hi.us if you have any questions.

Sincerely,

DAVID C. GOODE
Director

Attachments

cc: Mr. Milton Arakawa, Wilson Okamoto Corporation

DG/wykk:gq (ED13-484)
S:\ENG\DESIGN\FAP\BR-3100(015) Kulanihakoi Bridge Replacement\EA\DPW Trans to OEQC.docx

Agency Action EA
Chapter 343, HRS
Publication Form

Project Name: Draft Environmental Assessment for the Kūlanihāko'i Bridge Replacement Project

Island: Maui

District: Wailuku

TMK: (2) 3-9-001: portion of 015, 147, 162, and South Kīhei Road Right-of-Way

Permits:

- Nationwide Permit, Section 404, Clean Water Act
- Section 10 Permit, Rivers and Harbors Act
- National Environmental Policy Act (NEPA) Categorical Exclusion
- Section 401, Clean Water Act, Water Quality Certification
- National Pollutant Discharge Elimination Permit for Dewatering Activity
- Noise Permit
- Stream Channel Alteration Permit
- Coastal Zone Management Federal Consistency Certification
- Special Management Area Use Permit
- Shoreline Setback Variance
- Special Flood Hazard Area Development Permit
- Grading/Grubbing Permit
- Permit to Perform Work within County Right-of-Way

Proposing/Determination Agency:

County of Maui
Department of Public Works
200 South High Street, 4th Floor
Wailuku, HI 96793
Contact: Ms. Wendy Kobashigawa
Telephone No.: (808) 270-7745

Consultant:

Wilson Okamoto Corporation
1907 S. Beretania Street, Ste. 400
Honolulu, HI 96826
Contact: Mr. Milton Arakawa, AICP
Telephone No.: (808) 946-2277

Status: 30-day comment period

Summary:

The existing Kūlanihāko'i Bridge is a four (4)-cell concrete box culvert system which spans Kūlanihāko'i Gulch, in Kīhei, Maui, Hawaii. The County of Maui Department of Public Works (DPW) is proposing to replace the existing Kūlanihāko'i Bridge as the existing culverts are structurally deficient and in advanced stages of deterioration The replacement bridge will be constructed with six (6) new culverts; each approximately six 6 feet wide, 4 feet high and 50 feet across South Kīhei Road. New inlet and outlet head walls will also be constructed. The roadway section over the new bridge will be widened from two (2), 10-foot travel lanes with paved shoulders to two (2) 12-foot travel lanes, one in each direction, a 5-foot wide bike lane, a 5-foot wide paved walkway, and a 2.5-foot wide curb and gutter separating the walkway from the roadway on both sides of the bridge. A 4-foot tall traffic rated bridge wall will be constructed on top of the culverts on each side as a traffic barrier for safety purposes. Existing temporary concrete barriers will be replaced with permanent guardrails and end connections, designed to comply with current standards. Roadway improvements to South Kīhei Road in the vicinity of the bridge include widening the roadway on the mauka side to accommodate a 5-foot wide bike lane and a 5-foot wide paved walkway with a 2.5-foot wide curb and gutter separating the walkway from the roadway.

DRAFT ENVIRONMENTAL ASSESSMENT

KŪLANIHĀKOʻI BRIDGE REPLACEMENT
Project No. BR-3100 (015)

District of Wailuku, Island of Maui, State of Hawaiʻi

Prepared For:

COUNTY OF MAUI

DEPARTMENT OF PUBLIC WORKS

Prepared By:

WILSON OKAMOTO
CORPORATION

June 2013

DRAFT ENVIRONMENTAL ASSESSMENT

KŪLANIHĀKOʻI BRIDGE REPLACEMENT

District of Wailuku, Island of Maui, State of Hawaiʻi

Project No. BR-3100 (015)

Prepared For:

County of Maui
Department of Public Works
200 South High Street, 4th Floor
Wailuku, Hawaiʻi 96793

Prepared By:

Wilson Okamoto Corporation
Engineers and Planners
1907 South Beretania Street, Suite 400
Honolulu, Hawaiʻi 96826
WOC Job No. 8256-01

June 2013

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PREFACE

This Draft Environmental Assessment (EA) / Anticipated Finding of No Significant Impact (FONSI) has been prepared pursuant to Chapter 343, Hawai'i Revised Statutes (HRS), and Title 11, Chapter 200, Hawai'i Administrative Rules (HAR), Department of Health, State of Hawai'i. The County of Maui, Department of Public Works (DPW) is proposing to replace and upgrade the Kūlanihāko'i Bridge in the Kīhei District of the Island of Maui. The project requires the use of County funds and lands, therefore, the project is subject to the State environmental review process.

In addition to using County funds, Federal Highway Administration (FHWA) funds will also be used. Separate documentation will be prepared for the proposed project to satisfy the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended.

The proposed action assessed herein is for the replacement of the Kūlanihāko'i Bridge. The replacement bridge will be longer and wider than the existing bridge and will also involve several roadway improvements including installation of guardrails, and a dedicated paved walkway and bikeway on the mauka side of the roadway. Also associated with the project is a temporary bridge and bypass road that will be constructed on the mauka side of the Kūlanihāko'i Bridge to accommodate traffic while the bridge is being replaced. It is anticipated that a Finding of No Significant Impact (FONSI) will be issued and filed with the State Office of Environmental Quality Control (OEQC) by the approving agency following public review of the Draft EA.

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SUMMARY

Proposing Agency:	County Maui, Department of Public Works
Approving Agency:	County Maui, Department of Public Works
Location:	Kīhei, Maui, Hawai'i
Tax Map Keys (TMKs):	(2) 3-9-001: 015 (por.), 147 (por.), 162 (por.) and South Kīhei Road Right-of-Way (por.)
Recorded Fee Owner:	County of Maui and Kenranes Ltd.
Existing Use:	Public roadway with shoulders and a four (4) cell culvert bridge supporting the road over the Kūlanihāko'i Gulch.
State Land Use Classification:	Urban
Community Plan Designation:	Open Space and Park
County Zoning Designation:	Drainage (DR), Park (PK), and Apartment (A-1)
Proposed Action:	The proposed action assessed herein is for the replacement of the Kūlanihāko'i Bridge. The replacement bridge will be longer and wider than the existing bridge and will also involve several roadway improvements including installation of guardrails, and a dedicated paved walkway and bikeway on the mauka side of the roadway. Also associated with the project is a temporary bridge and bypass road that will be constructed on the mauka side of the Kūlanihāko'i Bridge to accommodate traffic while the bridge is being replaced.
Impacts:	No significant impacts are anticipated from the construction and operation of the proposed improvements. Construction activities are anticipated to have short-term noise, traffic, and air quality impacts in the surrounding area. Construction noise and air quality impacts will be minimized by compliance with applicable State Department of Health Rules. No significant long-term environmental or community impacts in the vicinity of the project site are anticipated.
Anticipated Determination:	Finding of No Significant Impact (FONSI)

Parties Consulted During Pre-Assessment:

Federal Agencies
U.S. Army Corps of Engineers (COE)
U.S. Fish and Wildlife Service
National Oceanic and Atmospheric Administration (NOAA) – National Marine Fisheries Service

State Agencies
Department of Accounting and General Services
Department of Business, Economic Development & Tourism (DBEDT)
DBEDT, Land Use Commission
DBEDT, Office of Planning
Department of Education
Department of Health (DOH)
DOH, Clean Water Branch
DOH, Environmental Management Division
DOH, Environmental Planning Office
DOH, Office of Environmental Quality Control
Department of Land and Natural Resources (DLNR)
DLNR, Engineering Division
DLNR, Land Division
DLNR, State Historic Preservation Division
DLNR, Office of Conservation and Coastal Lands
Department of Transportation
Office of Hawaiian Affairs

County of Maui Agencies
Department of Environmental Management
Department of Fire and Public Safety
Department of Parks and Recreation
Department of Planning
Department of Public Works
Department of Transportation
Department of Water Supply
Police Department

Other Interested Parties and Individuals
Kīhei Community Association

1. INTRODUCTION

1.1 Project Location

The County of Maui, Department of Public Works (DPW) proposes to replace and upgrade the Kūlanihāko'i Bridge, which spans Kūlanihāko'i Gulch, in Kīhei, Maui, Hawai'i. Kūlanihāko'i Bridge is located on South Kīhei Road approximately 200 feet south of the South Kīhei Road and Ka'ono'ulu Street intersection (see Figure 1-1). The project area is further identified as Tax Map Key (TMK) (2) 3-9-001:015 (por.), 147 (por.) and 162 (por.), and a portion of the South Kīhei Road right-of-way (see Figure 1-2).

1.1.1 Existing Uses

South Kīhei Road, in the vicinity of Kūlanihāko'i Bridge currently consists of two (2) 10-foot wide travel lanes (one lane in each direction) with shoulders ranging from 4.2 to 5.6 feet wide. Currently, there are temporary concrete barriers placed along both sides of the bridge (see Figure 1-3).

The bridge is a four-cell concrete box culvert system and each cell is six (6) feet wide and four (4) feet high by 38-feet across South Kīhei Road. South Kīhei Road extends 27-feet and nine inches over the four cell box culvert. Since the box culverts span more than 20-feet, it is considered a "bridge" (see Figure 1-4).

1.1.2 Surrounding Uses

The project site is bounded by Ka'ono'ulu Street to the north, Kīhei Bay Vista and the Hawaiian Islands Humpback Whale National Marine Sanctuary to the south, the Kūlanihāko'i Gulch to the east, and Kalepoleopo Beach Park to the west (see Figure 1-5).

In addition, there are various resorts and residential areas mauka of the project site, including the Aston Maui Lu Resort to the northeast, the Ka'ono'ulu Estates to the east, and the Kīhei Bay Vista and Kīhei Bay Surf to the southeast.

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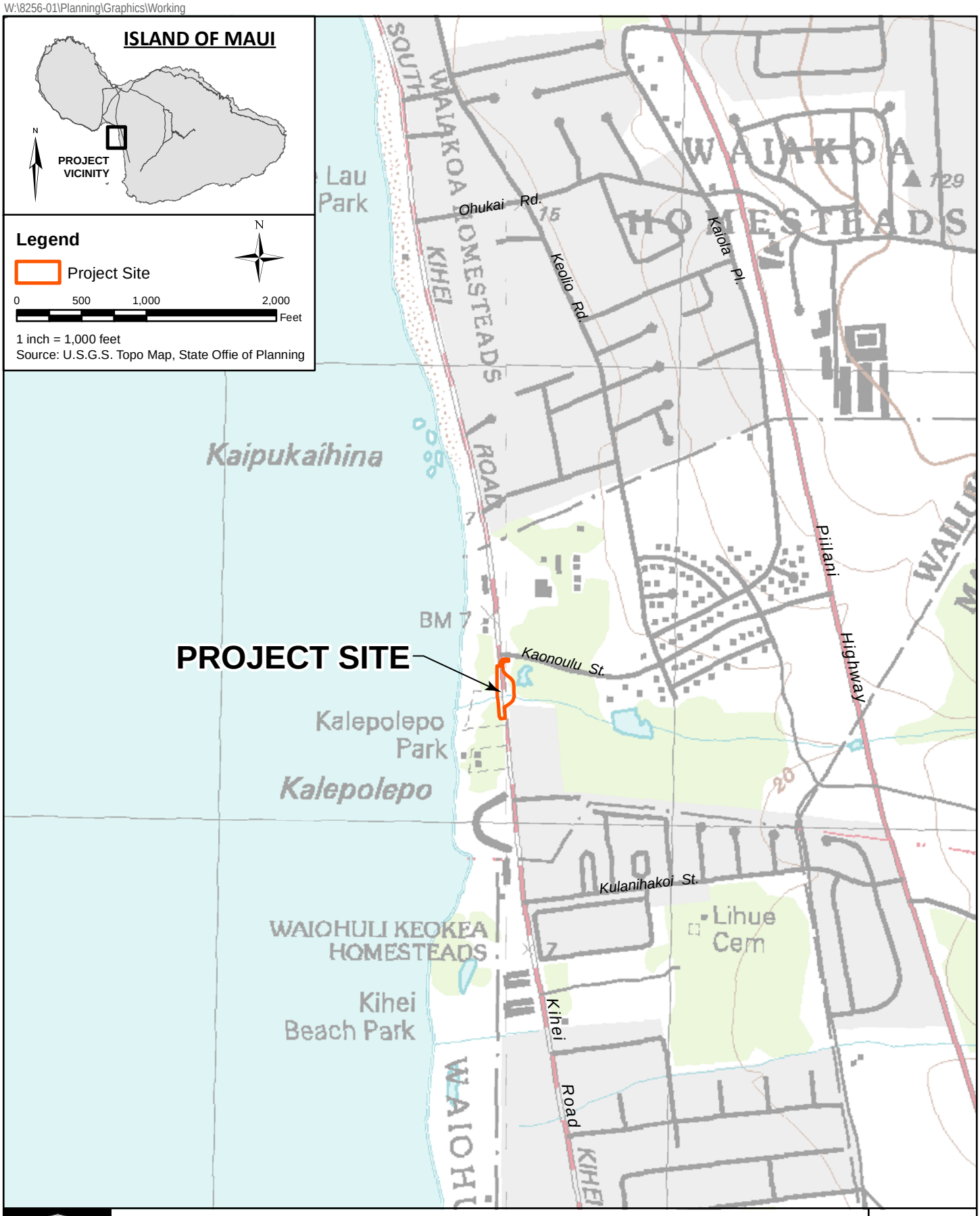

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KULANIHAKOI BRIDGE REPLACEMENT

LOCATION MAP

FIGURE 1-1

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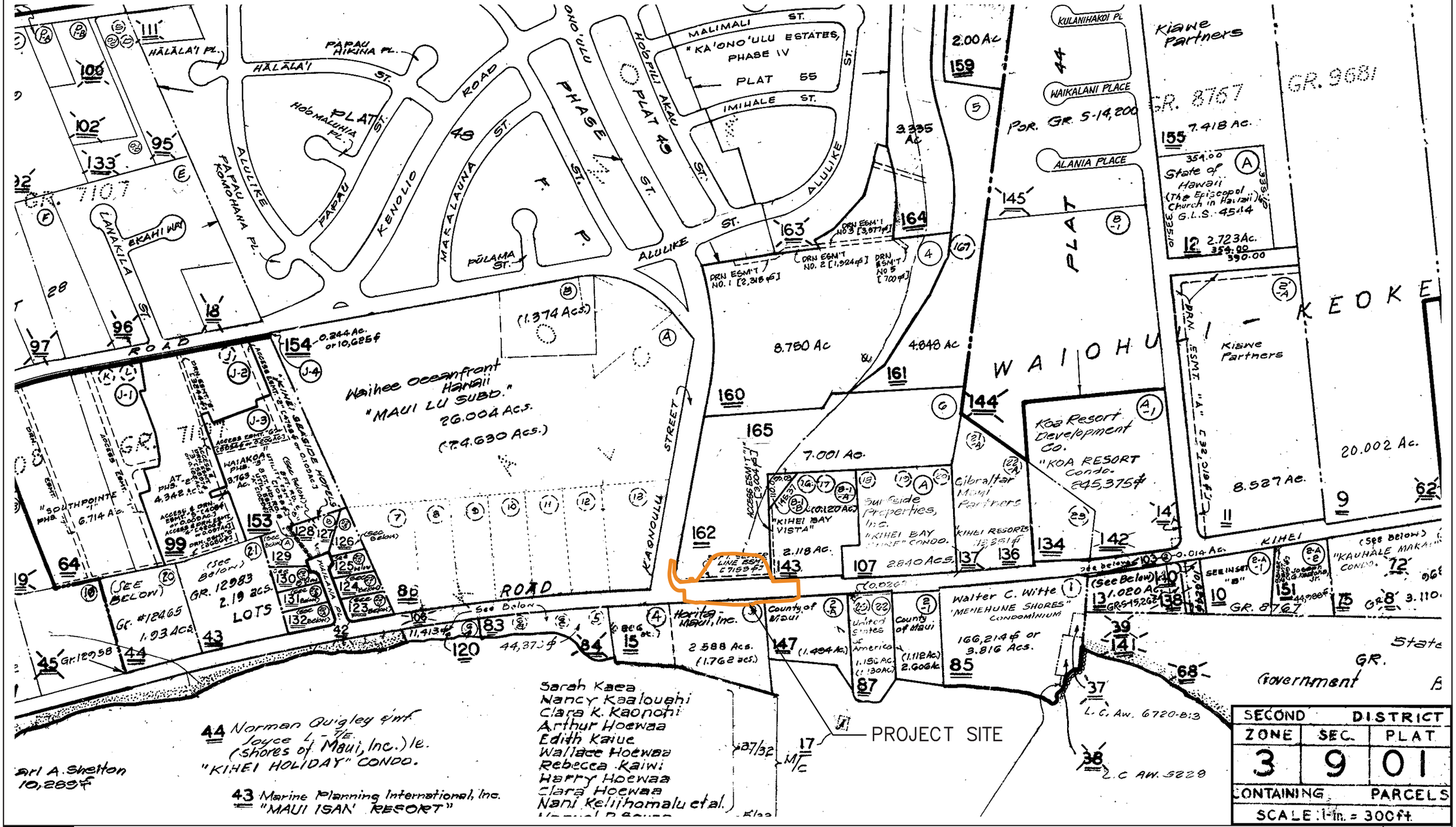

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KULANIHAKOI BRIDGE REPLACEMENT

TAX MAP KEY 3-9-001: 015, 147 AND 162

FIGURE 1-2

Photograph 1: View of South Kihei Road looking south

Photograph 2: View of South Kihei Road looking north

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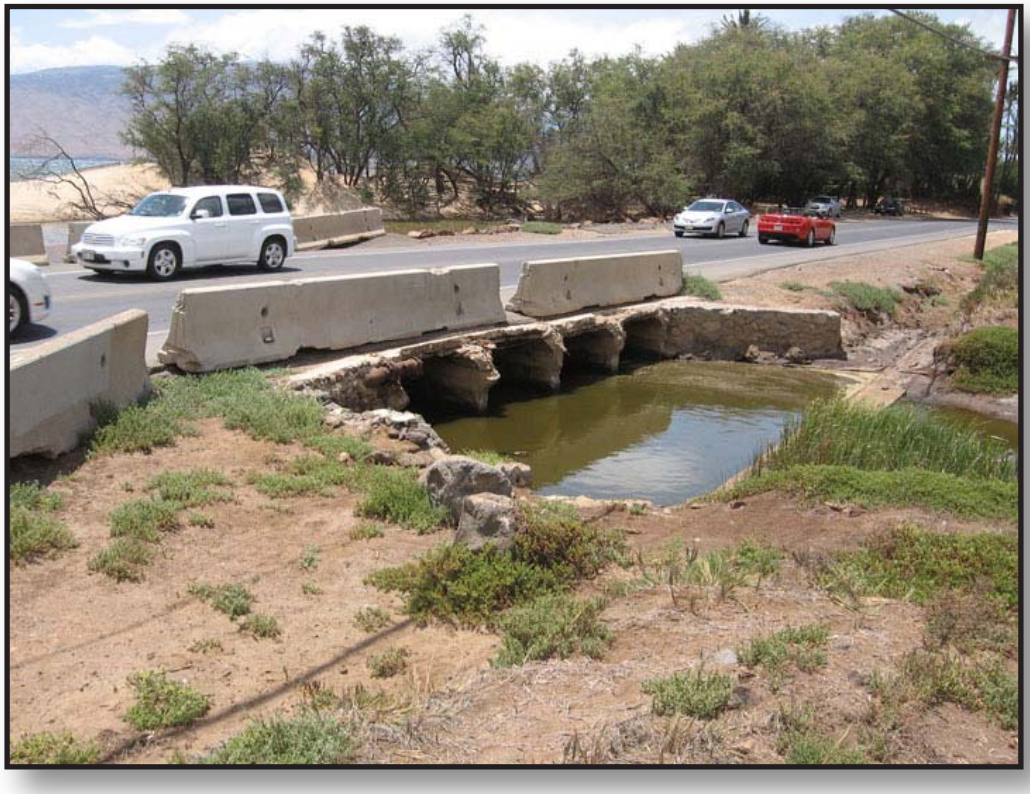
KULANIHAKOI BRIDGE REPLACEMENT

EXISTING SOUTH KIHEI ROAD PHOTOS

FIGURE
1-3



Photograph 3: View of Kulanihakoi Bridge inlet looking northeast

Photograph 4: View of Kulanihakoi Bridge outlet looking southeast

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KULANIHAKOI BRIDGE REPLACEMENT

SURROUNDING LAND USE MAP

FIGURE 1-5

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2. PROJECT DESCRIPTION

2.1 Project Purpose and Need

The existing culverts are structurally deficient and in advanced stages of deterioration. The County of Maui bridge inspection report, dated January 2011, notes that the culverts and retaining walls are in critical condition. There are numerous delaminations, spalls with exposed rebar, and rebar that has been corroded away in the 4-cell reinforced concrete culvert. There are also major problems with embankment erosion and adequacy of opening.

A more recent bridge inspection report, dated March 2012, notes that Kūlanihāko'i Bridge is in a very deteriorated condition, with exposed reinforcement and crumbling concrete, severe spalling and advanced corrosion of the reinforcing of the top slab of the culvert. The report recommends that immediate repairs or shoring of the top slab be implemented. If left unrepaired there is a risk of possible collapse of the existing culverts due to vehicles traversing over it. Based on the results of the bridge inspection report, the sufficiency rating of the bridge is rated 2.0 on a scale of 0 to 100 with 100 representing a bridge fully meeting current design standards. The recommendation of the inspection report is to replace the bridge.

In addition, the existing traffic safety features of the bridge do not meet current standards. Currently, only temporary concrete barriers are located along both sides of the bridge on South Kīhei Road. There are no approach guardrails or transitions at either ends of the bridge. This results in the ends of the portable bridge parapets to be exposed to traffic.

Roadway improvements to South Kīhei Road are also necessary as there is a need for enhanced safety for vehicles, pedestrians and bicyclists. Currently pedestrians and bicyclists share existing paved roadway shoulders on both sides of South Kīhei Road ranging in width from approximately 4.2 to 5.6 feet.

2.2 Project Description

The proposed project involves the replacing the existing bridge as well as various roadway improvements. The proposed improvements are described below (see Figures 2-1 to 2-4):

The existing Kūlanihāko'i Bridge, which is comprised of four culverts, will be replaced with a longer and wider bridge consisting of six (6) culverts. Prior to construction of the new culverts, the existing four (4) culverts will need to be demolished and removed along with the existing inlet and outlet headwalls and temporary concrete barriers. Once the existing four (4) culverts are removed, the foundation for the new culverts will need to be installed. The base would be excavated to accommodate an 8-inch thick gravel layer or similar structural fill.

The replacement bridge will be constructed with six (6) new culverts; each approximately six (6) feet wide, four (4) feet high and 50 feet across South Kīhei Road. The pre-cast concrete culverts will be approximately one (1) foot thick. Thus, the new bridge will extend approximately 50-feet across South Kīhei Road. The six (6) culverts, placed side by side, would extend approximately 48-feet within the South Kīhei Road right-of-way. The culverts

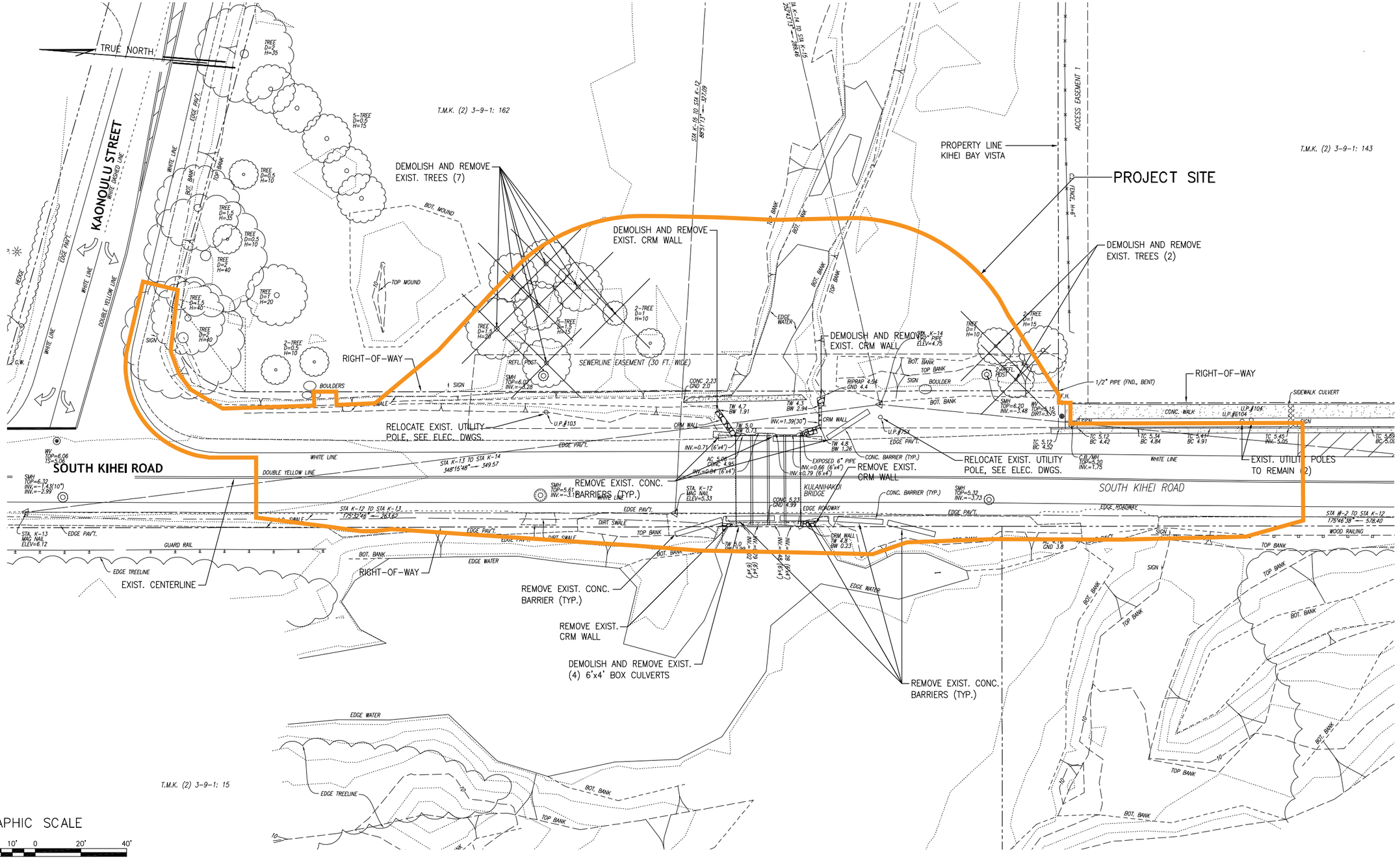
will be cast at an off-site location and then trucked to the project site where a crane will be used to lower the culverts into place. The invert of the culverts will sit at sea level. Inlet and outlet head walls will also be constructed. The inlet and outlet head walls will be one foot thick, constructed of concrete rubble masonry and will be cast-in-place.

The roadway section over the replacement bridge will be widened from two (2), 10-foot travel lanes with paved shoulders to two (2) 12-foot travel lanes, one in each direction, a 5-foot wide bike lane, a 5-foot wide paved walkway, and a 2.5-foot wide curb and gutter separating the walkway from the roadway on both sides of the bridge. A 4-foot tall traffic rated bridge wall will be constructed on top of the culverts on each side as a traffic barrier for safety purposes. The bridge wall will be constructed of stone masonry and would be 1-foot thick. The temporary concrete barriers will be replaced with permanent guardrails and end connections, designed to comply with current standards.

Roadway improvements to South Kīhei Road in the vicinity of the bridge include widening the roadway on the mauka side to accommodate a 5-foot wide bike lane and a 5-foot wide paved walkway with a 2.5-foot wide curb and gutter separating the walkway from the roadway. There is an existing paved walkway that terminates at the northern end of the Kīhei Bay Vista property approximately 100 feet south of the bridge. From this point, the project intends to extend the paved walkway over the new bridge until it reaches Ka‘ono‘ulu Street where it connects with an existing paved shoulder. The curb and gutter and the bike lane would follow the same route as the proposed walkway. From the bridge, the proposed improvements extend along the mauka side of the road, approximately 300 linear feet.

The proposed improvements will include a 5-foot wide bike lane and a 5-foot wide paved walkway on the makai side of the bridge. Since there are no existing sidewalk connections on the makai side of the road in close proximity of the bridge, there are limited extensions, approximately 50 feet north and 100 feet south. If and when future improvements are pursued on the makai side of South Kīhei Road, further curb, gutter, sidewalk and bike lane improvements can be implemented.

Due to the widening of the roadway, installation of a new 24-inch drain line on the mauka side of the roadway, north of the bridge, will be required to replace the existing dirt swale which currently collects runoff from the road. However, this swale would be paved over to accommodate the proposed widening. The proposed 24-inch drain line would collect the runoff from a headwall inlet that would be constructed on the mauka side of the roadway near the intersection of South Kīhei Road and Ka‘ono‘ulu Street. From there it would connect to a manhole and then traverse beneath the roadway until it reaches the bridge where it would connect with the northern most culvert. There is also an existing 30-inch drain line on the mauka and south side of the bridge which collects road runoff from an area near Kīhei Bay Vista that will be left in place. However, a new outlet into the southernmost culvert will be needed.



KULANIHAKOI BRIDGE REPLACEMENT

DEMOLITION PLAN

FIGURE 2-1

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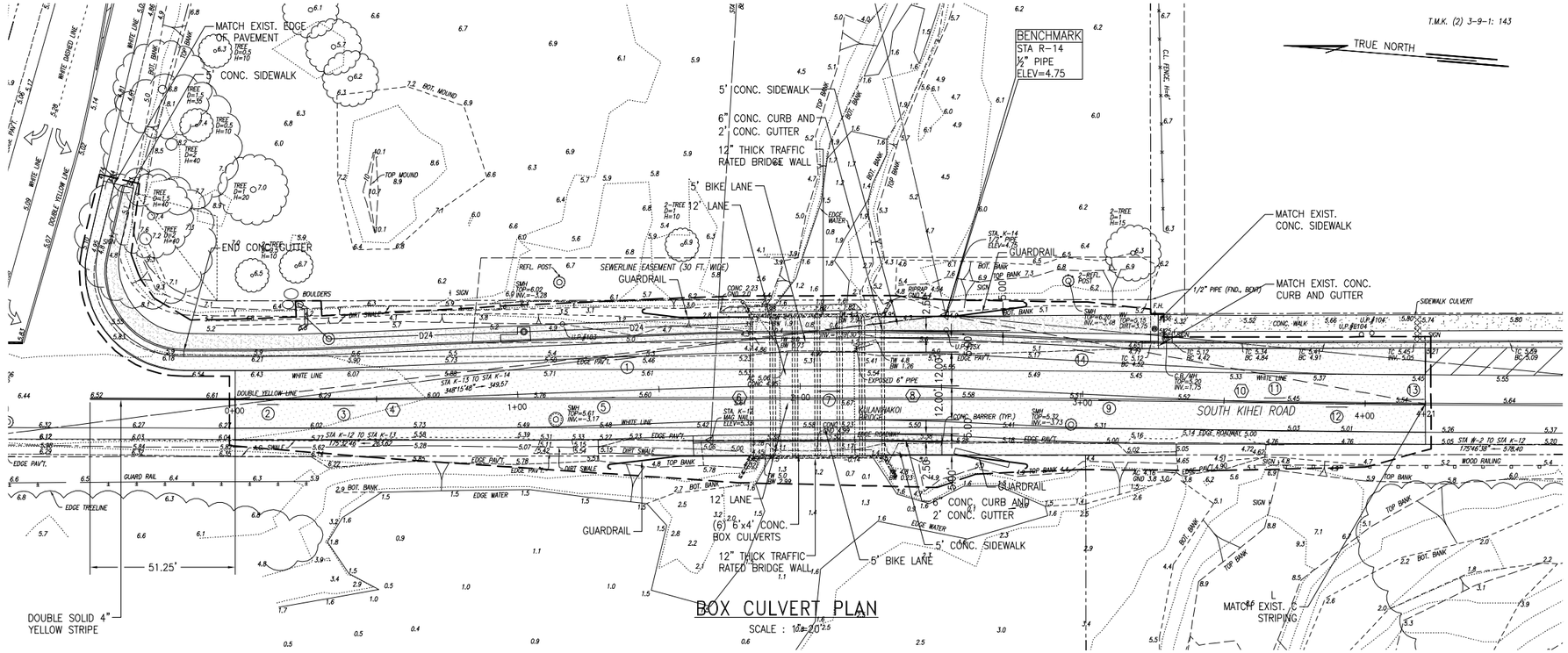

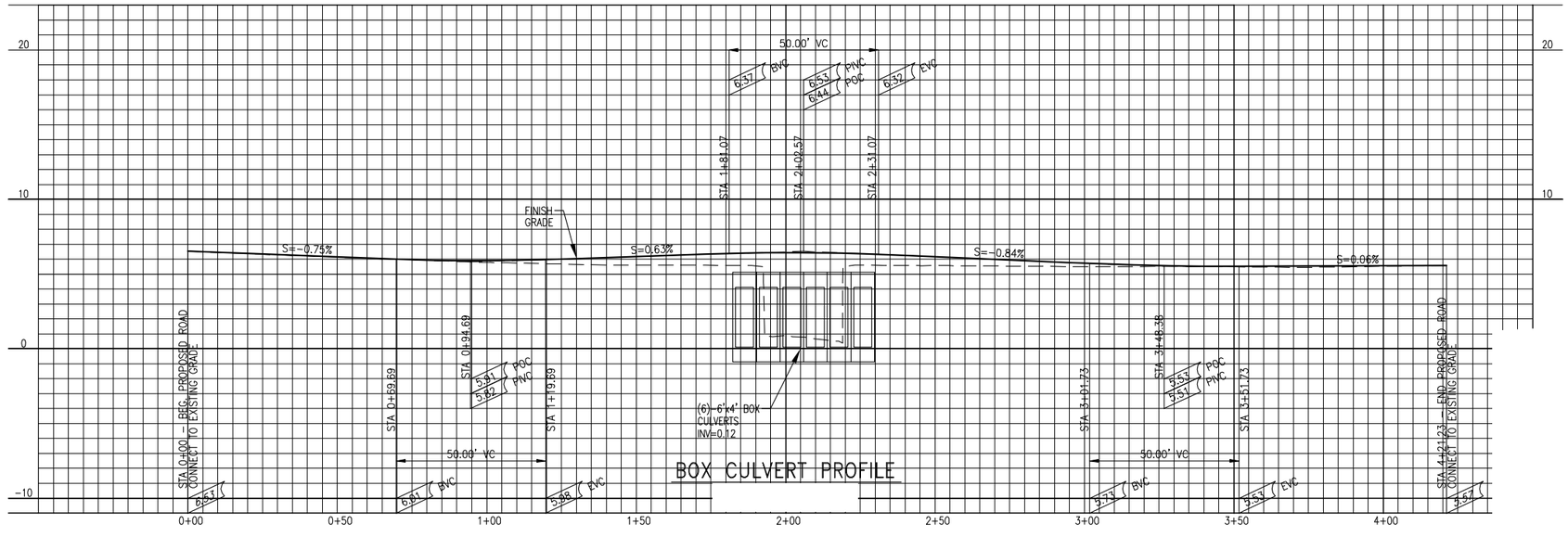

GRAPHIC SCALE

4' 2' 0 4' 8'

20' 10' 0 20' 40'

LEGEND

NEW A.C. PAVEMENT

NEW CONCRETE PAVEMENT OR WALKWAY

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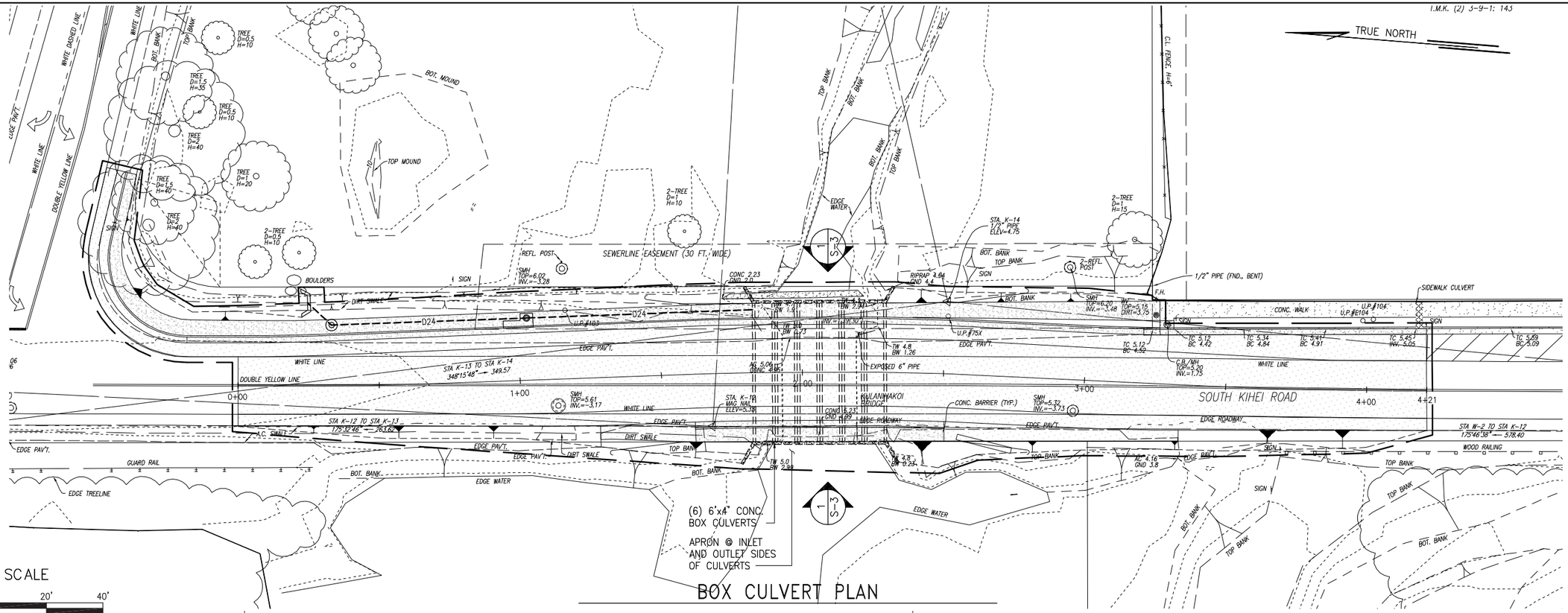
KULANIHAKOI BRIDGE REPLACEMENT

BOX CULVERT PLAN AND PROFILE

FIGURE 2-2

I.M.K. (2) 3-9-1: 143

TRUE NORTH

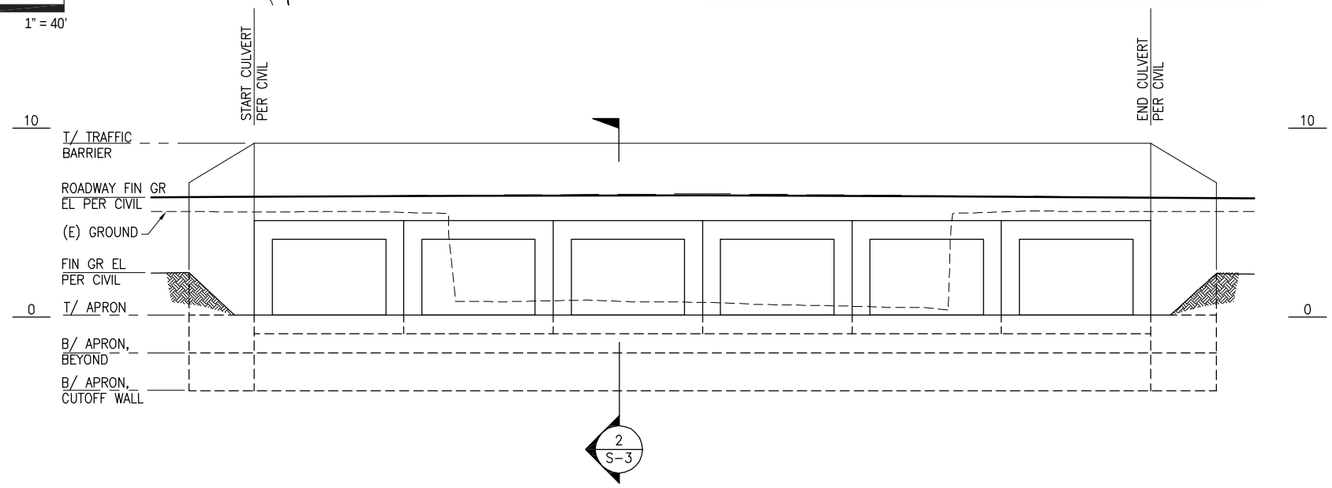


BOX CULVERT PLAN

GRAPHIC SCALE

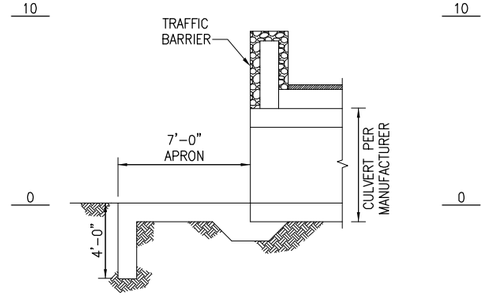
20' 10' 0 20' 40'

SCALE: 1" = 40'



1 S-3 WALL ELEVATION

SCALE: 1/4"=1'-0"



2 S-3 SECTION

SCALE: 1/4"=1'-0"

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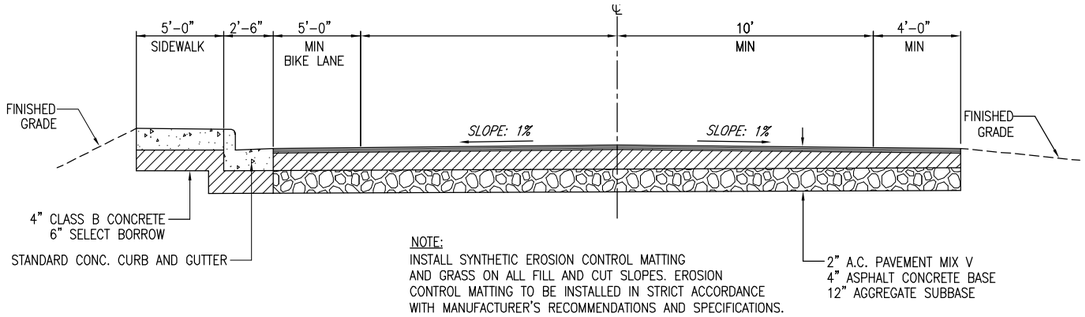
KULANIHAKOI BRIDGE REPLACEMENT

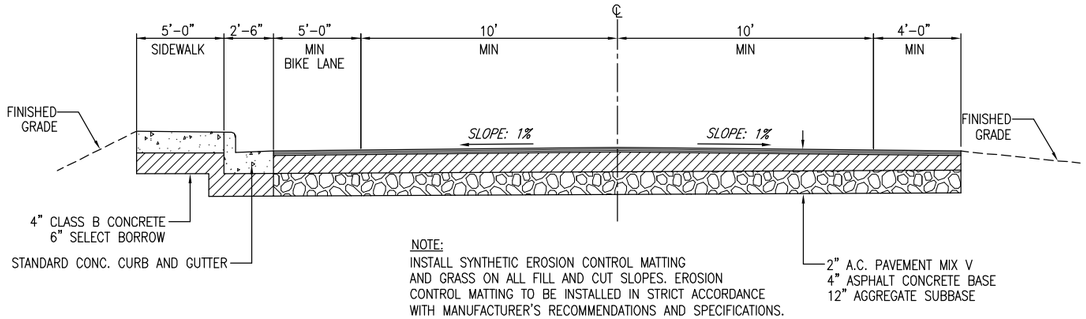
BOX CULVERT PLAN

FIGURE 2-3



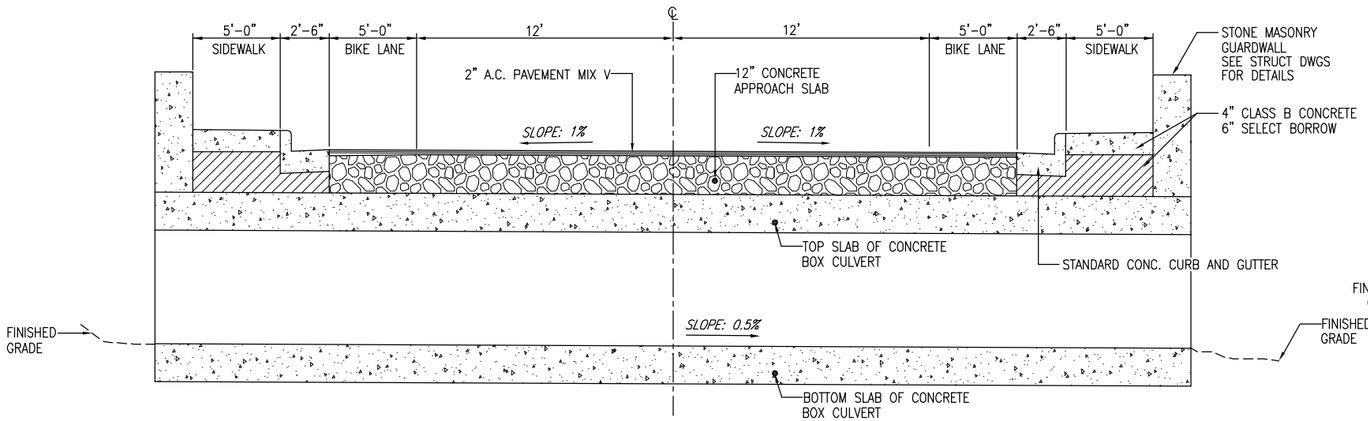
A C–3 **TYPICAL SECTION - ROAD SECTION STA. 0+00 TO 1+82.37**

NOT TO SCALE



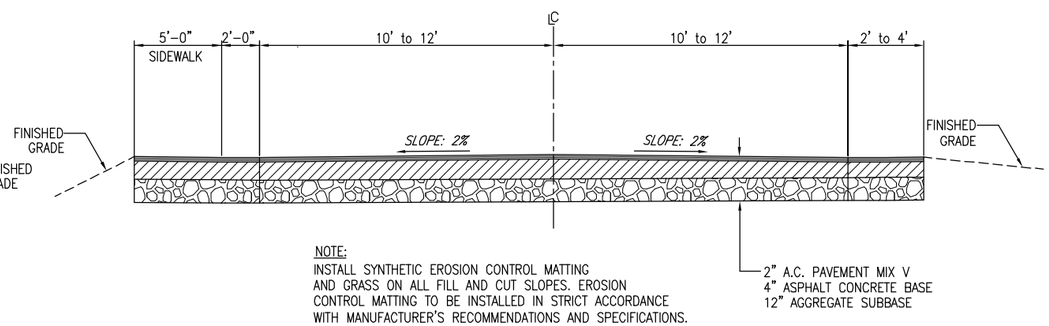
C C–3 **TYPICAL SECTION - ROAD SECTION STA. 2+29.77 TO 4+21.23**

NOT TO SCALE



B C–3 **TYPICAL SECTION - ROAD SECTION STA. 1+82.37 TO 2+29.77**

NOT TO SCALE



D C–3 **TYPICAL SECTION - BYPASS ROAD SECTION STA. 0+00 TO 1+98.53 AND ROAD SECTION STA. 2+68.53 TO 4+32.34**

NOT TO SCALE

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KULANIHAKOI BRIDGE REPLACEMENT

TYPICAL SECTIONS

FIGURE 2-4

Widening of the roadway will also require the relocation of two (2) electrical utility poles as the poles are currently located in the area planned for the paved walkway. The poles will be relocated near their existing location, but closer to the mauka edge of the road right-of-way. The relocation of the electrical poles will be coordinated with the Maui Electric Company (MECO) prior to construction.

In addition, as the new culverts extend farther across South Kīhei Road than the existing culverts, a portion of an existing 12-inch waterline located on the mauka side of the existing bridge will need to be relocated under the new culverts. The relocated waterline is proposed to be encased in a concrete jacket.

During construction of the replacement bridge, that portion of South Kīhei Road would not be usable. Thus, prior to the removal of the existing culverts and the construction of the replacement bridge, a temporary bridge and bypass road will need to be constructed on the mauka side of the existing bridge to accommodate traffic along South Kīhei Road during construction. Construction of the temporary bridge and bypass road is described below (see Figure 2-5 and Figure 2-6).

The temporary steel panel bridge and bypass road will be constructed on the mauka side of the existing bridge. The temporary bridge will be approximately 31-feet wide and span approximately 70-feet over the drainageway. The steel panels on each side of the bridge are approximately 3.5-feet wide, leaving enough room to accommodate two, 12-foot travel lanes, one in each direction. The mauka side of the temporary bridge will include a 5-foot wide suspended walkway (see Figure 2-7). Prior to construction of the temporary steel bridge, an area on both sides of the temporary bridge will need to be cleared and excavated to construct the concrete footings that will support the temporary bridge. The area of the footings would not exceed 20-feet by 38-feet on each side of the bridge. The depth of excavation is expected to exceed 3.5-feet. The bridge will be assembled in sections off-site and trucked over to the project site for installation.

Construction of the temporary bypass road on both sides of the temporary bridge will also include two, 12-foot travel lanes, one in each direction and a temporary 5-foot wide temporary sidewalk on the mauka side of the roadway (refer back to Figure 2-4). The route of the bypass road is currently undeveloped and covered with vegetation that would need to be removed prior to roadway construction (refer back to Figure 2-1). In addition, the slope of the ground in this area varies slightly and will require cut and fill activities to create a level area for the temporary road.

After completion of the permanent culvert improvements, the temporary bridge and bypass road would be removed.

It should be noted that there is another set of temporary bridge improvements being proposed as an emergency temporary repair. This was prompted by the March 2012 County of Maui Bridge Inspection Report which showed accelerated deterioration of the existing culverts. The report recommends that immediate repairs or shoring of the top slab of the existing bridge be implemented to eliminate the risk of possible collapse of the existing culverts due to vehicles traversing over it. Therefore, in response to this recommendation,

while waiting for the new bridge to be constructed, the DPW has decided to construct an emergency temporary steel bridge over the existing culverts to avoid such risk.

This has been prompted by the accelerated deterioration of the existing bridge as well as the projection that design, permitting, and construction for the temporary bridge and bypass road mauka of the existing bridge is not expected to be completed until 2015 assuming all applicable approvals are obtained. An emergency temporary bridge over the road is less complicated regarding permitting and can be constructed by 2013. Because of the need to expedite construction of the emergency temporary bridge over South Kīhei Road, a Special Management Area (SMA) Assessment has been granted on March 4, 2013. However, since the construction of the replacement bridge will need sufficient space for the new culverts to be installed by crane, the temporary bridge and bypass road on the mauka side of the existing bridge would still be necessary. Once the temporary bridge and bypass road mauka of the existing bridge is constructed, the emergency temporary bridge over the existing culverts would be disassembled and removed.

It is noted that the project involves the installation of six (6) new culverts rather than four (4) culverts as the six (6) culverts will provide an incremental increase in drainage capacity from approximately 204 cfs to 306 cfs (assuming the outlet is not blocked) while still remaining feasible. However, ocean wave action results in sand plugs of varying heights and sizes which blocks the ocean outlet. When substantial storm flows occur, this may be sufficient to open the plug. However, it is noted that the drainageway immediately mauka of the proposed project is relatively flat and undefined. Thus, substantial storm flows overtop the relatively flat drainageway and provides a limitation to provision of greater additional capacity. Moreover, the existing built environment provides limitations on increasing drainage volume horizontally and vertically under South Kīhei Road. While the proposed project does slightly increase drainage capacity and decrease flood risk, it is not intended to address flooding issues on a regional basis.

2.3 Project Cost and Schedule

Construction of the proposed project is anticipated to commence by the first quarter of 2015, with completion approximately nine (9) months later. The project cost is estimated at $3.6 million, which will be funded by the County and FHWA.

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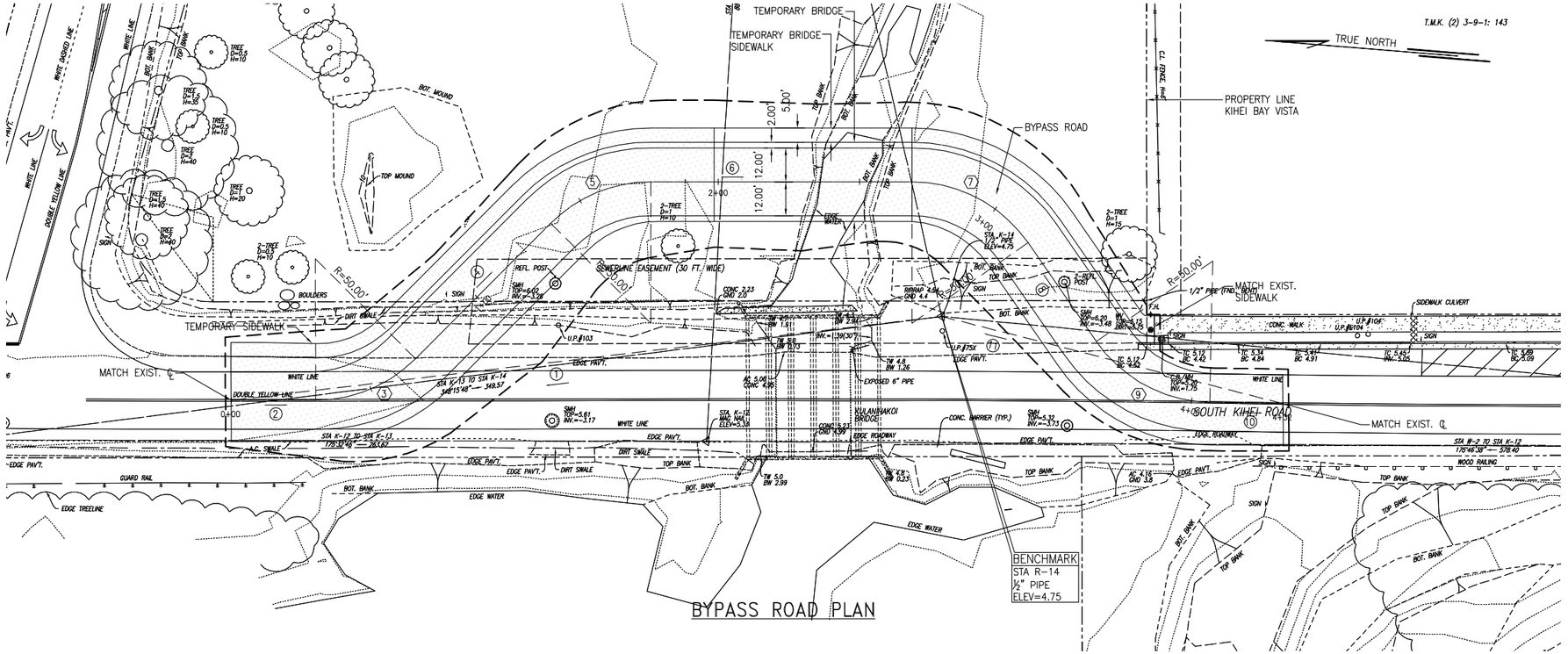

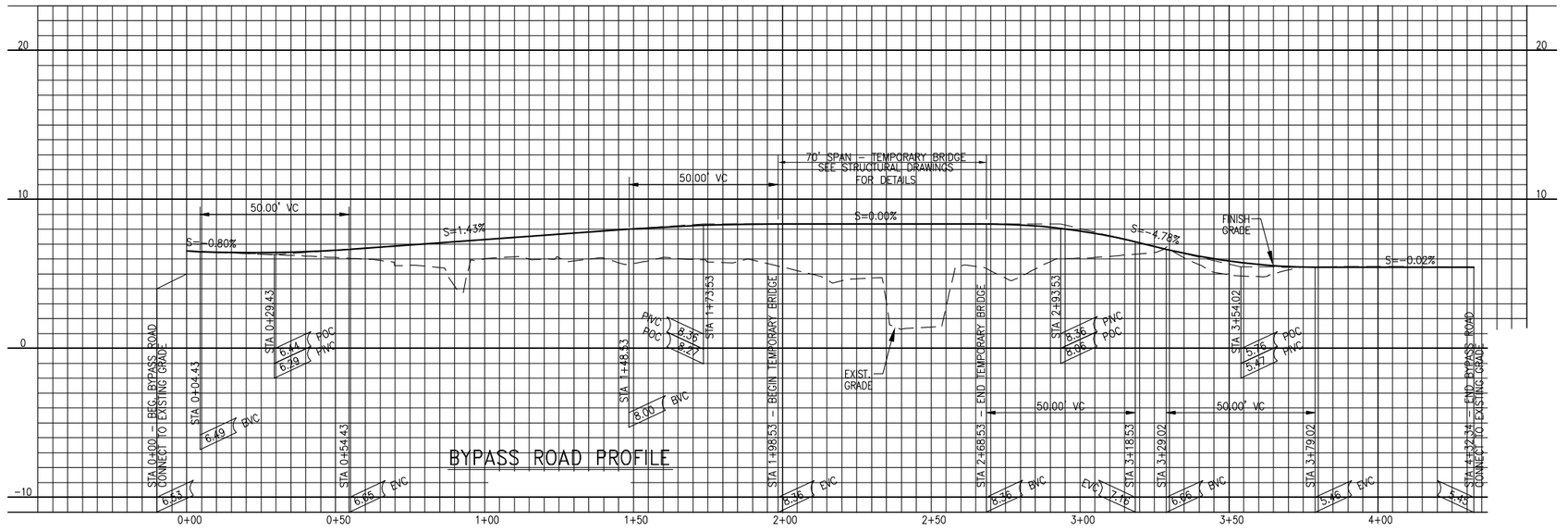

GRAPHIC SCALE

4' 2' 0 4' 8'
SCALE: 1"=4'

20' 10' 0 20' 40'
SCALE: 1"=20'

LEGEND

NEW A.C. PAVEMENT

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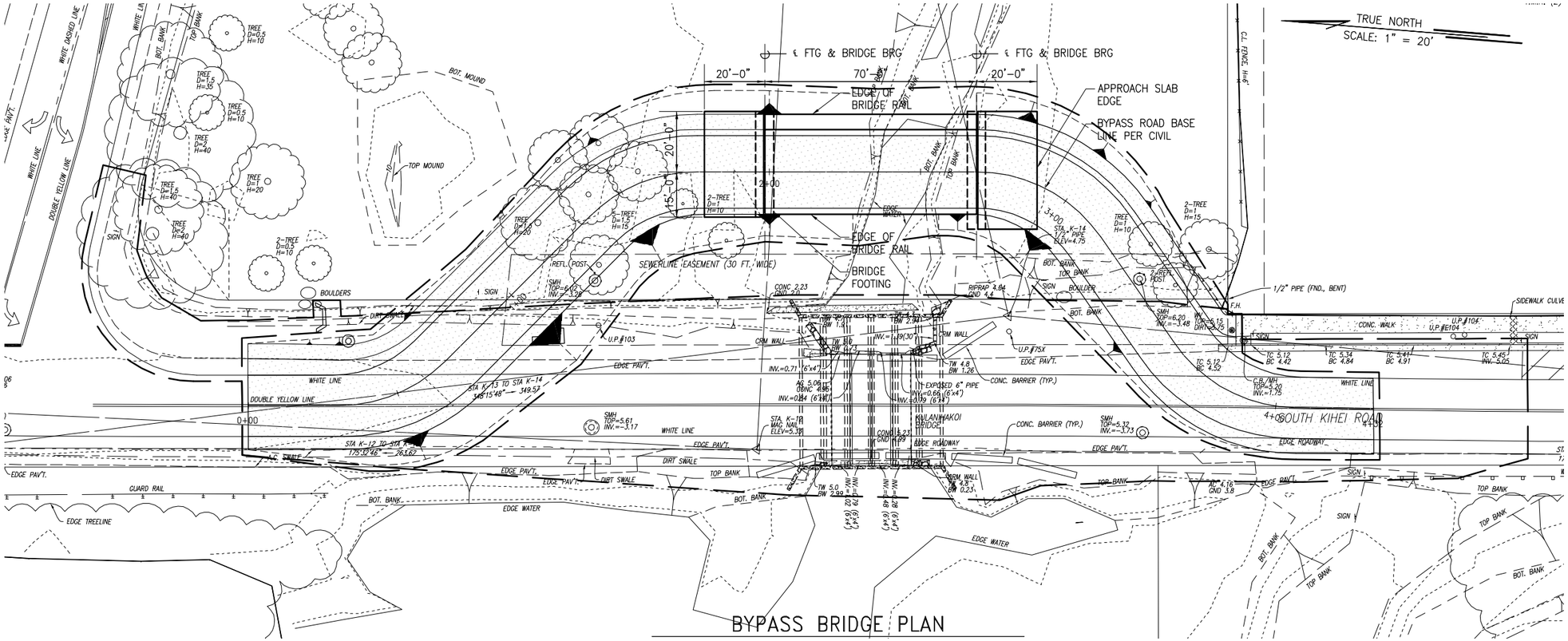
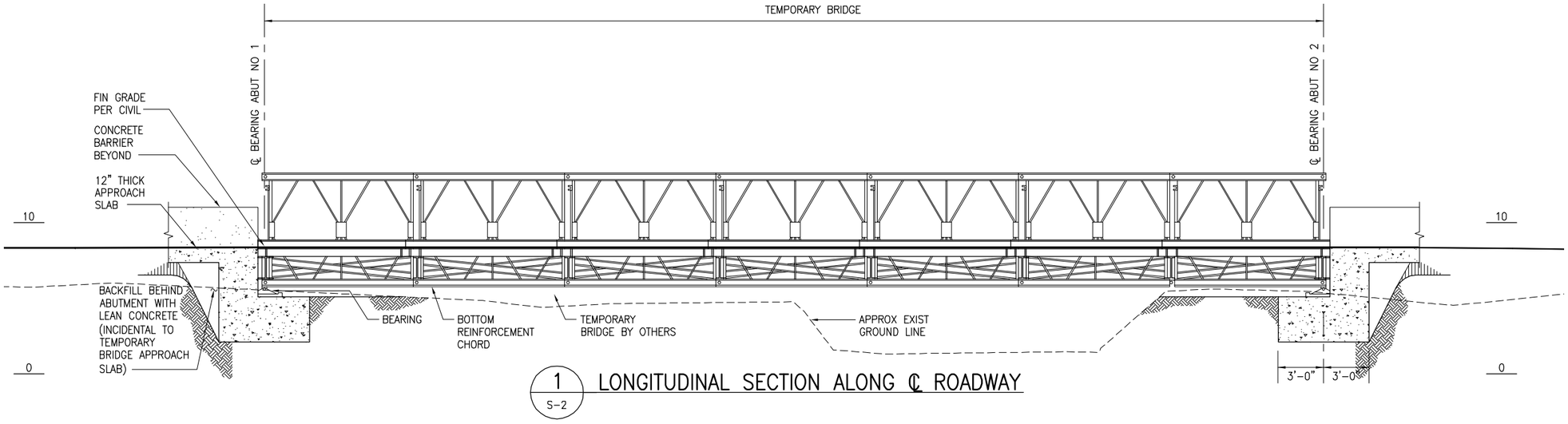
KULANIHAKOI BRIDGE REPLACEMENT

BYPASS ROAD PLAN AND PROFILE

FIGURE 2-5

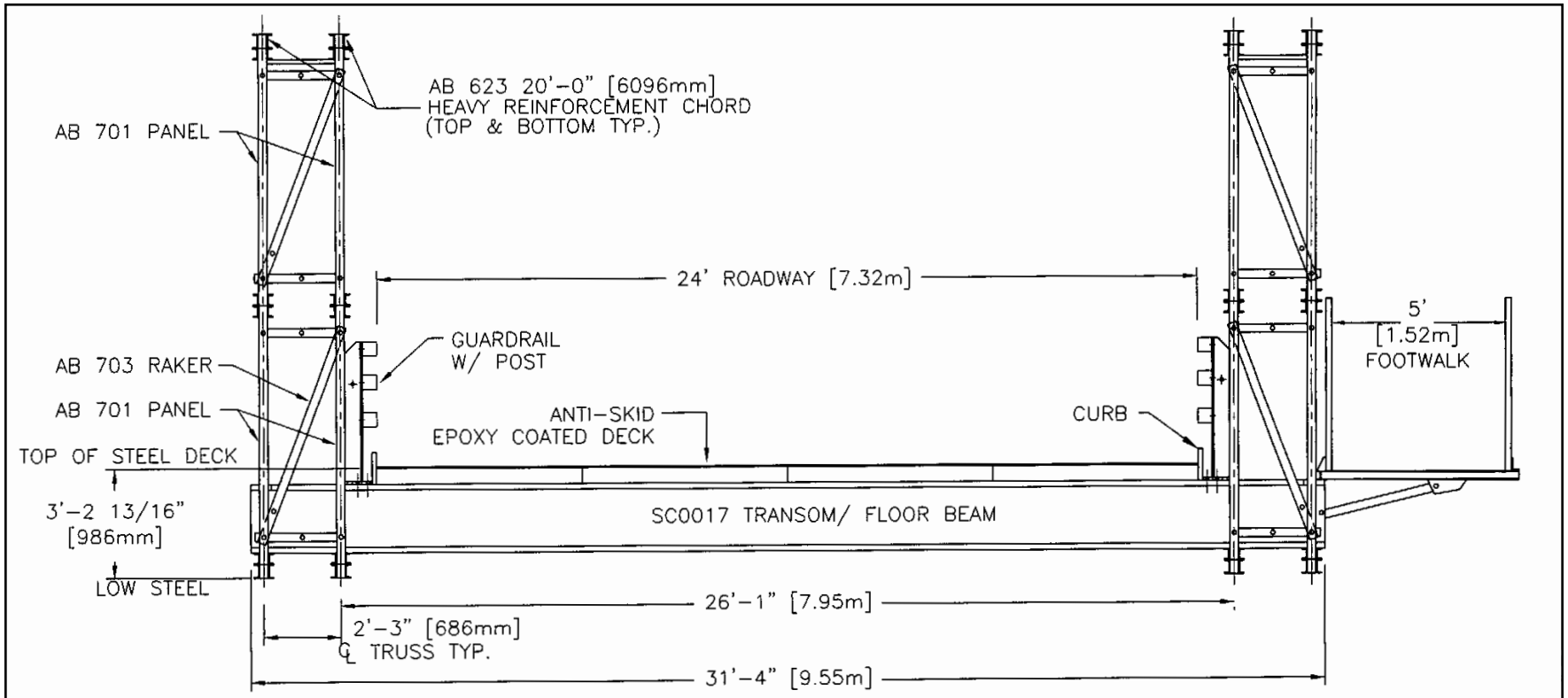




KULANIHAKOI BRIDGE REPLACEMENT

BYPASS ROAD PLAN AND LONGITUDINAL SECTION

FIGURE 2-6



BRIDGE CROSS SECTION

SCALE: 1:50

APPR. | BY | DESCRIPTION | DATE | NO.

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DRAWN BY RJ	DATE JUNE 6 2007	CONTRACT NO.	
CHECKED BY ES	SCALE: N.T.S.		
APPROVED BY ES		DRAWING NO. PROPOSAL	REV.
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KULANIHAKOI BRIDGE REPLACEMENT

TEMPORARY BRIDGE CROSS SECTION VIEW

FIGURE

2-7

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3. DESCRIPTION OF EXISTING ENVIRONMENT, IMPACTS, AND MITIGATION MEASURES

3.1 Climate

Maui's climate varies by terrain but is relatively uniform year round with mild temperatures, moderate humidity, and relatively consistent northeasterly trade winds. Regional topography and climatic conditions attribute to a variety of micro-climates found across the island. The project site is located in the semi-arid Kīhei-Mākena region.

The mean annual temperature of the island of Maui, near sea level, is approximately 75 degrees Fahrenheit (°F). The Kīhei coast is known to be sunny, warm, and dry throughout the year. Annual temperatures for the Kīhei region average in the mid to high 70s. During the summer months and dry season, average daily temperatures in Kīhei range from 77.0°F to 77.6°F.

Average rainfall distribution in the Kīhei-Mākena region varies from under 10 inches per year along the coastline to more than 20 inches per year in the higher elevations. Rainfall in the Kīhei-Mākena region is highly seasonal with most of the precipitation occurring during the winter months. Trade winds out of the northeast average 10 to 15 miles per hour (mph) in the Kīhei-Mākena region during the afternoon. Typically, lighter winds are felt during the morning and evening. Storms are infrequent and generally occur during the winter months in Hawai'i, although tropical storms and hurricanes occasionally approach the island between June and November.

Impacts and Mitigation Measures

No significant impacts on climate in the project area are anticipated. Construction and operation of the proposed project are not anticipated to affect temperatures, wind, or rainfall levels in the project area.

3.2 Physiography

3.2.1 Geology and Topography

The Island of Maui was formed by the merging of two volcanoes, Haleakalā, and the West Maui Mountains. The merging of these volcanoes created the second largest island in the Hawaiian island chain. Dominating East Maui, Haleakalā is a dormant volcano rising 10,025 feet above sea level. The western and northern slopes are relatively smooth but are sloping to moderately steep. The land is rough and rocky near the summit of Haleakalā Crater and on the eastern and southwestern slopes. The West Maui Mountains are a deeply dissected volcano rising 5,788 feet. Canyons and steep ridges comprise the central area of West Maui making it not easily accessible.

The project site is located near the makai terminus of Kūlanihāko'i Gulch, a major geomorphic feature along the south slope of Haleakalā. The drainage watershed which feeds into Kūlanihāko'i Gulch starts at the approximately 9,600 foot elevation near the summit of Haleakalā. The southwestern slope of Haleakalā is characterized by widely spaced erosional gullies. While slopes can be quite extreme at upper elevations, the project site is located within the relatively flat coastal plain. The elevation of South Kīhei Road at the project site is approximately 5.5 feet above sea level. The inverts of the existing culverts

range from between sea level to 1 foot above sea level. Immediately upstream and downstream of the culverts, the invert of the drainageway usually holds standing water. The elevations of the swale in the immediate vicinity range from 0.5 to 1.6 feet above sea level. Downstream of the swale, a sand plug is formed by wave action. Elevations may range between 0.5 to 4.5 feet. This may be quite variable depending on wind and wave action.

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts on geology or topography are anticipated during construction or operation of the proposed project. Construction of the proposed project will require cut and fill activities for grading and excavations for the new culverts as well as the road widening. None of the proposed cuts involve further excavation into the dune system on the makai side of the bridge. Grading within the project site will slightly alter the existing topography, however, graded and excavated areas will be backfilled to restore the topography similar to existing conditions.

3.2.2 Soils

According to the U.S. Department of Agriculture, Natural Resource Conservation Service, soils within the project site are classified as Dune Land (DL) and Keālia Silt Loam (KMW) (see Figure 3-1).

Dune Land (DL) consists of hills and ridges of sand-size particles drifted and piled by wind. The hills and ridges are actively shifting or are so recently fixed or stabilized that no soil horizons have developed. The sand is dominantly coral and seashells with elevations ranging from seal level to 150 feet.

Keālia Silt Loam (KMW) consists of deep, poorly drained soils that formed in alluvium. Keālia soils are on nearly level coastal flats that are affected by a fluctuating salt water table and can be found in elevations ranging from sea level to 10 feet. Ponding occurs in low areas after heavy rain and when the soil dries, salt crystals form on the surface. Slope of the soil varies between 0 to 1 percent. Permeability is moderately rapid. Hazard of water erosion is slight, but can be severe when dry and windy.

A Dune Investigation Report was prepared by Sea Engineering, Inc. in August 2012 to determine the location of the coastal dune in relation to the project site to comply with the Maui County Grading Ordinance Section 20.08.035 (I) which prohibits the grading of coastal dunes. The report is included in Appendix A and is summarized below.

The County ordinance defines a coastal dune as "one of possibly several continuous or nearly continuous mounds or ridges of unconsolidated sand contiguous and parallel to the beach, situated so that it may be accessible to storm waves and seasonal high waves for release to the beach or offshore waters." Thus, there are three main criteria that are used to establish the presence or limits of a dune: unconsolidated sandy soil, a mound or ridge formation, and the possible reach of storm or seasonal high waves.

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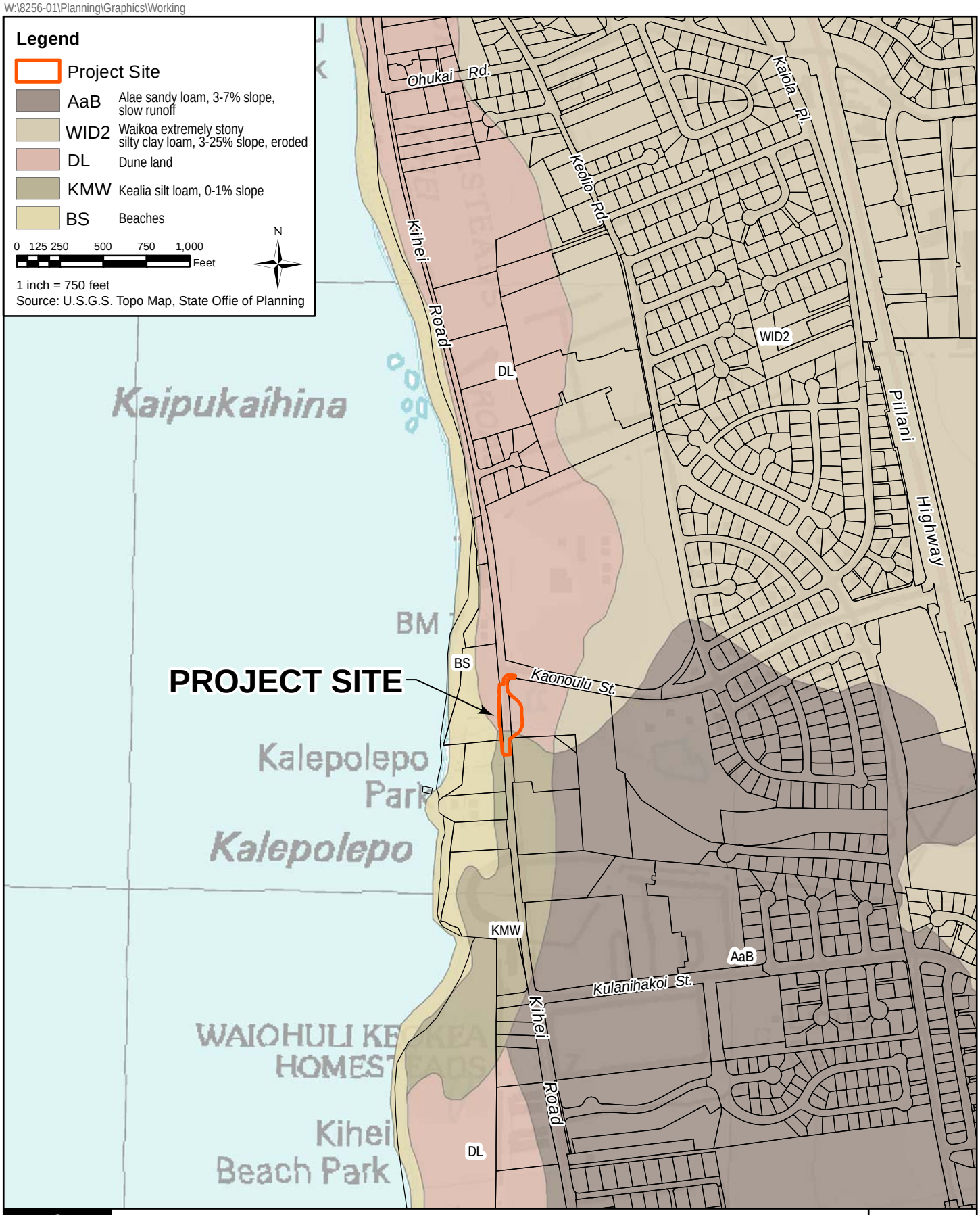

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KULANIHAKOI BRIDGE REPLACEMENT

SOIL SURVEY MAP

FIGURE 3-1

However, the limits of a coastal dune may not always be definitive. Sometimes there is no clearly defined break in slope, sometimes the terrain is obscured by heavy underbrush, or there may be several lines of dunes. In heavily used areas the coastal dune structure can be obscured by terrain alteration due to vehicle or foot traffic, or by previous grading and construction activities.

Kūlanihāko'i Gulch is an intermittently flowing stream channel, which during heavy rains erodes a stream channel through the beach and discharges runoff waters into the ocean. When the rain stops, and flow ceases, a beach berm reforms in front of the stream, and a muliwai typically forms. A muliwai is the Hawaiian word for brackish water pools near the mouths of streams created by seasonal barriers of sand or sediment. The muliwai and stream channel occupy the zone immediately seaward of the bridge and road for a distance of approximately 160 feet north and 130 feet south of the bridge. When the stream is not flowing, a visible low elevation swale is present in the beach and backshore marking the location of the channel. Seaward of Kūlanihāko'i Bridge is Kalepolepo Beach, a sand beach approximately 750 feet long extending from the revetment fronting the Maui Lu Hotel in the north, to the Kalepolepo Fishpond in the south.

Dune formation is active in this area as the prevailing tradewinds are modified by the local effects of Haleakalā and blow strongly from the northwest in the afternoons, transporting dry beach sand inland. Coastal dunes up to 16 feet high are present to the north and the south of the stream channel/swale.

The north coastal dune lies seaward of the muliwai, and forms the north side of the stream channel. The landward limit of the north dune is located at the base of the slope along the seaward waterline of the muliwai. The south dune forms the south side of the stream channel. The landward limit of the south dune follows the south edge of the stream channel/swale, and then along the edge of South Kīhei Road to the south. The edges of the dunes are illustrated by the red lines in Figure 3-2. A beach berm lies between the dunes and stream channel, and the ocean.

Impacts and Mitigation Measures

Construction activities will involve land-disturbing activities, such as grubbing, clearing, grading, and excavation that may result in some soil erosion and potential construction-related impacts to the quality of surface and coastal waters in the greater project vicinity. Various mitigative measures will be incorporated into the project's construction plan to minimize soil disturbances and potential short-term erosion impacts during construction activities. Excavation and grading activities associated with construction of the proposed improvements will be regulated by the County's grading ordinance.

A Department of the Army (DOA) Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a Water Quality Certification (WQC), issued by the State Department of Health (DOH), pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a best management practices (BMP) plan will be prepared for construction activities within the project site.

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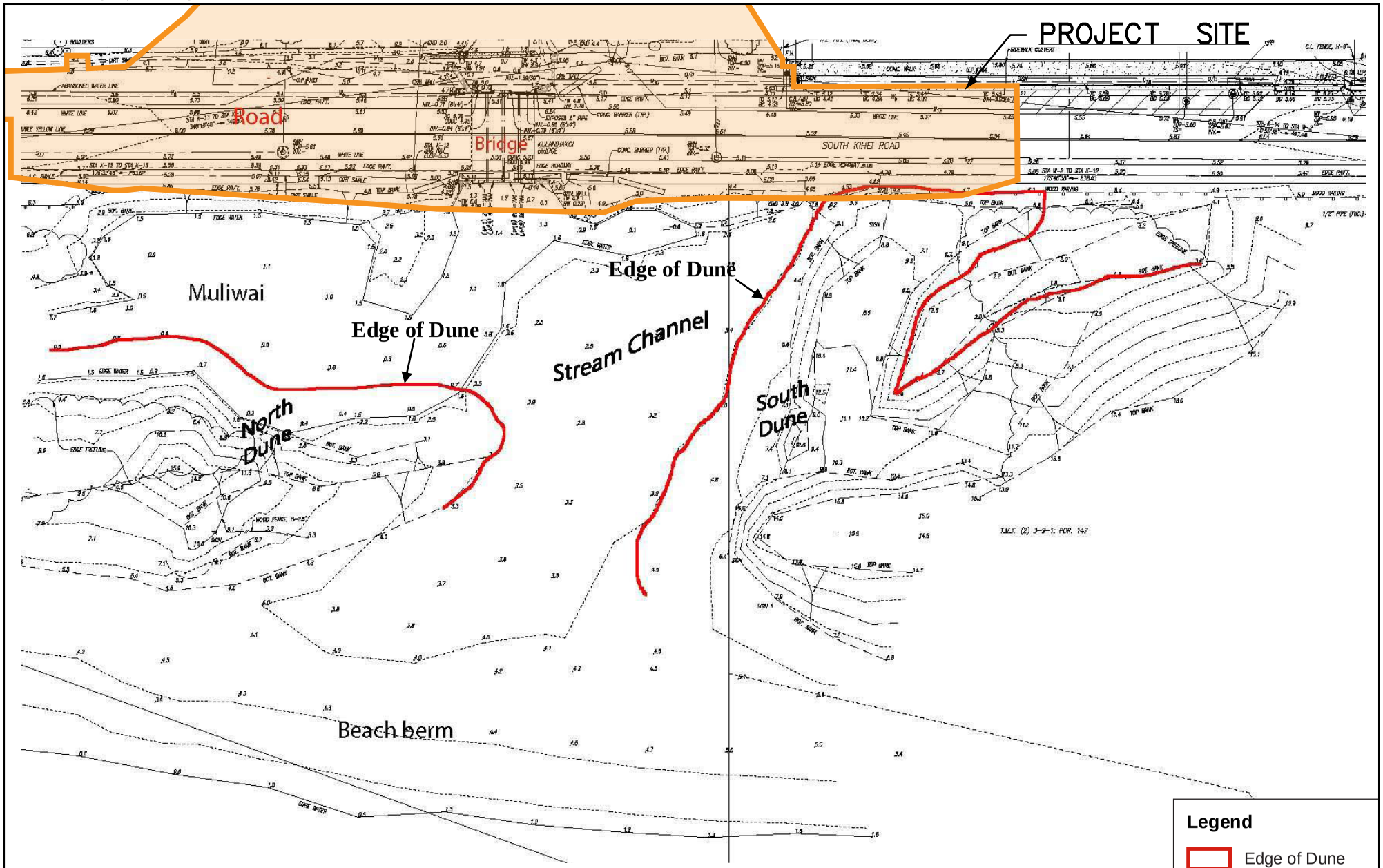

Topographic Map of the Project Site Showing Coastal Morphologies and the Edge of the Dunes.

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KULANIHAKOI BRIDGE REPLACEMENT

DUNE DELINEATION MAP

FIGURE
3-2

Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms.

Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, a National Pollutant Discharge Elimination System (NPDES) Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

Based on the findings of the dune study, the proposed limits of construction of the project do not extend to the coastal sand dune, as defined by the County grading ordinance.

3.3 Hydrology

3.3.1 Surface Water

The project site traverses near the Kūlanihākoʻi Gulch ocean outlet. The Kūlanihākoʻi Gulch originates at the 9,600 foot elevation contour near summit of Haleakalā, extending downslope and westward approximately 16-miles to its Pacific Ocean outlet adjacent to Kalepolepo Beach Park on Māʻalaea Bay. At the project site, the gulch is a broad, flat open area with minimal relief and a substratum of dark sand.

Surface water is present at the project site where the outlet is blocked by a deposit of sand (Kalepolepo Beach), forming a muliwai (brackish water pond or estuary) extending inland through the project site. For the majority of the time, this area of the gulch is permanently wet, estuarine, and tidal.

A Water Quality and Biological Survey for the project site was prepared by AECOS Inc. in March 2013. The survey extended from 115 feet upstream of South Kīhei Road to just offshore of Kalepolepo Beach. The Water Quality and Biological Survey is included as Appendix B and a summary of the water quality findings are summarized below.

Based on the Water Quality Survey, it was determined that the brackish gulch waters near the project site were nutrient, sediment, and chlorophyll laden, relative to State of Hawaiʻi water quality criteria for estuaries. The results indicate that generally poor water quality conditions were present during the survey, however, it is not an unusual situation for a muliwai.

Kūlanihākoʻi Gulch appears on the DOH, 2012 list of impaired waters in Hawaiʻi, prepared under the Clean Water Act. The listing indicates that the water body may not meet State of

Hawai'i water quality criteria for estuaries. The estuary is listed as impaired for total nitrogen, nitrate+nitrate, turbidity, and chlorophyll. It has been assigned a low priority for total Maximum Daily Load (TMDL) studies.

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts on surface waters in the project vicinity are anticipated during construction or operation of the proposed project as the proposed project is not anticipated to adversely affect the already poor water quality of the muliwai at the site.

A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms.

In addition, the proposed project will also require a DOA permit pursuant to Section 10 of the Rivers and Harbors Act of 1899, which regulates work within, over and beneath navigable waters of the U.S.

Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

3.3.2 Wetlands

According to the Water Quality and Biological Study prepared by AECOS Inc. in March 2013 (refer to Appendix B), the U.S. Fish and Wildlife Service (USFWS), National Wetland Inventory (NWI) ;"Wetlands Mapper" shows the area of the muliwai classified as PUBHh: diked or impounded, permanently flooded, freshwater wetland (palustrine) with unconsolidated (sand or mud) bottom; and a much larger area extending to the south thorough several resort complexes as PEM1C: seasonally flooded freshwater wetland with persistent emergent vegetation. The AECOS study updates these findings.

The AECOS study found that the muliwai should be classified as E1UB2: estuarine subtidal with sand bottom; as the area is not "dike" or unnaturally impounded. In addition, the wetland corresponding to the area in the NWI as PEM1C is no longer present as the area is now a fully developed landscape.

The study also attempted to delineate the wetland boundary using soil sampling and certain species of vegetation as key indicators of a wetland environment. However, the vegetation in the project area is limited and its use as an indicator problematic because the area is a part of a native plant restoration project where the "natural" distribution of pickleweed (*Batis maritima*) has been removed and the native 'ākulikuli encouraged to thrive. 'Ākulikuli is considered a facultative wetland species that is nearly always found around the margins of coastal wetlands in sand material. Consequently, the area surveyed, with the exception of the muliwai, is difficult to demarcate as a wetland.

There are two possible wetland delineations for the project area. The first is based on the acceptance that the soils and plants found at the project site are generally indicative of a coastal wetland, and therefore the boundary of the 'ākulikuli demarcates the wetland area. The second is based on the acceptance that the soils and plants are not natural and have been affected by the native plant restoration efforts in the area, therefore they are not good indications of a wetland and thus the clearest boundary is that of the muliwai shore.

Impacts and Mitigation Measures

In the long-term, no significant impacts to wetland resources associated with the project site are anticipated during construction or operation of the proposed project.

During construction, as it is difficult to demarcate the boundary of the wetland, the area of the proposed bypass road through the two different wetland boundaries would be on the order of 600 square feet (muliwai only) to 4,600 square feet (dune sand dominated by 'ākulikuli).

A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be required for the proposed project. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site-specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

Following construction, the wetland area is proposed to be restored to its existing conditions.

3.3.3 Groundwater

The State Department of Land and Natural Resources (DLNR), Commission on Water Resource Management (CWRM) has established a groundwater hydrologic unit and coding

system for groundwater resource management. The proposed project site is located within the Central Aquifer Sector Area which is comprised of four (4) Aquifer System Areas identified as Kahului, Pā'ia, Makawao, and Kam'aole. The project site is located within the Kama'ole Aquifer System (60304) area which is a regionally extensive brackish aquifer extending from North Kīhei to Mākena. The Kama'ole Aquifer System yields 11 million gallons per day (mgd).

Impacts and Mitigation Measures

In the short- or long-term, no significant impacts to groundwater resources associated with the project site are anticipated during construction or operation of the proposed project. Construction activities are not likely to introduce to, nor release from the soil any materials which could adversely affect groundwater. Construction material wastes will be appropriately disposed of to prevent leaching.

3.3.4 Coastal Waters

The nearest coastal water offshore of the project site is Mā'alaea Bay, located approximately 0.05-miles west of the project site. Pursuant to Hawai'i Administrative Rules (HAR) Title 11, Chapter 54, Water Quality Standards, the coastal waters in the vicinity of the project site are classified as Class A marine waters. Class A marine waters are recognized as waters to be used for "recreational purposes and aesthetic enjoyment to be protected. These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class".

A Water Quality and Biological Survey report was prepared by AECOS Inc. in March 2013 for the proposed project site (refer to Appendix B). In addition to surveying the water quality of Kūlanihāko'i Gulch, coastal waters directly offshore of Kalepolepo Beach were also surveyed. It was determined that the coastal waters fronting Kūlanihāko'i Gulch may also be impaired. The water quality, as monitored by DOH Station Kalepolepo Beach (ID H10002141), just south of the gulch mouth is reported as impaired for total nitrogen, nitrate+nitrage, ammonia, turbidity, and chlorophyll. Water quality data from 2008 to present show that marine waters fronting the gulch were nutrient, sediment, and chlorophyll laden, well oxygenated and had a pH near 8.10.

Impacts and Mitigation Measures

No short- or long-term significant impacts on coastal waters in the project vicinity are anticipated during construction or operation of the proposed project.

Construction activities will involve land-disturbing activities, such as grubbing, clearing, grading, and excavation that may result in some soil erosion and potential construction-related impacts to the quality of surface and coastal waters in the greater project vicinity. Various mitigative measures will be incorporated into the project's construction plan to minimize soil disturbances and potential short-term erosion impacts during construction activities. Excavation and grading activities associated with construction of the proposed improvements will be regulated by the County's grading ordinance.

A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be

required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms.

Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

In the long-term, as the proposed culverts will be constructed at a 0.5% slope, the drainage capacity will increase slightly from essentially 204 cfs to 306 cfs. In the event of a 100-year storm, this increase in capacity will increase the likelihood of storm flows breaking through the sand plug. This could slightly relieve some of the upstream flooding, but may slightly increase flows past the sand plug.

3.4 Natural Hazards

3.4.1 Flood and Tsunami Hazard

According to the Flood Insurance Rate Map (FIRM) (Community Panel Numbers 1500030586F and 1500030567F, Effective Date: September 19, 2012) prepared by the Federal Emergency Management Agency (FEMA), the project site is designated Zone VE and Zone AE (see Figure 3-3).

Zone VE includes areas with a 1% or greater change of flooding and have an additional hazard associated with storm waves. In general, these areas have a 26% chance of flooding over the life of a 30-year mortgage.

Zone AE is characterized as a "special flood hazard area subject to inundation by the 1% annual chance flood." Zone AE is also a "floodway," in which "the channel of the stream plus any adjacent floodplain areas that must be kept free of the encroachment so that the 1% annual chance flood can be carried without substantial increases in flood height." The 1% annual flood is also commonly referred to as the 100-year flood or the base flood.

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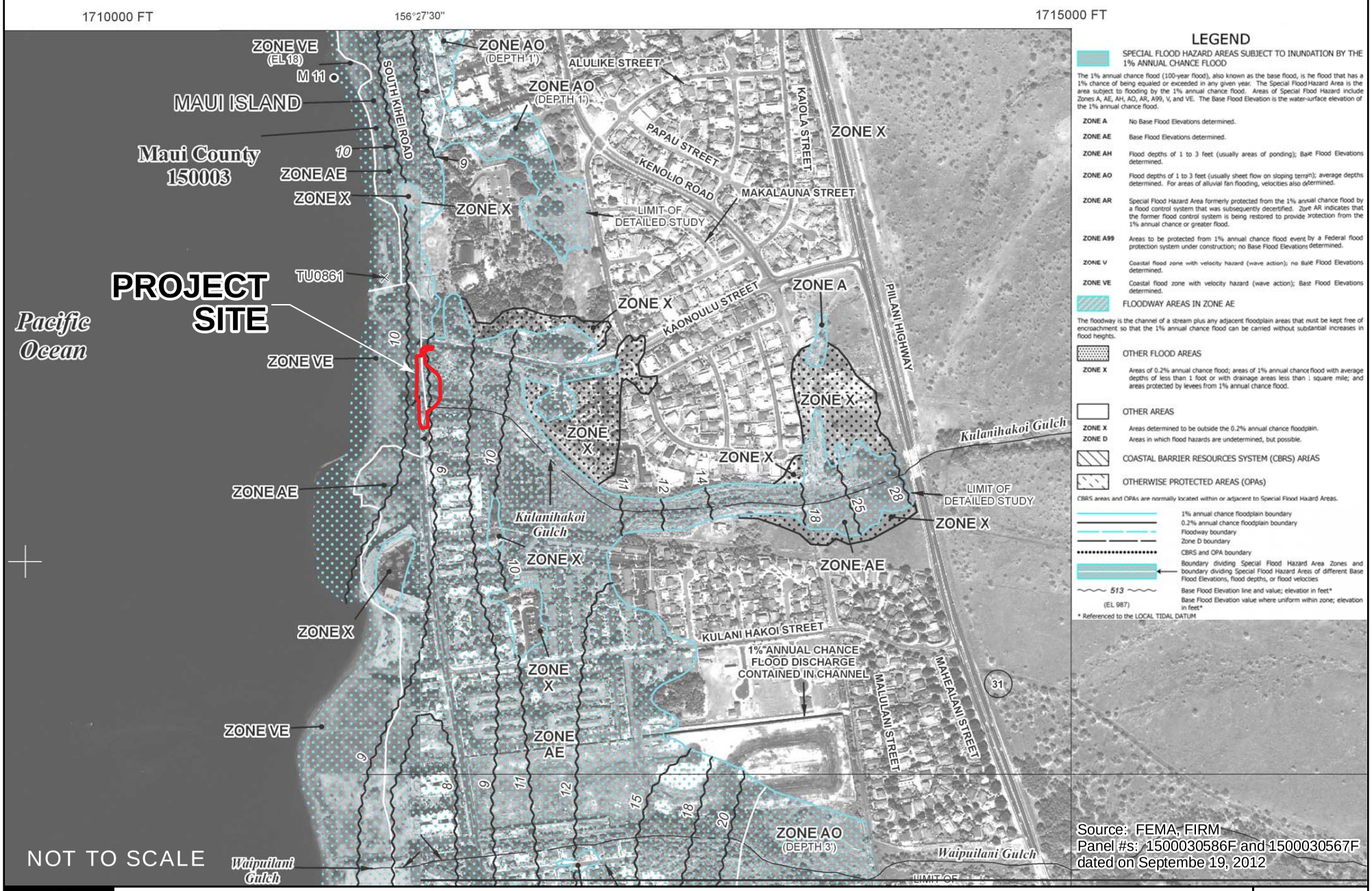

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KULANIHAKOI BRIDGE REPLACEMENT

FLOOD INSURANCE RATE MAP

FIGURE 3-3

According to the Tsunami Evacuation Zone maps for Maui, the project site lies entirely within the tsunami evacuation zone (see Figure 3-4).

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts on flood hazards in the project area and anticipated as the proposed improvements are not anticipated to increase flood risks or cause any adverse flood-related impacts at the project site or lower elevation properties.

Construction activities within the respective flood hazard districts will be conducted in accordance with regulations set forth in Section 19.62.060, Maui County Code. Before construction of any development begins within any flood hazard area, flood-related erosion hazard area, or mudslide area, a special flood hazard area development permit shall be obtained from the Director of the Department of Planning.

The project will also comply with the rules and regulations for the National Flood Insurance Program (NFIP) present in Title 44, of the Code of Federal Regulations (44CFR), as the project is within a Special Flood Hazard Area.

3.5 Natural Environment

3.5.1 Flora

A Water Quality and Biological Survey for the project site was conducted by AECOS Inc. in March 2013 (refer to Appendix B). The findings of the botanical survey are summarized below.

The botanical survey found that plant growth is sparse over much of the area, or otherwise consists of a ground cover of ʻākulikuli (*Sesuvium portulacastrum*) that is dense in some locations. Less prominent and mostly south of the muliwai, is an area with seaside heliotrope (*Heliotropium curssavicum*). A total of 15 plant species were identified in the project vicinity and all were identified as flowering plants.

It is important to note that typically in most lowland areas on Maui, the native and Polynesian plant numbers are not more than 10 to 16 percent of the total species identified from a location. At the Kūlanihāko'i Gulch mouth, 60 percent are native or early Polynesian introduced plants. While this situation is unusual, it is due to the area being maintained as a native plant restoration project. The area is served by a pipe irrigation system with sprinkler heads, suggesting some current or prior level of artificial watering. While native ʻākulikuli and ʻaki'aki are plants associated with coastal dune and muliwai environments, it is unknown to what extent the vegetation patterns have been influenced to their present state by the native planting and maintenance activities. It would be expected that the estuarine area would be dominated by pickleweed (*Batis maritimus*), as this non-native species is found throughout the Kīhei area as coastal wetlands, however, it noted as rare in the project area.

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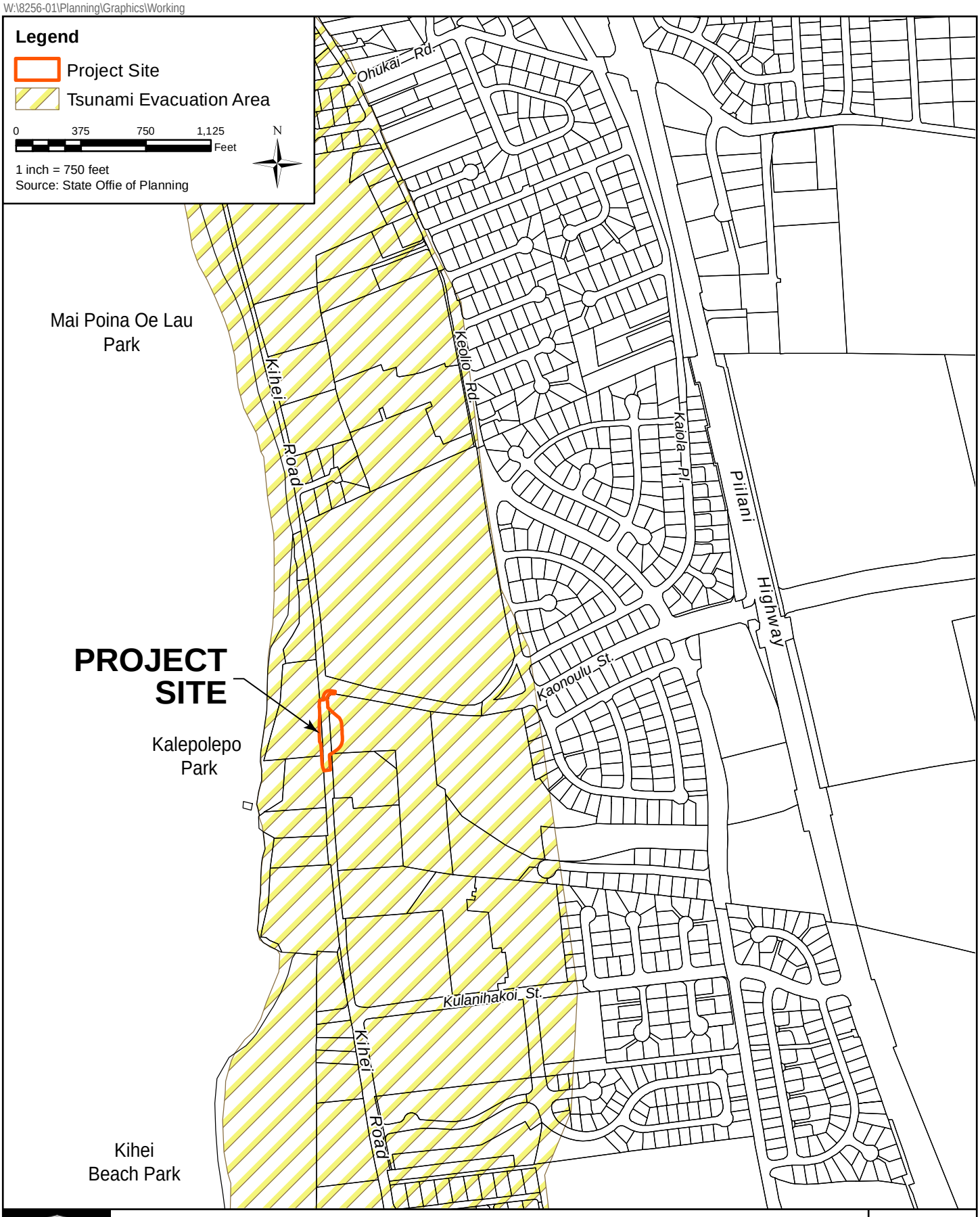

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KULANIHAKOI BRIDGE REPLACEMENT

TSUNAMI EVACUATION MAP

FIGURE 3-4

The dune areas support 'aki'aki (*Sporobolus virginicus*), a native grass common to this habitat. Non-native species are uncommon or rare in the survey area except for a grove of kiawe (*Prosopis pallida*) located on the makai side of South Kīhei Road. The native 'ākia (*Wikstroemia usa-urvi*) has been planted on a low dune.

Impacts and Mitigation Measures

No short- or long-term significant impacts on flora species are anticipated due to the construction and operation of the proposed project as there are no rare, threatened, or endangered flora species located within or adjacent to the project site. There are also no federally designated Critical Habitats within or adjacent to the project site. However, as the area is being cared for by a community group with a strong interest in preserving the native flora at this location, it is recommended that the bypass road area be restored back to the appropriate native plants once construction is completed and the temporary bypass road removed.

3.5.2 Fauna

A Water Quality and Biological Survey for the project site was conducted by AECOS Inc. in March 2013 (refer to Appendix B). The findings of the biological survey are summarized below.

Aquatic Resources:

The aquatic biota observed during the September 2012 survey of Kūlanihāko'i Gulch estuary included a mixture of native and naturalized (non-native) species. Native species observed included āholehole, 'ama'ama (*Mugil cephalus*), and 'alamihi crab (*Metopograspus thuhukar*). Non-native species included mixed schools of Cuban mollies (*Limia vittata*) and hybrid mollies (*Poecilia* sp.), Blackchin tilapia (*Sarotherodon melanotheron*), and Mozambique tilapia (*Oreochromis massambicus*). All these species are common inhabitants of estuarine waters in the main Hawaiian Islands. Rambur's forktail (*Ischnura ramburi*), a naturalized damselfly typically common at low elevations, also utilizes the project area.

Though the reach of the gulch typically containing water is short, it is possible that native *'o'opu 'akupa* (*Eleotris sandwicensis*) and *'ōpaekala'ole* (*Macrobrachium grandimanus*) not observed during the survey may utilize the brackish environment near the project site. Any population present is likely limited in size by the continual blockage of the gulch mouth by deposited sand, as these diadromous species need passage to the open ocean as larva and passage upstream to brackish waters as post-larva to carry out their life cycle.

Avian Resources:

The findings of the survey are consistent with the location of the property, and the habitats present on and adjacent to the site. A total of 23 individual water obligate avian species, of six different species, representing six separate families, were recorded during the survey. All but one of the six water bird species detected are native species.

One of these species, the Hawaiian Stilt (*Himantopus mexicanus knudseni*), is an endangered endemic sub-species protected under both federal and state endangered species statutes. One stilt was recorded foraging in the muliwai approximately 30 feet makai of the culvert just behind the beach. Thirteen others were recorded flying over the site from north-to-south.

Another of these species, the Black-crowned Night-Heron (*Nycticoraxnycticorax hoactli*), is a resident indigenous species found widespread across the islands that utilizes a wide range of waterside environments.

The three others, the Pacific Golden-Plover (*Pluvialis fulva*), the Ruddy Turnstone (*Arenaria interpres*) and the Wandering Tattler (*Tringa incana*) are indigenous migratory shorebird species that nest in the high Arctic during the late spring and summer months, returning to Hawai'i and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawai'i for the trip back to the Arctic in late April or the very early part of May each year.

The remaining species, the Cattle Egret (*Bubulcus ibis*), is alien to the Hawaiian Islands.

Although no seabirds were detected during this survey, it is probable that both endangered Hawaiian Petrel (*Pterodroma sandwichensis*) and threatened endemic sub-species of Newell's Shearwater (*Puffinus auricularis newelli*) overfly the project area between April and the middle of December each year. Both species have been recorded flying to and from their nesting colonies located in the mountains mauka of the project site. Both of these pelagic seabird species nest high in the mountains in burrows excavated under thick vegetation, especially uluhe (*Dicranopteris linearis*) fern. There is no suitable nesting habitat for either of these seabird species on or close to the project site. It is also probable that Wedge-tailed Shearwaters (*Puffinus pacificus*) may occasional overfly the site during the breeding season as they nest in coastal areas in the general Kīhei area. Wedge-tailed Shearwaters are not protected under the endangered species act, but are protected under the federal Migratory Bird Treaty Act as well as under the State of Hawai'i Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife's Administrative Rules Chapter 13, Section 124, which prohibits injuring or killing indigenous wildlife.

Mammalian Resources:

No mammalian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of the survey.

The findings of the mammalian survey are consistent with the location of the property and the habitat currently present on the site. Although no rodents were recorded it is likely that some, if not all, of the four established alien muridae found on Maui, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*) and European house mice (*Mus musculus domesticus*) use various resources found within the general project area on a seasonal basis. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependent on them.

No Hawaiian hoary bats were detected during the course of this survey. Given the habitat present on the site, any usage of the area by this species would be of an incidental foraging nature as there are no suitable roosting trees for this species on or within the vicinity of the project site.

Impacts and Mitigation Measures

No long-term impacts to fauna are anticipated as a result of the construction and operation of the proposed project.

Aquatic Resources: No impacts on aquatic or marine biota are anticipated as a result of the construction and operation of the proposed project. No rare, threatened or endangered aquatic species are located within or adjacent to the project site. There are also no federally designated Critical Habitats within or adjacent to the project site.

Avian Resources: Potential impacts to listed avian species include temporary disturbance by construction activity of individual birds that may be attracted to the area to forage, and although very unlikely, possibly nest. Nesting may occur in areas away from the construction footprint mauka of the culvert and may be disturbed by construction activities to the point of abandoning the nest which is considered harassment under the Endangered Species Act. The probability of this scenario can be lessened by constructing the bypass road outside of the nesting season, forcing discriminating reproductive pairs to locations upslope of the temporary road.

The primary cause of mortality in the three aforementioned seabirds is thought to be predation by alien mammalian species at the nesting colonies. Collision with man-made structures is considered to be a second significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting on the ground. When disoriented, these birds may collide with manmade structures, and if not killed outright, become injured and easy targets of opportunity for feral mammals. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction it is deemed expedient, or necessary to conduct nighttime construction activities, 2) following build-out, the potential operation of streetlights and security lighting during the seabird nesting season. As the proposed project does not involve the installation of any new street lighting nor is any night work anticipated during the construction of the project, no significant impacts to seabirds are anticipated as a result of the construction and operation of the proposed project.

If night-time construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be properly shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

Immediately prior to the initiation of construction a qualified biologist should survey the areas *mauka* of the project site to determine if any nesting stilt are present. If nesting stilt are found, the project will need to consult with the USFWS over appropriate measures and or conditions that may need to be met to ensure that construction activity does not harm or harass nesting stilts.

Mammalian Resources: The principal potential impact that development activities pose to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within a construction project site may

temporarily displace individual bats, which may use the vegetation as a roosting location. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site while the vegetation is being cleared. Additionally, adult female bats sometimes leave their pups in the roost tree when they forage. Very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 15 and September 15, the period in which bats are potentially at risk from vegetation clearing. As there is no suitable bat roosting habitat within or close to the project site, it is not expected that the proposed project will result in impacts to this listed species.

3.6 Historic and Archaeological Resources

An Archaeological Literature Review and Field Inspection for the project site was conducted by Cultural Surveys Hawai'i, Inc. in October 2012 to evaluate the presence of significant historic properties within the project site. The archaeological literature review included studies of archival sources, historic maps, Land Commission Awards (LCA) and previous archaeological reports to construct a history of land use and to determine if archaeological resources have been recorded on or near the project site. A field inspection of the project area followed to identify any surface archaeological resources and to investigate and assess the potential for impact to such sites. The inspection also sought to identify any sensitive areas that may require further investigation or mitigation before the project proceeds. The Archaeological Literature Review and Field Inspection report is included in Appendix C and is summarized below.

Archaeological projects in the vicinity of the project site identified both pre-Contact and post-Contact site types, many of which were associated with the sugar plantation era and plantation camps, ranching and World War II (WWII) periods in history. Pre-Contact archaeological sites associated with traditional Hawaiian agriculture have also been discovered in the vicinity surrounding the project site.

Previous archeological studies have led to archaeological interpretation based on the division of the settlement pattern for Maui into three zones: 1) coastal; 2) barren or transitional; and 3) inland. The coastal zone is an approximately one-fourth of a mile wide band running along the shoreline. The inland zone begins approximately five to seven miles from the shoreline and is characterized by larger rainfall accumulation and more lush vegetation. The transitional or barren zone is classified as the area between the edge of the coastal zone and the beginning of the inland zone and characterized by brush/scrub vegetation and low annual rainfall accumulation.

Based on available archaeological evidence and interpretations, and as a result of the settlement pattern, site types expected for coastal zones, where temporary habitations related to marine exploration may be present, may include stacked-stone enclosures, and possibly smaller ceremonial structures, such as stacked-stone fishing shrines. It is possible that human burials would have been interred in the coastal sand dunes where present.

The current project area has experienced ground disturbances as a result of construction of the South Kīhei Road and natural events associated with the surrounding stream and wetland environment, including periodic flooding. In particular, flooding events have caused

repeated and extensive damage to the existing bridge over the years. As a result of these disturbances, the likelihood of locating intact cultural deposits or archeological remains would be low.

Conversely, the project area borders Kalepolepo and may have been considered part of a village once located there. Kalepolepo village became a major hub of historic activity in the mid-1800's. Several historically significant places, such as the Koa House, the David Malo Memorial Church, and the Kalepolepo fishpond were located there. Portions of the fishpond have recently been restored. Additionally, due to the coastal location and dune sand environment, human remains could be present in sandy deposits of the project area.

Field inspections were conducted in August 2012. The area inspected included the immediate area of Kūlanihāko'i Bridge located at the mouth of Kūlanihāko'i Stream along South Kīhei Road as well as an area approximately 500 feet north and 500 feet south of the bridge along South Kīhei Road and approximately 574 feet upstream and 272 feet downstream from the bridge. The Kalepolepo fishpond is located directly south of the stream mouth in the near shore ocean waters. In recent history, the surrounding area has been transformed by the development of resorts and condominiums along the shoreline. During the field inspection, scattered remains of two domestic cows (*Bos taurus*) were observed in the flood plain, however, no historically significant cultural material was visible on the ground surface.

Based on the background research and the results of the field inspection, it was concluded that the area has been heavily disturbed and modified by natural flooding events as well as historic and modern activities.

Impacts and Mitigation Measures

Based on the field inspection findings and background research, there is a low potential for the discovery of previously unidentified historic properties beyond the historic era itself. The area surrounding the bridge includes the Kūlanihāko'i Stream mouth, a natural wetland and associated flood plain. While impacts by flooding episodes and modifications associated with road construction and maintenance have greatly altered sediments of the project areas, the possibility of encountering intact subsurface cultural deposits, including human burials, should not be underestimated. Therefore, archaeological monitoring is recommended for all ground disturbing activities during all phases of the temporary bridge and bypass road work and bridge replacement. It is also recommended that a monitoring report be generated after the construction of the temporary bridge and bypass road and the replacement bridge.

A site inspection was conducted on December 13, 2012 by SHPD and Cultural Surveys Hawai'i. Based on the site inspection, SHPD requested that an Archaeological Inventory Survey (AIS) be prepared for the project site. The AIS is currently pending and will be submitted to SHPD for approval when it has been completed. Subsequent consultation with SHPD, by letter dated February 1, 2013, indicated that they have concerns that the project area is located within a zone of beach sand dune and Aeolian sand deposits which are known to contain human burial features and historic habitation sites. It is therefore likely that historic properties, including human remains, may be present beneath the previously

disturbed road grade and sub-grade or within previously unaffected areas of the right-of-way. SHPD requested that all project associated excavations be monitored by a qualified archaeologist in order to identify and mitigate any subsurface cultural features and deposits. They further recommend that an archaeological monitoring plan be submitted to their office for review and approval prior to initiation of this project.

Should any significant archeological, cultural, or historic resources be found during construction activities, all work will cease in the vicinity of the find and SHPD will be notified immediately to determine appropriate mitigation measures.

With regard to the bridge itself, the structure was constructed in 1911 and is now 102 years old. It is therefore considered a historic property and recordation of the bridge would be required under Chapter 13-275, Hawai'i Administrative Rules if deemed eligible based on SHPD's evaluation of the bridge's significance. Consultation with SHPD, by letter dated December 20, 2012, indicated that while the bridge is unique due to age and represents the first generation of concrete bridges in the islands, it is literally falling apart and has lost any distinguishing architectural characteristics. On this basis SHPD has determined that the bridge has lost its integrity and is not eligible to be recorded on the State Inventory of Historic Properties. Therefore, the proposed project will have no effect on historic property.

3.7 Air Quality

The State of Hawai'i Department of Health (DOH), Clean Air Branch, monitors the ambient air in the State for various gaseous and particulate air pollutants. The U.S. Environmental Protection Agency (EPA) has set national ambient air quality standards (NAAQS) for six criteria pollutants: carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, ozone, and particulate matter (PM_{10} and PM_2). Hawai'i has also established a state ambient air standard for hydrogen sulfide. The primary purpose of the statewide monitoring network is to measure ambient air concentrations of these pollutants and ensure that these air quality standards are met.

Air pollution in Hawai'i is caused by many different man-made and natural sources. There are industrial sources of pollution, such as power plants and petroleum refineries; mobile sources, such as cars, trucks and buses; agricultural sources, such as sugar cane burning, and natural sources, such as windblown dust and volcanic activity. The DOH Clean Air Branch is responsible for regulating and monitoring pollution sources to ensure that the levels of criteria pollutants remain well below the State and federal ambient air quality standards.

The State maintains two air monitoring stations on the island of Maui, one in Kīhei and one in Pā'ia. Both stations monitor for particulate matter ($PM_{2.5}$) less than or equal to 2.5 micrograms per cubic meter (µg/m3). Current readings from the Kīhei station indicate that the concentration of $PM_{2.5}$ is well below Federal air quality standards. There are no State standards for $PM_{2.5}$. Although there is very little information available, air quality at the project site is generally considered to be good due to the presence of abundant tradewinds throughout most of the year.

Impacts and Mitigation Measures

In the short-term, during construction of the proposed project, two potential types of air pollution emissions will likely occur, resulting in air quality impacts: 1) airborne dust from construction activities such as grading and excavation within the project site; and 2) exhaust emissions from construction vehicles and equipment from the project site.

Potential air quality impacts during construction of the Preferred Alternative will be mitigated by complying with the State DOH Administrative Rules, Title 11, Chapter 60 "Air Pollution Control". The construction contractor is responsible for complying with the State DOH regulations which prohibit visible dust emissions at property boundaries. Compliance with State regulations will require adequate measures to control airborne dust by methods such as water spraying and sprinkling of loose or exposed soil or ground surface areas and dust-generating equipment during construction. As may be deemed appropriate, planting of landscaping as soon as possible on completed areas will also help to control dust. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving the equipment and personnel to the site during off-peak hours. Exhaust emissions from construction vehicles are anticipated to have negligible impact on air quality in the project vicinity as the emissions would be relatively small and readily dissipated.

In the long-term, operation of the project will have no significant long-term impact on ambient air quality in the project vicinity. Air quality levels would be most affected by vehicular emissions generated by project-related traffic, however, the elevated vehicular emission concentrations are anticipated to dissipate.

3.8 Noise

Ambient noise in the project area is predominantly attributed to vehicular traffic traveling along South Kīhei Road and adjacent roadways. Also contributing to the acoustic environment is noise from low pitch sounds of waves along the coast, wind and birds.

Impacts and Mitigation Measures

In the short-term, noise from construction activities such as excavation, grading, cutting, and paving will be unavoidable. The increase in noise level will vary according to the particular phase of construction. Noise may also increase as a result of operation of heavy vehicles and other power equipment during the construction period.

Construction noise impacts will be mitigated by compliance with provisions of the State DOH Administrative Rules, Title 11, Chapter 46, "Community Noise Control" regulations. These rules require a noise permit if the noise levels from construction activities are expected to exceed the allowable levels stated in the DOH Administrative Rules. It shall be the contractor's responsibility to minimize noise by properly maintaining noise mufflers and other noise-attenuating equipment, and to maintain noise levels within regulatory limits. Also, the guidelines for heavy equipment operation and noise curfew times, as set forth by the DOH noise control rules, will be adhered to; or if necessary, a noise permit shall be obtained.

In the long-term, no significant noise impacts are anticipated once the construction of the proposed project has been completed. Since the project is not expected to increase roadway capacity or travel demand, ambient noise levels in the vicinity should not change significantly.

3.9 Traffic

In the vicinity of the project site, South Kīhei Road is a predominantly two-lane, two-way roadway generally oriented in the north-south direction that provides access through Kīhei.

A Traffic Assessment Report (TAR) was prepared for the proposed project by Wilson Okamoto Corporation in December 2012. The purpose of the TAR is to assess traffic operating conditions resulting from the proposed project, and to identify recommendations, if appropriate, that would mitigate the traffic impacts. The TAR is included in Appendix D and is summarized below.

Field investigations were conducted in October 2012 and consisted of a 24-hour mechanical count survey near the existing Kūlanihāko'i Bridge.

The highway capacity analysis performed in this TAR is based on procedures presented in the "Highway Capacity Manual", Transportation Research Board, 2010, and the "Highway Capacity Software", developed by the Federal Highway Administration. The analysis is based on the concept of Level of Service (LOS), a quantitative and qualitative assessment of traffic operations. LOS are defined by LOS "A" through "F", with LOS "A" representing ideal or free-flow traffic operating conditions and LOS "F" representing unacceptable or potentially congested traffic operating conditions.

"Volume to Capacity" (v/c) ratio is another measure indicating the relative traffic demand to the road carrying capacity. A v/c ratio of one (1.00) indicates that the roadway is operating at near capacity. A v/c ratio greater than 1.00 indicated that the traffic demand exceeds the road's carry capacity.

In the vicinity of the project site, the morning peak hour of traffic generally occurs between 7:15 and 8:15 AM while the afternoon peak hour generally occurs between 4:30 and 5:30 PM.

Near the existing Kūlanihāko'i Bridge, South Kīhei Road carries 574 vehicles northbound and 443 vehicles southbound during the AM peak period. During the PM peak period, traffic volumes are higher with 657 vehicles traveling northbound and 581 vehicles traveling southbound. The northbound direction of traffic operates at LOS "D" during both peak periods with a v/c ratio of 0.37 and 0.40 during the AM and PM peak periods, respectively. The southbound direction of traffic operates at LOS "C" with a v/c ratio of 0.29 during the AM peak period and at a LOS "D" with a v/c ratio of 0.35 during the PM peak period.

Impacts and Mitigation Measures

Traffic conditions were forecasted to year 2015, the anticipated completion date of the project.

Prior to the removal of the existing bridge, a two-lane, two-way temporary bypass road and bridge will be constructed mauka of the existing bridge to accommodate traffic along South Kīhei Road during construction. The peak hour traffic conditions during this interim construction period are summarized in Table 3-1. The existing LOS is provided for comparison purposes.

Under interim conditions, traffic operations along South Kīhei Road are generally expected to remain similar to existing conditions due to the maintenance of the existing number of travel lanes. The northbound direction of traffic is expected to continue operating at LOS "D" during both peak periods with v/c ratios similar to existing conditions. The southbound direction of traffic is expected to operate at a slightly lower LOS"D" during the AM peak period, but the v/c ratios for that direction are expected to remain similar to existing conditions during both peak periods.

Table 3-1
Existing and Interim LOS Traffic Operating Conditions

Direction of Travel		AM		PM	
		Existing	Interim	Existing	Interim
Northbound	LOS	D	D	D	D
	v/c ratio	0.37	0.37	0.40	0.40
Southbound	LOS	C	D	D	D
	v/c ratio	0.29	0.29	0.35	0.35

The replacement of Kūlanihāko'i Bridge is expected to be completed by the Year 2015. The 2015 peak traffic conditions with the new bridge are summarized in Table 3-2. The existing levels of service are provided for comparison purposes.

Table 3-2
Existing and Year 2015 Traffic Operating Conditions

Direction of Travel		AM		PM	
		Existing	Year 2015	Existing	Year 2015
Northbound	LOS	D	D	D	D
	v/c ratio	0.37	0.4	0.40	0.43
Southbound	LOS	C	D	D	D
	v/c ratio	0.29	0.31	0.35	0.38

Under Year 2015 conditions, traffic operations along South Kīhei Road are generally expected to remain similar to existing conditions despite the anticipated ambient growth in traffic due to the provision of wider travel lanes and shoulder areas along

this segment of South Kīhei Road. The northbound direction of traffic is expected to continue operating at LOS "D" during both peak hours with v/c ratios of 0.40 and 0.43 during the AM and PM peak periods, respectively. The southbound direction of traffic is also expected to operate at LOS "D" during both peak periods with v/c ratios of 0.31 and 0.38 during the AM and PM peak periods, respectively.

Based on the analysis of the traffic data, the following recommendations should be implemented in conjunction with the proposed project:

1. Provide sufficient sight distances for motorists to safely navigate the proposed temporary bypass road and bridge.
2. Provide sufficient turning radii along the temporary bypass road and bridge to accommodate all anticipated vehicle types. If the provision of these radii is not technically feasible, consider restriction of larger vehicles along this segment of South Kīhei Road and the provision of a detour utilizing Pi'ilani Highway.
3. Prepare a Construction Traffic Management Plan to minimize the impact of construction activities on the surrounding roadways.

Traffic operations during the interim construction period and once the project is complete in Year 2015 are anticipated to remain similar to existing conditions. As such, the proposed project is not expected to have a significant impact on traffic in the project vicinity. In addition, recommendations have been provided to ensure that the temporary detour road and bridge can safely accommodate existing traffic during construction and minimize the impact of construction activities on the surrounding roadways.

The proposed temporary bridge and bypass road on the mauka side of South Kīhei Road has been designed to accommodate larger vehicles such as buses and fire trucks. However, there are limitations to semi-trailers which would need to be re-routed during construction of the replacement bridge. The replacement bridge will be designed to accommodate all vehicle types.

During the construction of the tie-in between the temporary bypass road and the existing South Kīhei Road there will be a period of time (approximately two weeks) when South Kīhei Road will need to be closed. During this time, vehicles are planned to be detoured through Pi'ilani Highway.

3.10 Visual Resources

Hawai'i's visual resources are an important component of the state's tourism industry and of the quality of life enjoyed by the state's residents. The state's visual resources include a broad range of natural and developed areas and a tremendous variety of land uses, water bodies, and vegetation types.

The slopes of Haleakalā are visible from the project site, with the West Maui Mountains visible to the northwest. The County of Maui's Maui Island Plan identifies South Kīhei Road in the vicinity of the project site as a "medium" scenic corridor.

Impacts and Mitigation Measures

In the short-term, a temporary bypass road and bridge are being proposed on the mauka side of the existing roadway. This use will be generally similar in visual character to that of the temporary bridge over the existing culverts. Compared to the existing culverts, the temporary bridge on the mauka side of South Kīhei Road would provide a higher view object (approximately 14 feet) for individuals utilizing South Kīhei Road or in close proximity to this portion of the road. However, the temporary bridge and bypass road are necessary in order to maintain usage of this portion of South Kīhei Road during construction of the replacement Kūlanihāko'i Bridge. Once the new bridge is constructed, the temporary bypass road and bridge will be removed.

In the long-term, the proposed replacement bridge is not anticipated to have significant impacts on notable view planes nor adversely affect important public viewing points or visual resources. As an already existing roadway and bridge, the project will not significantly change the scenic and visual character of the surrounding area.

3.11 Socio-Economic Characteristics

The project site is located within the Kīhei Census Designated Place (CDP). Demographic and other information was reviewed from the U.S. Census 2010 for the Kīhei CDP and the County of Maui and is shown on Table 3-3.

Based upon the data shown on the table, Kīhei CDP has a slightly younger population than the County of Maui. The median age of the population for Kīhei CDP was 38.4 versus 39.6 for the County.

By racial mix, the Kīhei CDP has a higher percentage of Whites (50.7%) than the County (34.4%). Kīhei CDP also has a slightly lower percentage of Asians (21.7%) and those of two or more races (16.3%) than the County (28.8% and 23.5%, respectively). These three races (Whites, Asians and those with two or more races) make up the majority of the population. Native Hawaiian and other Pacific Islanders comprise a slightly lower proportion than the County as a whole, with 6.5% and 10.4%, respectively.

According to the 2010 Census, Kīhei CDP has a slightly lower housing occupancy rate, 67.5%, than the County, 76.6%. Housing units in this region are evenly occupied by both renters (52.0%) and owners (48.0%). The County data differs slightly to that of the Kīhei CDP data in that the proportion of housing units are occupied more by owners than renters (55.8% and 44.2%, respectively).

Impacts and Mitigation Measures

In the short- term, construction expenditures will provide positive benefits to the local economy. This would include creation of some construction and construction support jobs, and the purchase of materials from local suppliers, as well as indirect benefits to local retail businesses resulting from construction activities.

Table 3-3
Demographic Characteristics

Subject	Kīhei CDP		County of Maui	
	Number	Percent	Number	Percent
TOTAL POPULATION	20,881	100	154,834	100
AGE				
Under 5 years	1,273	6.1	10,020	6.5
5-19 years	3,694	17.7	29,117	18.8
20-64 years	13,832	66.2	95,894	61.9
65 years and over	2,082	10.0	19,803	12.8
Median age (years)	38.4	---	39.6	---
RACE				
White	10,582	50.7	53,336	34.4
Black or African American	244	1.2	870	0.6
American Indian and Alaskan Native	134	0.6	603	0.4
Asian	4,533	21.7	44,595	28.8
Native Hawaiian and other Pacific Islander	1,359	6.5	16,051	10.4
Two or more races	3,396	16.3	36,328	23.5
Other	633	3.0	3,051	2.0
HOUSEHOLD (BY TYPE)				
TOTAL HOUSEHOLDS	8,095	100	53,886	100
Family households (families)	4,736	58.5	35,498	65.9
Married-couple family	3,439	42.5	25,408	47.2
With own children under 18 years	1,409	17.4	10,185	18.9
Female householder, no children	823	10.2	6,623	12.3
With own children under 18 years	470	5.8	3,427	6.4
Nonfamily household	3,359	41.5	18,388	34.1
Average household size	2.6	---	2.82	---
HOUSING OCCUPANCY AND TENURE				
TOTAL HOUSING UNITS	11,994	100	70,397	100
Occupied Units	8,095	67.5	53,886	76.6
By owner	3,889	48.0	3,005	55.8
By renter	4,206	52.0	23,831	44.2
Vacant Units	3,899	32.5	16,493	23.4

In the long-term, the proposed project will replace the existing deteriorating bridge, which will create safer access over Kūlanihāko'i Bridge. In addition, the roadway improvements to South Kīhei Road will create safer pedestrian and bicycle access that will benefit the public who travel along this route.

3.12 Public Services and Facilities

3.12.1 Police and Fire Protection

Police protection in the project area is provided by the County of Maui Police Department (MPD). The project area is a part of District VI, which covers the Kīhei-Mākena region and is served by a substation located at the Kīhei Town Center, approximately 2.2 miles from the project site. In addition, MPD is currently proposing a new Kīhei Police Station to be located mauka of Pi'ilani Highway near its intersection with Kanani Road.

Fire prevention, protection is provided by the County of Maui, Department of Fire and Public Safety. The project area is served by the Kīhei Fire Station located on South Kīhei Road near Kalama Park approximately 2.1 miles south of the project site. The Wailea Fire Station, located approximately 4.9 miles to the south of the project site, provides back up support for the Kīhei Station when required.

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts or increased demand on police and fire services resulting from the project are anticipated. The proposed project will replace the current, deteriorating bridge and enhance safety for motorists, bicyclists and pedestrians along this section of roadway. No additional vehicular lanes are proposed that could increase roadway capacity or traffic flow. Therefore, the project is not anticipated to induce population growth and associated demands on police and fire protection.

During construction of the temporary bypass road and bridge and the new Kūlanihāko'i Bridge, access through South Kīhei Road will be maintained at existing levels of service, therefore, the proposed project is not anticipated to have significant impacts on fire and police access through the project site.

3.12.2 Health Care Services

The only major medical facility on the island is the Maui Memorial Medical Center, which is located in Wailuku, approximately 11.3 miles from the project site. The 231 bed facility provides general, acute, and emergency care services.

Various clinics and physician's offices are situated throughout the Kīhei and Wailea areas, however, these facilities provide medical services on a smaller scale. Clinics within the project vicinity include Kīhei Clinic and Wailea Medical Services, Kīhei Pediatric Clinic, Kīhei Physicians, Kīhei-Wailea Medical Center, Maui Medical Group, and Kaiser Permanente.

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts or increased demand on medical services are anticipated. The proposed project will replace the current, deteriorating

bridge and enhance safety for motorists, bicyclists and pedestrians along this section of roadway. No additional vehicular lanes are proposed that could increase roadway capacity or traffic flow. Therefore, the project is not anticipated to induce population growth and associated demands on medical facilities and services.

3.12.3 Education

The project site is located within the State Department of Education's (DOE) Baldwin-Kekaulike-Maui complex area which includes Kamali'i Elementary School, Kīhei Elementary School, Lokelani Intermediate, and Kīhei Public Charter School.

The closest education facility to the project site is Kīhei Public Charter School located 0.7 miles northeast from the project site. Kīhei Public Charter School serves children from kindergarten to 12th grade. The other schools within the project vicinity are all located over one mile away from the project site.

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts or increased demand on educational facilities are anticipated. The proposed project will replace the current, deteriorating bridge and enhance safety for motorists, bicyclists and pedestrians along this section of roadway. No additional vehicular lanes are proposed that could increase roadway capacity or traffic flow. Therefore, the project is not anticipated to induce population growth and associated demands on medical facilities and services.

During construction of the temporary bypass road and bridge and the new Kūlanihāko'i Bridge, access through South Kīhei Road will be maintained at existing levels of service, therefore, the proposed project is not anticipated to have significant impacts on students who travel along this route to and from school.

In the long-term, safer pedestrian and bicycle access over Kūlanihāko'i Bridge will benefit students who travel along this route.

3.12.4 Recreational Facilities

The County has several parks located in the project vicinity. The nearest County recreational facility to the project site is the 1.5 acre Kalepolepo Beach Park, located approximately 500 feet west of the project site along South Kīhei Road. Located approximately 0.25 miles north of the project site is the 5.3 acre Mai Poina O'e Ia'u Beach Park. Amenities available at this park include parking, picnic areas, and restrooms. Further south of the project site is the 20.22 acre Kīhei Beach Reserve, also known as Waipu'ilani Park located approximately 0.5 miles from the project site. Amenities available at this park include restrooms, a soccer field, and tennis courts.

Other recreational facilities in the project vicinity include the Kīhei Community Center and Aquatic Center, as well as resort affiliated, world-class golf courses and tennis centers.

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts or increased demand on recreational facilities in the project vicinity are anticipated. The proposed project will replace the current, deteriorating bridge and enhance safety for motorists, bicyclists

and pedestrians along this section of roadway. No additional vehicular lanes are proposed that could increase roadway capacity or traffic flow. Therefore, the project is not anticipated to induce population growth and associated demands on recreational facilities and parks.

3.12.5 Solid Waste Collection and Disposal

The County of Maui, Environmental Management Solid Waste Division Refuse Collection Program collects residential solid waste in the project vicinity. On an island-wide basis, solid waste from residential properties is disposed at three landfill locations: Central Maui Sanitary Landfill, Olowalu residential Recycling & Refuse Convenience Center, and Hāna Sanitary Landfill. Construction waste is disposed at Maui Construction & Demolition Landfill. Refuse collection for non-single family residential properties are provided by private refuse companies.

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts to municipal solid waste collection and disposal facilities are anticipated during the construction of the proposed project.

Construction of the proposed project will generate solid waste typical of roadway construction related activities over the short-term. The contractor will be required to remove all debris from the site, and properly dispose of it at the Maui Construction and Demolition Landfill in conformance with County regulations.

3.13 Infrastructure and Utilities

3.13.1 Water System

Water service in the Kīhei-Mākena area is provided by the County of Maui Department of Water Supply (DWS). The DWS serves five main sections within the County; Central Maui, Upcountry Maui, West Maui, East Maui, and Moloka'i. The project area is a part of the Central Maui system which includes Wailuku, Pā'ia, Kahului, Pu'unēnē, and Kīhei.

Within the project site, there is an existing 12-inch waterline located within the right-of-way of South Kīhei Road.

Impacts and Mitigation Measures

In the short-term, as the new culverts extend further across South Kīhei Road than the existing culverts, a portion of the existing 12-inch waterline will need to be replaced under the new culverts. All relocation work will be coordinated with DWS prior to construction.

In the long-term, the project is not anticipated to result in increased demand on the water system in the area. The proposed project will replace the current, deteriorating bridge and enhance safety for motorists, bicyclists and pedestrians along this section of roadway. No additional vehicular lanes are proposed that could increase roadway capacity or traffic flow. Therefore, the project is not anticipated to induce population growth and associated demand on water. The proposed project is not anticipated to require using water on a regular basis.

3.13.2 Wastewater System

Wastewater service in the Kīhei area is provided by the County of Maui Department of Environmental Management. The Kīhei Wastewater Reclamation facility is responsible for handling all wastewater needs in the Kīhei area. Wastewater flows from the area are conveyed through a series of force mains, pump stations, and gravity lines to the reclamation facility for processing.

Within the vicinity of the project site there is a 30-foot wide sewer line easement located adjacent to the South Kīhei Road right-of-way. Within the easement lies a 27-inch sewer pipeline.

Impacts and Mitigation Measures

In the short- and long-term, the proposed project is not anticipated to result in increased demand on the wastewater system in the area. The proposed project will replace the current, deteriorating bridge and enhance safety for motorists, bicyclists and pedestrians along this section of roadway. No additional vehicular lanes are proposed that could increase roadway capacity or traffic flow. Therefore, the project is not anticipated to induce population growth and associated demand on the wastewater system. The proposed project will not generate any wastewater and the existing wastewater pipeline is not proposed to be altered. Construction plans for the project will be circulated to the Department of Environmental Management for review.

3.13.3 Drainage System

According to the County of Maui's Draft Report, *Kīhei Drainage Master Plan Waiakoa Gulch to Kilohana Drive Existing Conditions*, dated April 2009, there are eight different flood districts in the Kīhei region. The Kūlanihāko'i Bridge is located in the Kūlanihāko'i District, which is the largest district in the region that extends from an area adjacent to the summit of Haleakalā down to the ocean. For the Kūlanihāko'i District, runoff flows from a 100-year storm event are contributed by six drainage areas; Pi'ilani Basins 5, 6, 7, and 8 and Makai Basins Kula2_1 and Kula 2_2. All runoff flows eventually discharge into Kūlanihāko'i Gulch where they continue to flow toward South Kīhei Road and the existing four culverts. For a 100-year storm event, at the point where the flows reach the existing culverts, the total flow for the 100-year storm event is approximated at 14,148 cfs. In addition, sand dunes which accumulate downstream of the gulch cause flooding problems and backwater effects during heavy storm events.

A Drainage Report for the project site was prepared by Wilson Okamoto Corporation in March 2013. The Drainage Report is included in Appendix E and is summarized below.

For a 100-year storm event, calculations show that the downstream elevations of the existing culverts are slightly higher than the upstream elevations, which may be caused by the accumulating sand dunes which prevent runoff from flowing out to the ocean and causing backwater effects that flood neighboring properties. Results also show that the existing culverts are not capable of handling large volumes of runoff which leads to runoff overtopping the roadway. The existing culverts currently have no drainage capacity as they are essentially level with the surrounding area. This in turn, along with the presence of the sand plug, creates a pooling effect in which water rises and fills the area rather than allowing the water to flow.

Impacts and Mitigation Measures

In the short- and long-term, no significant impacts are anticipated on the existing storm drainage system as a result of the construction and operation as the proposed project itself will not generate any additional runoff

In the short-term, the temporary bridge on the mauka side of the existing bridge would have a drainage capacity of 705 cfs as the finished grade of the temporary bypass bridge would be approximately three feet above the top bank of the existing drainageway. Based on this runoff value, it was determined that the largest storm event that the temporary bypass bridge could handle would be a 1-year, 24 hour storm event. The location and the elevation of the temporary bridge is constrained due to the physical location of the project area, making it difficult to raise the bridge over the drainageway to accommodate a greater volume of flow. For a 100-year storm event, the temporary bridge is likely to be flooded due to large amounts of runoff flowing from upstream. In addition, the sand dunes would continue to impede the ability of the runoff to flow out to the ocean and continue to cause backwater effects that flood neighboring properties. For the temporary bridge to accommodate a 100-year storm event, the bridge would have to be raised. However, due to the physical constraints of the project site, raising the bridge would increase the slope of the bypass road, making it too steep for vehicles to travel on.

In the long-term, as the project involves increasing the number of culverts from four to six culverts and constructing them at a 0.5% slope, the proposed replacement bridge will provide an incremental increase in drainage capacity from 204 cfs to 306 cfs. This increase in drainage capacity would not be enough to accommodate the 100-year storm event. The new culverts would still be incapable of handling large volumes of runoff from severe storm events. In addition, the sand dunes would continue to impede the ability of the runoff to flow out to the ocean. Though the proposed project does slightly increase drainage capacity, the purpose of the project is to replace the deteriorating culverts and is not intended to address flooding issues on a regional basis.

3.13.4 Electrical and Communications Systems

Electrical power on the island of Maui is provided by Maui Electric Company (MECO), a subsidiary of Hawaiian Electric Company, Inc. The electrical source for the project area is the Mā'alaea Power Plant.

Telephone service in the Kīhei area, like the rest of the State, is provided by Hawaiian Telcom.

Oceanic Time Warner Cable of Hawai'i is the local CATV provider in the region.

Within the project site, two electrical overhead utility poles are located in the right-of-way on the mauka side of South Kīhei Road.

Impacts and Mitigation Measures

In the short-term, the two electrical poles will need to be relocated as they are currently located where the paved walkway is being proposed. All relocation work will be coordinated with MECO prior to construction.

In the long-term, the proposed project is not anticipated to significantly impact or increase demand on electrical and communication systems in the area. The proposed project will replace the current, deteriorating bridge and enhance safety for motorists, bicyclists and pedestrians along this section of roadway. No additional vehicular lanes are proposed that could increase roadway capacity or traffic flow. Therefore, the project is not anticipated to induce population growth and associated demand for electric and communication services. The proposed project is not anticipated to require electrical and communication services for its operation.

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4. RELATIONSHIP TO PLANS, POLICIES, AND CONTROLS

This section discusses the State and County of Maui land use plans, policies and controls relating to the proposed project.

4.1 State Land Use Plans and Policies

4.1.1 Hawai'i State Plan

The Hawai'i State Plan, Chapter 226, HRS, provides goals, objectives, policies, and priorities for the State. The Hawai'i State Plan also provides a basis for determining priorities, allocating limited resources, and improving coordination of State and County Plans, policies, programs, projects, and regulatory activities. It establishes a set of themes, goals, objectives, and policies that are meant to guide the State's long-range growth and development activities. The proposed project is consistent with the following applicable objectives and policies:

Sec. 226-11 Objectives and policies for the physical environment – land-based, shoreline, and marine resources.

(a) Planning for the State's physical environment with regard to land-based shoreline, and marine resources shall be directed towards achievement of the following objectives:

(1) Prudent use of Hawai'i's land-based, shoreline, and marine resources.

(2) Effective protection of Hawai'i's unique and fragile environmental resources.

(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:

(3) Take into account the physical attributes of areas when planning and designing activities and facilities.

(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.

(6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawai'i.

(8) Pursue compatible relationships among activities, facilities, and natural resources.

Discussion: Construction activities will involve land-disturbing activities, such as grubbing, clearing, grading, and excavation that may result in some soil erosion and potential construction-related impacts to the quality of surface and coastal waters in the greater project vicinity. Various mitigative measures will be incorporated into the project's construction plan

to minimize soil disturbances and potential short-term erosion impacts during construction activities. Excavation and grading activities associated with construction of the proposed improvements will be regulated by the County's grading ordinance.

A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms.

The proposed project is not anticipated to have any long-term impacts to land-based, shoreline, and marine resources. Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

Sec. 226-17 Objective and policies for facility systems – transportation.

(a) Planning for the State's facility systems with regard to transportation shall be directed towards the achievement of the following objectives:

(1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.

Discussion: The proposed project will replace the current, deteriorating bridge and enhance safety for motorists, bicyclists, and pedestrians along this section of roadway by providing an exclusive bike lane and paved walkway on the mauka side of the road. In addition, the makai side of the bridge and immediately adjacent areas will accommodate a bike lane and paved walkway. Improvements to additional segments can be implemented if and when future improvements are pursued on the makai side of South Kīhei Road.

4.1.2 State Land Use District

The State Land Use Law, Chapter 205, HRS, is intended to preserve, protect and encourage the development of lands in the State for uses that are best suited to the public health and welfare of Hawai'i's people. Under Chapter 205, HRS all lands in the State of Hawai'i are classified by the State Land Use Commission (LUC) into four major categories referred to as State Land Use Districts. These districts are identified as the Urban District, Agricultural District, Conservation District, and Rural District.

The LUC's Land Use District Boundary map for the Island of Maui depicts the lands within the project area as being designated within the State Urban District (see Figure 4-1). Permitted uses within the State Urban district are prescribed under Title 12, Chapter 205 (Land Use Commission), HRS, and the State Land Use Commission's Administrative Rules prescribed under Title 15, Subtitle 3, Chapter 15 HAR.

Pursuant to §15-15-24, HAR, pertaining to permissible uses within the Urban District, permitted uses include any and all uses permitted by the counties, either by ordinances or rules, and are subject to any conditions imposed by the Land Use Commission pursuant to Section 205-4.5, HRS. Since roadways, such as the proposed project, are considered an incidental use that is permitted in each of the County's zoning districts, the proposed project is a permitted use within the Urban District.

4.1.3 Hawai'i Coastal Zone Management Program

The National Coastal Zone Management (CZM) Program was created through passage of the Coastal Zone Management Act of 1972. Hawai'i's CZM Program, adopted as Chapter 205A, HRS, provides a basis for protecting, restoring and responsibly developing coastal communities and resources. The Hawai'i CZM area includes all lands within the State and the areas seaward to the extent of the State's management jurisdiction. Hence, the proposed project site is located in the CZM area. A discussion of the project's consistency with the objectives and policies of the CZM Program is provided below.

(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
- *(i) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by: 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 use 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;*

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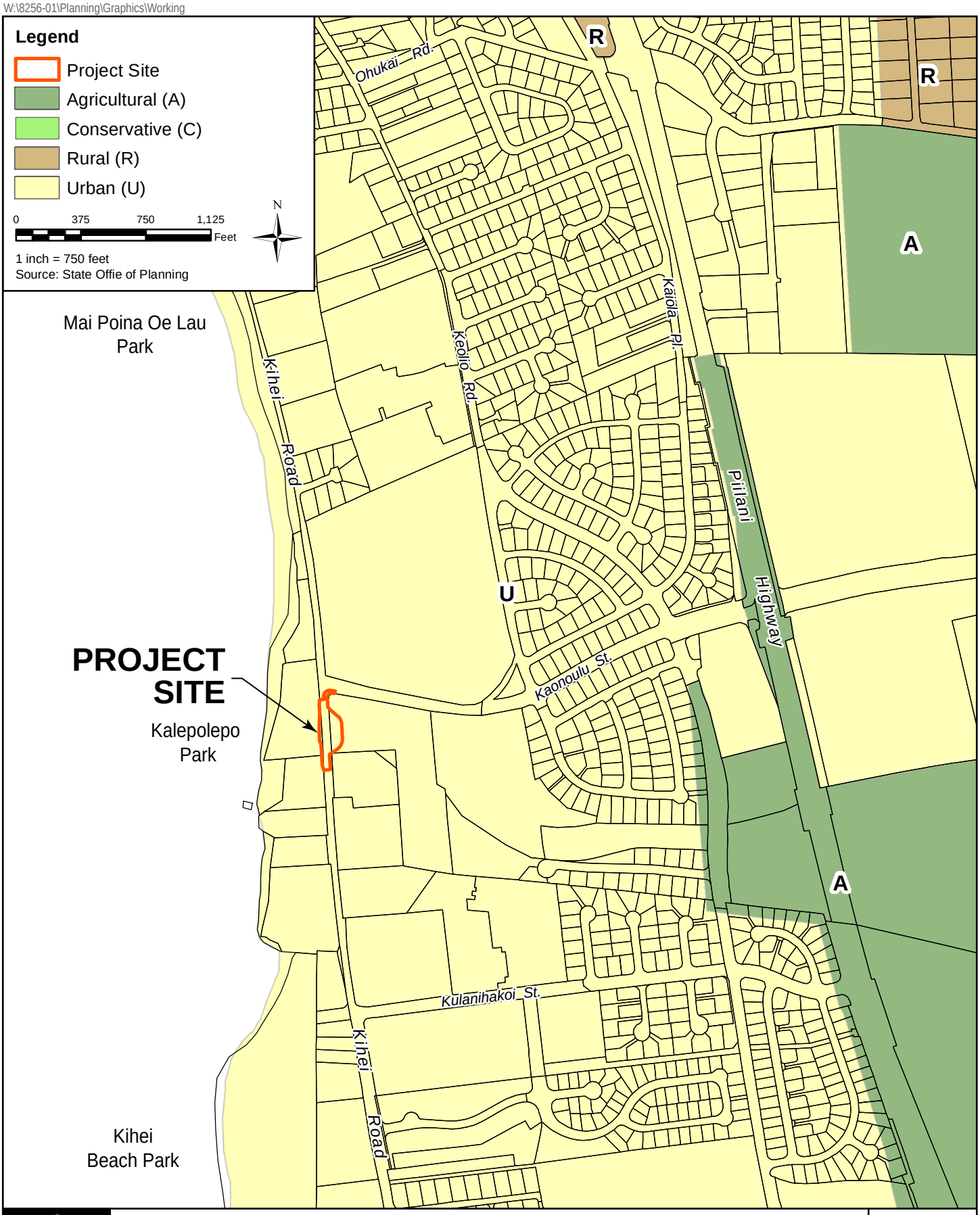

KULANIHAKOI BRIDGE REPLACEMENT

STATE LAND USE DISTRICTS MAP

FIGURE 4-1

WILSON OKAMOTO CORPORATION
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(vi) Adopting water quality standards and regulating point and nonpoint sources of pollution to protect, and where feasible, restore the recreational value of coastal waters.

(vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and

(viii) 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.

The proposed project, at its closest point, is located approximately 120-feet from the draft certified shoreline.

In the short-term, storm water runoff may carry increased amounts of sediment into the storm drain system due to erosion from soils exposed during excavation and grading activities. This runoff could potentially impact the water quality of coastal waters in the area. However, excavation and grading activities associated with the construction of the proposed project will be regulated by the County's grading ordinance.

A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms.

Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

In the long-term, as the proposed culverts will be constructed at a 0.5% slope, the drainage capacity will increase slightly from 204 cfs to 306 cfs. In the event of a 100-year storm, this increase in capacity will increase the likelihood of storm flows breaking through the sand plug. This could slightly relieve some of the upstream flooding, but may slightly increase flows past the sand plug. No significant impacts are anticipated on recreational resources.

(2) Historic Resources

Objective:

(A) 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 archaeological 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.

An Archaeological Literature Review and Field Inspection for the project site was conducted for the property in December 2012. Based on the field inspection findings and background research, there is a low potential for the discovery of previously unidentified historic properties beyond the historic era itself. The area surrounding the bridge includes the Kūlanihāko'i Stream mouth, a natural wetland and associated flood plain. While impacts by flooding episodes and modifications associated with road construction and maintenance have greatly altered sediments of the project areas, the possibility of encountering intact subsurface cultural deposits, including human burials, should not be underestimated. Therefore, archaeological monitoring is recommended for all ground disturbing activities during all phases of the temporary bridge and bypass road work and bridge replacement. It is also recommended that a monitoring report be generated after the construction of the temporary bridge and bypass road and the replacement bridge.

A site inspection was conducted on December 13, 2012 by SHPD and Cultural Surveys Hawai'i. Based on the site inspection, SHPD requested that an AIS be prepared for the project site. The AIS is currently pending and will be submitted to SHPD for approval when it has been completed. Subsequent consultation with SHPD, by letter dated February 1, 2013, indicated that they have concerns that the project area is located within a zone of beach sand dune and Aeolian sand deposits which are known to contain human burial features and historic habitation sites. It is therefore likely that historic properties, including human remains, may be present beneath the previously disturbed road grade and sub-grade or within previously unaffected areas of the right-of-way. SHPD requested that all project associated excavations be monitored by a qualified archaeologist in order to identify and mitigate any subsurface cultural features and deposits. They further recommend that an archaeological monitoring plan be submitted to their office for review and approval prior to initiation of this project.

Should any significant archeological, cultural, or historic resources be found during construction activities, all work will cease in the vicinity of the find and SHPD will be notified immediately to determine appropriate mitigation measures.

With regard to the bridge itself, the structure was constructed in 1911 and is now 102 years old. It is therefore considered a historic property and recordation of the bridge would be required under Chapter 13-275, Hawai'i Administrative Rules if deemed eligible based on

SHPD's evaluation of the bridge's significance. Consultation with SHPD, by letter dated December 20, 2012, indicated that while the bridge is unique due to age and represents the first generation of concrete bridges in the islands, it is literally falling apart and has lost any distinguishing architectural characteristics. On this basis SHPD has determined that the bridge has lost its integrity and is not eligible to be recorded on the State Inventory of Historic Properties. Therefore, the proposed project will have no effect on historic property.

(3) Scenic and Open Space Resources

Objective:

(A) 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 which are not coastal dependent to locate in inland areas.

In the short-term, a temporary bypass road and bridge are being proposed on the mauka side of the existing roadway. This use will be generally similar in visual character to that of the temporary bridge over the existing culverts. Compared to the existing culverts, the temporary bridge on the mauka side of South Kīhei Road would provide a higher view object (approximately 14 feet) for individuals utilizing South Kīhei Road or in close proximity to this portion of the road. However, the temporary bridge and bypass road are necessary in order to maintain usage of this portion of South Kīhei Road during construction of the replacement Kūlanihāko'i Bridge. Once the new bridge is constructed, the temporary bypass road and bridge will be removed.

In the long-term, the proposed replacement bridge is not anticipated to have significant impacts on notable view planes nor adversely affect important public viewing points or visual resources. As an already existing roadway and bridge, the project will not significantly change the scenic and visual character of the surrounding area.

(4) Coastal Ecosystems

Objective:

(A) 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.

The proposed project, at its closest point, is located approximately 120-feet from the draft certified shoreline.

In the short-term, storm water runoff may carry increased amounts of sediment into the storm drain system due to erosion from soils exposed during excavation and grading activities. This runoff could potentially impact the water quality of coastal waters in the area. However, excavation and grading activities associated with the construction of the proposed project will be regulated by the County's grading ordinance.

A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measure will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms. The proposed project is not anticipated to have any long-term impacts to land-based, shoreline, and marine resources. Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

The proposed project is not anticipated to have any long-term impacts on coastal ecosystems. Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

In the long-term, as the proposed culverts will be constructed at a 0.5% slope, the drainage capacity will increase slightly from 204 cfs to 306 cfs. In the event of a 100-year storm, this increase in capacity will increase the likelihood of storm flows breaking through the sand plug. This could slightly relieve some of the upstream flooding, but may slightly increase flows past the sand plug. No significant impacts are anticipated on coastal ecosystems.

(5) Economic Uses

Objective:

(A) 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) Ensure that coastal dependent developments such as harbors and ports, and coastal related development such as visitor facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and

(C) 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.

The proposed project provides the necessary infrastructure to promote the safe and efficient movement of people, goods and services important to the State's economy. The project will provide direct construction and operational jobs and will also have beneficial secondary economic benefits by promoting the procurement of materials and supplies from local vendors.

(6) Coastal Hazards

Objectives:

(A) 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;

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

(C) Prevent coastal flooding from inland projects.

According to the Flood Insurance Rate Map (FIRM) (Community Panel Numbers 1500030586F and 1500030567F, Effective Date: September 19, 2012) prepared by the Federal Emergency Management Agency (FEMA), the project site is designated Zone VE and Zone AE.

Zone VE includes areas with a 1% or greater change of flooding and have an additional hazard associated with storm waves. In general, these areas have a 26% chance of flooding over the life of a 30-year mortgage.

Zone AE is characterized as a "special flood hazard area subject to inundation by the 1% annual chance flood." Zone AE is also a "floodway," in which "the channel of the stream plus any adjacent floodplain areas that must be kept free of the encroachment so that the 1% annual chance flood can be carried without substantial increases in flood height." The 1% annual flood is also commonly referred to as the 100-year flood or the base flood.

According to the Tsunami Evacuation Zone maps for Maui, the project site lies entirely within the tsunami evacuation zone.

Construction activities within the respective flood hazard districts will be conducted in accordance with regulations set forth in Section 19.62.060, Maui County Code. Before construction of any development begins within any flood hazard area, flood-related erosion hazard area, or mudslide area, a special flood hazard area development permit shall be obtained from the Director of the Department of Planning.

The project will also comply with the rules and regulations for the National Flood Insurance Program (NFIP) present in Title 44, of the Code of Federal Regulations (44CFR), as the project is within a Special Flood Hazard Area.

(7) Managing Development

Objective:

(A) Improve the development review process, communication, and public participation in the management of coastal resource 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 or 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.

The Hawai'i State environmental review process, HRS 343, requires project review by government agencies and affords the public the opportunity to provide comments on the proposed project. The proposed improvements are also subject to the Special Management Area (SMA) permit process. Applicable State and County requirements will be adhered to in the design and construction phases of the proposed improvements.

(8) Public Participation

Objective:
(A) 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.

The Hawai'i State environmental review process, Chapter 343, HRS, requires project review by government agencies and affords organizations and the general public the opportunity to provide comments on the proposed project. The proposed improvements are also subject to the SMA and Shoreline Setback Variance permit process as discussed in Section 4.2.2, which includes public notification and a public hearing.

(9) Beach Protection

Objective:
(A) 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.

The proposed project will involve some construction activities within the shoreline setback area and will, therefore, need a shoreline setback variance from the County of Maui Planning Department.

Currently, a draft of the certified shoreline is in the process of being reviewed by the State Department of Land and Natural Resources (DLNR). In accordance with the Shoreline Setback Rules and Regulations for the Maui Planning Commission, the shoreline setback was calculated by utilizing the erosion based setback line which is located further mauka than the average lot depth based setback line. The proposed outlet wing wall adjacent to the southernmost culvert will be located within the shoreline setback. The dimensions of the wing wall within the shoreline setback are 10-feet long, 6-feet to 2-feet high (the wall will

slope towards the ocean), and 1-foot wide. The wing wall is a part of the culvert structure and is intended to retain and protect the foundation of South Kīhei Road.

Depending on the location of the final certified shoreline, other portions of the project may or may not be located in the shoreline setback, including the outlet wing wall adjacent to the northernmost culvert. Similar to the southern outlet wing wall, the northern outlet wing wall is also part of the culvert structure that is intended to help retain and protect the foundation of South Kīhei Road.

The proposed six (6) culverts, two (2) inlet wing walls, and other roadway improvements are located within the existing County right-of-way. These areas have been utilized for roadway and drainage purposes for slightly over a century. In addition, the proposed temporary bridge and bypass road on the mauka side of the existing bridge will be removed and the area would be restored once the permanent culvert improvements are constructed. As the proposed project involved the replacement and upgrade of existing aging infrastructure, the construction and operation of the project is not anticipated to have any significant impacts on beaches for public use and recreation.

(10) Marine Resources

Objective:

(A) Promote the protection, use, and development of marine and coastal resources to assure their sustainability.

Policies:

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

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

(F) 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;

(G) 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

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

The proposed project is not anticipated to have any significant adverse impacts on marine and coastal resources. Potential water quality impacts to nearshore coastal waters during construction of the improvements will be mitigated by adherence to State water quality regulations governing grading, excavation and stockpiling.

In the short-term, storm water runoff may carry increased amounts of sediment into the storm drain system due to erosion from soils exposed during excavation and grading activities. This runoff could potentially impact the water quality of coastal waters in the area. However,

excavation and grading activities associated with the construction of the proposed project will be regulated by the County's grading ordinance.

A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms. The proposed project is not anticipated to have any long-term impacts to land-based, shoreline, and marine resources. Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

The proposed project is not anticipated to have any significant long-term impacts on marine resources. Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

4.1.4 Complete Streets, Act 54 Session Laws of Hawai'i 2009

Act 54, Session Laws of Hawai'i 2009 requires that DOT and county transportation departments ensure the accommodation of all users of the road, regardless of their age, ability, or preferred mode of transportation. It also calls for the creation of a statewide task force to review existing state and county highway design standards and guidelines and requires the DOT and county transportation department to adopt a Complete Streets Policy. Complete streets are defined as "*transportation facilities that are planned, designed, operated, and maintained to provide safe access and mobility for all users, including bicyclists, pedestrians, transit riders, freight, and motorists, and that are appropriate to the function and context of the facility."* Complete streets principles for Hawai'i include the following:

- *Safety – Plan, design, and construct transportation facilities and land developments to create an environment that reduces risk and supports the safe movement of people and goods by all modes.*
- *Flexible design – Design transportation facilities using best practices that integrate community values and recognize the importance of the surrounding context and environment.*
- *Accessibility and mobility for all – Plan and design transportation facilities for ease of use and access to destinations by providing an appropriate path of travel for all*

users, and enhance the ability to move people and goods throughout the state and its counties.

- *Use and comfort of all users – Ensure all users of all abilities including bicyclists, pedestrians, transit riders, and drivers feel comfortable and safe using the transportation system.*
- *Consistency of design standards and guidelines – Encourage consistent use of national best practices to generate consistency in the application of striping and pavement markings for all users on all islands. References of national best practices include the Manual on Uniform Traffic Control Devices (MUTCD) and A Policy on Geometric Design of Highways and Streets (American Association of State Highway and Transportation Officials [AASHTO] Green Book).*
- *Energy efficient – Plan, design, and construct a transportation system that offers transportation choices for residents and visitors and reduces reliance on single-occupant vehicles to improve energy efficiency in travel, and mitigates vehicle emissions.*
- *Health – Recognize the health benefits in providing alternative mode choices, while acknowledging that some routes may be healthier than others.*
- *Appropriate funding – Support a jurisdiction's ability to secure funding for multimodal facilities and provide a framework to consider and pursue funding sources and opportunities.*
- *Building partnerships with organizations statewide – Build partnerships among the HDOT, the Counties, other governmental agencies, and stakeholders to implement complete streets throughout the state.*
- *Green infrastructure/streets – Use trees and landscaping as integral components of a Complete Street to provide both human and ecosystem benefits, such as shade, to reduce the urban heat island effect, vegetation for carbon sequestration, reducing/filtering non-point source pollution and sediments, retaining stormwater, increasing groundwater storage recharge, and providing wildlife habitat.*

The above policies should be considered on all public highways, roadways, and streets statewide when updating long-term planning documents and/or ordinances and when considering project alternatives. Agency design standards should also be updated to incorporate complete streets principles.

Discussion: The proposed project is consistent with the policies of the complete streets. The proposed project will replace the current, deteriorating bridge and provide a bike lane and a paved walkway on the mauka side of the roadway making the area safer for pedestrians, bicyclists, and vehicles. In addition, the makai side of the bridge will be built to accommodate a bike lane and paved walkway if and when future improvements are pursued on the makai side of South Kīhei Road.

4.2 County of Maui Land Use Plans and Policies

4.2.1 County of Maui General Plan 2030

The Maui County General Plan is a long-term, comprehensive blueprint for the physical, economic, environmental development and cultural identity of the County. The General Plan

is comprised of three parts; The Countywide Policy Plan, The Maui Island Plan, and Community Plans.

4.2.1.1 Countywide Policy Plan

As part of the 2030 Maui County General Plan Update, the County adopted a *Countywide Policy Plan* in March 2010, which replaces the *General Plan of the County of Maui 1990 Update.* The *Countywide Policy Plan* provides broad goals, objectives, policies, and implementing actions that portray the desired direction of the County's future. This includes: (1) a vision statement and core values for the County to the year 2030; (2) an explanation of the plan-making process; (3) a description and background information regarding Maui County today; (4) identification of guiding principles; and (5) a list of countywide goals, objectives, policies, and implementing actions related to the following themes:

- Protect the Natural Environment
- Preserve Local Culture and Traditions
- Improve Education
- Strengthen Social and Healthcare Services
- Expand Housing Opportunities for Residents
- Strengthen the Local Economy
- Improve Parks and Public Facilities
- Diversify Transportation Options
- Improve Physical Infrastructure
- Promote Sustainable Land Use and Growth Management
- Strive for Good Governance

The proposed project is consistent with the following *Countywide Policy Plan* objectives and policies relating to diversifying transportation options:

H. Diversify Transportation Options

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

Objective:

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

Policies:

e. *Ensure that roadway systems are safe, efficient, and maintained in good condition.*
g. *Design new road and roadway improvements to retain and enhance the existing character and scenic resources of the communities through which they pass.*
l. *Evaluate all alternatives to preserve quality of life before widening roads.*

Objective:

2. *Reduce the reliance on the automobile and fossil fuels by encouraging walking, bicycling, and other energy-efficient and safe alternative modes of transportation.*

Policies:

a. *Make walking and bicycling transportation safe and easy between and within communities.*
c. *Design and retrofit existing rights-of-way with adequate sidewalks, bicycle lanes, or separated multi-use transit corridors.*

Implementing Actions:

a. *Design, build, and modify existing bikeways to improve safety and separation from automobiles.*

Discussion: The proposed project will replace the current, deteriorating bridge and provide a bike lane and a paved walkway on the mauka side of the roadway making the area safer for pedestrians, bicyclists, and vehicles. In addition, the makai side of the bridge and immediately adjacent areas will accommodate a bike lane and paved walkway. Improvements to additional segments can be implemented if and when future improvements are pursued on the makai side of South Kīhei Road.

4.2.1.2 Maui Island Plan

As part of the 2030 Maui County General Plan Update, the County adopted the *Maui Island Plan* in December 2012. The *Maui Island Plan* establishes a pro-active planning process by establishing urban and rural growth areas that indicated where development is intended and will be supported. It is comprised of goals, policies, programs, and actions based on an assessment of current and future needs and available resources.

The purpose of the *Maui Island Plan* is to:

- Assess existing conditions, trends, and issues specific to Maui;
- Provide policy direction for the use and development of land, the extension and improvement of transportation services and infrastructure, the development of community facilities, the expansion of the island's economic base, the provision of housing, and the protection of natural and cultural resources;
- Establish policies to manage change and to direct decision about future land use and development; and
- Provide the foundation to set capital improvement priorities, revise zoning regulations, and develop other implementation tools.

The proposed project is consistent with or promotes the following *Maui Island Plan* objectives and policies relating to transportation:

Goal:

6.4 An interconnected, efficient, and well maintained, multimodal transportation system.

Objective:

6.4.1 More integrated island-wide transportation and land use planning program that reduces congestion and promotes more efficient (transit-friendly) land use patterns.

Policies:

6.4.1.a Plan for an integrated multi-modal transportation system comprised of public transit, bicycle, pedestrian, automobile, and other transportation modes.

Objective:

6.4.2 Safe, interconnected transit, roadway, bicycle, equestrian, and pedestrian network.

Policies:

6.4.2.d Identify and improve hazardous and substandard sections of roadways, drainage infrastructure, and bridges, provided that the historical integrity of the roads and bridges are protected.

Discussion: The proposed project will replace the current, deteriorating bridge and provide a bike lane and a paved walkway on the mauka side of the roadway making the area safer for pedestrians, bicyclists, and vehicles. In addition, the makai side of the bridge and immediately adjacent areas will accommodate a bike lane and paved walkway. Improvements to additional segments can be implemented if and when future improvements are pursued on the makai side of South Kīhei Road.

4.2.1.3 Kīhei-Mākena Community Plan

The Kīhei-Mākena Community Plan is one of the nine Community Plans for Maui County that reflects current and anticipated conditions in the Kīhei-Mākena region. The Kīhei-Mākena Community Plan provides specific recommendations to address the goals, objectives, and polices contained in the General Plan, while recognizing the values and unique attributes of the Kīhei-Mākena area in order to enhance the region's overall living environment.

According to the Kīhei-Mākena Community Land Use Map, the project site is designated as open space (OS) and park (see Figure 4-2). The OS designation is intended to limit development on certain urban and non-urban designated lands which may be inappropriate for intensive development due to environmental, physical, or scenic constraints; this category includes, but is not limited to shoreline buffer areas, landscape buffers, drainageways, view planes, flood plains, and tsunami areas. The park designation applies to land developed or to be developed for recreational use. This includes all public and private active and passive parks. The proposed project is consistent with these designations as the proposed project is a roadway which is considered to be an incidental use by the County.

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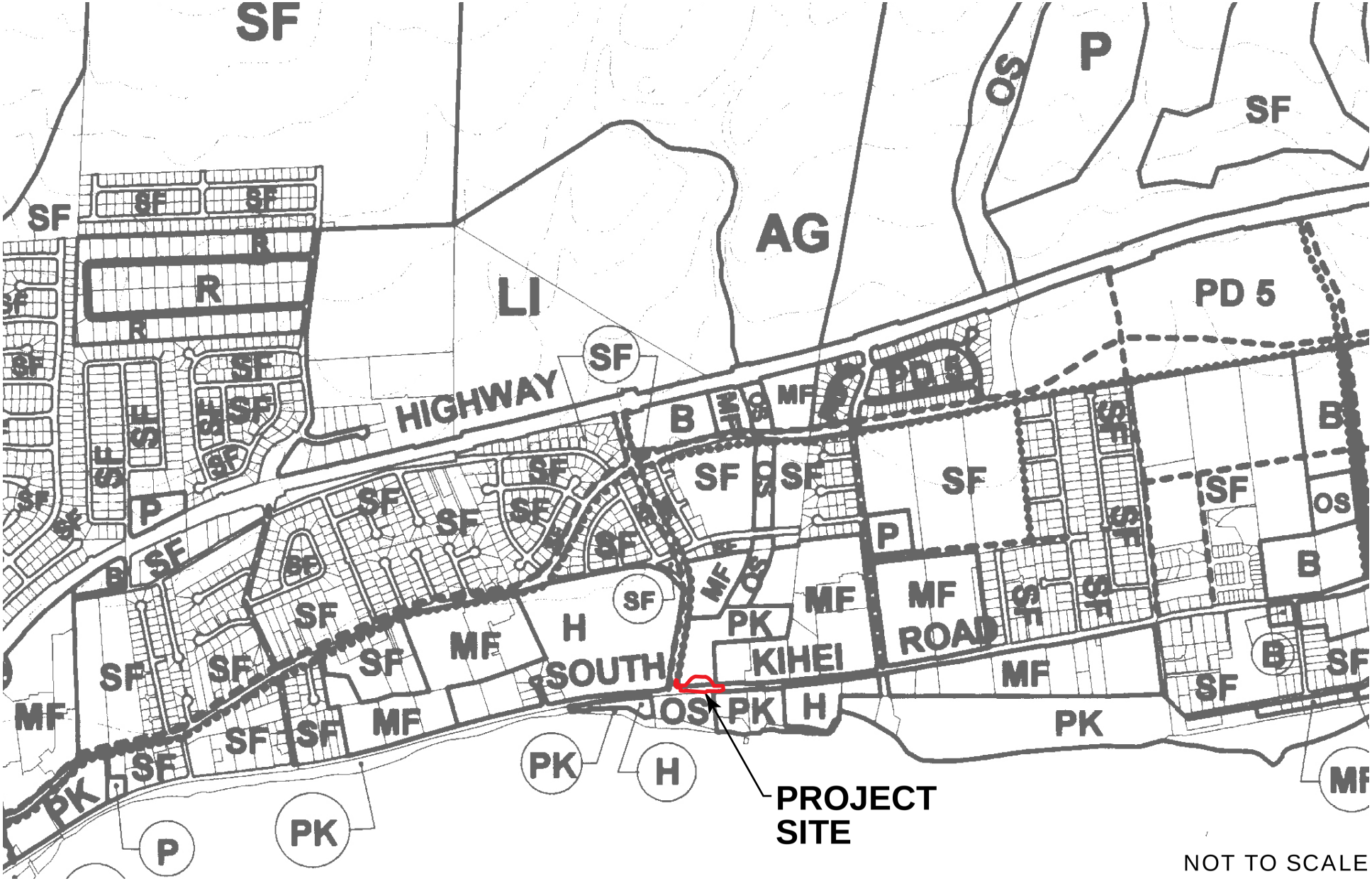

NOT TO SCALE

Source: County of Maui, Planning Department

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KULANIHAKOI BRIDGE REPLACEMENT

KIHEI - MAKENA COMMUNITY PLAN

FIGURE

4-2

In addition, the proposed project is consistent with the Kīhei-Mākena Community Plan goals, objectives, policies, and implementing actions as follows:

Environment

Goal

Preservation, protection, and enhancement of Kīhei-Mākena's unique and fragile environmental resources.

Objectives and Policies

b. Preserve, protect and restore unique natural areas with significant conservation values.

f. Protect all wetland resources, such as those at Keālia Pond and near Road 'C." These open space and wildlife habitat resources are important for flood control and for their natural beauty.

Discussion: Construction activities will involve land-disturbing activities, such as grubbing, clearing, grading, and excavation that may result in some soil erosion and potential construction-related impacts to the quality of surface and coastal waters in the greater project vicinity. Various mitigative measures will be incorporated into the project's construction plan to minimize soil disturbances and potential short-term erosion impacts during construction activities. Excavation and grading activities associated with construction of the proposed improvements will be regulated by the County's grading ordinance.

A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms.

The proposed project is not anticipated to have any long-term impacts to land-based, shoreline, and marine resources. Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion. The wetland area is proposed to be restored back to its existing conditions.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

Cultural Resources

Goal

Identification, preservation, enhancement, and appropriate use of cultural resources, cultural practices, and historic sites that:

a. *Provides a sense of history and defines a sense of place for the Kīhei-Mākena region*

Objectives and Policies

a. *Identify, preserve, protect and restore historical and cultural sites.*

b. *Protect those areas, structures and elements that are a significant and functional part of Hawai'i's ethnic and cultural heritage.*

Discussion: An Archaeological Literature Review and Field Inspection for the project site was conducted for the property in December 2012. Based on the field inspection findings and background research, there is a low potential for the discovery of previously unidentified historic properties beyond the historic era itself. The area surrounding the bridge includes the Kūlanihāko'i Stream mouth, a natural wetland and associated flood plain. While impacts by flooding episodes and modifications associated with road construction and maintenance have greatly altered sediments of the project areas, the possibility of encountering intact subsurface cultural deposits, including human burials, should not be underestimated. Therefore, archaeological monitoring is recommended for all ground disturbing activities during all phases of the temporary bridge and bypass road work and bridge replacement. It is also recommended that a monitoring report be generated after the construction of the temporary bridge and bypass road and the replacement bridge.

A site inspection was conducted on December 13, 2012 by SHPD and Cultural Surveys Hawai'i. Based on the site inspection, SHPD requested that an AIS be prepared for the project site. The AIS is currently pending and will be submitted to SHPD for approval when it has been completed. Subsequent consultation with SHPD, by letter dated February 1, 2013, indicated that they have concerns that the project area is located within a zone of beach sand dune and Aeolian sand deposits which are known to contain human burial features and historic habitation sites. It is therefore likely that historic properties, including human remains, may be present beneath the previously disturbed road grade and sub-grade or within previously unaffected areas of the right-of-way. SHPD requested that all project associated excavations be monitored by a qualified archaeologist in order to identify and mitigate any subsurface cultural features and deposits. They further recommend that an archaeological monitoring plan be submitted to their office for review and approval prior to initiation of this project.

Should any significant archeological, cultural, or historic resources be found during construction activities, all work will cease in the vicinity of the find and SHPD will be notified immediately to determine appropriate mitigation measures.

With regard to the bridge itself, the structure was constructed in 1911 and is now 102 years old. It is therefore considered a historic property and recordation of the bridge would be required under Chapter 13-275, Hawai'i Administrative Rules if deemed eligible based on SHPD's evaluation of the bridge's significance. Consultation with SHPD, by letter dated December 20, 2012, indicated that while the bridge is unique due to age and represents the first generation of concrete bridges in the islands, it is literally falling apart and has lost any distinguishing architectural characteristics. On this basis SHPD has determined that the bridge has lost its integrity and is not eligible to be recorded on the State Inventory of Historic Properties. Therefore, the proposed project will have no effect on historic property.

Physical and Social Infrastructure

Goal

Provision of facility systems, public services and capital improvement projects in an efficient, reliable, cost effective, and environmentally sensitive manner which accommodates the needs of the Kīhei-Mākena community, and fully support present and planned land uses, especially in the case of project district implementation

Transportation

Objectives and Policies

b. Develop and implement a well-planned road and public transportation system to allow residents and visitors to move safely, effectively, and comfortably within the region. Roadway improvements should be planned, designed, and constructed as prioritized under the Implementing Actions section below, and as generally described in the Kīhei Traffic Master Plan.

g. Plan, design, and construct a pedestrian and bikeway network throughout the Kīhei-Mākena region which considers the utilization of existing stream beds, drainageways, wetlands and public rights-of-way along coastal and inland areas.

Discussion: The proposed project will replace the current, deteriorating bridge and provide a bike lane and a paved walkway on the mauka side of the roadway making the area safer for pedestrians, bicyclists, and vehicles. In addition, the makai side of the bridge and immediately adjacent areas will accommodate a bike lane and paved walkway. Improvements to additional segments can be implemented if and when future improvements are pursued on the makai side of South Kīhei Road.

4.2.2 County of Maui Zoning

The purpose and intent of the County of Maui Comprehensive Zoning Ordinance (Title 19, Article II), is to regulate the utilization of land in a manner encouraging orderly development in accordance with the land use directives of the Hawaii Revised Statutes, the revised charter of the County, and the general plan and the community plans of the County.

According to the County of Maui Planning Department, the project site is zoned Drainage (DR), Park (PK), and Apartment (A-1). However, roadways, such as the proposed project, are

considered an incidental use that is permitted in each of the County's zoning districts. Thus the proposed project is consistent with the County zoning districts.

4.2.3 County of Maui Special Management Area

Pursuant to the Hawai'i CZM Program, Chapter 205A, HRS, the counties have enacted ordinances establishing Special Management Areas (SMA). Any "development" within the SMA requires an SMA Use Permit administered by the County of Maui Planning Department. Through the SMA permit system, the County assesses and regulates developments proposed for areas located within the SMA and the proposed developments are evaluated for compliance with the CZM objectives and policies and SMA guidelines set forth in Chapter 205A, HRS. Figure 2-2 shows that the entire project site is located within the SMA. Since the project has a total cost fair market value greater than $125,000 in value and is considered a "development," an SMA Use Permit will be required for the proposed project. The proposed project is consistent with the CZM objectives and policies as described in Section 4.1 of this document.

4.3 Permits and Approvals

The following is a list of permits, approvals, and reviews that may be required prior to construction and operation of the proposed project.

<u>Federal</u>

Department of the Army
- Department of the Army, Nationwide Permit, Section 404, Clean Water Act
- Department of the Army, Section 10 Permit, Rivers and Harbors Act

Federal Highways Administration
- National Environmental Policy Act (NEPA) Categorical Exclusion
- Section 7 of the Endangered Species Act
- Section 106 of the National Historic Preservation Act

<u>State of Hawai'i</u>

Department of Health
- Section 401, Clean Water Act, Water Quality Certification
- National Pollutant Discharge Elimination System (NPDES) Permit for Dewatering Activity
- Noise Permit

Department of Land and Natural Resources
- Chapter 6E, HRS, State Historic Preservation Law
- Stream Channel Alteration Permit

Office of Planning
- Coastal Zone Management (CZM) Federal Consistency Certification

County of Maui

Planning Department

- Special Management Area Use Permit
- Shoreline Setback Variance
- Special Flood Hazard Area Development Permit
- Grading/Grubbing Permit
- Permit to Perform Work within County Right-of-Way

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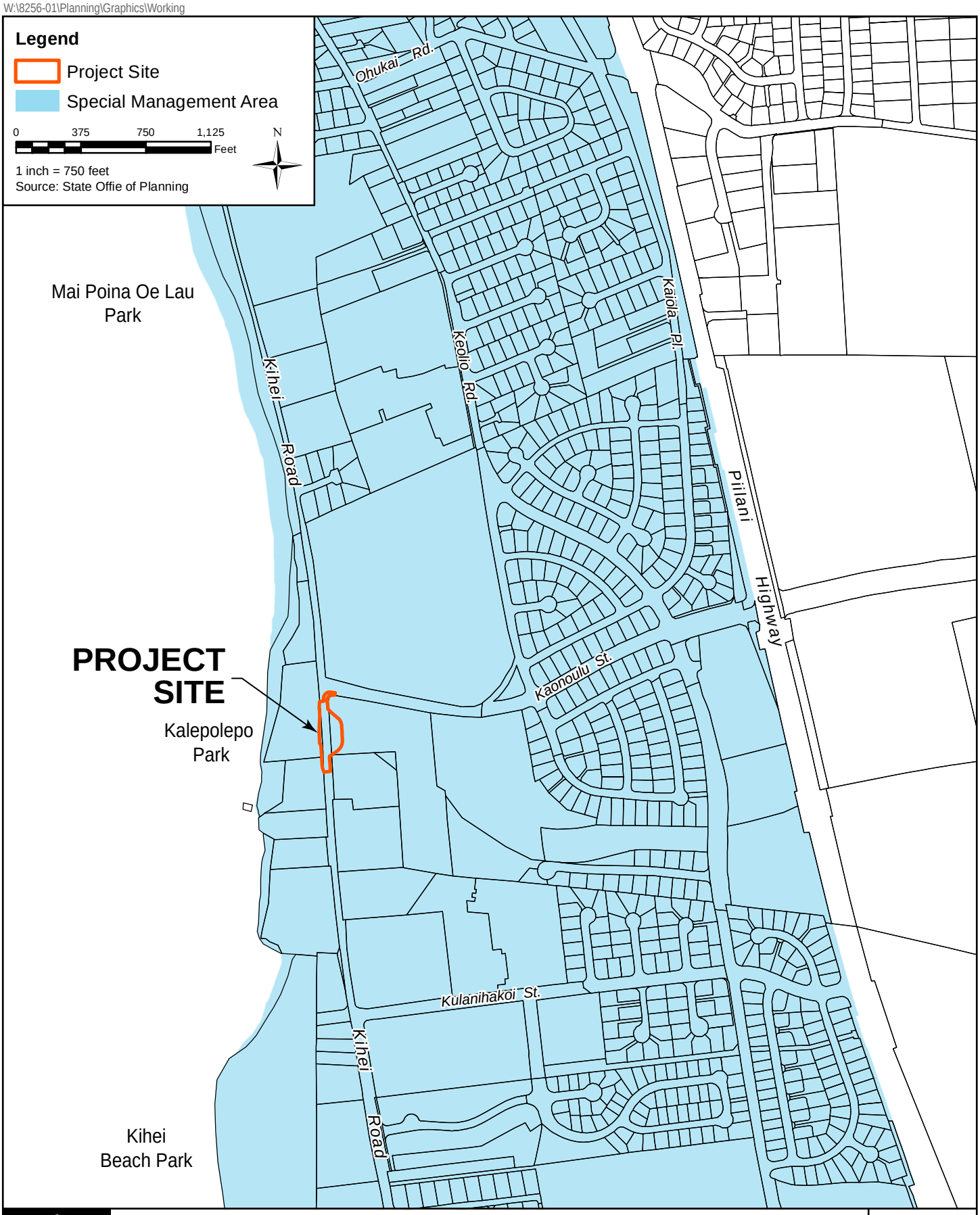

KULANIHAKOI BRIDGE REPLACEMENT

SPECIAL MANAGEMENT AREA MAP

FIGURE 4-3

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5. ALTERNATIVES

5.1 No Action Alternative

Under the no action alternative, the replacement of the deteriorating culverts and the proposed roadway improvements would not be pursued. Environmental impacts would be avoided, construction costs spared, and the need for permits precluded.

The existing culverts would continue to deteriorate and substandard conditions for motorists, pedestrians, and bicyclists would continue. As the bridge is structurally deficient, the culverts have the potential to collapse in the near future due to vehicles traversing over it. If the bridge should collapse, this portion of South Kīhei Road would need to be closed and vehicles rerouted causing increased congestion on other nearby roadways such as Ohukai Road, Ka'ono'ulu Road, Kūlanihāko'i Street, Waipu'ilani Road, and Pi'ilani Highway. This would inconvenience residents and businesses who depend on that portion of South Kīhei Road as a through road for their needs.

5.2 Alternative 1: Construction of Four (4) 6-Feet Wide and 4-Feet High Culverts

This alternative proposes constructing four (4) new culverts to replace the existing four (4) deteriorating culverts. As stated in earlier sections, the proposed six (6) culverts only provides a slight increase in drainage capacity for a 100-year, 24-hour storm event. Currently because of the relatively flat topography of the area, installation of four (4) new 6-feet wide by 4-feet high culverts at South Kīhei Road would basically ensure that the same flooding parameters which result from the existing four (4) culverts would continue. Since the sand plug is a natural occurrence at the ocean outlet, flows would continue to be impeded. Silt and sediment would continue to accumulate at the muliwai. With the replacement of the four culverts, South Kīhei Road can continue to be utilized as a collector road. Basically, the replacement of the four (4) culverts represents a continuation of the status quo.

5.3 Alternative 2: Construction of Eight (8) 6-Feet Wide and 4-Feet High Culverts

This alternative proposes constructing a total of eight (8) culverts, each 6-feet wide and 4-high. Drainage capacity of the culverts was analyzed, assuming the downstream end of the stream was not blocked off from the existing accumulated sand plug at the shoreline. The results showed that the eight (8) culverts would have an increased flow capacity (409 cfs) and could handle more flow than the existing four culverts as well as the proposed culverts (204 cfs and 306 cfs, respectively). However, this increased capacity does not significantly reduce the amount of runoff overtopping South Kīhei Road. This is due to the accumulated sand dunes blocking the natural flow of the outlet of the stream as well as the relatively flat topography of lands around South Kīhei Road and the shoreline. This causes runoff to pond until water levels reach a height higher than the sand plug or the sand plug is breached. Therefore, adding additional culverts will not reduce the existing flooding in the area.

Although there is an increase in drainage capacity and depth of flow over the roadway is slightly decreased, the proposed bridge replacement ultimately does not resolve the existing flooding that occurs near and around the project site during heavy storm events. This is due to the accumulating sand dunes blocking off the downstream path causing runoff to back up and flood the roadway. The eight (8) culverts were also analyzed assuming that the outlet is

not blocked. The results from the model and calculations show that the depth overtopping the roadway is reduced significantly by about three feet.

While the additional culverts would provide a slight decrease in flows overtopping South Kīhei Road, the decrease is not significant enough that it would address the regional flooding problem in the area. While flooding is a concern, it is beyond the scope of this project as it is a regional issue and should be addressed by a drainage master plan. The County of Maui is currently updating their Kīhei Drainage Master Plan which is anticipated to be completed within two years.

5.4 Alternative 3: Construction of Larger Culverts or Construction of a Bridge over South Kīhei Road to Accommodate the 100-Year Storm

This alternative proposes installation of larger culverts or a bridge over the existing culverts to handle the 100-year storm.

As discussed earlier in Section 3.13.3, at the point where the 100-year storm runoff flows reach the existing culverts, the total flow would be approximately 14,148 cfs. To accommodate this flow, the size of the culverts, as well as the velocity of the peak flows need to be considered. For example, if the velocity of the flow is assumed to travel at 10 feet per second, the culverts would need to be a total of 10-feet high and 140-feet wide. However, if the velocity of the flow is assumed to travel at 25 feet per second, the culverts would need to be a total of 10-feet high and 56-feet wide. Freeboard requirements for the bridge present another safety factor that needs to be considered. This would result in wider and/or deeper channels, therefore, at a minimum, the roadway would also need to be raised, the invert of the culverts deepened, and/or the span of the culverts would need to be widened to accommodate the 100-year storm flow. The roadway would need to be constructed at a slight incline, but due to the physical constraints of the project site, neighboring properties. would require extensive improvements which may require reconstruction of the Ka'ono'ulu intersection and the existing drainage system along South Kīhei Road to prevent flooding of the Kīhei Bay Vista complex from the proposed bridge. Although in this alternative the storm flows would not overtop the roadway, flooding would still be an issue for the surrounding areas because of the sand plug and the flat topography of the area.

Similarly for the bridge alternative, the bridge could sit approximately 3-feet higher than the existing road with a mid-span pier to help reduce the amount of runoff overtopping the roadway during heavy storm events. Assuming that the outlet is not blocked off by the existing accumulating sand dunes, it was determined that storm runoff from the 100-year storm event would still overtop the bridge, but not as severe as the proposed six (6) culverts. To compensate for this occurrence, the bridge could be raised higher. This is a similar situation to the larger culvert in which, due to the physical constraints of the project site, constructing a bridge would require extensive improvements which may require reconstruction of the Ka'ono'ulu intersection and the existing drainage system along South Kīhei Road to prevent flooding of the Kīhei Bay Vista complex from the proposed bridge.

5.5 Alternative 4: Increasing Drainage Channel Capacity

This alternative proposes construction of a drainage channel. The makai portions of Kūlanihāko'i Gulch are not a well-defined water course. There are limited channel capacities that are unable to contain peak flows during storm periods. As a result, during significant rainfall events, runoff from the upper areas of the watershed descends onto the Kīhei flood plains in voluminous quantities. Thus, during significant rains, the existing drainage channel will be overtopped before it reaches the existing culvert even if the culvert is properly sized for the 100 year storm. In order to fully accommodate the 100-year storm flows, the upstream and downstream drainageways need to have the capacity to accommodate peak flows. This would require a drainage channel to be excavated from Ka'ono'ulu Estates IV, near Pi'ilani Highway, to the ocean.

Due to the relatively flat coastal topography and the sand dunes which tend to form at the stream mouth, the drainage channel would likely need to extend partially into the ocean. Makai portions of the channel would most likely contain sea water on a relatively permanent basis. Such a channel would likely involve land acquisition and involve view and aesthetic impacts. Portions of existing beach areas would be occupied by a drainage structure at the stream mouth.

A significantly larger and more direct drainage route to the ocean would likely mean increased sediment and other pollutants deposited into the nearshore environment. The increased volume and velocity of runoff may affect the bathymetry of the area, which in turn affects wave action, coral growth and sand transport. Since the watershed is significant in terms of its size, impacts to the nearshore environment would need to be studied carefully. Possible effects on coral, aquatic biota, fish and marine mammals need to be considered.

While increasing the drainage channel capacity is an alternative, the scope and assessment of impacts for this alternative is much larger than replacing a single deteriorated culvert bridge at South Kīhei Road. As drainage in this area is a regional problem, a coordinated drainage master plan for the region is needed to address how drainage throughout the area will be handled. The County of Maui is currently updating their Kīhei Drainage Master Plan which is anticipated to be completed in approximately two years.

5.6 Alternative 5: Installation of Upstream Detention

This alternative proposes upgrading the culverts at South Kīhei Road and installing appropriately sized detention basins located mauka of Pi'ilani Highway. Detention basins would allow for controlled release of runoff so water would likely be flowing downstream of the basins for a period of time after rain has stopped. Depending on its size and the percolation capacity of the soil, retention basins can allow significant portions of peak runoff to percolate into the ground and allows some settlement and removal of sediment and other pollutants.

Upstream detention does not only involve the excavation of basins. Analysis must be undertaken to ensure that drainageways leading to the basin and leaving the basin are adequate to carry flows. If not, excavation to provide for adequate drainage capacity will be needed. It should be noted that this alternative will require a significant amount of land from upstream owners.

As mentioned earlier, the total flows for a 100-year storm would be approximately 14,148 cfs. The 100-year storm is measured over a 24-hour period. Therefore, a 24-hour period would yield flows of approximately 1,222,387,200 cubic feet of storm flow per day. To accommodate this maximum amount of flow and to not allow any flow to enter the ocean, the upstream detention basin would need to be approximately the size of 1-mile in length by 1-mile in width by approximately 44-feet in depth.

To ensure that the detention basins and related drainageways function properly over time, maintenance concerns need to be addressed. Debris, silt and sediment which accumulate in the basin and drainageways must be removed in order to ensure adequate capacity. Personnel needed to maintain the system as well as the cost of maintenance needs to be taken into consideration. Access through private property must also be provided so that maintenance activities can be undertaken.

While installing detention basins and related draingeways are an alternative, the scope and assessment of impacts for this alternative is much larger than replacing a single deteriorated culvert bridge at South Kīhei Road. As drainage within this watershed is a regional problem, a coordinated drainage master plan for the region is needed to address how drainage throughout the area will be handled. The County of Maui is currently updating their Kīhei Drainage Master Plan which is anticipated to be completed in approximately two years.

5.7 Alternative 6: Diversion of Upstream Flows to Another Drainage District

This alternative proposes diverting runoff flows generated mauka of Pi'ilani Highway within the Kūlanihāko'i drainage district to other nearby drainage districts. This alternative may lessen flooding and environmental impacts in the area of Kūlanihāko'i Gulch from Pi'ilani Highway to the shoreline, however, it would exacerbate flooding issues in the neighboring districts.

Although the Kūlanihāko'i Gulch generates most of the flows within the Kūlanihāko'i District, there are smaller subdistricts which contribute to the total amount of flow. In terms of the 100-year storm flows, the Kūlanihāko'i District generates more than 13,000 cfs mauka of Pi'ilani Highway. Under this alternative, these flows would be diverted to neighboring drainage districts.

Waiakoa District which is the neighboring district to the north, generates 100-year storm flows of approximately 9,000 cfs mauka of Pi'ilani Highway. If Kūlanihāko'i District flows were diverted to the Waiakoa District, approximately 22,000 cfs of peak flows would need to be accommodated. Similarly, Waipu'ilani Gulch, which is the neighboring district to the south, generates 100-year storm flows of more than 10,000 cfs. If flows from the Kūlanihāko'i Distict were diverted to the Waipu'ilani District to the south, then 23,000 cfs of peak flows would need to be accommodated.

Should this alternative be pursued, analysis would have to be undertaken to ensure that the neighboring drainageways have the capacity to accommodate the peak flows from the Kūlanihāko'i District. This would most likely require that channel(s) of adequate size to accommodate peak flows would likely need to be excavated in which ever neighboring district was chosen. Roadway culverts also have to be significantly enlarged. Because of

the relatively flat coastal topography and the sand dunes which tend to form at the stream mouth, the drainage channel may need to extend partially into the ocean. Makai portions of the channel may also contain sea water on a relatively permanent basis.

Such channel(s) would likely involve land acquisition and involve view and aesthetic impacts. Portions of existing beach areas would be occupied by a drainage structure at the stream mouth(s) of the neighboring drainage district.

A significantly larger and more direct route to the ocean would likely mean increased sediment and other pollutants deposited into the nearshore environment of the neighboring drainage district. The increased volume and velocity of runoff may also affect the bathymetry of the area, which in turn would affect wave action, coral growth and sand transport. Since the drainage area and peak runoff have significantly increased within the adjoining drainage district, impacts to the nearshore environment would need to be studied carefully. Possible effects on coral, aquatic biota, fish and marine mammals are likely to be significant and concentrated.

While the general concept of diversion of upstream flows to another drainage district is a possible alternative, diversion of peak runoff to other areas further away would only add more expense and concentrate the issues of dealing with peak runoff to another area besides the Kūlanihāko'i Drainage District. In addition, the scope and assessment of impacts for this alternative is much larger than replacing a single deteriorated culvert bridge at South Kīhei Road. As drainage in this area is a regional problem, a coordinated drainage master plan for the region is needed to address how drainage throughout the area will be handled. The County of Maui is currently updating their Kīhei Drainage Master Plan which is anticipated to be completed in approximately two years.

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6. ANTICIPATED DETERMINATION OF FONSI

The proposed project involves the following improvements:

Potential impacts of the proposed improvements have been evaluated in accordance with the significance criteria of Section 11-200-12 of the Department of Health's Administrative Rules. Discussion of the project's conformance to the criteria is presented as follows:

(1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;

An Archaeological Literature Review and Field Inspection for the project site was conducted for the property in December 2012. Based on the field inspection findings and background research, there is a low potential for the discovery of previously unidentified historic properties beyond the historic era itself. The area surrounding the bridge includes the Kūlanihāko'i Stream mouth, a natural wetland and associated flood plain. While impacts by flooding episodes and modifications associated with road construction and maintenance have greatly altered sediments of the project areas, the possibility of encountering intact subsurface cultural deposits, including human burials, should not be underestimated. Therefore, archaeological monitoring is recommended for all ground disturbing activities during all phases of the temporary bridge and bypass road work and bridge replacement. It is also recommended that a monitoring report be generated after the construction of the temporary bridge and bypass road and the replacement bridge.

A site inspection was conducted on December 13, 2012 by SHPD and Cultural Surveys Hawai'i. Based on the site inspection, SHPD requested that an AIS be prepared for the project site. The AIS is currently pending and will be submitted to SHPD for approval when it has been completed. Subsequent consultation with SHPD, by letter dated February 1, 2013, indicated that they have concerns that the project area is located within a zone of beach sand dune and Aeolian sand deposits which are known to contain human burial features and historic habitation sites. It is therefore likely that historic properties, including human remains, may be present beneath the previously disturbed road grade and sub-grade or within previously unaffected areas of the right-of-way. SHPD requested that all project associated excavations be monitored by a qualified archaeologist in order to identify and mitigate any subsurface cultural features and deposits. They further recommend that an archaeological monitoring plan be submitted to their office for review and approval prior to initiation of this project.

Should any significant archeological, cultural, or historic resources be found during construction activities, all work will cease in the vicinity of the find and SHPD will be notified immediately to determine appropriate mitigation measures.

With regard to the bridge itself, the structure was constructed in 1911 and is now 102 years old. It is therefore considered a historic property and recordation of the bridge would be required under Chapter 13-275, Hawai'i Administrative Rules if deemed eligible based on SHPD's evaluation of the bridge's significance. Consultation with SHPD, by letter dated December 20, 2012, indicated that while the bridge is unique due to age and represents the first generation of concrete bridges in the islands, it is literally falling apart and has lost any

distinguishing architectural characteristics. On this basis SHPD has determined that the bridge has lost its integrity and is not eligible to be recorded on the State Inventory of Historic Properties. Therefore, the proposed project will have no effect on historic property.

There will be no destruction or loss of any significant, endangered, or threatened botanical, faunal, geological, or other natural resources. With the exception of the Hawaiian Stilt, none of the plant or animal species identified within the project site are threatened or endangered, or are a species of concern. Prior to construction, it is recommended that a qualified biologist survey areas mauka of the proposed project site to determine if any nesting stilt are present. If nesting stilt are found, the County will need to consult with the USFWS over appropriate measures or conditions that may need to be met to ensure that construction activity does not harm nesting stilts. There are no federally delineated Critical Habitat within or close to the project corridor, thus construction and operation of the proposed project will not result in any impacts to federally designated Critical Habitats.

(2) Curtails the range of beneficial uses of the environment;

The proposed project will not curtail the beneficial uses of the environment. Use of the project site for the proposed project would be consistent with its current use as a culvert bridge and a roadway.

(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 proposed project does not conflict with long-term environmental policies, goals, and guidelines of the State of Hawai'i. As presented in this EA, the project's potential temporary adverse impacts are associated primarily with short-term construction-related activities and can be mitigated through adherence to standard construction mitigation practices.

(4) Substantially affects the economic or social welfare of the community or state;

In the short-term, the proposed project will confer positive benefits in the local economy. Direct economic benefits will result from construction expenditures both through the purchase of material from local suppliers and through the employment of local labor, thereby stimulating that sector of the economy. Indirect economic benefits may include benefits to local retailing businesses resulting from construction activities.

There are no significant adverse long-term socio-economic impacts anticipated with the proposed improvements. The replacement of the culverts and the associated improvements to South Kīhei Road are not expected to induce growth beyond that which is anticipated for the region. The improvements are intended to benefit the entire Kīhei region without impacting a specific ethnicity or income group. The proposed project will not result in a disproportionality high adverse impact on minority and low-income populations.

(5) Substantially affects public health;

No significant adverse short or long-term impacts are anticipated as a result of the proposed project.

In the long-term, the proposed project will provide positive effects as the proposed project will replace the existing, deteriorating culverts and provide a bike lane and a paved walkway on the mauka side of the roadway. This will enhance the safety of motorists, bicyclists, and pedestrians along this section of roadway.

(6) Involves substantial secondary impacts, such as population changes or effects on public facilities;

No secondary effects are anticipated with the construction or operation of the proposed project. The improvements, in and of themselves, are not anticipated to affect the population of the Kīhei District. Rather, the project is proposed to fulfill an essential community need to provide safe access to and from the region for vehicles, bicyclists, and pedestrians alike.

(7) Involves a substantial degradation of environmental quality;

The proposed project is not anticipated to involve a substantial degradation of environmental quality.

Construction activities associated with the proposed improvements will create some adverse short-term impacts such as unavoidable noise impacts and air quality impacts from soil excavation and other ground disturbance activities. Unavoidable construction noise impacts on nearby land uses in the immediate vicinity of the proposed project will be mitigated to some degree by complying with the provisions of the State DOH Administrative Rules, Title 11, Chapter 46, Community Noise Control. Potential air quality impacts during construction of the proposed project will be mitigated by complying with the State DOH Administrative Rules, Title 11, Chapter 60, Air Pollution Control.

Potential water quality impacts to surface and near shore coastal waters during construction of the proposed improvements will be mitigated by adherence to State and County water quality regulations governing grading, excavation, and stockpiling. A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH, pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms. Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

In the long-term, no significant air quality, noise, or water quality impacts are anticipated from the operation of the proposed project.

(8) Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;

No cumulative effects are anticipated, inasmuch as the proposed project involves replacing an existing culvert bridge and roadway improvements in an already urbanized setting.

(9) Substantially affects a rare, threatened, or endangered species, or its habitat;

No listed, candidate, or proposed rare, threatened, or endangered species of flora or fauna under either the Federal or State endangered species statutes nor any critical habitat units will be disturbed as a result of the proposed improvements.

Prior to construction, it is recommended that a qualified biologist survey areas mauka of the proposed project site to determine if any nesting Hawaiian stilt are present. If nesting stilt are found, the County will need to consult with the USFWS over appropriate measures or conditions that may need to be met to ensure that construction activity does not harm nesting stilts. There are no federally delineated Critical Habitat within or close to the project corridor, thus construction and operation of the proposed project will not result in any impacts to federally designated Critical Habitats.

(10) Detrimentally affects air or water quality or ambient noise levels;

No long-term significant impacts to air quality, water quality, or noise levels within the project site are anticipated with the construction of the proposed project.

During construction of the proposed project, two potential types of air pollution emissions will likely occur, resulting in air quality impacts: 1) airborne dust from construction activities such as grading and excavation within the project site; and 2) exhaust emissions from construction vehicles and equipment from the project site.

Potential air quality impacts during construction of the proposed project will be mitigated by complying with the State DOH Administrative Rules, Title 11, Chapter 60-11.1 "Air Pollution Control." The construction contractor is responsible to complying with the State DOH regulations which prohibit visible dust emissions at property boundaries. Compliance with State regulations will require adequate measures to control airborne dust by methods such as water spraying and sprinkling of loose or exposed soil or ground surface areas and dust-generating equipment during construction. As may be deemed appropriate, planting of landscaping or re-paving as soon as possible on completed areas will also help to control dust. During construction, air quality levels would be most affected by vehicular emissions generated by project-related traffic, however, the elevated vehicular emission concentrations are anticipated to dissipate.

Potential water quality impacts to surface and near shore coastal waters during construction of the proposed improvements will be mitigated by adherence to State and County water quality regulations governing grading, excavation, and stockpiling. A DOA Nationwide Permit, pursuant to Section 404 of the Clean Water Act and a WQC, issued by the DOH,

pursuant to Section 401 of the Clean Water Act will be required. In conjunction with the Section 401 and 404 permits, a BMP plan will be prepared for construction activities within the project site. Erosion and sediment control measures will be instituted in accordance with site specific assessments, incorporating appropriate structural and/or non-structural BMPs such as minimizing time of exposure between construction and landscaping, and implementing erosion control measures such as silt fences and filter berms. Following construction, exposed soils at the project site will have been built over, paved over, or re-vegetated to control erosion.

Construction activities are not likely to introduce to, nor release from the soil any materials which could adversely affect groundwater. Construction material wastes will be appropriately disposed of and must also be prevented from leaching into receiving bodies of water.

Dewatering may be required for the proposed project. Should dewatering be deemed necessary, the contractor will be responsible to obtaining all applicable permits including, but not limited to, an NPDES Permit for Dewatering Activities. The permit application will require a BMP plan, an erosion control plan, and a water quality monitoring plan. Water quality impacts associated with the disposal of dewatering effluent will also be addressed in the BMP plan, including appropriate characterization of any potential pollutants such as sediments and nutrients in the effluent.

No long-term significant impacts to noise levels within the project site are anticipated as a result of construction and operation of the proposed project.

In the short-term, noise from construction activities such as excavation, grading, cutting and paving will be unavoidable. The increase in noise level will vary according to the particular phase of construction. Noise may also increase as a result of operating heavy construction vehicles and other power equipment during the construction period.

Construction noise impacts will be mitigated by compliance with provisions of the State DOH Administrative Rules, Title 11, Chapter 46, "Community Noise Control" noise control regulations. These rules require a noise variance for any night work. Night work is anticipated for the project and, as such, a noise variance will be obtained. Further, DOH rules require a noise permit if the noise levels from construction activities are expected to exceed the allowable levels stated in the DOH Administrative Rules. It shall be the contractor's responsibility to minimize noise by properly maintaining noise mufflers and other noise-attenuating equipment, and to maintain noise levels within regulatory limits. Also, the guidelines for hours of heavy equipment operation and noise curfew times as set forth by the DOH noise control rules will be adhered to; or if necessary, a noise permit will be obtained.

In the long-term, no significant noise impact is anticipated once the proposed project has been completed. Noise from vehicles will continue to be the primary noise source along the project site, however, no adverse noise effects from the project are anticipated since the project is not expected to generate additional traffic in the vicinity.

(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;

No short- or long-term significant impacts are anticipated as the project site is not located within an environmentally sensitive area.

According to the Flood Insurance Rate Map (FIRM) (Community Panel Numbers 1500030586F and 1500030567F, Effective Date: September 19, 2012) prepared by the Federal Emergency Management Agency (FEMA), the project site is designated Zone VE and Zone AE.

Zone VE includes areas with a 1% or greater change of flooding and have an additional hazard associated with storm waves. In general, these areas have a 26% chance of flooding over the life of a 30-year mortgage.

Zone AE is characterized as a "special flood hazard area subject to inundation by the 1% annual chance flood." Zone AE is also a "floodway," in which "the channel of the stream plus any adjacent floodplain areas that must be kept free of the encroachment so that the 1% annual chance flood can be carried without substantial increases in flood height." The 1% annual flood is also commonly referred to as the 100-year flood or the base flood.

According to the Tsunami Evacuation Zone maps for Maui, the project site lies entirely within the tsunami evacuation zone.

Construction activities within the respective flood hazard districts will be conducted in accordance with regulations set forth in Section 19.62.060, Maui County Code. Before construction of any development begins within any flood hazard area, flood-related erosion hazard area, or mudslide area, a special flood hazard area development permit shall be obtained from the Director of the Department of Planning.

The project will also comply with the rules and regulations for the National Flood Insurance Program (NFIP) present in Title 44, of the Code of Federal Regulations (44CFR), as the project is within a Special Flood Hazard Area.

(12) Substantially affects scenic vistas and viewplanes identified in county or state plans or studies; or,

In the short-term, a temporary bypass road and bridge are being proposed on the mauka side of the existing roadway. This use will be generally similar in visual character to that of the temporary bridge over the existing culverts. Compared to the existing culverts, the temporary bridge on the mauka side of South Kīhei Road would provide a higher view object (approximately 14 feet) for individuals utilizing South Kīhei Road or in close proximity to this portion of the road. However, the temporary bridge and bypass road are necessary in order to maintain usage of this portion of South Kīhei Road during construction of the replacement Kūlanihāko'i Bridge. Once the new bridge is constructed, the temporary bypass road and bridge will be removed.

In the long-term, the proposed replacement bridge is not anticipated to have significant impacts on notable view planes nor adversely affect important public viewing points or visual resources. As an already existing roadway and bridge, the project will not significantly change the scenic and visual character of the surrounding area.

(13) Requires substantial energy consumption.

Operation of the proposed project will not result in a significant increase in energy consumption.

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7. CONSULTATION

7.1 Pre-Assessment Consultation

The following agencies and organization were consulted during the preparation of the Draft EA. Of the 14 parties that formally replied during the pre-assessment period, some had no comments while others provided substantive comments as indicated by the ✓ and ✓✓, respectively. All written comments are reproduced in Appendix F.

Federal Agencies

✓✓ U.S. Army Corps of Engineers (COE)
U.S. Fish and Wildlife Service
National Oceanic and Atmospheric Administration (NOAA)
NOAA, National Marine Fisheries Service

State Agencies

✓ Department of Accounting and General Services
Department of Business, Economic Development & Tourism (DBEDT)
DBEDT, Land Use Commission
✓✓ DBEDT, Office of Planning
Department of Education
Department of Health (DOH)
✓✓ DOH, Clean Water Branch
DOH, Environmental Management Division
✓✓ DOH, Environmental Planning Office
✓✓ DOH, Office of Environmental Quality Control
Department of Land and Natural Resources (DLNR)
✓✓ DLNR, Engineering Division
DLNR, Land Division
DLNR, State Historic Preservation Division
✓✓ DLNR, Office of Conservation and Coastal Lands
✓ Department of Transportation
Office of Hawaiian Affairs

County of Maui

✓✓ Department of Environmental Management
✓✓ Department of Fire and Public Safety
✓ Department of Parks and Recreation
Department of Planning
✓ Department of Public Works
Department of Transportation
Department of Water Supply
Police Department

Other Interested Parties and Individuals

✓✓ Kīhei Community Association

7.2 Draft Environmental Assessment Consultation

The following agencies and organizations will be consulted during the public review period of the Draft EA:

Federal Agencies

- U.S. Army Corps of Engineers (COE)
  - COE, Civil Works Technical Branch
  - COE, Regulatory Branch
- U.S. Fish and Wildlife Service
- U.S. Geological Survey
- National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service

State Agencies

- Department of Business, Economic Development, and Tourism (DBEDT)
  - DBEDT, Office of Planning
- Department of Health (DOH)
  - DOH, Clean Water Branch
  - DOH, Environmental Planning Office
  - DOH, Office of Environmental Quality Control
- Department of Land and Natural Resources (DLNR)
  - DLNR, Engineering Division
  - DLNR, Land Division
  - DLNR, Office of Conservation and Coastal Lands
  - DLNR, State Historic Preservation Division
- Office of Hawaiian Affairs
- University of Hawai'i Environmental Center
- Department of Transportation

County of Maui

- Department of Environmental Management
- Department of Fire and Public Safety
- Department of Parks and Recreation
- Department of Planning
- Department of Public Works
- Department of Transportation
- Department of Water Supply
- Police Department

Utility Companies

- Maui Electric Company
- Oceanic Time Warner Cable
- Hawai'i Gas
- Hawaiian Telcom

Other Interested Parties and Individuals

- Kīhei Community Association
- Kenranes, Ltd.

8. REFERENCES

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APPENDIX A

Dune Investigation, Kūlanihāko'i Bridge

Sea Engineering, Inc.

August 13, 2012

Sea Engineering, Inc.
Makai Research Pier 41-305 Kalanianaole Hwy.
Waimanalo, Hawaii 96795-1820
Ph: (808) 259-7966 Fax: (808) 259-8143
Email: sei@seaengineering.com
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Memorandum

DATE: August 13, 2012

TO: Milton Arakawa, Wilson Okamoto

FROM: Marc Ericksen

SUBJECT: Dune Investigation, Kulanihakoi Bridge

On August 8, 2012 Sea Engineering, Inc. (SEI) conducted a site investigation of the Kulanihakoi Bridge in Kihei, Maui to determine the location of the coastal dune. Figure 1 presents an aerial photograph of the project site. The site investigation was conducted in order to determine the dune location to comply with the Maui County Grading Ordinance, Sect 20.08.035, which prohibits the grading of coastal dunes.

The county ordinance defines a coastal dune as "one of possibly several continuous or nearly continuous mounds or ridges of unconsolidated sand contiguous and parallel to the beach, situated so that it may be accessible to storm waves and seasonal high waves for release to the beach or offshore waters." Thus, there are three main criteria that are used to establish the presence or limits of a dune: unconsolidated sandy soil, a mound or ridge formation, and the possible reach of storm or seasonal high waves. The limits of a coastal dune may not always definitive, however. Sometimes there is no clearly defined break in slope, sometimes the terrain is obscured by heavy underbrush, or there may be several lines of dunes. In heavily used areas the coastal dune structure can be obscured by terrain alteration due to vehicle or foot traffic, or by previous grading and construction activities.

The project site is Kulanihakoi Bridge in Kihei, Maui, located approximately 200 feet south of the Kaonoulu Street – South Kihei Road intersection. The bridge consists of four 6 x 4 ft culverts spanning Kulanihakoi Gulch. The gulch is an intermittently flowing stream channel, which during heavy rains erodes a stream channel through the beach and discharges runoff waters into the ocean. When the rain stops, and flow ceases, a beach berm reforms in front of the stream, and a muliwai typically forms. A muliwai is the the Hawaiian word for brackish water pools near the mouths of streams created by seasonal barriers of sand or sediment. Figures 2 – 4 show Google Earth images of the project area on March 23, 2011, December 5, 2004, and November 7, 2000. On March 23, 2011 the stream is not flowing and a large muliwai is present. On December 5, 2004 the stream is not flowing and a small muliwai is present. On November 5, 2004 the stream has cut a narrow channel through the beach and is flowing into the ocean. Figure 5 shows the muliwai present during the site visit on August 8, 2012. When the stream is not flowing, a visible low elevation swale is present in the beach and backshore marking the location of the channel (Figure 6).

Seaward of Kalanihakoi Bridge is Kalepolepo Beach, a sand beach approximately 750 feet long extending from the revetment fronting the Maui Lu Hotel in the north, to the Kalepolepo Fishpond in the south. Dune formation is active in this area as the prevailing tradewinds are modified by the local effects of Haleakala and blow strongly from the northwest in the afternoons, transporting dry beach sand inland. Coastal dunes up to 16 feet high are present to the north and the south of the stream channel/swale. The north coastal dune is shown in Figure 5 and Figure 7. The landward limit of the north dune is located at the base of the slope along the seaward waterline of the muliwai. Photographs of the south dune are presented in Figures 8 and 9. The limit of the south dune follows the south edge of the stream channel/swale, and then along the edge of South Kihei Road to the south (Figure 9).

Figures 10 and 11 present photographs of the muddy sediment deposited in the stream channel and muliwai areas.

Figure 12 presents a topographic map illustrating the coastal morphologies present in the project area. The muliwai and stream channel occupy the zone immediately seaward of the bridge and road for a distance of approximately 160 feet north and 130 feet south of the bridge. The north coastal dune lies seaward of the muliwai, and forms the north side of the stream channel. The south dune forms the south side of the stream channel. The edges of the dunes are illustrated by the red lines in Figure 12. A beach berm lies between the dunes and stream channel, and the ocean.

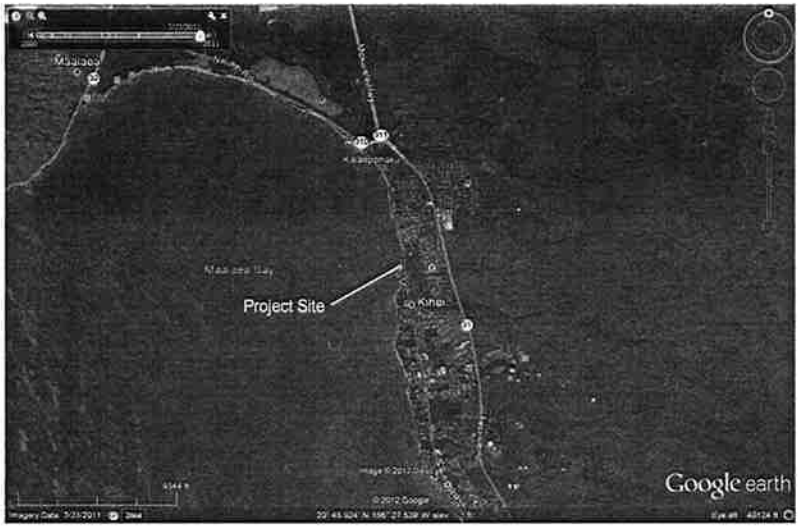

Figure 1 – Google Earth aerial photograph of project site

Figure 2. Google Earth image of the project site on March 23, 2011 showing large muliwai

Figure 3. Google image of the project site on December 5, 2004

Figure 4. Google Earth image of the project site on November 7, 2000 showing the stream channel through the beach

Figure 5. Muliwai present behind north coastal dune

Figure 6. Low elevation swale in the beach marking location of stream channel between the north (left) and south (right) dunes

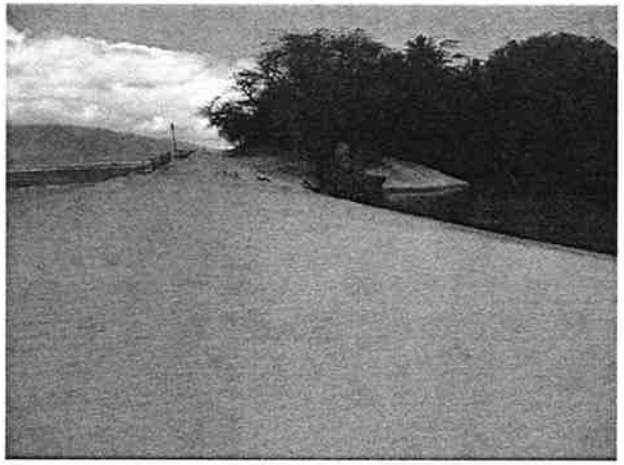

Figure 7. North coastal dune

Figure 8. South coastal dune

Figure 9. Landward edge of the south dune, along South Kihei Road

Figure 10. Muddy sediment in the stream channel

Figure 11. Mud along the banks of the muliwai

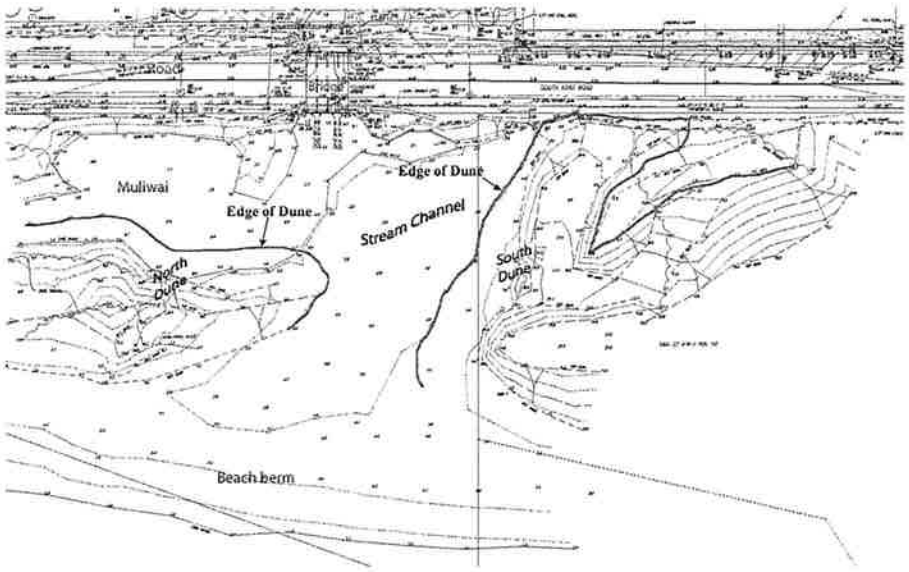

Figure 12. Topographic map of the project site showing coastal morphologies and the edge of the dunes.

APPENDIX B

Water Quality and Biological Surveys for a Bridge Repair on Lower Kūlanihāko‘i Gulch in Kīhei, Maui

AECOS, Inc.

March 5, 2013

AECOS No. 1314

Water quality and biological surveys for a bridge repair on lower Kūlanihāko'i Gulch in Kīhei, Maui

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March 5, 2013

Water quality and biological surveys for a bridge repair on lower Kūlanihāko'i Gulch in Kīhei, Maui

March 5, 2013 **Draft** *AECOS* No. 1314

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Introduction

The bridge (culvert)[2] on South Kīhei Road at Kūlanihāko'i Gulch on the Island of Maui (Fig 1) is slated to be replaced. The project will involve construction of a temporary bypass road *mauka* (inland side) of the existing road at a distance of approximately 55 ft (17 m) from the *mauka* edge of the existing road. The ~25-ft wide bypass road and will cross the drainage on fill and a temporary bridge.

AECOS Inc. was contracted by Wilson Okamoto Inc[3] to investigate biological resources and water quality at the proposed project site (TMK: (2) 3-9-001: 162) and in September 2012, *AECOS* biologists conducted field surveys in the project area. This report details findings of those surveys. The report also provides an assessment of the federal jurisdictional boundary at the project location.

Kūlanihāko'i Gulch

Kūlanihāko'i Gulch arises as several gulches extending upslope as far as the 1,500-m (4900-ft) elevation contour on East Maui Mountain. The gulch extends west-southwest approximately 19.3 km (12 mi) from its origin above Kula Highway to its Pacific Ocean outlet at Kalepolepo Beach Park on Ma'alaea Bay.

[1] Rana Biological Consultants, Inc.
[2] Kulanihakoa #76 (Box Culvert), bridge No. 009000310900001 (NOEI, 2012).
[3] This document will be incorporated into the Kulanhakoi Bridge Replacement Environmental Assessment (EA) and will become part of the public record.

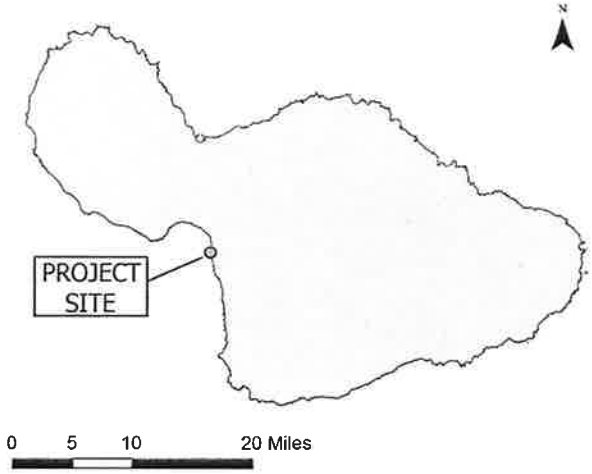

Figure 1. General location of the project on the Island of Maui.

Although water flow is intermittent, the gulch is a well-defined feature with a bottom of exposed bedrock and boulders at higher elevations. In the project area, the "gulch" is a broad, flat open area with minimal relief and a substratum of dark sand. Much of the floodplain of this drainage has been developed in houses and condominium units.

Surface water is present at the South Kīhei Road project site, where the outlet is typically blocked by a deposit of sand (Kalepolepo Beach), forming a *muliwai* (brackish water pond or estuary) extending inland through the project site. Under most circumstances, the short wetted section of Kūlanihāko'i Gulch here is permanently wetted, estuarine, and tidal.

Methods

Water Quality

Field measurements for temperature, dissolved oxygen, and pH were conducted and water samples were collected for total suspended solids (TSS), turbidity, nitrate-nitrite nitrogen, total nitrogen (TN), total phosphorus (TP), and chlorophyll from four stations in the project area. Additionally, samples for oil & grease, pesticides, polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), benzene, toluene, ethylbenzene, and xylenes (BTEX) were collected from the project site for the permitting of construction dewatering under the National Pollution Discharge Elimination System (NPDES). All water samples were collected in screw cap-polypropylene or glass bottles and vials on September 17, 2012 and delivered to *AECOS* laboratory in Kāne'ohe, O'ahu for laboratory analyses (*AECOS* Log No. 28604). Table 1 lists analytical methods and instrumentation used in the analyses.

Table 1. Analytical methods and instruments used for water quality analysis.

Analysis	Method	Reference	Instrument
Ammonia	EPA 350.1	USEPA (1993)	Technicon Auto Analyzer II
Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)	EPA 602	USEPA (1993)	Gas chromatograph
Chlorophyll	SM 10200H (M)	Standard Methods 20th Edition (1998)	Turner fluorometer
Dissolved Oxygen	SM 4500-O G	Standard Methods 20th Edition (1998)	YSI Model Pro 2030 Dissolved Oxygen Meter
Nitrate + Nitrite	EPA 353.2 Rev 2.0	USEPA (1993)	Technicon AutoAnalyzer II
Oil & grease	EPA 1664A	USEPA (1993)	Separatory funnel; Balance
pH	SM 4500 H+	Standard Methods 20th Edition (1998)	Hannah pocket pH meter
Pesticides and PCBs	EPA 608.1/608.2	USEPA (1993)	Gas chromatograph
PAHs	EPA 610	USEPA (1993)	High performance liquid chromatograph (HPLC) or gas chromatograph (GC)

Table 1 (continued).

Analysis	Method	Reference	Instrument
Salinity	SM 2520B	Standard Methods 20th Edition (1998)	YSI Model Pro 2030 Dissolved Oxygen Meter
Temperature	thermister calibrated to NBS Cert. thermometer SM 2550 B	Standard Methods 20th Edition (1998)	YSI Model Pro 2030 Dissolved Oxygen Meter
Total Nitrogen	persulfate digestion/EPA 353.2	Grasshoff et al (1986)/ USEPA (1993)	Technicon AutoAnalyzer II
Total Phosphorus	EPA 365.30	USEPA (1993)	Technicon AutoAnalyzer II
Total Suspended Solids	Method 2540 D	Standard Methods 20th Edition (1998)	Mettler H31 balance
Turbidity	EPA 180.1 Rev 2.0	EPA (1993)	Hach 2100N Turbidimeter

Water quality sampling locations are shown in Fig. 2. Station "Upstream" was located 35 m (115 ft) upstream from South Kīhei Road. Station "Bridge" was located at the upstream end of the bridge culvert slated for repair. Station "Downstream" was located 35 m (115 ft) downstream from South Kīhei Road near where the stream mouth is blocked by a sand berm. Station "Ocean" was located just offshore of Kalepolepo Beach in coastal waters 1 m (3 ft) deep. All water samples were collected from just below the water surface. Sampling occurred during a predicted low tide estimated at +0.36 ft (NOAA, 2012) for Kīhei, Maui.

Jurisdictional Waters Considerations

Kūlanihāko'i Gulch is a drainage feature that discharges directly into Ma'alaea Bay, a tidal waterbody subject to federal jurisdiction under Section 10 of the Rivers and Harbors Act and Sections 402 and 404 of the Clean Water Act. Because flow of water in the gulch itself is intermittent, this feature is a "not relatively permanent", non-navigable tributary that is jurisdictional by virtue of a significant nexus or influence on the adjacent coastal waters (Grumbles and Woodley, 2008). The *muliwai* within the project area, although not directly connected to the ocean for much of the time, is nonetheless insufficiently isolated to be regarded as non-jurisdictional. The *muliwai* is also likely tidal.

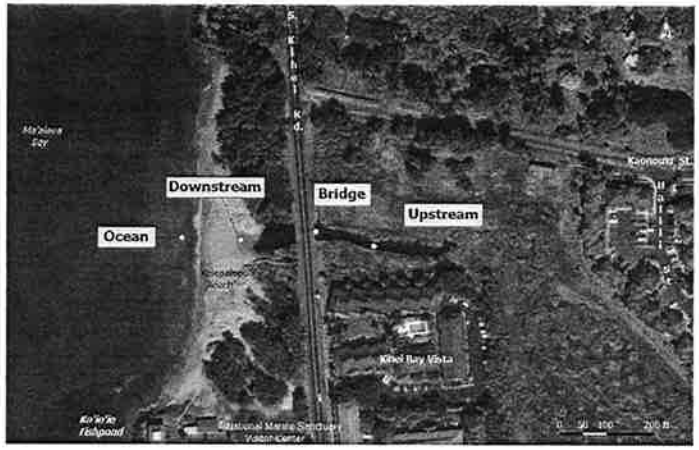

Figure 2. The locations of water quality stations for the South Kīhei Road crossing of lower Kūlanihāko'i Gulch. The *muliwai* is quite evident in this image.

The channel of the *muliwai* is well-defined and the jurisdictional boundary would be the elevation contours corresponding to the mean high (or mean higher high) water marks: +0.78 ft (0.238 m) or +1.14 ft (0.347 m) relative to mean sea level (MSL; NOAA, 2003). Conservatively, the +1.14 ft elevation contour should be used. Based on the site topographic survey, the invert of the *muliwai* at the proposed bypass road location is between 0.8 and 1.6 ft above MSL. The surveyors' "bottom of the bank is around 1.6 ft. and top of the bank typically over 5 ft. Thus the tidal jurisdictional boundary is effectively the relatively steep bank, extending upstream to the limit of "permanent" water (beyond the proposed project site). The question then to be answered: are adjacent wetlands present that would extend the jurisdictional boundary out beyond the banks of the *muliwai*?

In order to help establish wetland lateral boundaries for the Kūlanihāko'i *muliwai*, a transect line was laid out from the NE corner of the road culvert structure in an eastward direction for a distance of 40 m (131 ft), a point well

"upstream" of the proposed bypass road. This "base" line was then used to conduct soil testing and mark vegetation patterns on lines set perpendicular at 10-m (33-ft) intervals. Most of this effort was undertaken on the right (north) bank of the estuary, as the left bank was higher, steeper, and more densely vegetated. Our field investigation followed methods of wetland delineation described in *Corps of Engineers Wetland Delineation Manual* ("Manual"; USACE, 1987) and *Regional Supplement* (USACE, 2012a). The wetland status of plant species follows the 2012 National Wetland Plant List (Lichvar, 2012). No boundary (wetland delineation) flags were set out.

Location information (GPS) was gathered in the field using a Trimble GeoXT (submeter) GPS unit. Data obtained were subsequently subjected to differential correction using base audit data provided by the CORS Haleakala download site.

Botanical

Botanical resources were identified by walking around the area on September 17, 2012 and noting the names and relative abundances of all ferns, fern allies, gymnosperms, and flowering plants growing there. The survey area extended well-beyond the actual project site in all directions: from Kaonoulu Street to the property fence of Kīhei Bay Vista in the north-south direction, and from the beach shore to a little beyond the upper end of the *muliwai* in the east-west direction. Field notes were translated into a flora listing. For the most part, plant names given in the listing follow *Manual of the Flowering Plants of Hawai'i* (Wagner et al., 1990, 1999) for native and naturalized flowering plants, and *A Tropical Garden Flora* (Staples and Herbst, 2005) for ornamental plants. Names have been updated as appropriate to reflect more recent taxonomic or nomenclatural name changes.

Aquatic Biota

Aquatic resources in Kūlanihāko'i Gulch were identified by visually observing and sampling *muliwai* waters with hand nets to identify biota present. The September 17, 2012 survey area included the entire *muliwai* in the project area which extended 100 m (330 ft) upstream from the S. Kīhei Road culvert.

Avian Biota

One avian count station was sited approximately 15 m (50 ft) *mauka* of the S. Kīhei Road bridge and a second was sited approximately 15 m (50 ft) *makai* of the bridge on the beach on the morning of September 17. A single thirty-minute time dependent waterbird count was made at each station. Field observations

were made with the aid of Leica 8 X 42 binoculars and by listening for vocalizations. Time not spent counting at point count stations was used to search the rest of the site for species and habitats not detected during the point counts. Weather conditions were ideal, with no rain, unlimited visibility and winds of between 3 and 10 km per hour.

Terrestrial Mammals

With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of Maui are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all terrestrial vertebrate mammalian species detected within the project area during the survey.

Survey Results

Water Quality

The results from *in situ* measurements and analyses of water samples collected from three stations near the project site are provided in Table 2. As is typical, waters in the estuarine reach of Kūlanihāko'i Gulch were not flowing into Mā'alaea Bay as a sand berm blocked flow toward the ocean (although seepage through the sand would be occurring). Salinity readings ranged from 24 to 26 ppt within gulch, and indicate brackish water composed of a mix of seawater and freshwater. Gulch waters in close proximity to the culvert, as evidenced by Stas. Upstream, Bridge, and Downstream were super-saturated with oxygen during the sampling event with DO concentrations of 7.33 to 7.88 mg/l, representing 110 to 116% saturation at the measured temperatures. All three stations in the *muliwai* had basic pH values with readings ranging only slightly, from 8.01 to 8.07.

Particulates, as measured by TSS, were high in gulch waters, ranging from 33 to 40 mg/l at the three *muliwai* stations. Turbidity levels, an indication of cloudiness of the water, ranged from 9.98 to 10.8 ntu, reflecting the turbid green water observed during sampling. Nitrate-nitrite levels ranged from 221 to 331 µgN/l with total nitrogen concentrations in excess of 1700 µgN/l at all three *muliwai* stations. Chlorophyll concentrations of 12.6, 10.8, and 13.3 µg/l at Stas. Upstream, Bridge, and Downstream, respectively, are high and indicate

Table 2. Results for *in situ* measurements and analysis of water samples collected on September 17, 2012 at Kūlanihāko'i Gulch.

Station	Temp. (°C)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% sat.)	pH --	Salinity (psu)	TSS (mg/l)
Upstream	29.6	7.33	110	8.07	25	40
Bridge	27.4	7.88	114	8.01	24	33
Downstream	31.5	7.40	116	8.04	26	33
Ocean	26.5	6.85	103	8.11	34	74

	Turbidity (ntu)	Nitrate+ Nitrite (µg N/l)	Ammonia (µg N/l)	Total N (µg N/l)	Total P (µg P/l)	Chlorophyll (µg /l)
Upstream	10.4	331	32	2310	49	12.6
Bridge	9.98	260	1500	2100	680	10.8
Downstream	10.8	221	25	1710	48	13.3
Ocean	3.60	103	8	674	70	0.66

an abundance of phytoplankton in the water column, contributing to elevated suspended solids and turbidity readings. Such conditions are common in estuaries in Hawai'i as nutrients in runoff accumulates in the stagnant water, promoting algal blooms; these blooms may persist until a freshet flow in the gulch breaks through the sand barrier and flushes out the estuary.

Nearshore marine waters sampled at Sta. Ocean revealed typical conditions for upper Ma'alaea Bay: turbid, well-oxygenated seawater with a pH near 8.00. Total suspended solids (TSS) of 74 mg/l is high for coastal waters, and likely a result of wind and waves suspending sediments in the water column at this station just off the beach.

Physiography, Soils, and Wetlands

The South Kīhei Road culvert at Kūlanihāko'i Gulch crosses over a small and more or less permanent water body that is fed by brackish groundwater and regularly isolated from the nearby ocean by a broad deposit of sand that is Kalepolepo Beach. This *muliwai* or estuary at the mouth of the gulch, lies between developed lots on Kaonoulu Street to the north and the Kīhei Bay Vista resort condominium to the south (Fig. 2). The ground is low-lying, with gentle undulations of wind-blown sand (dunes), most prominent towards the seaward end of the survey area. Prevailing winds blow onshore, moving sand inland. This sand intermixes with sediment brought into the area by freshets in Kūlanihāko'i Gulch, resulting in a gradient of greater proportion of calcareous sand at the beach end, and a darker, more terrigenous sand at the inland end of the survey area.

Soils in the project area are classified as dune land (DL), consisting of "hills and ridges of sand-size particles drifted and piled by wind [aeolian]. The hills and ridges are actively shifting or are so recently fixed or stabilized that no soil horizons have developed" (Foote, et al., 1972, p. 29). It is worth noting that sand dune fences, intended to catch sand and stabilize dunes, are installed at Kalepolepo Park on the *makai* side of South Kīhei Rd. Although dune lands are not hydric soils, wetlands can develop in dune lands where groundwater intersects (is exposed in) low areas between dunes. Such wetlands might be regarded as isolated (non-jurisdictional), but the present situation is one of a jurisdictional *muliwai* (see p. 4-5, above) in a dune setting. Close-ups of two soil pits in the dune land are provided in Figure 3.

The USFWS, National Wetland Inventory (NWI) "Wetlands Mapper" (USFWS, 2012c) shows the area of the *muliwai* classified "PUBHh": diked or impounded, permanently flooded, freshwater wetland (palustrine) with unconsolidated (sand or mud) bottom; and a much larger area extending to the south through several resort complexes as PEM1C (seasonally flooded freshwater wetland with persistent emergent vegetation). Neither of these designations match what is on the ground in the locations indicated by USFWS. The *muliwai* should be classified as E1UB2[4] (estuarine subtidal with sand bottom); it is not "diked" or unnaturally impounded. A wetland corresponding to the area in the NWI designated PEM1C is no longer present (now a fully developed landscape).

[4] Although a valid code according to USFWS (2006) and Cowardin et al. (1979), this code cannot be decoded by the Service's NWI decoder (USFWS, 2012c). However, SCDNR (undated) will correctly decode this sequence as an estuarine, subtidal, sand bottom environment.

Botanical

Plant growth is sparse over much of the area, or otherwise consists of a ground cover of *ʻākulikuli* (*Sesuvium portulacastrum*) that is dense in some locations (Fig. 4). Less prominent and mostly to the south of the *muliwai*, occurs seaside heliotrope (*Heliotropium curassavicum*).

Figure 4. View of the *muliwai* looking upstream from a point between the "Bridge" and "Upstream" water quality stations. Plant growth is mostly native *ʻākulikuli*. The foamy material on the surface is moving seaward on a falling tide (was earlier accumulated at the upper end of the *muliwai*).

A total of 15 plant species were identified from the project vicinity (Table 3). All are flowering plants (no ferns or fern allies or gymnosperms). Note that our table is divided into two sections: **3a** for non-native plant species and **3b** for native (or Polynesian-introduced) plant species. Typically, in most lowland areas on Maui, the native and Polynesian plant numbers are no more than 10-16% of the total species identified from a location (see, for example, David, Guinther and Miranda, 2012). At Kūlanihākoʻi Gulch mouth, 60% of the

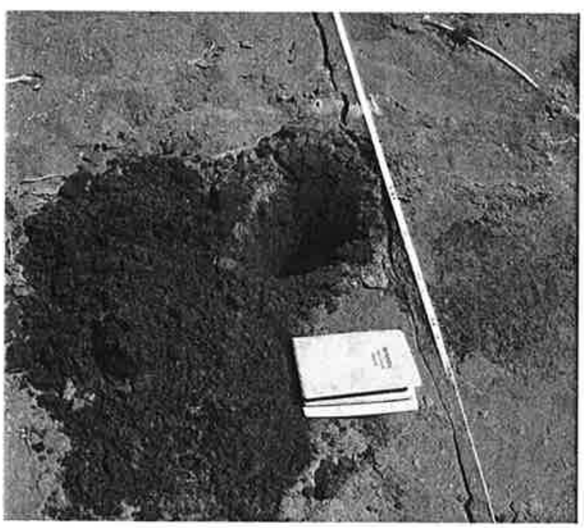

Figure 3A. Soil pit at SP-01. Note absence of vegetation and dryness of ~1 inch surface layer of sand.

Figure 3B. Soil pit at SP-02. Dry surface layer closer to 4 inches. Deeper sand is moist (darker) in both locations.

Table 3. Flora survey results for the South Kīhei Road crossing at Kūlanihāko'i Gulch (September 2012)

3a. Non-native (ornamentals and naturalized) plants

Family Species	Common name	Status	Abundance	Notes
	FLOWERING PLANTS DICOTYLEDONS			
ANACARDIACEAE				
Schinus terebinthefolius Raddi	Christmas berry	Nat	R	FACU
BATACEAE				
Batis maritima L.	pickleweed	Nat	R1	OBL
FABACEAE				
Prosopis pallida (Humb. & Bonpl. ex Willd.) Kunth	*kiawe*	Nat	O	FACU
SOLANACEAE				
Nicotiana glauca R.C. Graham	tree tobacco	Nat	R	UPL
Solanum lycopersicum var. *cerasiforme* (Dunal) Spooner, Anderson, & Jansen	cherry tomato	Nat		UPL
	MONOCOTYLEDONES			
POACEAE (GRAMINEAE)				
Cynodon dactylon (L.) Pers.	Bermuda grass	Nat	U2	FACU

Table 3b. Native (and early Polynesian introduced) Plants

Family Species	Common name	Status	Abundance	Notes
	FLOWERING PLANTS DICOTYLEDONS			
AIZOACEAE				
Sesuvium portulacastrum (L.) L.	*'ākulikuli*	**Ind**	AA	FAC
BORAGINACEAE				
Cordia subcordata Lam.	*kou*	Pol	O	FACU
Heliotropium curassavicum L.	*kīpūkai*	**Ind**	A	FAC
GOODENIACEAE				
Scaevola sericea Vahl.	*naupaka*	**Ind**	O	FACU
MALVACEAE				
Thespesia populnea (L.) Sol. ex Corrêa	*milo*	**Ind?**	O3	FAC
THYMELAEACEAE				
Wikstroemia uva-ursi A. Gray	*'ākia*	**End**	R	UPL
STERCULIACEAE				
Waltheria indica L.	*'uhaloa*	**Ind?**	U12	FACU
	MONOCOTYLEDONES			
CYPERACEAE				
Bolboschoenus maritimus (L.) Palla	*kaluhā*	**Ind**	R2	OBL

Table 3 (continued).

Family Species	Common name	Status	Abundance	Notes
POACEAE (GRAMINEAE)				
Sporobolus virginicus (L.) Kunth	*'aki'aki*	**Ind**	A	FAC

Legend to Table 1:

Status = distributional status
- **End** = endemic, native to Hawai'i and found naturally nowhere else
- **Ind** = indigenous; native to Hawai'i, but not unique to the Hawaiian Islands
- **Ind?** = possibly indigenous or a very early Polynesian introduction
- Nat = naturalized, exotic, plant introduced to the Hawaiian Islands since the arrival of Cook Expedition in 1778, and well-established outside of cultivation
- Pol = early Polynesian introduction ("canoe plant")

Abundance = occurrence ratings for plants
- R – Rare - only one or two plants seen
- U - Uncommon - several to a dozen plants observed
- O - Occasional - found regularly, but not abundant anywhere
- C - Common - considered an important part of the vegetation and observed numerous times
- A - Abundant - found in large numbers; may be locally dominant
- AA - Abundant - very abundant and dominant; defining vegetation type

Numbers (as in R3) offset occurrence ratings (1 – several plants, 2 – many plants; 3 – abundant in a limited area) in cases where distribution across the survey area may be limited, but individuals seen are more than indicated by the occurrence rating alone.

Notes:
Plant wetland status after Lichvar (2012). Codes explained in the text.

species are in the 1b part of the table. While this situation is highly unusual, there is a good explanation: this area is maintained as a Native Plant Restoration Project (Fig. 5). The area is also served by a pipe irrigation system with sprinkler heads, suggesting some current or prior level of artificial watering. While native *'akulikuli* and *'aki'aki* are plants associated with coastal dune and *muliwai* environments, it is unknown to what extent the vegetation patterns have been influenced to their present state by the native planting and maintenance activities. One would expect the estuarine area to be dominated by pickleweed (*Batis maritimus*), as this non-native is conspicuous throughout the Kīhei area in coastal wetlands. This species was noted as rare in the project area in September 2012.

Dune areas support *'aki'aki* (*Sporobolus virginicus*), a native grass common to this habitat. Non-natives (other than a *kiawe* [*Prosopis pallida*], which forms a grove on the *makai* side of South Kīhei Rd.) are uncommon or rare in the survey area. The native *'akia* (*Wikstroemia usa-urvi*) has been planted on a low dune, where it is presently not doing very well.

Figure 5. Keiki o ka 'aina eco.village ohana sign at project site.

Wetland Determination

Work proposed to replace the existing culvert structure is within jurisdictional (tidal) waters as defined physically by the vertical elements of the structure itself, and a Section 404 permit will be required for this work, presumably Nationwide No. 3 authorizing maintenance and replacement activities, including placement of fill or other temporary structures necessary to conduct maintenance activities (ACOE, 2012b). A second element of the project is the proposed bypass road to be built across the floodplain of Kūlanihāko'i Gulch (Fig. 5). This road crosses the *muliwai* some 50 ft (15 m) upstream of the culvert and might be considered necessary to the work associated with the culvert replacement. However, if deemed by the Corps as not necessary for the maintenance/replacement of the culvert, an individual permit would be required since Nationwide 14 (linear transportation projects) cannot be used in much of the Kīhei area[5].

The actual jurisdictional area beyond the *muliwai* as described above depends upon whether the floodplain out to some boundary is considered a wetland.

[5] Regional conditions adopted by the Honolulu District of the USACE in 2012 include the "Kihei Wetlands" restriction, which states that NWPs 7, 13, 14, 40, 41, and 43 may not be used in the Kīhei area between Pi'ilani Highway and the shoreline, south of Mokulele Highway to Kilohana Drive (USACE, 1212c).

Figure 6 summarizes the field work done by combining (georectifying) our GIS shapefile with the project plan view map. After adjusting both images to the same scale and matching the north arrows, a series of eight position points obtained at recognizable locations on the culvert (open circles) were lined up with the plan view drawing of the structure. Other recorded points (some not shown) were used to show the location of the 40-m base transect and the approximate edge of the *'akulikuli* (as well, interpreted from satellite images). The GPS recorded positions of five soil sampling pits (SP-01 through SP-05) are superimposed on the project map. Results from each of these sampling locations are summarized in the wetland data sheets (Appendix A).

The aeolian (windblown) nature of the "soil" is most evident in the photo of SP-02 (Fig. 3b). The dry surface layer transitions to a moist layer underneath. This moistened sand appears naturally dark (low chroma), but generally lacking properties indicating reduced conditions resulting from long-term submergence in anoxic groundwater. However, SP-03 located in a depression (or dry side-channel of the *muliwai*) has properties suggestive of reducing conditions that are interpreted here as indicating a hydric soil. None of the pits reached groundwater or even saturated sediment. A couple of the pits (SP-03 and SP-05) showed layering; in the case of SP-05 a thin layer of alluvial sediment was present near the bottom of the pit. Outcrops of this material are evident further upstream in the vicinity of the top end of the *muliwai*.

A drainage ditch parallels the east side of South Kīhei Road in the project area. This ditch is connected to the *muliwai* near the northeast corner of the culvert structure. The proposed bypass road would cross this ditch at a point 90 ft north of the culvert. A portion of this ditch appears to be permanently wetted as a narrow arm of the *muliwai*. However, in the area where the bypass road is proposed to cross, the invert of the ditch is more than +3 ft above MSL.

Aquatic Biota

The aquatic biota of the Kūlanihāko'i Gulch *muliwai* in the proposed project area comprises a mixture of native and naturalized (non-native) species (Table 4). Mixed schools of Cuban mollies (*Limia vittata*) and hybrid mollies (*Poecilia* sp.) swim just beneath the water surface near the South Kīhei Road crossing. Blackchin tilapia (*Sarotherodon melanotheron*), Mozambique tilapia (*Oreochromis massambicus*), and mullet (*Mugil cephalus*) are also present in schools throughout the length of the *muliwai*. Shore crabs (*Metopograpsus thuhukar*) crawl among the *'akulikuli* along *muliwai* margins and on the culvert proposed for repair. All these species are common inhabitants of estuarine

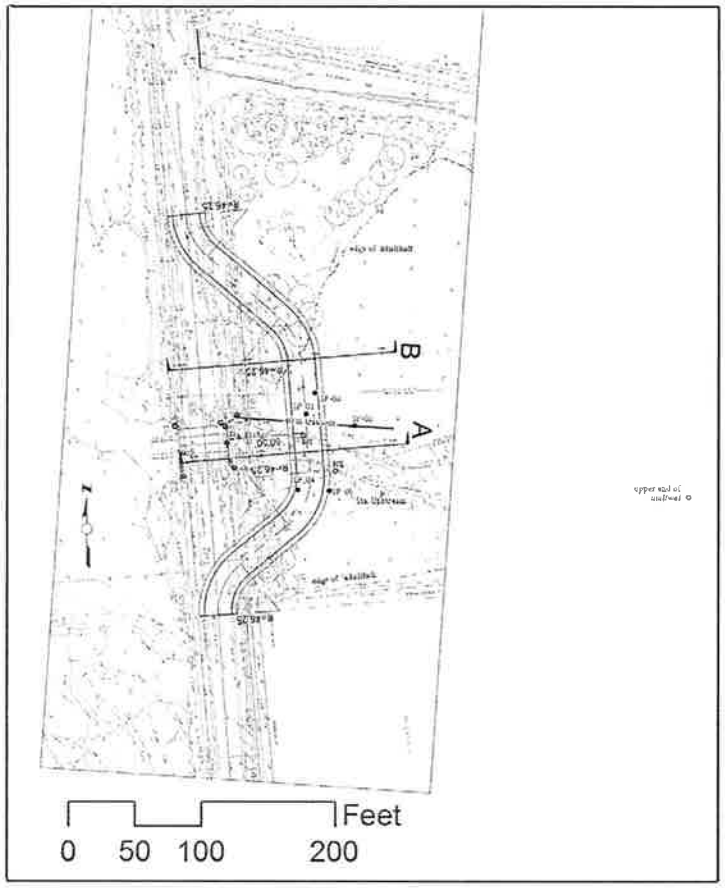

Figure 6. Light grey tilted rectangle is plan view of the project site georectifyed with the GIS shapefile of field collected points (see text). Proposed bypass road is shown as darker lines, and "A" and "B" are locations of profile sections in Fig. 7.

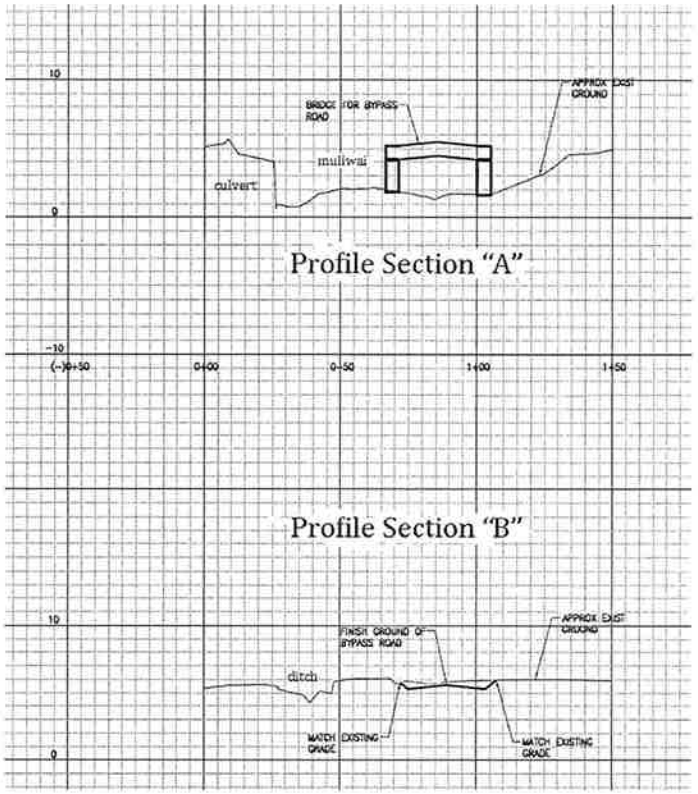

Figure 7. Sections "A" and "B" (see Fig. 6 for locations) of proposed bypass road.

waters in the main Hawaiian Islands. Rambur's forktail (*Ischnura ramburi*), a naturalized damselfly typically common at low elevations, also utilizes the project area.

Table 4. List of aquatic species observed in the estuarine reach (*muliwai*) of Kūlanihāko'i Gulch.

PHYLUM, CLASS, ORDER, FAMILY *Genus species*	Common name	Abundance	Status	ID Code
	INVERTEBRATES			
ARTHROPODA,INSECTA				
ODONATA				
COENAGRIONIDAE				
Ischnura ramburii Selys	Rambur's forktail	R	Nat	1
ARTHROPODA, MALACOSTRACA, DECAPODA				
GRAPSIDAE				
Metopograpsus thukuhar Owen	*'alamihi, kukuau*; purple-clawed shorecrab	R	**Ind**	1
OCYPODIDAE				
Ocypode pallidula Jacquinot	*'ōhiki* pallid ghost crab	R	**Ind**	2
	FISHES			
CHORDATA, ACTINOPTERYGII				
CICHLIDAE				
Oreochromis mossambicus	Mozambique tilapia	C	Nat	
Sarotherodon melanotheron Rüppell	blackchin tilapia	C	Nat	1
indet.	tilapia hybrid	R	Nat	
MUGILIDAE				
Mugil cephalus Linneaus	*'ama'ama*; striped mullet	O	**Ind**	1
POECILIIDAE				
Poecilia reticulata Peters	rainbow fish	U	Nat	1
Poecilia sp.	indet. mollies	C	Nat	1
Limia vittata Guichenot	Cuban molly	O	Nat	1

Key to Table 4:

Abundance categories:
- R – Rare – only one or two individuals observed.
- U – Uncommon – several to a dozen individuals observed.
- O – Occasional – seen irregularly in small numbers
- C – Common -observed everywhere, although generally not in large numbers.
- A – Abundant – observed in large numbers and widely distributed.

Status categories:
- **End** – Endemic – species found only in Hawaii
- **Ind.** – Indigenous – species found in Hawaii and elsewhere
- Nat. – Naturalized – species introduced to Hawaii intentionally, or accidentally.

Table 4 (continued).

Identification codes:
- 1 – identified in the *muliwai* on September 17, 2012.
- 2 – identified on the beach berm on September 17, 2012.

Avian Biota

A total of 23 individual water obligate avian species, of six different species, representing six separate families, were recorded during station counts (Table 5). All but one of the six waterbird species detected are native species. One species, the Hawaiian Stilt (*Himantopus mexicanus knudseni*), is an endangered endemic sub-species. Another, the Black-crowned Night-Heron (*Nycticorax nycticorax hoactli*), is a resident indigenous species. Three others (Pacific Golden-Plover [*Pluvialis fulva*], Ruddy Turnstone [*Arenaria interpres*] and Wandering Tattler [*Tringa incana*]) are indigenous migratory shorebird species. The remaining species, the Cattle Egret (*Bubulcus ibis*), is alien to the Hawaiian Islands.

Table 5. Bird species detected near the Kūlanihāko'i Gulch crossing of S. Kīhei Road.

Common Name	Scientific Name	ST	Mauka	Makai
	PELECANIFORMES			
	ARDEIDAE - Herons, Bitterns & Allies			
Cattle Egret	*Bubulcus ibis*	A	4	-
Black-crowned Night-Heron	*Nycticorax nycticorax hoactli*	IR	2	-
	CHARADRIIFORMES			
	CHARADRIIDAE - Lapwings & Plovers			
	Charadriinae - Plovers			
Pacific Golden-Plover	*Pluvialis fulva*	IM	1	-
	RECURVIROSTRIDAE - Stilts&Avocets			
Black-necked Stilt	*Himantopus mexicanus knudseni*	**EE**	13	1

Table 5 (continued).

Common Name	Scientific Name	ST	Mauka	Makai
	SCOLOPACIDAE - Sandpipers, Phalaropes & Allies			
	Scolopacinae - Sandpipers & Allies			
Wandering Tattler	*Tringa incana*	IM	-	1
Ruddy Turnstone	*Arenaria interpres*	IM	1	-

Key to Table 5:

ST	Status
A	Alien – Introduced to the Hawaiian Islands by humans
IR	Indigenous Resident – A resident native species naturally found in Hawai'i and elsewhere
IM	Indigenous Migratory – native but not unique to the Hawaiian Islands, does not breed in Hawai'i
EE	Endangered Endemic – A species which is unique to the Hawaiian Islands, and is listed as endangered
Mauka	Count station inland form the culvert.
Makai	Count station on the beach, oceanside of the culvert.

Assessment

Water Quality

Kūlanihāko'i Gulch appears on the Department of Health list of impaired waters in Hawai'i (HDOH, 2012a) prepared under Clean Water Act, §303(d). The listing, described as Kīhei Coast-Kaonoulu Estuary (ID HIW00040), indicates the water body may not meet State of Hawai'i water quality criteria for estuaries (Table 4). The estuary is listed as impaired for total nitrogen, nitrate+nitrite, turbidity, and chlorophyll and has been assigned a low priority for Total Maximum Daily Load (TMDL) studies.

During the September 17, 2012 water quality survey, brackish gulch waters near the S. Kīhei Road project site were nutrient, sediment, and chlorophyll laden relative to State of Hawai'i water quality criteria for estuaries (Table 4). Values obtained in our survey cannot be directly compared with the criteria in Table 5 to assess compliance with the standards, because a comparison requires a representative geometric mean calculated from a minimum of three sampling events. The results do indicate that generally poor water quality conditions were present during the survey, although not an unusual situation for a *muliwai*.

Table 5. State of Hawai'i water quality criteria for estuaries from HAR §11-54-05.2(b) (HDOH, 2009).

Parameter	Total Nitrogen (µg N/l)	Nitrate + Nitrite (µg N/l)	Total Phosphorus (µg P/l)	Turbidity (NTU)	Chlorophyll (mg/l)
Geometric mean not to exceed given value	200.0	8.0	25.0	1.5	2.0
Not to exceed more than 10% of the time	350.0	25.0	50.0	3.0	5.00
Not to exceed more than 2% of the time	500.0	35.0	75.0	5.0	10.0

pH – shall not deviate more than 0.5 units from ambient and shall not be < 7.0 nor > 8.6.
Dissolved oxygen – not less than 75% saturation.
Temperature – shall not vary more than 1 °C from ambient
Salinity – not more than 10% from ambient conditions.

Table 6. Nearshore water quality data for HDOH Sta. Kalepolepo Beach located just south of the coastal outlet of Kūlanihāko'i Gulch (after HDOH, 2012b).

Date	Time	Temp.	Salinity	D. O.	% Sat.	pH	Turbidity
2012							
Aug 14	6:12 AM	22.94	31.74	5.84	83.6	8.19	5.47
Apr 25	6:09 AM	21.68	32.48	6.20	86.7	8.20	5.99
Jan 1	6:08 AM	22.91	35.04	6.14	88.6	8.19	7.54
2011							
Sep 14	6:03 AM	24.90	34.26	5.92	88.1	8.12	6.37
2010							
Dec 14	6:19 AM	24.89	34.86	5.63	84.0	8.14	2.12
Oct 5	6:22 AM	25.33	34.36	5.86	88.0	8.16	2.64

Table 6 (continued).

Date	Time	Temp.	Salinity	D. O.	% Sat.	pH	Turbidity
2010							
Jun 30	6:32 AM	24.36	33.06	4.88	71.9	7.99	3.15
May 4	6:40 AM	24.65	33.37	5.24	77.0	8.14	4.15
Mar 30	6:51 AM	22.61	33.92	5.93	84.3	8.02	2.73
2009							
Dec 8	6:59 AM	23.84	33.69	5.47	79.9	8.21	5.90
Sep 2	6:57 AM	24.55	33.51	5.26	77.5	8.14	2.52
Jul 21	7:15 AM	24.96	33.90	5.76	85.2	8.10	4.38
May 27	7:16 AM	26.32	32.35	4.83	73.0	8.07	5.56
Apr 7	7:10 AM	21.51	33.64	6.14	85.3	8.05	3.29
Jan 1	7:12 AM	23.91	34.35	–	–	7.98	3.28
2008							
Oct 1	7:04 AM	24.89	33.97	5.31	78.6	8.03	11.3
Jul 29	7:06 AM	24.62	32.41	5.45	79.9	8.01	2.94
	mean	**24.05**	**33.58**	**5.61**	**82.0**	**8.10**	**4.67**
	st. dev.	1.31	0.92	0.43	5.3	0.08	2.35
	min	21.51	31.74	4.83	71.9	7.98	2.12
	max	26.32	35.04	6.20	88.6	8.21	11.3
	n	*17*	*17*	*16*	*16*	*17*	*17*

The coastal waters fronting Kūlanihāko'i Gulch may also be impaired. The water quality as monitored by HDOH Station Kalepolepo Beach (ID HI000141) just south of the gulch mouth is reported as impaired for total nitrogen, nitrate+nitrite, ammonia, turbidity, and chlorophyll. Water quality data from 2008 to present for the HDOH station is presented in Table 6. Nearshore marine waters fronting the gulch, as measured by Sta. Ocean on September 17, 2012, were nutrient, sediment and chlorophyll laden, well oxygenated and had a pH near 8.10.

Jurisdictional Boundary Area

As noted above, the vegetation in the project area is limited and problematic because it is the result of removal of an unknown "natural" distribution of *Batis martima* and encouragement of native *'ākulikuli*. *'Ākulikuli* is considered a facultative wetland species (FAC; Lichvar, 2012). This plant is nearly always found around the margins of coastal wetlands in sandy material, although perhaps as typically grows just outside the wetland boundary as inside it. Consequently, the entire area surveyed, with the exception of the *muliwai*, is difficult to demarcate as wetland. If one accepts that the soils and plants are generally indicative of a coastal wetland, then the only definable boundary is the boundary of the *'ākulikuli* (shown in Fig. 5). If the soils and the plants are problematic at best, the clearest boundary is that of the *muliwai* shore. The area of the bypass road within these two minimal and maximal "wetland" area boundaries would be on the order of 600 sq.ft (*muliwai* only) to 4600 sq.ft (dune sand dominated by *'ākulikuli*).

Botanical Resources

No species of plants were noted that are of particular concern or are listed as threatened or endangered (DLNR, 1998; USFWS, 2005a, 2012). However, the site is being cared for by a community group (see Fig. 5) with a strong interest in preserving the native flora at this location. Therefore, it would be prudent to consider restoring the bypass road area back to appropriate native plants once the culvert repairs are completed sand the temporary road removed.

Aquatic Resources

The aquatic biota observed during the September 2012 survey of Kūlanihāko'i Gulch estuary included some native species: *āholehole*, *'ama'ama*, and *'alamihi* crab. Though the reach of the gulch typically containing water is short, it is possible that native *'o'opu 'akupa* (*Eleotris sandwicensis*) and *'ōpaekala'ole* (*Macrobrachium grandimanus*)—not observed during the survey—may utilize the brackish environment near the project site. Any population present is likely limited in size by the continual blockage of the gulch mouth by deposited sand, as these diadromous species need passage to the open ocean as larva and passage upstream to brackish waters as post-larva to carry out their life cycle. Project work is not anticipated to have long term adverse effects on any aquatic or marine biota within or nearby the project site.

Waterbird Resources

The findings of the waterbird survey are consistent with the location of the property, and the habitats present on and adjacent to the site. A total of six water obligate avian species were recorded on the site. As previously discussed, five of the species detected are native to the Hawaiian Islands (Table 5). One of these species, Hawaiian Stilt, is an endangered species protected under both federal and state endangered species statutes. One stilt was recorded foraging in the *muliwai* approximately 30 feet *makai* of the culvert just behind the beach. Thirteen others were recorded flying over the site from north-to-south. One species Black-crowned Night-Heron is an indigenous resident species widespread across the islands that utilizes a wide range of waterside environments. Three of the species detected—Pacific Golden-Plover, Ruddy Turnstone and Wandering Tattler—are indigenous migratory shorebirds that nest in the high Arctic during the late spring and summer months, returning to Hawai'i and the Tropical Pacific to spend the fall and winter months each year. They usually leave Hawai'i for the trip back to the Arctic in late April or the very early part of May each year. The Cattle Egret is alien to the Hawaiian Islands.

Although no seabirds were detected during this survey, it is probable that both endangered Hawaiian Petrel (*Pterodroma sandwichensis*) and threatened endemic sub-species of Newell's Shearwater (*Puffinus auricularis newelli*) over-fly the project area between April and the middle of December each year. Both species have been recorded flying to and from their nesting colonies located in the mountains *mauka* of the project site (Cooper and Day, 2003, 2004; Day and Cooper, 1999; Hamer Environmental, 2010; Planning Solutions and Rana Biological Consulting, 2010). Both of these pelagic seabird species nest high in the mountains in burrows excavated under thick vegetation, especially *uluhe* (*Dicranopteris linearis*) fern. There is no suitable nesting habitat for either of these seabird species on or close to the project site. It is also probable that Wedge-tailed Shearwaters (*Puffinus pacificus*) may occasional overfly the site during the breeding season as they nest in coastal areas in the general Kīhei area. Wedge-tailed Shearwaters are not protected under the endangered species act, but are protected under the federal Migratory Bird Treaty Act.

The primary cause of mortality in the three aforementioned seabirds is thought to be predation by alien mammalian species at the nesting colonies (USFWS 1983; Simons and Hodges, 1998; Ainley et al., 2001). Collision with man-made structures is considered to be a second significant cause of mortality of these seabird species in Hawai'i. Nocturnally flying seabirds, especially fledglings on their way to sea in the summer and fall, can become disoriented by exterior lighting on the ground. When disoriented, these birds may collide with manmade structures, and if not killed outright, become injured and easy targets

of opportunity for feral mammals (Hadley, 1961; Telfer, 1979; Sincock, 1981; Reed et al., 1985; Telfer et al., 1987; Cooper and Day, 1998; Podolsky et al., 1998; Ainley et al., 2001; Hue et al., 2001; Day et al., 2003).

Mammalian Resources

No mammalian species currently protected or proposed for protection under either the federal or State of Hawai'i endangered species programs were detected during the course of this survey (DLNR, 1998; USFWS, 2005a, 2012).

The findings of the mammalian survey are consistent with the location of the property and the habitat currently present on the site. Although no rodents were recorded it is likely that the some, if not all of the four established alien *muridae* found on Maui, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*) and European house mice (*Mus musculus domesticus*) use various resources found within the general project area on a seasonal basis. All of these introduced rodents are deleterious to native ecosystems and the native faunal species dependant on them.

No Hawaiian hoary bats were detected during the course of this survey. Given the habitat present on the site any usage of the area by this species would be of an incidental foraging nature – there are no suitable roosting trees for this species on or close to the project site

Seabirds

The principal potential impact that development activity poses to protected seabirds is the increased threat that birds will be downed after becoming disoriented by lights associated with the project during the nesting season. The two main areas that outdoor lighting could pose a threat to these nocturnally flying seabirds is if, 1) during construction it is deemed expedient, or necessary to conduct nighttime construction activities, 2) following build-out, the potential operation of streetlights and security lighting during the seabird nesting season.

Waterbirds

Potential impacts to listed waterbird species include temporary disturbance by construction activity of individual birds that may be attracted to the area to forage, and possibly nest, in areas away from the construction footprint *mauka* of the culvert (nesting is extremely unlikely anywhere in Kalepolepo Beach

Park). Although very unlikely (but theoretically possible), a pair of birds could, during the nesting season, set up a nest close to the *mauka* side of the culvert and be disturbed by construction activities to the point of abandoning the nest (harassment under the Endangered Species Act). The probability of this scenario can be lessened by constructing the by-pass road outside of the nesting season, forcing discriminating reproductive pairs to locations upslope of the temporary road.

Hawaiian hoary bat

The principal potential impact that development activity poses to bats is during the clearing and grubbing phases of construction as vegetation is removed. The removal of vegetation within a construction project site may temporarily displace individual bats, which may use the vegetation as a roosting location. During the pupping season, females carrying their pups may be less able to rapidly vacate a roost site while the vegetation is being cleared. Additionally, adult female bats sometimes leave their pups in the roost tree when they forage. Very small pups may be unable to flee a tree that is being felled. Potential adverse effects from such disturbance can be avoided or minimized by not clearing woody vegetation taller than 4.6 meters (15-feet), between June 15 and September 15, the period in which bats are potentially at risk from vegetation clearing. As there is no suitable bat roosting habitat within or close to the project site, it is not expected that the proposed action will result in impacts to this listed species.

Conclusions and Recommendations

None of the plants or aquatic species observed in the project area is listed as threatened or endangered (DLNR, 1998; USFWS, 2012). Furthermore, the proposed action will not result in modification of any federally designated Critical Habitat, as there is none present on or adjacent to the South Kīhei Road crossing of Kūlanihāko'i Gulch.

Aside from possible short term turbidity plumes associated with project, the proposed work is not anticipated to adversely affect the already poor water quality in *muliwai* at the site. A Best Management Practices (BMP) plan should be designed and implemented to minimize and localize adverse environmental impacts to protect water quality and aquatic biota in the vicinity of the project site during construction.

If night-time construction activity or equipment maintenance is proposed during the construction phases of the project, all associated lights should be

properly shielded, and when large flood/work lights are used, they should be placed on poles that are high enough to allow the lights to be pointed directly at the ground.

Immediately prior to the initiation of construction a qualified biologist should survey the areas *mauka* of the project site to determine if any nesting stilt are present. If nesting stilt are found, the project will need to consult with the USFWS over appropriate measures and or conditions that may need to be met to ensure that construction activity does not harm or harass nesting stilts.

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Attachment A

Wetland data sheets

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kulanihakoi Culvert at South Kihei Road City: Kihei Sampling Date: 9/17/2012 Time: 10:30

Applicant/Owner: County of Maui State/Terr./Comm.: Hawaii Island: Maui Sampling Point: SP-01

Investigator(s): Eric Guinther, AECOS Inc TMK/Parcel: (2) 3-9-001: 162

Landform (hillslope, coastal plain, etc.): coastal estuary and floodplain Local relief (concave, convex, none): minimal/flat

Lat: 20° 45' 56.110" N Long: 156°27'29.408" W Datum: NAD83 Slope (%):

Soil Map Unit Name: Dune Land (DL) NWI classification: PUBHh/upland border

Are climatic/hydrologic conditions on the site typical for this time of year: Yes X No (If no, explain in Remarks)

Are Vegetation X, Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes No X

Are Vegetation , Soil X, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No	
Hydric Soil Present?	Yes	No X	**Is the Sampled Area within a Wetland? Yes No X**
Wetland Hydrology Present?	Yes	No X	

Remarks: 5 m north on line normal to 20 m mark.

VEGETATION—Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Herb Stratum (Plot size: 10 sq ft)			
1. *Sesuvium portulacastrum*	10	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	10 =Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
	=Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x1=
FACW species	x2=
FAC species	x3=
FACU species	x4=
UPL species	x5=
Column Totals: (A)	(B)

Prevalence Index = B/A=

Hydrophytic Vegetation Indicators:

_____ 1 - Rapid Test for Hydrophytic Vegetation

__X__ 2 - Dominance Test is >50%

_____ 3 - Prevalence Index is ≤3.0[1]

_____ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No

Remarks

Flora is entirely natives planted in appropriate habitats and possibly watered at some time in the past. 60% bare sand.

SOIL

Sampling Point: SP-01

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type [1]	Loc [2]	Texture	Remarks
0 - 8	5YR 2.5/1	100					loamy sand	
8 - 14	5YR 5/1	75					loamy sand	varves present
"	5 YR 3/3	25					silty sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks: "Soil" is aolean: sand blown inland and mixed to various degrees with terrigenous sediments brought into area by freshets; evidence of layering (aeolian or alluvial?) below 8 inches. Breaking apart in blocks with very thin fluorescent purple surfaces on exposed joints. Dark color reflects source material (volcanic sand).

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):_____

Water Table Present? Yes_____ No__X__ Depth (inches):_____

Saturation Present? (includes capillary fringe) Yes_____ No__X__ Depth (inches):_____

Wetland Hydrology Present? Yes_____ No__X__

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Drifted wood deposits indicate area is subject to infrequent freshet flooding and not in a pattern suggestive of wave-distributed material at high tide, or ordinary flow deposited material.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kulanihakoi Culvert at South Kihei Road City: Kihei Sampling Date: 9/17/2012 Time: 10:30

Applicant/Owner: County of Maui State/Terr./Comm.: Hawaii Island: Maui Sampling Point: SP-02

Investigator(s): Eric Guinther, AECOS Inc. TMK/Parcel: (2) 3-9-001: 162

Landform (hillslope, coastal plain, etc.): coastal estuary and floodplain Local relief (concave, convex, none): minimal/flat

Lat: 20° 45' 56.276" N Long: 156° 27' 29.357" W Datum: NAD83 Slope (%):

Soil Map Unit Name: Dune Land (DL) NWI classification: upland

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No (If no, explain in Remarks)

Are Vegetation X, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes ___ No X

Are Vegetation ___, Soil X, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present? Yes ___ No X

Hydric Soil Present? Yes ___ No X

Wetland Hydrology Present? Yes ___ No X

Is the Sampled Area within a Wetland? Yes ___ No X

Remarks: 10 m north on line normal to 20 m mark.

VEGETATION—Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Herb Stratum (Plot size: 25 sq ft)			
1. Sesuvium portulacastrum (near)	0	n/a	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 =Total Cover		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
	=Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x1=
FACW species	x2=
FAC species	x3=
FACU species	x4=
UPL species	x5=
Column Totals: (A)	(B)

Prevalence Index = B/A=

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- ___ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks

Flora is entirely natives planted in appropriate habitats and possibly watered at some time in the past. Problematic because windblown sand is countering the effort to grow *Sesuvium* through infrequent watering.

SOIL

Sampling Point: SP-02

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type [1]	Loc [2]	Texture	Remarks
0 – 4		100					dry sand	sand is fine
4- 19	5YR 5/1	99					loamy sand	
	5 YR 3/3	1					silty sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A6)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: Yes_____ No__X__

Remarks:

Soil is aolean sand blown inland, mixed to various degrees with terrigenous sediments brought into area by freshets. Here, recently deposited sand lies over the dark layer.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required: check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- _X_ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No_____ Depth (inches):_____

Water Table Present? Yes_____ No_____ Depth (inches):_____

Saturation Present? (includes capillary fringe) Yes_____ No_____ Depth (inches):_____

Wetland Hydrology Present? Yes_____ No__X__

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kulanihakoi Culvert at South Kihei Road City: Kihei Sampling Date: 9/17/2012 Time: 11:30

Applicant/Owner: County of Maui State/Terr./Comm.: Hawaii Island: Maui Sampling Point: SP-03

Investigator(s): Eric Guinther, AECOS Inc. TMK/Parcel: (2) 3-9-001: 162

Landform (hillslope, coastal plain, etc.): coastal estuary and floodplain Local relief (concave, convex, none): minimal/flat

Lat: 20° 45' 56.075" N Long: 156° 27' 29.043" W Datum: NAD83 Slope (%):

Soil Map Unit Name: Dune Land (DL) NWI classification: PUBHh

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No (If no, explain in Remarks)

Are Vegetation X, Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present? Yes No X

Are Vegetation , Soil X, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No

Hydric Soil Present? Yes X No

Wetland Hydrology Present? Yes X No

Is the Sampled Area within a Wetland? Yes X No

Remarks: 6.1 m (20 ft) north of *muliwai* WL (1.9 m north of transect 30 m mark).

VEGETATION—Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Herb Stratum (Plot size: 100 sq. ft.)			
1. *Sesuvium portulacastrum*	10	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	10 =Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
	=Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of: Multiply by:

OBL species x1=

FACW species x2=

FAC species x3=

FACU species x4=

UPL species x5=

Column Totals: (A) (B)

Prevalence Index = B/A=

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- _X_ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No

Remarks

Flora is entirely natives planted in appropriate habitats and possibly watered at some time in the past.

SOIL **Sampling Point: SP-03**

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type [1]	Loc [2]	Texture	Remarks
0 - 1	10 YR 2.5/1	100					loamy sand	aolean
1 - 15	10 YR 2.5/2	100	black inclusions	<1%			loamy sand	oxidation w/exposure
15 - 17	7.5 YR 4/3+	100					sandy clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:
- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Glayed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:
- X Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: **Yes** X **No** _____

Remarks:

Soil is aolean sand blown inland, mixed to various degrees with terrigenous sediments brought into area by freshets. Deeper layer is flood deposited sediment with evidence of stratification layers .

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required; check all that apply)
- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- X Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)
- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No X Depth (inches):_____

Water Table Present? Yes_____ No X Depth (inches):_____

Saturation Present? (includes capillary fringe) Yes_____ No X Depth (inches):_____

Wetland Hydrology Present? **Yes** X **No** _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Located 6.1 m (20 ft) away from shore of flooded *muliwai* within an unvegetated depression between 4.6 m (15 ft) and 7.4 m (24 ft) on line perpendicular to transect. Depression separated from *muliwai* shore by low dune covered in *Sesuvium portulacastrum*.

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kulanihakoi Culvert at South Kihei Road City: Kihei Sampling Date: 9/17/2012 Time: 12:05

Applicant/Owner: County of Maui State/Terr./Comm.: Hawaii Island: Maui Sampling Point: SP-04

Investigator(s): Eric Guinther, AECOS Inc. TMK/Parcel: (2) 3-9-001: 162

Landform (hillslope, coastal plain, etc.): coastal estuary and floodplain Local relief (concave, convex, none): minimal/flat

Lat: 20° 45' 55.511" N Long: 156° 27' 29.509" W Datum: NAD83 Slope (%): _____

Soil Map Unit Name: Dune Land (DL) NWI classification: PUBHh

Are climactic/hydrologic conditions on the site typical for this time of year: Yes X No (If no, explain in Remarks)

Are Vegetation X, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No X

Are Vegetation _____, Soil X, or Hydrology X naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No _____

Hydric Soil Present? Yes _____ No X

Wetland Hydrology Present? Yes _____ No X

Is the Sampled Area within a Wetland? Yes _____ No X

Remarks: Located 6.4 m (20 ft) south of *muliwai* water line on elevated ground.

VEGETATION—Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Herb Stratum (Plot size: 100 sq. ft)			
1. *Sesuvium portulacastrum*	80	Y	FAC
2. *Heliotropum currasavicum*	10	N	FAC
3.			
4.			
5.			
6.			
7.			
8.			
	90 =Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	=Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x1= _____
FACW species _____	x2= _____
FAC species _____	x3= _____
FACU species _____	x4= _____
UPL species _____	x5= _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A= _____

Hydrophytic Vegetation Indicators:
- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** _____

Remarks
Flora is entirely natives planted in appropriate habitats and possibly watered at some time in the past.

SOIL

Sampling Point: SP-04

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type [1]	Loc [2]	Texture	Remarks
0 - 16	5 YR 2.5/2	100					loamy sand	
16 - 17							gravel	over sand w/pebbles

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains — [2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present: Yes_____ No__X__

Remarks:

Soil is aolean sand blown inland, mixed to various degrees with terrigenous sediments brought into area by freshets. Possible fill layer below 16 in

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No__X__ Depth (inches):_____

Water Table Present? Yes_____ No__X__ Depth (inches):_____

Saturation Present? (includes capillary fringe) Yes_____ No__X__ Depth (inches):_____

Wetland Hydrology Present? Yes_____ No__X__

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM—Hawai'i and Pacific Islands

Project/Site: Kulanihakoi Culvert at South Kihei Road City: Kihei Sampling Date: 9/17/2012 Time: 12:25

Applicant/Owner: County of Maui State/Terr./Comm.: Hawaii Island: Maui Sampling Point: SP-05

Investigator(s): Eric Guinther, AECOS Inc. TMK/Parcel: (2) 3-9-001: 162

Landform (hillslope, coastal plain, etc.): coastal estuary and floodplain Local relief (concave, convex, none): minimal/flat

Lat: 20° 45' 55.509" N Long: 156° 27' 29.244" W Datum: NAD83 Slope (%):

Soil Map Unit Name: Dune Land (DL) NWI classification: PUBHh

Are climactic/hydrologic conditions on the site typical for this time of year: Yes__X__ No_____(If no, explain in Remarks)

Are Vegetation__X__, Soil_____, or Hydrology_____significantly disturbed? Are "Normal Circumstances" present? Yes_____ No__X__

Are Vegetation_____, Soil__X__, or Hydrology__X__naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS—Attach a site map showing sampling point locations transects, important features, etc.

Hydrophytic Vegetation Present? Yes__X__ No_____

Hydric Soil Present? Yes_____ No__X__

Wetland Hydrology Present? Yes_____ No__X__

Is the Sampled Area within a Wetland? Yes____ No__X__

Remarks: 4.8 m (16 ft) south of *muliwai* shore opp. transect 30 m mark.

VEGETATION—Use scientific names of plants.

Tree Stratum (Plot size: _____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Herb Stratum (Plot size: 100 sq.ft.)			
1. *Sesuvium portulacastrum*	80	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	80 =Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	=Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x1=
FACW species	x2=
FAC species	x3=
FACU species	x4=
UPL species	x5=
Column Totals: (A)	(B)

Prevalence Index = B/A=

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ Problematic Hydrophytic Vegetation [1] (Explain in Remarks or in the delineation report)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes_X__ No____

Remarks

Flora is entirely natives planted in appropriate habitats and possibly watered at some time in the past.

SOIL

Sampling Point: SP-05

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type [1]	Loc [2]	Texture	Remarks
0 - 16	5YR 2.5/2	100					loamy sand	
16 - 17	5YR 2.5/1	100					clay	
17- 24							gravel	over sand w/pebbles

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains

[2]Location: PL=Pore Lining, M=Matrix

Hydric Soil Indicators:

- ___ Histisols (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Muck Presence (A8)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Dark-Surface (S7)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ Stratified Layers (A5)
- ___ Sandy Mucky Mineral (S1)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:_____

Depth (inches):_____

Hydric Soil Present: **Yes**_____ **No** X

Remarks:

Soil is aolean sand blown inland, mixed to various degrees with terrigenous sediments brought into area by freshets. Some evidence of alluvial layering below 16 inches.

HYDROLOGY

Wetland Hydrology Indicators: (Explain observations in Remarks, if needed.)

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Innundation Visible on Aerial Imagery (B7)
- ___ Water Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Tilapia Nests (B17)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tiled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Fiddler Crab Burrows (C10) (Guam, CNMI, and American Samoa)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Salt Deposits (C5)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes_____ No X Depth (inches):_____

Water Table Present? Yes_____ No X Depth (inches):_____

Saturation Present? (includes capillary fringe) Yes_____ No X Depth (inches):_____

Wetland Hydrology Present? **Yes**_____ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

APPENDIX C

An Archaeological Literature Review and Field Inspection for Kūlanihāko‘i Bridge Replacement Project, Ka‘ono‘ulu Ahupua‘a, Wailuku District, Maui Island

TMK: (2) 3-9-001: 999, 015, 147, 162 (pors)

Cultural Surveys Hawai‘i, Inc.

October 2012

An Archaeological Literature Review and Field Inspection for Kūlanihāko'i Bridge Replacement Project, Ka'ono'ulu Ahupua'a, Wailuku District, Maui Island
TMK: (2) 3-9-001: 999, 015, 147, 162 (pors)

Prepared for
Wilson Okamoto Corporation

Prepared by
Colleen P. Medeiros, B.S.
Robert H. Hill, B.A.
And
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai'i, Inc.
Wailuku, Hawai'i
(Job Code: KONOULU 4)

October 2012

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Section 1 Management Summary

Reference	An Archaeological Literature Review and Field Inspection for Kūlanihāko'i Bridge Replacement Project, Ka'ono'ulu Ahupua'a, Kula District, Maui Island TMK:(2) 3-9-001: 999, :015, 147, 162 (pors.)
Date	August 2012 (Draft)
Project Number (s)	Cultural Surveys Hawai'i, Inc. (CSH) Job Code: KAONOULU 4
Investigation Permit Number	CSH completed this literature review and field inspection for the proposed Kūlanihāko'i Bridge Replacement Project South Kīhei Road under State Archaeological Permit No. 11-17 (2012) issued by the Department of Land & Natural Resources/State Historic Preservation Division (DLNR/ SHPD), per Hawai'i Administrative Rules (HAR) § 13-13-282.
Project Location	The Kūlanihāko'i Bridge is located along South Kīhei Road, in the Ka'ono'ulu Ahupua'a, Kula District, Maui Island TMK: (2) 3-9-001: 999, 015, 147, 162 (pors). This area is depicted on the Mā'alaea (1996) and Puu O Kali (1992) quadrangle 7.5-minute USGS topographic map (Figure 1).
Project Funding and Land Jurisdiction	Project Funding: Maui County Department of Public Works Land Jurisdiction: Private and County
Agencies	County: Maui County, Department of Public Works State: Department of Land and Natural Resources State Historic Preservation Division (SHPD)

Project Description	The County of Maui Department of Public Works has proposed a two step process to replace the existing deteriorating Kūlanihāko'i Bridge. The existing bridge consists of four (4) reinforced concrete box culverts. Each cell is six (6) feet wide and four (4) feet high by 38 feet long. A March 2012 bridge inspection report notes that there is severe spalling and advanced corrosion of the reinforcing of the top slab of the culvert. The report recommends that immediate repairs or shoring of the top slab be implemented. In order to immediately address repair of the bridge, the first step involves the erection of a temporary steel bridge to extend over the existing bridge. The temporary steel bridge would span approximately 60 feet and would be approximately 24 feet wide to accommodate two lanes of traffic. The first step involves County funding. The second step involves more extensive and time-consuming permitting involving Federal, State and County wetland and shoreline issues. Since the existing culverts are proposed to be replaced, the temporary steel bridge over the culverts would be located in close proximity and would inconvenience construction. Thus, the initial temporary steel bridge is proposed to be removed and a new temporary steel bridge and roadway is proposed to be erected *mauka* of the existing culverts. After the new temporary steel bridge and roadway are constructed, then the existing culverts will be removed and replaced with six (6) new culverts, each six (6) feet wide and four (4) feet high with inlet and outlet wing walls. The second step involves Federal and County funding
Project Acreage	Approximately 3.65 acres
Area of Potential Effect (APE)	The APE for this project will be limited to the immediate area surrounding the Kūlanihāko'i Bridge and stream. Field investigations examined an area 500 feet both north and south of the bridge along South Kīhei Road, as well as 574 feet upstream and 272 feet downstream to the beach.
Historic Preservation Regulatory Context	The project area is subject to Hawai'i State environmental and historic preservation review legislation [Hawai'i Revised Statutes (HRS) Chapter 343 and HRS 6E-8/ Hawai'i Administrative Rules (HAR) Chapter 13-13-275 respectively]. This document is intended to assist in the project planning, and informs planners of further requirements to complete the project's historic preservation review.
Fieldwork Effort	The fieldwork for the project was conducted by Colleen P. Medeiros, B.S., on August 15 2012 and was completed in 1.5 hours.

Number of Historic Properties Identified	Historic properties identified in the current project area include the Kūlanihāko'i Bridge and associated culverts constructed in 1911 and over 50 years old.
Summary and Recommendations	Based on the field inspection findings and background research archaeological monitoring is recommended for all ground disturbing activities during all phases of temporary bridge work, bridge repair and bridge replacement. Additionally, the Kūlanihāko'i Bridge was constructed in 1911 and is 101 years old. It is therefore considered a historic property and archaeological recordation of the bridge is required under Chapter 13-275, Hawaii Administrative Rules. The following are the specific monitoring recommendations: • Onsite archaeological monitoring for all ground disturbing activities for both steps one and two. • It is recommended that monitoring reports are generated after each step of bridge work; ▪ Step one, temporary ACROW bridge installation; ▪ Step two, temporary *mauka* bridge construction, and bridge replacement; • It is recommended that documentation of the bridge is included in the monitoring plan provisions and that recording occur during the monitoring phase of work. Archaeological or architectural recordation of the bridge should take place prior to crews beginning construction work in the project area. • Additional consultation with the Archaeological and Architectural branches of the SHPD is recommended prior to drafting of a monitoring plan.

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Section 2 Introduction

2.1 Project Background

At the request of Wilson Okamoto Corporation and on behalf of the Maui County Department of Public Works, Cultural Surveys Hawai'i, Inc. (CSH) prepared this Literature Review and Field Inspection for the proposed Kūlanihāko'i Bridge Replacement Project located along South Kīhei Road between the Aston Maui Lu Resort and the Kihei Bay Vista Condominium in the Ka'ono'ulu Ahupua'a, Kula District, Maui Island TMK:(2) 3-9-001: 999, 015, 147, 162 (pors.) (Figure 1 and Figure 2).

The Kūlanihāko'i Stream and Gulch is one of several drainage channels of South Maui that experiences flooding during the heavy *nāulu* or southern-exposure rains which occur during the winter months. The flooding is often accompanied by debris carried down from the *mauka,* or Kula, reaches of this gulch. The County of Maui Department of Public Works has proposed to replace the 6 foot wide by 4 foot high by 38 foot long culverts that form the existing bridge in response to severe deterioration of the culverts. In a March 2012 assessment of the structural condition of the bridge, Nagamine Okawa Engineers, Inc. (2012) concluded that due to "severe spalling and advanced corrosion of the reinforcing in the top slab of the culvert, the structural capacity of the culvert has been affected. Immediate repairs or shoring of the top slab is recommended in the engineering report. Posting of the bridge may be necessary". Because of safety issues associated with the deteriorated condition of the existing bridge, the County is working towards an expedited design-build process.

The County of Maui Department of Public Works has proposed a two step process to replace the existing deteriorating Kūlanihāko'i Bridge. In order to immediately address repair of the bridge, the first step involves the erection of a temporary steel bridge to extend over the existing bridge. The temporary steel bridge (ACROW) would span approximately 60 feet and would be approximately 24 feet wide to accommodate two lanes of traffic. Footings for the temporary bridge need to be established on both ends of the bridge. The exact calculations for the footings have not been done as of this writing. However, it is anticipated that excavations for footings will be approximately 8 feet long by 24 feet wide and 5 feet deep on each end of the temporary bridge. Excavation will be contained within the existing S. Kihei Road right of way and will not alter the existing culverts. In order to expedite the installation of the temporary bridge, use of a design build process is anticipated. The first step involves County funding.

The second step involves more extensive and time-consuming permitting involving Federal, State and County wetland and shoreline permit compliance. Since the existing culverts are proposed to be replaced, the temporary steel bridge over the culverts would be located in close proximity and would inconvenience construction. Thus, the initial temporary steel bridge is proposed to be removed and a new temporary steel bridge and roadway is proposed to be erected *mauka* of the existing culverts. After the new temporary steel bridge and roadway are constructed, then the existing culverts will be removed and replaced with six (6) new culverts, each six (6) feet wide and four (4) feet high with inlet and outlet wing walls. The second step involves Federal and County funding.

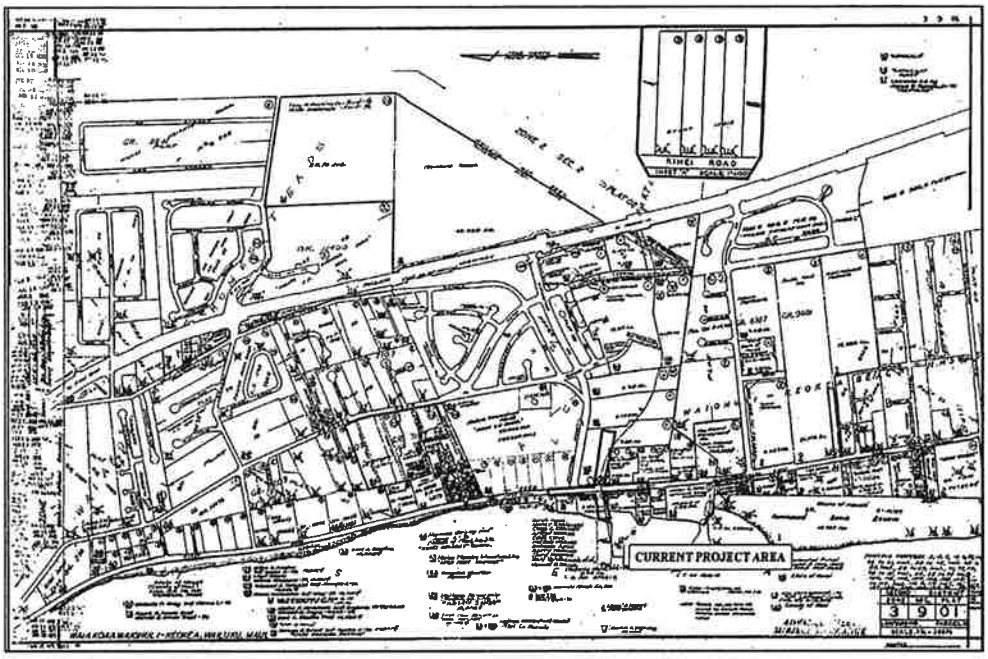


Figure 2. TMK showing Kūlanihāko'i project area outlined in red.

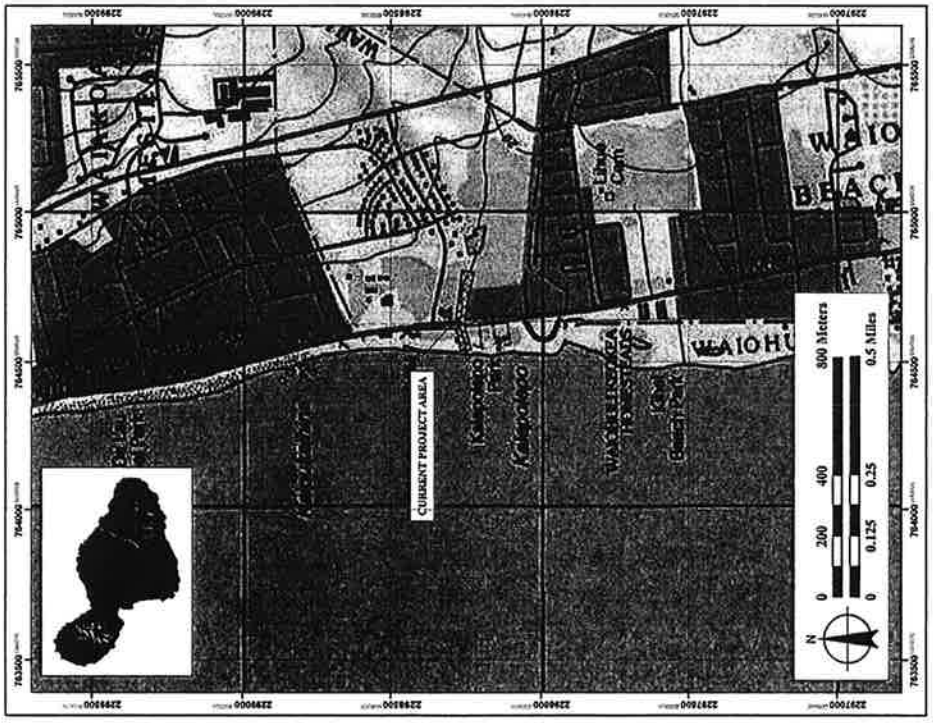


Figure 1. Mā'alaea (1996) and Pu'u O Kali (1992) 7.5 minute USGS topographic quadrangles showing project area.

2.2 Scope of Work

The scope of work included:

1. Historical research to include study of archival sources, historic maps, Land Commission Awards and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property.

2. Limited field inspection of the project area to identify any surface archaeological features and to investigate and assess the potential for impact to such sites. This assessment will identify any sensitive areas that may require further investigation or mitigation before the project proceeds.

3. Preparation of a report to include the results of the historical research and the limited fieldwork with an assessment of archaeological potential based on that research, with recommendations for further archaeological work, if appropriate. It will also provide mitigation recommendations if there are archaeologically sensitive areas that need to be taken into consideration.

2.3 Environmental Setting

2.3.1 Natural Environment

Located on the leeward facing slopes of Haleakalā, the current project area is located adjacent to the Kīhei coastline at mean sea level. The overall topography of the lands comprising the Kūlanihāko'i project area is flat to gently sloping, on arid lands composed chiefly of alluvium covered in dune sands drained between the Waiakoa and Waiohuli Gulches. The mouth of the Kūlanihāko'i Gulch makes up the study area for the current project area. The main soils within the project area are of the Pūlehu-'Ewa-Jaucas association. This soil association is mainly found in alluvial fans and in the basins of central Maui. The specific soils of the lands surrounding the project area include those of the Kealia Soil Series (KMW soil units), which include Dune Land (DL), Beach Sand (BS), and 'Alae (Aab soil units), while the soil series within the project area are predominantly Kealia Soil Series (KMW soil units), Dune Land (DL), and Beach Sand (BS) (Figure 3).

The Kealia Soil Series consists of somewhat poorly drained soils on the coastal flats. The upland portion of the Kealia Series is influenced more by the presence of volcanic ash and was developed from material weathered from basic igneous rock (Foote et al. 1972:12). Keālia soils are geographically associated with Pūlehu, Mala -and Jaucas soils, which are used for wildlife, pasture and urban development (Foote et al. 1972:8). The Pūlehu Soil Series consists of well-drained soils on alluvial fans, stream terraces, and basins and are developed in alluvium washed from basic igneous rock (Foote et al. 1972:115). The soils of the 'Ewa Series are nearly level to moderately sloping and are characterized by well-drained soils found in basins and on alluvial fans. These soils have developed in alluvium derived from basic igneous rock (Foote et al. 1972:28). The 'Alae Series soils consist of excessively drained soils on alluvial fans that have developed in the volcanic ash and recent alluvium derived from basic volcanic igneous rock. For the most part, the soils of this series are nearly level to gently sloping with cobblestones covering most of the surface (Foote et al. 1972:14). Finally, the Jaucas Soil Series is characterized by excessively drained, calcareous soils of the coastal area next to the ocean. These soils are developed from coral and shells deposited by wind and wave action. They are level to strongly sloping (Foote et al. 1972:48).

Rainfall accumulation within the project area averages less than 15 to 19 inches annually with the heaviest rainfall occurring during the winter months (December through February) and little to no rainfall during the summer months (June through August) (Giambelluca et al. 1986; Stearns and MacDonald 1942). This pattern of rainfall and low annual precipitation rate may have once sustained a lowland, dry shrubland, and grassland native ecosystem (Pratt and Gon 1998). The majority of the landscape within the project area, however, has been modified by historic era ranching activities and modern development.

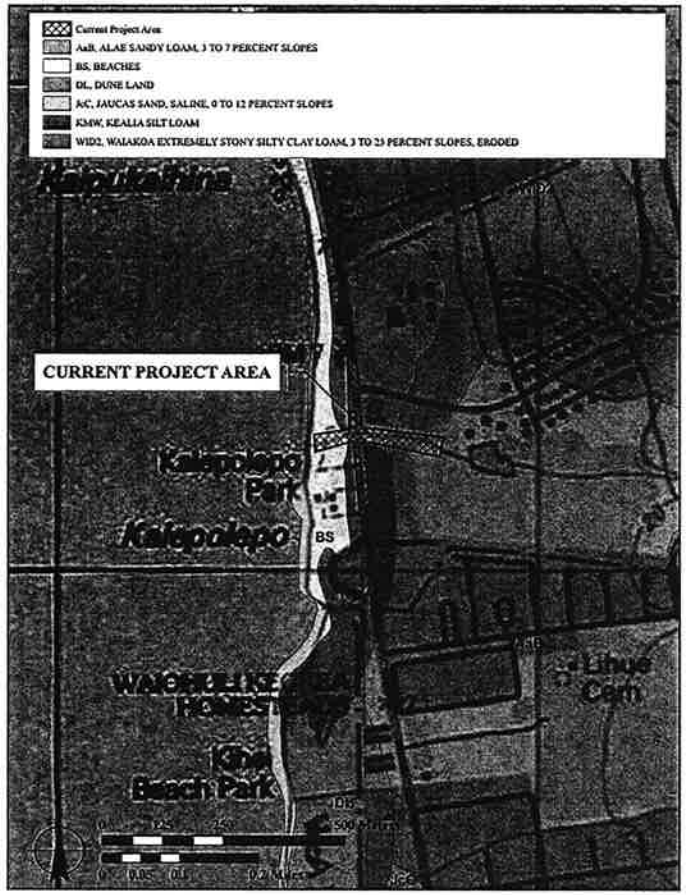


Figure 3. Mā'alaea (1996) and Pu'u O Kali (1992) 7.5 minute USGS topographic quadrangles showing soils of and surrounding project area.

2.3.2 Built Environment

The project area is located along South Kīhei Road at Kūlanihāko'i Gulch. The Kalepolepo Park, the Kihei Bay Vista condominium, and the Pacific Whale Foundation visitor center is located to the south of the project area and the ASTON Maui Lu Resort is located to the north and northeast of the project area. The surrounding area has been built up and includes several large condominium developments, including the Villas at Kenolio, located inland and east of the project area. The project area is located south of the Mokulele-Pi'ilani Highway junction on South Kīhei Road.

Figure 4. Google Earth aerial image showing project area location in relation to the surrounding built environment.

Section 3 Methods

An archaeological field inspection of the project area was conducted by CSH archaeologist Colleen P. Medeiros, B.S., under the general supervision of Hallett H. Hammatt, Ph.D. The fieldwork was conducted on August 15, 2012. The field investigation required 1.5 hours to complete.

3.1 Field Methods

The project area includes the Kūlanihāko'i Stream drainage way which South Kīhei Road crosses, and the limited land area immediately surrounding the drainage way and South Kīhei Road. The field inspection method involved a pedestrian inspection of the land areas on the northern side of the Kūlanihāko'i Stream and the southern side of the stream along South Kīhei Road. Photographs were taken and a photo log completed. The project area was inspected for evidence of traditional cultural architecture and/or cultural materials present, vegetation and general surroundings noted.

3.2 Document Review

A variety of resources devoted to historical perspectives of the region and traditional stories and accounts were reviewed. Research venues included the Hawai'i State Historic Preservation Division of the Department of Land and Natural Resources and the Survey Office of the Department of Accounting and General Services. All relevant Land Commission Awards (LCAs) and Royal Patents were researched using resources associated with the Waihona 'Aina online database (Waihona 'Aina 2002).

Section 4 Background Research

4.1 Traditional and Historic Background

The division of Maui's lands into political districts occurred during the rule of Kaka'alaneo, under the direction of his *kahuna*, Kalaiha'ōhi'a (Beckwith 1970:383). This division resulted in twelve districts or *moku* during traditional times: Honua'ula, Kahikinui, Kaupō, Kīpahulu, Hāna, Ko'olau, Hāmākua Loa, Hāmākua Poko, Ka'anapali, Lahaina, and Kula. The current project area is located on the leeward flank of Haleakalā in the *moku* of Kula and in the *ahupua'a* of Ka'ono'ulu (Figure 5) along the shoreline at Kīhei.

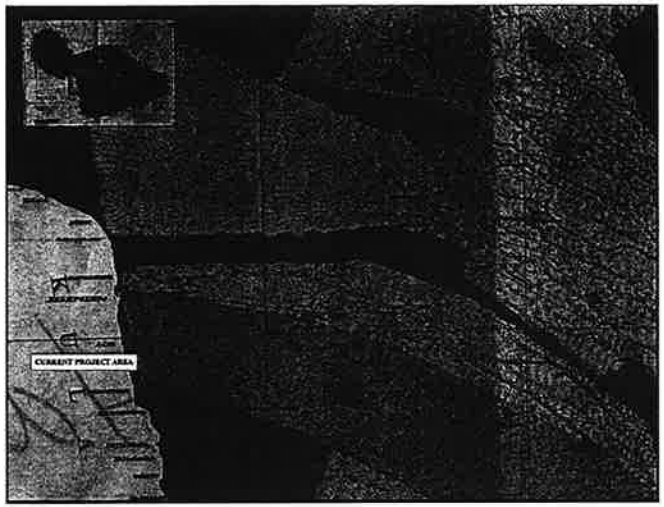


Figure 5. A portion of the F.S Dodge map (1885) showing Ka'ono'ulu Ahupua'a in relation to the traditional *moku* of Kula (crown lands in yellow, government lands in green).

4.2 Traditional and Historical Background

4.2.1 Mythological and Traditional Accounts

While the mythological and traditional accounts of the Kīhei area are relatively scarce, an analysis of the place name meanings for the region surrounding the project area may yield some insight into the patterns of life in an area. Literal translations of several of the place names for

land areas and divisions near to the project area are listed below. Unless otherwise noted, the translations are taken from Pukui et al. (1974):

Table 1. Place Names in the vicinity of Kalepolepo.

Akolea	A species of fern (*Polypodium keraudreniana*) traditionally known to have grown in plentiful quantities at Kalepolepo, according to Fornander (see Kama'oma'o below). Handy states that the region was known to support only the sweet potato (Handy 1991:511).
Alakoa	Lit., "soldiers' street."
Kaipukai Hina	Lit., Hina's meat dish." Name given to the coastal region just north of the present-day "Gordon Gibson monument to Vancouver," which is seaward at a promontory fronting the Maui Lu Resort property.
Kalaepōhaku	Lit., "the stone promontory," located south of the Kīhei Landing pier. A rocky promontory which is a boundary marker in North Kīhei.
Kale'ia	Lit., "the abundance", possibly in reference to the resources available from the fishponds and offshore fishing grounds at Mā'alaea.
Kalepolepo	Lit., "the dirt." According to Fornander, Kalepolepo was known as the seaward extremity of the plain of Kama'oma'o. In Fornander's "The Legend of Kekuhaupio," the story's pivotal battle occurs at the edge of Kama'oma'o, at Kalepolepo (Fornander 1919:456). Again, in Fornander's "A Story of Puupehe," a battle is fought at the edge of the plains of Kama'oma'o at Kalepolepo.
Kaluaihākōkō (Point)	*Lit.*, the pit [for] wrestling. Hākōkō is said to have been the name of a chief. A coastal promontory at the Kalama Park area of Kīhei.
Kalepeamoa	*Lit.*, "the comb [acquired] by [a] chicken. The crest of Haleakalā's southwest rift zone, where the eastern boundary line of Ka'ono'ulu Ahupua'a terminates and returns west to the shoreline of Kīhei along its boundary with Waiohuli Ahupua'a.
Kama'oma'o	Lit., "the greenness." Plain near Kalepolepo, where, according to Fornander, the large pond of Keālia is located. In Fornander's "A Story of Puupehe, two prophets, Pueonuiokona and Pumaia fought over the fate of spirits of the dead who were destined to wander across the isthmus of Maui. The battle took place at Kalepolepo, near Keālia Pond. Pumaia was killed by the owl, Pueonuiokona, who disemboweled Pumaia and spread his remains across the *akolea*, a species of fern (*Polypodium keraudreniana*) once found on the arid plains of Kama'oma'o (Fornander 1919:554).
Ka'ono'ulu	Lit., "the desire [for] breadfruit." Ahupua'a land division in the Kula District of Maui, with a land area of 5,715 acres. The eastern boundary of this *ahupua'a* terminates at a point named Kalepeamoa before

	running west back to the shoreline of Kīhei
Ka'ōpala	literally "the rubbish"; the traditional boundary line between Pūlehu Nui Ahupua'a and Waikapū Ahupua'a
Kawililipoa	Kawililipoa is an *'ili* of Kama'ole Ahupua'a, cited by Stokes in 1918 as the site of three *heiau* south of Kalepolepo (See Section 4.3, Previous Archaeological Research).
Ka'ie'ie	"a plaything for floating in the rapids", an ancient name for Kalepolepo (Sterling 1998:252)
Keālia	literally "salt encrustation"; a pond near Kīhei and major salt pan location (Sterling 1998:95)
Keāhuaiwi	literally "the bone pile"; the name of a gulch immediately adjacent to and north of Waiakoa Gulch in North Kīhei
Kenolio	Prominent South Maui family name.
Kīhei	literally "cape or cloak"; sandy point and boundary marker between Pūlehu Nui and Waikapū (Sterling 1998:255); commonly used place name for the coastal south Maui area
Kīheipūko'a	*kīhei* literally translates as "cape or cloak" and *pūko'a* literally translates as "coral head"; Kīheipūko'a was a traditional place-name for the shoreline near Keālia between Kalepolepo and Mā'alaea (Sterling 1998:257)
Kikaupōhaku	Lit., "rock of Kikau." In the traditional story of the building of the Kalepolepo pond walls by Wilcox, Kikau's rock was placed at the northwest corner of the fish pond wall by *na menehune*.
Kohemālamalama	*Lit.*, "the vagina"; also the ancient name for the island of Kaho'olawe, an island located approximately six miles southwest of the Kīhei coastline.
Kula (*moku*)	literally translated as "plain"; traditionally known as an arid flat region (Handy in Sterling 1995:242)
Kūlanihāko'i	*Lit.*, "agitated heaven that stands." Named for a mythical floating land in the sky.
Waiakoa	*Lit.*, "water (used) by warrior."
Pohaku Ki'i	"tilted stone"; a resting place for travelers
Pūlehu Nui (*ahupua'a*)	Large *pūlehu* where *pūlehu* is literally translated as "broiled"

The above place names, together with the environmental data, suggest that the lands of and surrounding coastal Ka'ono'ulu were fairly dry and barren in an agricultural sense but rich in

marine resources. Previous research on pre-Contact settlement in the Kula District (Kolb et al. 1997) has suggested that most permanent habitations were in the uplands with a smaller permanent population located along the coastline. While a reconstruction of the coastal and archaeological landscape of Kula Moku underscores the importance of the uplands as a focus of agriculture and habitation, Hawaiian traditions and the presence of four fishponds are evidence that the coastal environs were also a focus of settlement and marine exploitation. The relative scarcity of recorded coastal place names, however, may be an indication of a smaller population that was widely spread out across the leeward coastal line. The vicinity surrounding the current project area was also a site of conflict between the Hawai'i Island chief Kalaniopu'u and Maui Island chief Kahekili and is perhaps the origin for such place names as "Waiakoa" and "Keāhuaiwi".

Note that many of the place names are associated with regional shoreline fishponds. Kalepolepo Fishpond (also named Ka'ono'ulu Kai and Ko'ie'ie) is located along the shoreline of Ka'ono'ulu Ahupua'a, within the traditional district of Kula, Island of Maui. The *ahupua'a* of Ka'ono'ulu is one of six major Kula land divisions which extend from the Ocean to the upper reaches of Haleakalā. Ka'ono'ulu is situated near the center of the Kula District, with Pūlehu Nui and Waiakoa to the north and Waiohuli, Kēōkea and Kama'ole to the south. Ka'ono'ulu is approximately 0.4 mile wide at the shoreline, and 0.7 mile wide at Kalepamoa (9,000 ft AMSL). The *ahupua'a* has a maximum width of one mile, which occurs at 800 ft AMSL. Kalepolepo Pond is at the southern boundary of the *ahupua'a* (Donham 1996:1).

4.2.2 Traditional Accounts

The earliest account concerning Kīhei and Hawaiian politics is given by Kamakau (1991) during the time of Alapa'i and Kekaulike:

> Alapa'i sailed from Kohala on Hawai'i...But when he landed at Mokulau in Kaupō (Maui) and heard that Ke-kau-like was dying, he gave up all thought of war and wished only to meet Ke-kau-like and his (half) sister Ke-ku'i-apo-iwa-nui...He landed at Kīheipuko'a with all his chiefs and fighting men...While he was at Kīhei, Alapa'i heard that the ruling chief of Oahu was making war upon Molokai. Most of the chiefs of Moloka'i...were of Hawai'i...Alapa'i's sympathy was aroused, for these were his own brothers and children (relatives), and he made ready to go to their help on Moloka'i (Kamakau 1991:70).

Other accounts involve the continuing conflict between Kahekili of Maui Island and Kalani'opu'u of Hawai'i Island during the late 18th century. Following a losing battle at Kaupō in 1775, Kalani'opu'u dedicated several war *heiau* on Hawai'i Island to aid in the defeat of Kahekili. Upon hearing this news Kahekili sent for the *kahuna* (priest) Kaleopu'upu'u who directed construction of the *heiau* of Kaluli and Pu'uohala on the north side of Wailuku. When Kaluli Heiau was completed Kaleopu'upu'u said to Kahekili:

> This is the house of your god; open the sluice gate that the fish may enter (Kamakau 1991:85).

In the year 1776, the army of Kalani'opu'u landed at Keoneo'o'io with their war canoes extending to Makena at Honua'ula and proceeded to ravage the countryside. Kalani'opu'u landed with additional forces at Kīheipūko'a at Keālia to Kapa'ahu, 800 strong and eager to drink the waters of Wailuku:

> Across the plains of Pu'u'ainako (Cane-trash-hill) and Kama'oma'o shone the feather cloaks of the soldiers ... Ka-hekili was at Kalanihale just below Kihahale and above the plateau of Ka'ilipoe at Pohakuaokahi ... Kaleopu'upu'u [said] to Ka-hekili, "The fish have entered the sluice; draw in the net." (Kamakau 1991:85)

The forces of Kahekili descended on and destroyed the soldiers of Kalani'opu'u, slaying the Alapa (elite soldiers of Kalani'opu'u) on the sandhills at the southeast of Kalua [an area close to the present-day Waikapū, according to the accounts]. Only two men escaped to Kīheipūko'a to tell Kalani'opu'u the news of their defeat. After a second day of warfare, Kalani'opu'u sued for peace and was granted such by Kahekili and his messengers at Kīheipūko'a (Kamakau 1991:88-89).

Fornander (1880) notes that Kalaniopu'u, a ruling chief of Hawai'i, was temporarily at Kalepolepo in the 1750's (Fornander 1880:142).

Fornander's traditional accounts for the portion of Kīhei including Kalepolepo and plains of Kama'oma'o at the edge of Keālia Pond includes "A Story of Puupehe," about two prophets, Pueonuiokona and Pumaia who fought each other over the fate of sprits of the dead who were said to wander across the central isthmus of Maui. The battle took place at Kalepolepo, near Keālia Pond. Pumaia was killed by the owl, Pueonuiokona, who disemboweled Pumaia and spread his remains across the *akolea*, a species of fern (*Polypodium keraudreniana*) once found on the arid plains of Kama'oma'o in the vicinity of Keālia Pond (Fornander 1919:554).

Fornander's account of the chief Kauholanuimahu, who resided at Honua'ula and exercised royal authority names him as the builder of the fishpond at Keone'o'io (in Kalihi Ahupua'a) (Fornander 1880:70-71). When Charles Wilcox wrote about Kalepolepo for the monthly magazine of Hawai'i named "Paradise of the Pacific" in December, 1921, his article included the traditional story of how the race of Hawaiians known as *Na Menehune*, constructed the Ko'ie'ie fishpond.

> Koieie is the ancient name of Kalepolepo, and the ruined sea walls of fishponds are the hallmarks of its importance to the rulers of ancient Hawaii. When the Konohiki summoned the people of Maui to build fish ponds for the king at Kēōkea-kai, Waiohuli-kai and Kaonoulu-kai, one man, Kikau, a *kilo* [fish-spotter], protested that no such works could be completed without the help of the *Menehune*. For this Kikau was told that when the king's ponds were completed he should be baked in the *imu*[underground oven].
>
> In building the sea walls men were stationed in long lines, passing stones by hand from the rocky sidehills miles away to the workmen laying the courses for the walls in the sea. The trampings of so many busy feet raised much dust, and workmen throwing dust at one another prompted the konohiki to call them derisively "Kanaka o Kalepolepo eku i ka lepo," or "Kelepolepo root in the dirt."
>
> At the completion of the Keokea-kai pond the konohiki gave splendor to the event by riding on the capstone while it was being carried in a litter of stout poles on the shoulders of over twenty men to its resting place at the northeast corner of the pond.

After the ceremony he summoned Kikau and asked him he thought of it, and Kikau replied that the works were still unfinished. "When the last stone of the last pond is laid your life shall be forfeited," replied the konohiki.

The completion of the sea walls of the Waiohuli Pond was marked by a similar ceremony, and two heavy boulders were carried on separate litters from the quarry a mile away to the northwest corner of the pond. The konohiki rode on the larger of the two capstones and, on the other, his wife was carried ahead of him, both dressed in the costume of their rank, attended by kahili-bearers and kaukaus [warrior chiefs] chanting meles.

As the seawalls of the Kaonoulu pond neared completion a block of lava fully a ton in weight was selected for the capstone and forty men put their shoulders to the litter of stout poles and waited. The konohiki mounted the ceremonial stone dressed in his war cloak and gave the word. With kahilis waving and kaukaus reciting the glories of his *mele-inoa*, the rock was lifted and the procession moved. When but a third of the distance had been covered the litter broke down, the big stone fell to the earth, and the konohiki was thrown to the ground and fell sprawling, face down in the dirt.

That night a great storm arose – rain, wind, hail, thunder and lightning and an earthquake and heavy storm waves from the sea, with a flood of red waters from the hillsides, spent its fury on Kalepolepo. In the midst of the storm the elves or *eepa*, birth brothers of Kikau, gathered, and each lightning flash revealed the host of elves busily tearing down the seawalls, undoing the work of the konohiki, so that Kikau might not die.

In the morning the storm had passed – and the seawalls of the ponds built with so much labor were seen to have been torn down, and the heavy boulder last ridden by the konohiki which, when set in place, meant the completion of the work, had disappeared.

Again the people were summoned to rebuild the ruined fishponds, only to have the final ceremony end with an accident. Another storm came up, a swarm of elves at night, and the whole work mysteriously undone as before.

The konohiki acknowledged his fault and offered to be guided by Kikau in rebuilding the ruined ponds which must be completed or his own life would be forfeited to the king. Kikau told him to summon the people of Koolau to bring opae and the people of Wailuku to bring baby taro or taro shoots (hā kalo)in great quantities and when this was done Kikau would invoke his aumakuas [guardian spirits] to summon the menehunes to do the work.

When these supplies were brought in, the taro cooked and the opae laid in the ti-leaves, Kikau advised the konohiki to proclaim a tabu of silence for the people to remain silent and stay indoors; that no pig be allowed to squeal, no dog to bark, no rooster to crow, on that particular night – and so it was proclaimed.

That evening the first signs of the bestirring of the menehunes were seen in the rising of spirals of red dust from afar off – from the uplands – as they came trooping to the lower lands there were swirling clouds of red dust to the north and east of Koieie (former name of Kalepolepo).

In no time (manawa ole) the ruined walls of the ponds were rebuilt and then, to mark the completion of their work, they fell to the final task of laying, in a select spot at the northwest corner of Kalepolepo pond, the huge boulder now known as Kikaupohaku.

4.2.3 Early Historic Period

Kīhei was one of the locations visited by the English explorer Captain George Vancouver. A monument at Mai Poina 'Oe Ia'u Beach Park in Kīhei commemorates Vancouver's on-shore expedition in 1792, when he first met the ruling chief Kahekili. With its sheltered coastline and easy access to upcountry resources over a vast slope, Kīhei would continue to be a common stop for visiting ships. In 1841, Wilkes commented, "At Malaea [Mā'alaea] Bay there is good anchorage for vessels of any size, and a fine fishery" (Wilkes 1845).

During the early and middle 1800s, the Hawaiian demography was affected by two dramatic factors: radical depopulation resulting from Western disease; and nucleation around the developing port towns. The traditionally Hawaiian population was largely dispersed and, although there were royal centers and areas of more concentrated population, these areas never came close to rivaling the populations of the historic port towns that developed on Hawai'i's shorelines during the 1800s. In this regard, Kuykendall (1938:313) notes that in the period from 1830 to 1854:

> The commercial development during this period, by magnifying the importance of a few ports, gave momentum and direction to a townward drift of population; the population of the kingdom as a whole was steadily going down, but the population of Honolulu, Lahaina and Hilo was growing.

We believe that Kuykendall's observation was most likely the demographic pattern at the Kalepolepo entrepot, an area that may have included the project area when it existed, and a hub of early historic activity for Kīhei and eventually all of Kula Moku (Kolb et al. 1997:69). The development of Kalepolepo as an entrepot and a focus of Christian life in the 1840s and 1850s most likely increased the population in the immediate vicinity above the pre-Contact population figures, contrary to the island-wide trend of depopulation.

On the 2nd of September [1853], David Malo was ordained pastor of the church at Keokea, Kula. The church at Kalepolepo became his outstation, where he spent a great deal of time. Malo's father had been connected to Kamehameha's court and army. Malo was born in Keahou, in the northern part of the Kona district (Island of Hawai'i) in 1795. In his youth Malo was part of the entourage of Kuakini, brother of Queen Ka'ahumanu. Malo then became the pupil of 'Auwae, Kamehameha's bard, genealogist and ritual expert. Malo then studied at Lahainaluna when it opened in 1831. Malo authored a cultural history of Hawai'i about 1840 to assist missionary Lorrin Andrews with his research on developing a dictionary and a grammar for the Hawaiian language; Malo's *Moolelo Hawaii* was translated by Nathaniel B. Emerson (Malo 1951) and published (Valeri 1985:xxv).

That the population and areal extent of the Kalepolepo community reached its zenith during the mid 1800's appears to be supported by Kolb (*et al.* 1997:68):

> The ancient village of Kalepolepo was relatively small, and was built around an economy primarily based upon the exploitation of ocean resources--primarily the excellent fishing grounds as well as three large fishponds. However, as the number of visiting ships increased, Kalepolepo soon became an important provisioning area. By 1850 we know that the economic opportunities were attracting a number of European entrepreneurs.

In 1820, the whaling industry was introduced in Hawai'i. Although the whaling trade centered on Lahaina, mainly affecting the Kula/Kīhei area through agricultural demands, Clark (1980:47) notes that "From the 1840s to the 1860s a small whaling station was maintained at Kalepolepo [Kīhei]." The introduction of whaling to the Maui community brought with it an increased demand for foodstuffs and in particular the long-lasting Irish potato. After 1830, dryland agriculture in the old Kula District expanded with a focus on Irish potato cultivation. The California Gold Rush of 1849 further intensified the demand as a California-Hawai'i potato trade began to flourish. Kula became the area of highest potato production and was known as "the potato district" (the area between 2000 and 5000 ft. amsl). During this time period sugar cultivation and ranching were established in the Kula region. Sugar was present prior to 1846, with six sugar producers operating on the slopes of Haleakalā (Wong Smith in Brown and Haun 1989:C-7). As Wong Smith points out (Brown and Haun 1989: C-6), ranching was present in the area prior to the 1840s. Much of the produce, sugar and livestock moved down the Kalepolepo and Kekuawaha'ula'ula Trails to the landing at Kalepolepo, adjacent to the project area. Donham (1992:5) notes that the inundation of land clearing and cultivation associated with the Gold Rush resulted in "deforestation [which] adversely affect[ed] the amount of rainfall in the district, and periods of drought became more common."

In the early 1850's John Halstead built the Koa House at Kalepolepo in Kīhei. At the time Halstead was contemplating the construction of the three-story frame house, neighbors wagered that the house "would not be able to stand up to the blasts of *Kaumuku* wind which sweeps the place at times like a localized tornado. The builder went on with his work and won the wager." Mauian Charles Wilcox wrote about the Koa House for the monthly magazine of Hawai'i named "Paradise of the Pacific" in March, 1905:

> No one remembers the actual date of its [Koa House] construction, but the fact that King Liholiho (Kamehameha IV) visited Kalepolepo on a royal tour immediately after accession to the throne in the fall of 1854, and stayed overnight as the guest of its owner, is proof it was built before that time.
>
> John Joseph Halstead was a scion of a notable New York family of the early colonial days who....went to sea as a whaler. He came to Hawaii and left ship in Lahaina in the early thirties. He engaged in business first as a carpenter and cabinet maker for the king and later as a trader He was said to have put up the first frame house in Lahaina. While there in the king's service he married Kauwaikikilani, a young woman of the chiefess class, being a granddaughter of Isaac Davis, commander of the royal artillery in Kamehameha's wars of conquest.

> With the news of the discovery of gold in California in 1848 came orders from San Francisco merchants for Irish potatoes and other food supplies for the Argonauts who came hurrying to the new gold fields. Many whites and Hawaiians fitted out and left Lahaina for the new El Dorado but Mr. Halstead did not join the pioneers of 1849. He chose instead to promote the Irish potato industry for the victual ling of whale ships in their seasonal voyages after whales.
>
> He moved over to Kalepolepo with his family and shortly thereafter built for himself the old house.....from the forties to the sixties at Kalepolepo a small whaling station was maintained. During the winter and spring months schools of whales would come to stay or calf in the quiet waters of Maalaea Bay, and at such times whale boats manned by native crews officered by experienced whalers would go out to battle the big mammals and if successful would return towing the carcass in to be cut up and tried for oil.
>
> Some time ago a writer in *The Friend* claimed that the old house at Kalepolepo was Reverend Green's granary during the wheat boom of the fifties and early sixties, when the upper Makawao country from Maliko to Waiohuli was cropped to wheat, Possibly some wheat may have been shipped from Kalepolepo in those days, for from early times to the late sixties it was a shipping port for Wailuku to Kula and Mr. Halstead had one or two big warehouses standing makai of his residence. S. Lono, the oldest resident of Kalepolepo aged over seventy-five years, remembers nothing of Mr. Green's activities in that time, except that the Reverend Green visited Kalepolepo quite often, usually to preach a sermon and take up a collection.
>
> At that time, Kalepolepo was a thriving village, with two churches, one being a Mormon church where George Cannon or Walter Murray Gibson expounded the Christian doctrines of Joseph Smith against Christian Calvinism as preached by the Reverend Green and David Malo. At one time Father Green preached a red hot sermon- a favorite hobby of his – against mixed marriages and caused quite a stir of scoffing from the colony of whites married to Hawaiian women living at Kalepolepo consisting of J.J. Halstead, Mr. Fern, father of the late mayor Fern of Honolulu, and Mr. Fredenberg. Mr. Fern and Fredenberg being in charge of the whaling station (Wilcox 1921).

4.2.4 Mid- to late-1800s

The most significant change in land-use patterns and allocation came with The Great Māhele of 1848 and the privatization of land in Hawai'i. This action hastened the shift of the Hawaiian economy from a subsistence-based to a market-based economy. During the Māhele, all of the lands in the Kingdom of Hawai'i were divided between *mō'ī* (king), *ali'i* and *konohiki* (overseer of an *ahupua'a*), and *maka'āinana* (tenants of the land) and passed into the Western land tenure model of private ownership. On March 8, 1848, Kauikeaouli (Kamehameha III) further divided his personal holdings into lands he would retain as private holdings and parcels he would give to the government. This act paved the way for government land sales to foreigners, and in 1850 the

legislature granted resident aliens the right to acquire fee simple land rights (Moffat and Fitzpatrick 1995: 41-51).

Native Hawaiians who desired to claim the lands on which they resided were required to present testimony before the Board of Commissioners to Quiet Land Titles. Upon acceptance of a claim the Board granted a Land Commission Award (LCA) to the individual. The awardee was then required to pay in cash an amount equal to one-third of the total land value or to pay this equivalent in unused land. Following this payment, a Royal Patent was issued that gave full title of ownership to the tenant. But by 1850, the government of Hawaii was offering land for sale to both Native Hawaiians and foreigners. Such lands were referred to as Royal Patent Grants or as Grants.

A number of land commission award parcels were located in the nearshore region of the Ka'ono'ulu Ahupua'a, in close proximity to the present project area. These parcels are tabled below. From these records, it appears that many of the residents of Kalepolepo had agricultural interests inland of the coast.

Table 2. Land Commission claims in Kalepolepo and vicinity.

LCA	Royal Patent Number	Claimant	Award Type	Acreage
05267	2793	Kuhiahiwa	1 *'āpana*	3.12
02764	----	Hiona	1 *'āpana* of kula land with 1 *mala* of Irish potatoes at Ka'ono'ulu.	-----
4120B	5067	Kapohaku [Konohiki of Keokea]	4 *'āpana*, one of which is a house lot at Kalepolepo measuring 0.25 acres.	17.89
5407	2791	Mahiai	3 *mala* [cultivated patches or fields] of Irish potatoes at Ka'ono'ulu.	3.49
6720B	3102	Nahelu	4 *'āpana*, one of which is a house lot in the *'ili* [land section] of Kalepolepo, bounded on the *mauka* side by Mahiai's land [see LCA 5407 above].	20.18
5228	------	Kuihelani	---------	28.00
9673	6329	Lonoaea	---------	4.06
5328	6575	Pupuka	1 *'āpana*	1.00
5267	7467	Kauhiahiwa	3 *'āpana*, one of which is a house lot in the *'ili* of Kalepolepo; bounded on the *muaka* side by Kapohaku's land [see LCA 4120B above].	4.50
7971F	2205	Nauliuli	1 *'āpana*	3.40
5279	6523	Palekai	1 *'āpana*	10.40
03237-M	7447	Hewahewa, H.	Ka'ono'ulu Ahupua'a as listed in the māhele registry, July 12, 1849	5,715

4.2.5 Brief History of the Ka'ono'ulu Ranch Company

The Ka'ono'ulu Ranch Company was established in the early 1900's by Harold Waterhouse Rice, who was appointed division overseer for the Maui Agricultural Company in 1907, the same year he married Charlotte M. Baldwin. He became assistant manager of the Maui Agricultural Company sugar plantation in 1909. He then purchased the Cornwell cattle ranch in 1916, developing and stocking the ranch with pure-bred cattle and horses and renaming the ranch. Harold Waterhouse Rice became a member of the territorial senate in 1918. Senator Rice and Charlotte Baldwin had four children, Charlotte Emily, Harold Frederick "Oskie," Maud Baldwin and Mary McKinney Rice (Nellist 1925).

As of the time of Statehood, in 1959, some 1,000 acres of the Kula forest district was in the private land holdings of the Ka'ono'ulu Ranch Company. Earlier, in 1920, the Board of Commissioners of Agriculture and Forestry requested that title to 1,006 acres of private land owned by the Ka'ono'ulu Ranch, be acquired by the Territory. Under the law then in effect, "if an area exceeds 40 acres an exchange cannot be made." According to Korte, as there was insufficient money for land purchases, the matter was dropped (Korte 1961).

The ranch is run today by Henry Rice, grandson of Harold Rice (Karp 2010). In a 2010 interview with the Wall Street Journal, Harold Rice described his family circumstances that lead up to his becoming the managing general partner of the Ka'ono'ulu Ranch Company, which included the history of the ranch lands as a potato farm. The article concluded by describing Henry Rice's day-to-day duties, which includes mending fences and taking care of the ranch cattle and employing a number of cowboys to help in these activities (Karp 2010).

At the present time, the cattle ranch operates mostly in the upland reaches of the Ka'ono'ulu Ahupua'a, however, in the lower elevations, a land parcel sold by the Ka'ono'ulu Ranch along Kīhei's Pi'ilani Highway is to be developed into a new high school for Kīhei, as well as a new "outlet center" type of shopping center (Imada 2012).

By the time John Halstead closed shop in 1876, the boom years of Kalepolepo had passed. By 1880 the government survey of the Kula area showed the demarcation of only a few Land Commission Awards and those who had received awards had replaced them with grants. Lower Kula consisted primarily of pastureland for ranching (Wong Smith in Donham 1990b:B-6). Kennedy (1992:7) notes that at this point *kiawe* was imported to feed cattle and provide wood.

Regarding the settlement at Kalepolepo and the impact of the changes associated with the change to ranching on the general area known as Kīhei, Clark comments:

Halstead finally closed his store in 1876, as demands for his goods had steadily decreased, and moved to Ulupalakua . . . By this time the once thriving Hawaiian village at Kalepolepo had been almost totally abandoned as well. The slopes of Haleakala had gradually become denuded of their forests and torrential rains had caused heavy soil runoffs into the Kalepolepo shoreline. Cattle had trampled down the brush and grassy fields, causing sand dunes to drift and fill up the pond. Clouds of dust filed the air instead of cooling winds. Except for a handful of fishing families, Kalepolepo (and likely the Kīhei area in general) was deserted. (Clark 1980:48).

Sugar would soon fill the void and in 1898 the Kīhei Plantation Company (KPC) was founded. The KPC began sugar operations in Kīhei and on the plains across central Maui.

4.2.6 Early to Mid-1900s

The Kihei Plantation Company, Ltd. was organized late in 1898 with a capitalization of 60,000 shares at $50 par value. Water was the most critical component in the decision to locate sugar cultivation along the leeward shores of Maui's arid coastline. The discovery of an ample supply of irrigation water early in 1898 led to the drilling of a large, successful well, but the supply of water was limited (Stearns 1942). Over the next four years, two ditches were developed to supplement the water needs of the 4,873 acres of sugar under cultivation at Kīhei (Gilmore 1936).

The history of the Kīhei Plantation Company begins with the annexation of the Hawaiian Islands by the United States in 1898. With annexation came political stability for Hawai'i. Sugar prices were rising due to the outbreak of war between the United States and Spain over the colonies in Cuba, Puerto Rico and the Philippines. Henry P. Baldwin, of the Maui plantation of HC&S, entered into a partnership with O'ahu businessman Benjamin F. Dillingham to convert Lorrin A. Thurston's landholdings in Kīhei into a sugar enterprise.

Up to that time, sugar cultivation within the central isthmus of Maui was centered around the main towns of Wailuku and Kahului. Water tunneled from springs in the West Maui Mountains flowed through ditches in Wailuku to irrigate fields as far away as Mā'alaea. Water from the windward rain belt of Kailua ran through a network of ditches from East Maui to Pā'ia, to irrigate fields in Pu'unēnē.

The McCandless Brothers drilled a successful Maui-Type well (U.S.Geological Survey Well 14 / Hawaiian Commercial & Sugar Well K1) in 1899. It was located just inland from the coast in North Kīhei, between Keālia Pond and the Waiakoa Homestead Lands. This well was drilled vertically to approximately 60 feet through the Honomanū basalts, and tunneled laterally over 1,500 feet in order to skim 10 million gallons of fresh irrigation water per day from sources beneath the Kīhei plains (McCandless 1936).

The Kihei Plantation Company had the McCandless Brothers drill two or three additional Maui-Type wells on the north side of reservoir K2 at the discharge end of the existing pipeline of Well 14. The plantation in Kīhei failed in 1908 before the well site was able to be developed. It would have been named the HC&S K2 well, and would have included a large pumping station (Stearns 1942).

The plantation company in Kīhei built bridges to span streams and gulches flowing through the company fields. The plantation had planned the construction of a mill in North Kīhei, and ordered a plant to be built. It was decided that the new HC&S mill under construction at Pu'unēnē would have more than enough capacity to mill all the cane from the Kīhei fields. The order for the mill was transferred to the 'Ōla'a Sugar Company in Hawai'i, in exchange for a supply of steel rails for new railway requirements at Pu'unēnē. A large scale Kona storm hit the plantation on November 15th, 1900, and caused immense damage to both Kīhei and the HC&S fields in Pu'unēnē (Dean 1950). Bridges were knocked out, buildings were flattened, and washouts filled irrigation ditches with silt. Repairs were effected immediately, with the new HC&S mill at Pu'unēnē commencing operations January 29, 1902.

4.2.6.1 Railway Operations

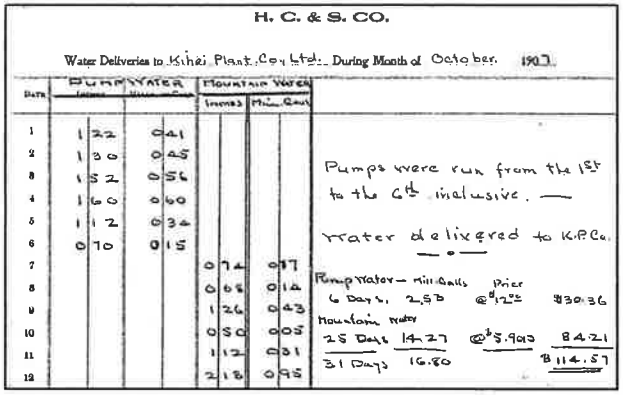
The Kihei Plantation Company planned to construct a railway to move their cane. The sugar agency of William Dimond & Company placed an order for a locomotive from the Baldwin Locomotive Works in Philadelphia. The order was placed April 1899, and the plantation locomotive "Haleakala" was built and sent on to Maui (Conde 1973).

By March of 1900, the first annual report of the Kihei Sugar Company stated, "It was our intention to complete the main [rail]road only as far as Camp #2, or for about 2 miles, but as the development of Camp #3 required pushing on of the road one and a half miles further, this has been done, having been completed the 15th of February." An additional six miles of track connected the Kīhei wharf to the various well pumping stations, and north to meet up with HC&S track (Conde and Best 1973). Establishing the railroad at Kīhei made it possible to harvest and transport over two thousand tons of sugar in a single year (Dean 1950).

The 3-foot gauge track for the Kihei Plantation Company railroad was built to the same specifications as the railway linking the HC&S Company mill at Spreckelsville to its fields; and to the sugar warehouses at the Kahului wharf. By 1902, with the new Pu'unēnē mill completed, a new milling contract with HC&S provided that all cane loaded by the Kihei Plantation Company was to be ground and manufactured into sugar by HC&S.

4.2.6.2 Water Source Development

The Lowrie Ditch project, named for former HC&S manager William J. Lowrie, brought an additional source of water to the Kīhei plains. His plan was to begin the ditch at the Pāpa'a'ea Reservoir, at the 1,000 ft. elevation, and maintain a four-foot drop per mile following the ditch's initial plunge from the Kailua reservoir. Steep mountain gulches were traversed using the force of the constant weight of water flowing in a series of siphons. The Halehaku Gulch, at 250 feet deep, and the Māliko Gulch, at over 350 feet deep, were both crossed by giant siphons fabricated of three-eighths-inch iron, and set in place by Japanese laborers. At a weir located above Pā'ia, the allocation of water began. The first tenth of the water flow in the Lowrie Ditch was divided out to the Pā'ia Plantation (an 11/20ths share) and the Haikū Plantation (a 9/20ths share). The distance traveled, from Kailua to the plantation's Kīhei boundary, was 21.9 miles (Thrum 1900).More water was required, both from wells and from the East Maui water shed. The manager for the Kihei Plantation Company, W.F. Pogue, asked the management of HC&S for an even larger allocation of water for the Kīhei lands. In 1901, Samuel T. Alexander ordered the construction of a new ditch, tapping the water sources from Nāhiku to Honomanū. It was determined that the Kihei Plantation Company would receive 2/9ths of the capacity from the enterprise (SeeFigure 6) (Dean 1950).



H. C. & S. CO.

Water Deliveries to Kihei Plant. Co. Ltd. During Month of October. 1907.

Date	Pump Water Inches	Pump Water Mill. Gal.	Mountain Water Inches	Mountain Water Mill. Gal.	
1	1 22	041			Pumps were run from the 1st to the 6th inclusive. —
2	1 30	045			
3	1 52	056			
4	1 60	060			
5	1 12	034			Water delivered to K.P.Co.
6	0 70	015			
7			0 74	007	
8			0 68	010	Pump Water — mill. Gals. Price
9			1 26	043	6 Days, 2.58 @ $12.50 $30.36
10			0 50	005	Mountain Water
11			1 12	031	25 Days 14.27 @ $5.903 84.21
12			2 18	095	31 Days 16.80 $114.57

Figure 6. A portion of an accounting statement for water delivered to the Kihei Plantation Company in 1907.

The Kihei Plantation Company failed to live up to the expectations of its promoters with an inadequate water supply as the key difficulty. With the waters of the Koʻolau Ditch flowing to the Kīhei fields, production appeared to have hit its peak. Although 5,609 tons of sugar was delivered in 1903, high costs required a change of managers in Kīhei, and a reduction of the HC&S milling charge to $7 per ton. The incoming HC&S manager, Frank Fowler Baldwin, determined that the best course of action was to buy out the company for $375,000 (Conde 1973).

In 1908, the lands of the Kihei Plantation Company were divided up between five new major business entities of HC&S. The Kahului Railroad, which had already been absorbed by HC&S, acquired the rail lines to Kīhei and the rolling stock of the plantation. The Kailua Plantation Company (994 acres), the Kalialinui Plantation Company (923 acres), the Kula Plantation Company (996 acres), the Makawao Plantation Company (982 acres), and the Pulehu Plantation Company (978 acres) acquired the remaining acreage not included in the railroad right-of-ways. Water rights reverted to HC&S, and were reapportioned between the new plantations. Sugar operations continued in North Kīhei until circa 1968, when the HC&S Company began to lease its marginal sugar lands in north Kīhei to the Trojan Seed Company (a hybrid corn research company from Olivia, Minnesota), an action which continues to the present day with the Monsanto Global Seeds Company.

4.2.7 The residential area of Kīhei

The residential community of Kīhei grew in the pre-WWII years because of the sunny weather and white-sand beaches. Truck farming of alfalfa had been done since the turn of the century, on many of the coastal inland Kamaʻole homesteads. Civic development in Kīhei included the Kalama Park and the Kīhei Road. An article in the *Maui News* described the

September 9th, 1936 celebration of the completion of the road between Kalepolepo and the Kalama Park (News 1936).

> Approximately 1500 persons attended a luau at Kalama Park Sunday given by the Kihei Community Club to celebrate the opening of the 2-mile stretch of paved highway between Kalepolepo and the [Kalama] Park.
>
> Earlier in the summer the County completed another 2-mile stretch between Maalaea Airport and the new Kihei Park. Work on the remaining unpaved section between Kalepolepo and the Kihei Store is now in progress.

The article continued by describing further progress in other public works projects in Kīhei:

> A new high mark was reached in county road construction during August when slightly more than 3 miles of cold emulsified asphalt pavement was laid in the county during the 1 month period, County engineer A.L. Burdick reported to the Board of Supervisors on Thursday night.
>
> This, he said, brings the total for the first eight months of the year to slightly more than 11 miles of completed grading and paving.
>
> Roads completed so far this year: Kihei Airport towards Kihei, 2.2 miles. Kihei, Kalama Park toward Kalepolepo, 2 miles. Hamakuapoko Road 1.1 miles, Farrington Avenue, Molokai 1.5 miles; Camp 5-6 Road 1.61 miles; Pulehu Road 1.64 miles; Waihee Road .15 miles; Kealahou School driveway .16 miles; Homestead roads, Kula .75 miles; total 11.11 miles.

Figure 7. Aerial photo of Kūlanihāko'i Bridge (School of Ocean and Earth Science Technology [SOEST] 1949)

4.2.8 Impact of the military on the project area

The Department of the Navy constructed a wood-frame two-story structure on the beach fronting the project area in 1948, following the end of World War II. The structure, which remains today as the building housing the Pacific Whale Foundation, was originally constructed to house military equipment used to monitor the effects of atomic bomb testing in the Pacific Ocean (Figure 8).

The complex of wood structures consisted of two transmitter buildings housing a bank of electrical generators in the event that electricity to the complex was interrupted, and a single administrative building manned by engineers who transmitted data gathered on the condition of the upper atmosphere to a laboratory in Boulder, Colorado. The geophysical station was responsible for broadcasting a series of radio signals accurate to within a few millionths of a second. For a brief time, the U.S. Bureau of Standards clock at Kalepolepo was a part of the coastline adjacent to the ancient fishpond. In 1971 this transmitting station was relocated to Barking Sands, on the island of Kaua'i.

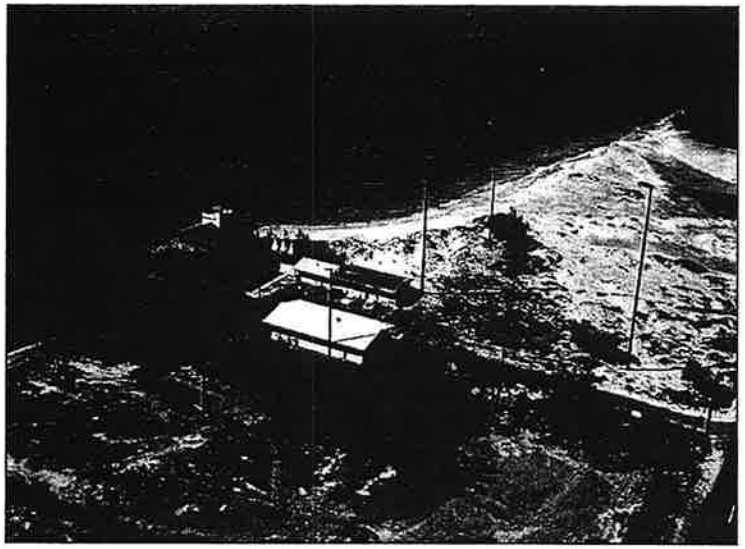


Figure 8. 1971 aerial photo of antenna, transmitter buildings and administrative building for WWVH, just seaward of the project area. Photo courtesy of National Institute of Standards and Technology (http://tf.nist.gov/stations/wwvhtour.htm).

4.2.9 Modern Land Use

Beginning in the 1970's, development in the region of the project area shifted from rural residential to vacation condominium development. Between 1970 and 1996 vacation rental units increased from 2,641 to 17,442. The leeward coasts, including Kīhei, became popular tourist destinations (Juvik 1998:14). Today, the ASTON Maui Lu Resort is located to the north of the project area and the Kihei Bay Vista Condominium is located to the south of the project area. The project area is south of the Mokulele-Pi'ilani Highway junction, along South Kihei Road. The existing drainageway and associated culverts due for replacement are at the Kūlanihāko'i Stream mouth, near Kalepolepo Beach park and fishpond along the shoreline.

4.3 Previous Archaeological Research

The majority of archaeological reconnaissance and inventory surveys in the North Kīhei area (Table 3) have produced relatively little significant information in the way of archaeological data. While this may be due in large measure to changes on the land associated with sugar cane cultivation, ranching, and military use, as well as resort and housing construction, it still seems inescapable that there are only few areas in the Hawaiian Islands abutting sandy beaches that have less in the way of documented Hawaiian cultural deposits than Kīhei. Archaeological projects in the vicinity identified both pre-Contact and post-Contact site types. Many of which were associated with the sugar plantation era and plantation Camps, ranching and WWII periods in history. Pre-Contact archaeological sites including dry stacked basalt walls, alignments, possible burial mounds and sites associated with traditional Hawaiian agriculture have also been discovered in the vicinity surrounding the project area.

Each of the fishponds located in the vicinity of the project area are listed on the State Inventory of Historic Places. The Ko'ie'ie Fishpond (SIHP 50-50-09-1288), adjacent to Kalepolepo Park is the smallest of the three fishponds in this region of Kīhei. The Waiohuli Kai Fishpond is just south of Ko'ie'ie Fishpond, is submerged and listed as SIHP 50-50-09-1704. The Kēōkea Kai Fishpond is yet further to the south and is also submerged (SIHP 50-50-09-1738). Kikuchi in 1973 performed a study of fishponds which categorized the Ko'ie'ie Fishpond as a Type I, Loko Kuipā type, or a "fishpond of littoral water whose side or sides facing the sea consist of a stone or coral wall usually containing one or more sluice gates" (Kikuchi 1976:37).

According to an early island-wide survey by Stokes, the closest *heiau* structures to the project area were reportedly south of Kalepolepo in Kama'ole Ahupua'a; and were described in the following manner:

> Heiau of Wailuku at Kawililipoa, land of Kamaole, inland; said to be a platform. Not seen. Heiau of Kolea and Kawililipoa, land of Kamaole. Said to have been for human sacrifice, not seen. Heiau at Kawililipoa, land of Kamaole, between the road and the beach. This foundation, which has been destroyed, was probably a platform originally. It was situated on a sandy flat, quarter of a mile from the sea; 200 feet west of the road and 200 to 300 feet south of the Mormon Church (Stokes 1918:125)

These heiau were also described by Walker in 1931. The Wailuku Heiau was noted as Walker Site 205, the Kolea Heiau as Walker Site 206 and Kawilipoa Heiau as Walker Site 207 (Walker 1931:271-273)

Table 3. Previous Archaeological Studies

Date	Area(s)	Nature of Study	Findings
Stokes 1916	Island wide	Archaeological Reconnaissance	3 *heiau* in Kamaole in the *'ili* of Kawililipoa, located directly south of the present project area. Stokes did not see any of these three *heiau*. He noted that they may have been destroyed.
Walker 1931	Island wide	Reconnaissance	3 *heiau* in Waiohuli Ahupua'a above 3,000 ft. elevation.
Kikuchi 1973	Statewide fish pond survey	Fishpond Survey	Noted 3 fish ponds in Kalepolepo area.
(Cox 1976) No project area map	Pūlehu Nui to Kama'ole	Archaeological Inventory Survey	Pi'ilani Highway right-of-way. Identified six sites, including three site complexes containing seven features and three isolated features.
(Cordy 1977)	Pūlehu Nui to Paeahu	Archaeological Reconnaissance	Identified 38 sites: 30 in Waiohuli, 0 in Ka'ono'ulu, and 8 in Kēōkea
(Neller and Keau 1981)	Ka'ono'ulu	Archaeological Reconnaissance	Finds include two historic fenced areas recorded as sites which were noted as possible graves, and a platform of indeterminate function. Further archaeological survey, data recovery and monitoring was recommended.
(Bordner and Cox 1982)	Waiohuli and Keokea	Archaeological Reconnaissance	A total of nine sites were located during the reconnaissance survey which included C-shapes, an L-shapes, a modified bedrock outcrop, a temporary habitation shelter, stone alignments, and a habitation site. Cultural material which consisted of shell midden was present at some of the sites.
(Kennedy 1986)	Waiohuli	Archaeological Reconnaissance	Area was cleared by bulldozer, rubble mounds along both east and west boarders of project area, no surface evidence of archaeology. No further archaeological work recommended.
(Kennedy 1988b)	Coastal Ka'ono'ulu	Archaeological Reconnaissance	No archaeological findings
(Kennedy 1988a)	Waiohuli	Archaeological Reconnaissance	No archaeological findings. No further archaeological work recommended.
(Kennedy 1989)	Waiohuli	Archaeological Subsurface Testing Results	No human burial findings

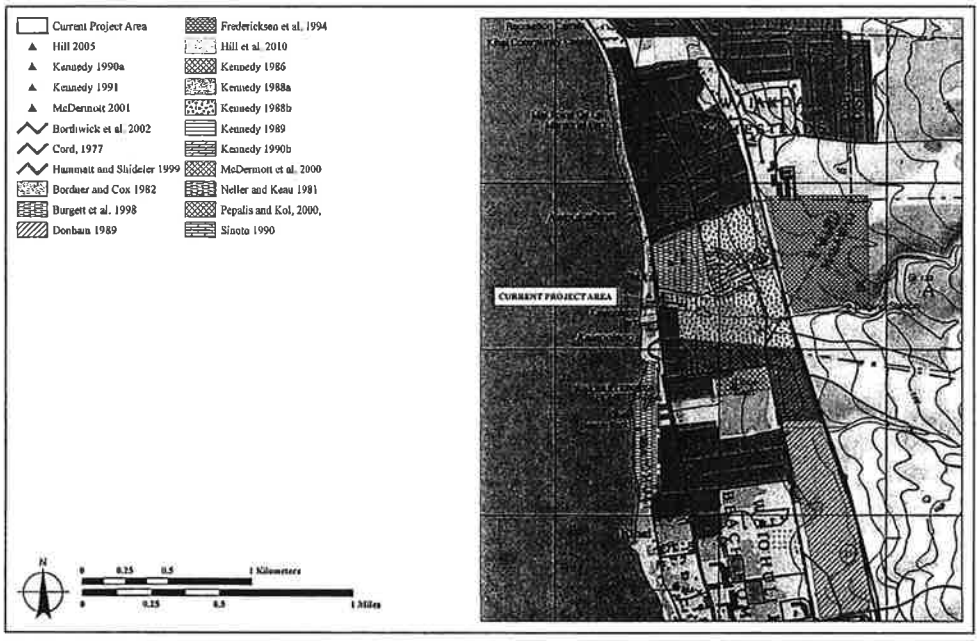


Figure 9. Portions of the Pu'u o Kali (1992) and Mā'alaea (1996) 7.5-minute USGS topographic quadrangles, showing the current project area relative to adjacent areas of previous archaeological study.

Date	Ahupua'a	Nature of Study	Findings
(Donham 1989)	Waiohuli	Archaeological Inventory Survey	Identified four sites, including two previously unrecorded sites. Recommended data recovery
(Kennedy 1990b)	Coastal Waiakoa	Survey	No archaeological findings
(Sinoto 1990)	Coastal Waiakoa	Survey & Testing	No archaeological findings (other than two pieces of midden)
(Kennedy 1990a)	Ka'ono'ulu	Monitoring Report	Recorded 4 surface midden scatters, single fragment of volcanic glass, animal bone and bone pick.
(Kennedy 1991)	Coastal Waiakoa	Field Inspection	Inadvertent burial find
(E. M. Fredericksen et al. 1994)	Ka'ono'ulu, *mauka* of Pi'ilani Highway	Inventory Survey	21 sites were identified, some military and some pre-contact
(Burgett et al. 1998)	Ka'ono'ulu	Inventory Survey	Lots A and B of the Maui Lu Resort. No archaeological findings.
(Hammatt and Shideler 1999)	Waiohuli	Archaeological Reconnaissance	No cultural material, no archaeological findings
(Pepalis and Kolb 2000)	Waiohuli	Archaeological excavations	Discovered soils from inland pond
(McDermott et al. 2000)	Waiohuli	Additional Archaeological Inventory Survey	Confirmation of an inland pond (SIHP 50-50-09-4981) from which 14C radiocarbon were attained that provides evidence of an earlier habitation sequence in Kihei than previously documented.
(McDermott 2001)	Coastal Kihei	Graduate Thesis; Historical Ecology of Coastal Kihei	N/A
(Borthwick et al. 2002)	Waiohuli	Inventory Survey	No archaeological findings
(Hill et al. 2005)	Waiohuli	Letter Report for a Field Inspection and Subsurface Testing	No archaeological findings
(Hill et al. 2010)	Pūlehu Nui, Ka'ono'ulu, Waiakoa	Mitigation Program	No cultural deposits or artifacts observed during mitigation work. No historic properties affected.

Stokes (1918) reported a *heiau* named Wailuku at Kamaole in the *'ili* of Kawililipoa, *mauka* [inland]. He also reported a sacrificial *heiau* named Kolea in about the same area and further stated that he had not seen either of them, but that his informants also reported an unnamed *heiau* in the same *'ili*, on the sea plain, 200 *makai* or west of the lower road and the same distance south of the Mormon church. This *heiau* was reported to have been a *kahua* [foundation] and had been destroyed.

Cordy (1977) identified a total of 38 single component and multi-component archaeological sites within the then proposed Pi'ilani Highway road corridor. Following that study, Cox (1976), performed an archaeological surface survey and excavations for the Pi'ilani Hghway right-of-way. Cox identified six sites, including three site complexes containing seven features and three isolated features. The sites are of pre-historic and historic era use and include a cave that was a temporary habitation shelter; a C-shape shelter; a historic house complex; an *ahu* (possible monument/platform burial); and a miscellaneous alignment. No further work was recommended.

Neller and Keau (1981) conducted an archaeological reconnaissance adjacent to the current project area at TMK (2) 3-9-01:17, 1, also known as Kalepolepo with the Kalepolepo fishpond fronting the property. Their findings include two historic fenced areas recorded as sites which were noted as possible graves, and a platform of indeterminate function. Further archaeological survey, data recovery and monitoring was recommended.

In 1990, Kennedy conducted monitoring of the TMK (2) 3-9-01: 015, a portion of which comprises the current project area. Findings resulting from monitoring included midden scatters, a single volcanic glass fragment, animal bone and a bone pick were recorded.

Further north of the current project area, Kennedy (1991) preformed a field inspection for an inadvertent burial find. A profile was drawn of the burial, then a three sided form was constructed to protect the burial and the burial was reburied in place.

Erik Fredericksen of Xamanek Researches (E. M. Fredericksen et al. 1994) conducted an inventory survey in Ka'ono'ulu Ahupua'a east of the current project area and *mauka* of Pi'ilani Highway. A total of 21 archaeological features reflecting pre-contact use of the area, as well as post-contact military and ranch use were recorded. The pre-contact or Early Hawaiian archaeological features included five stone piles possibly representing agricultural use, five surface scatters representing pre-contact temporary habitation, and one petroglyph. Military use of the area is represented by five stone cairns, three alignments, and one enclosure. A single feature, interpreted as an erosion containment area, was recorded in association with ranching activities.

Until recently, the few available radiocarbon dates from the Kīhei area were consistent in their rather broad, later prehistoric age determinations, most commonly post A.D. 1500 (D. L. Fredericksen et al. 1993; E. M. Fredericksen and Fredericksen 1995a, b). This fits with the model that the more intensive use of the Kīhei area was a later pre contact development that corresponded with the expansion of upland permanent habitation, ceremonial constructions, and agricultural clearing after A.D. 1400-1500 (Kolb et al. 1997:281-282).

Without a doubt, coastal habitation along with more populous inland/upland settlement was firmly established by A. D. 1400-1500. The majority of permanent habitation would have been in the uplands, concentrated in the well-watered and fertile agricultural areas. Coastal permanent

habitations were likely less numerous and centered on the ceremonial structures and fish ponds at Kalepolepo. While the fish ponds of the Kula coastline are thought to date to the 1500s (Kolb et al. 1997:66), the chronological timeline for initial settlement of the Kīhei area is still under debate. Based on the results of relatively recent studies (McDermott 2001; McDermott et al. 2000), habitation in the coastal areas may date to as early as A.D. 600-900. Evidence of earlier coastal habitation in the Kīhei area has recently come to light at excavations adjacent to the site of the Kalepolepo Church. Cultural layers described in the work of McDermott and others (2000) and McDermott (2001), in conjunction with those of Pepalis and Kolb (2002), provide some evidence in the form of charcoal concentrations, midden deposits, 14C dates, and palynomorph identification, that settlement in the vicinity of an inland pond feature had occurred by circa A.D. 600-900.

4.4 Background Summary and Predictive Model

Previous archaeological studies have led to archaeological site interpretation based on the division of the settlement pattern for Maui into three zones: 1) coastal; 2) barren or transitional; and 3) Inland (Cordy 1977; Cox 1976; Walton 1972). The coastal zone is an approximately one-fourth of a mile wide band running along the shoreline. The inland zoned begins approximately five to seven miles from the shore and is characterized by larger rainfall accumulation and more lush vegetation. The transitional or barren zone is classified as the area between the edge of the coastal zone and beginning of the inland zone and characterized by brush/scrub vegetation and low annual rainfall accumulation.

Based on available archaeological evidence and interpretations, and as a result of the settlement pattern, site types expected for coastal zones, where temporary habitations related to marine exploitation may be present may include stacked-stone enclosures, and possibly smaller ceremonial structures, such as stacked-stone fishing shrines. It is possible that human burials would have been interred in the coastal sand dunes where present.

With that said, the current project area has experienced ground disturbances as a result of construction of the South Kīhei Road and natural events associated with stream and wetland environment, including periodic flooding. Flooding events particularly have caused repeated and extensive damage to the bridge over the years. As a result of these disturbances the likelihood of locating intact cultural deposits or archaeological remains would be low.

Conversely, the project area borders Kalepolepo and may have been considered part of the village once located there. Kalepolepo village became a major hub of early historic activity in the mid-1800's. Several historically significant places, such as the Koa House, the David Malo Memorial Church, and the Kalepolepo fishpond were located there. Portions of the fishpond have recently been restored (see Section 4.2.3 Early Historic Period). Additionally, due to the coastal location and dune sand environment, human remains could be present in sandy deposits of the project area.

Section 5 Results of Fieldwork

5.1 Field Inspection Findings

An archaeological field inspection was conducted by archaeologist Colleen P. Medeiros, B.S., under the general supervision of Principal Archaeologist Hallett H. Hammatt, Ph.D., on August 15, 2012. The inspected area included is the immediate area of Kūlanihāko'i Bridge located at the mouth of the Kūlanihāko'i Stream along South Kīhei Road (Figure 10 and Figure 11) as well as an area approximately 500 feet north and 500 feet south of the bridge along South Kihei Road and approximately 574 feet upstream and 272 feet downstream from the bridge. As described in Section 2.3 Environmental Setting, the lands surrounding the Kūlanihāko'i Stream a remnant of a larger wetland area (Figure 12 and Figure 13). The Kalepolepo fishpond is located directly south of the stream mouth in the near shore ocean waters. In recent history the surrounding area has been transformed by the development of resorts and condominiums along the shoreline and today the project area sits immediately between the Aston Maui Lu Resort to the north, the Kihei Bay Vista Condominium to the south and the Villas at Kenolio to the east.

According to the Maui County Department of Public Works, the existing Kūlanihāko'i Bridge was constructed in 1911 and constructed of four individual reinforced concrete box culverts with each culvert cell measuring 6 ft. wide by 4 ft. high by 38 feet long. The total span of the four culverts is 27 ft. 9 in. Storm damage to the bridge was clearly visible and modern repairs have been made to the bridge over time. Storm damage is evidenced by a section of South Kihei Road which was undermined and subsequently back filled with rocks as a result of a storm. Dune sand has now partially covered this area. Both the *mauka* and *makai* facing sides of the culvert show damage where chunks of the culvert have broken away. The reinforcing-steel bar framing of the culvert is exposed along the entire *makai* side of the bridge, as well as sections of the *mauka* facing side (see Figure 10 and Figure 11).

Portions of intact sand dunes are present at the mouth of Kūlanihāko'i Stream (Figure 14 and Figure 15). Sand drifts are also present in places along the roadway frontage and sporadically covers areas of existing sidewalks and parking lots (Figure 16 through Figure 19).

Figure 10. Kūlanihāko'i Bridge, view Northwest.

Figure 11. Kūlanihāko'i Bridge, view northeast.

Figure 12. View east (*mauka*) from Kūlanihāko'i Bridge of stream and surrounding wetland (currently dry).

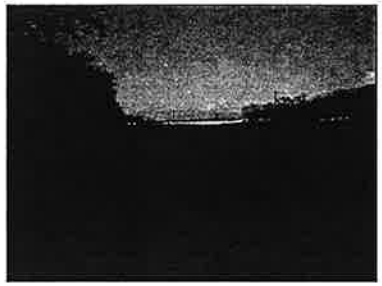


Figure 13. View west (*makai*) towards Kūlanihāko'i Bridge from upstream showing surrounding wetland (currently dry).

Figure 14. Sand dune on northwest side of Kūlanihāko'i Stream mouth.

Figure 15. Sand dune on southwest side of Kūlanihāko'i Stream mouth.

Figure 16. South Kihei Road eastern road frontage from the corner of South Kihei Road and Ka'ono'ulu Street, view south.

Figure 17. South Kihei Road western road frontage across the street from the corner of South Kihei Road and Ka'ono'ulu Street, view south.

Figure 18. South Kihei Road western frontage approximately 500 feet south of Kūlanihāko'i Bridge showing sandy soils along road, view north.

Figure 19. Kihei Bay Vista approximately 250 feet south of Kūlanihāko'i Bridge along South Kihei Road showing sand drifts, view east.

At the time of the field inspection there was standing water in the stream and ground water seeps were visible in the form of "pock" like formations, that are associated with the wetland ecosystem of the area (Figure 20). Signage indicating that a native plant restoration project was in progress within the inspection area was present. Vegetation consisted of both typical wetland plant species and other introduced plants including *akulikuli* (*Sesuvium portulacastrum*), *kiawe* trees (*Prosopis pallida*), *akiaki* (*Sporobolus virginicus*), *milo* (*Thespesia populnea*) *naupaka* (*Scaevola taccada*), and *pōhinahina* (*Vitex rotundifolia*).

Figure 20. Ground water seeps visible in the form of "pock" like formations.

According to Norman Saito, an informant who was once an engineer for the board of water supply for the County of Maui in the 1950's; Mr. Saito, recalled that the paving surface over the existing culvert was applied in the 1930's, which included some shoring-up of the edge of the roadway using a historic construction style attributed to pre-1940's plantation masons. The present-day Kūlanihāko'i Bridge appears to consist of two sections of prefabricated concrete culvert welded together to form the length of the existing bridge. Mr. Saito observed that the more modern construction style probably occurred because of the many repairs the bridge had undergone due to storm damage.

Presently the northern and southern wing walls have different construction styles. The northern wall is constructed of water rounded large basalt cobbles with a coarse concrete mortar typical of early 1900's construction methods while the southern wall is a modern-day rip-rap construction style where the basalt has been cut to form a level surface and modern concrete has replaced original material (Figure 21 and Figure 22). While the scattered remains of two domestic cows (*Bos taurus*) were observed in the flood plain, no historically significant cultural material was visible on the ground surface.

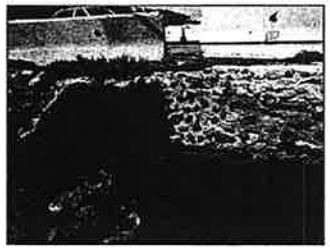


Figure 21. Northern wing wall historic construction.

Figure 22. Southern wing wall modern construction.

Section 6 Summary and Recommendations

6.1 Summary

A review of the historic documentation indicates that not far from the current project area, great events of Maui's pre-history unfolded. It was at Kiheipuko'a that great chiefs such as Alapa'i and Kalani'opu'u of Hawai'i Island landed, came ashore finding Kīheipūko'a (fronting Keālia Pond) an ideal canoe landing site. Alapa'i, who abandoned his plan for war, came ashore hoping to see the ailing Kekaulike, and Kalani'opu'u who landed his army of elite soldiers here, most of whom met their demise in the legendary battle, *Ahulau ka Pi'ipi'i i Kakanilua*, the battle in the sandhills of Kalua (Section 4.2.2 Traditional Accounts). As a result of its sheltered coast line, plentiful fishing resources and access to upcountry food resources, Kīhei then became a regular port for visiting ships primarily from the United States and England. Soon after the time of Captain Vancouver's visit in 1792, activities revolved around the Kalepolepo entrepot and thus became a major hub for Kīhei and Kula Moku. Kalepolepo housed a small whaling station and remained a busy port while the whaling industry in Hawai'i was at its peak (Section 4.2.3 Early Historic Period). Simultaneously, during the mid 1800's, the *Māhele 'Āina*, the Great dividing of the land, began and introduced the private ownership of lands. The Great Māhele, as it was also called, transformed the economy of Hawai'i from one that was subsistence-based to an economy that was market-based and was a catalyst for major cultural shifts. Native tenants had the right to claim their *kuleana* lands and 12 such claims were made in the coastal region of Ka'ono'ulu Aupua'a and ten of these were awarded (see Section 4.2.4 Mid- to late-1800s). With large tracts of land offered for lease or for purchase, some lands throughout Hawai'i were purchased for use as sugar cane plantations. In 1899 a large portion of the central isthmus was purchased by the Kīhei Plantation Company (KPC) and sugar cane dominated the lands surrounding the current project area from this time into the 1960's. Historically, Kīhei was a specific location, a narrowly defined spot fronting the current project area. The town of Kīhei was later founded as a result of both the whaling industry, then the sugar industry having used Kalepolepo (just south of the Kīhei local) as the main hub of early activity and commerce. Kīhei Town is now a popular vacation area and residential town.

In addition to the events and activities of human history impacting lands of the project area, natural flooding events associated with Kūlanihāko'i Gulch have also altered the project area over time. "Kona" storms [southern-exposure rain storms], like the storm recorded on November 15th, 1900, have caused major damage to the Kihei area, specifically this study area. More recent storms have been documented by The Maui News, such as one in January of 1971, which, according to longtime resident Mr. Robert Hill, did considerable damage to the road and culvert at the current project area. More recently, there have been three major flooding episodes between 2007 and 2012, all of which were the result of winter storms which occurred in December 2007, late December 2010, and January 2011. In all instances, flood waters from the *mauka* reaches of Kūlanihāko'i Gulch, overwhelmed the current drainage culvert at the project area location and flood water volume coupled with debris, which blocks the culvert (and water from draining into

the ocean) altogether, has caused major overflowing and subsequent flooding of surrounding roads and condominiums.

Therefore, the background research coupled with the results of the field inspection lead to the conclusion that the area has been heavily disturbed and modified by natural flooding events as well as historic and modern activities.

6.2 Potential Project Effect and Recommendations

Based on the field inspection findings and background research there is a low potential for the discovery of previously unidentified historic properties beyond the historic era itself. The area surrounding the bridge includes the Kūlanihāko'i Stream mouth, and a natural wetland and associated flood plain. Consequently, no cultural material was observed on the ground surface. While impacts by flooding episodes and modifications associated with road construction and maintenance have greatly altered sediments of the project area, the possibility of encountering intact subsurface cultural deposits, including human burials, should not be underestimated. Therefore archaeological monitoring is recommended for all ground disturbing activities during all phases of temporary bridge work, bridge repair and bridge replacement.

Additionally, as Kūlanihāko'i Bridge was originally constructed in 1911 and 101 years old, this structure exceeds the 50 year threshold for consideration as a historic property and therefore should be documented at the archaeological inventory survey level.

The following are the specific monitoring recommendations:

- Onsite archaeological monitoring for all ground disturbing activities for both steps one and two.
- It is recommended that monitoring reports are generated after each step of bridge work;
    - Step one, temporary ACROW bridge installation;
    - Step two, temporary *mauka* bridge construction, and bridge replacement;
- It is recommended that documentation of the bridge is included in the monitoring plan provisions and that recording occur during the monitoring phase of work. Archaeological or architectural recordation of the bridge should take place prior to crews beginning construction work in the project area.
- Additional consultation with the Archaeological and Architectural branches of the SHPD is recommended prior to drafting of a monitoring plan.

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APPENDIX D

Traffic Assessment Report for Kūlanihāko‘i Bridge Replacement

Wilson Okamoto Corporation

December 2012

Traffic Assessment Report

Kulanihakoi Bridge Replacement

Prepared for:
County of Maui
Department of Public Works

Prepared by:
Wilson Okamoto Corporation

December 2012

TRAFFIC ASSESSMENT REPORT

FOR THE

KULANIHAKOI BRIDGE REPLACEMENT

Prepared for:

County of Maui
Department of Public Works
200 South High Street
Wailuku, Maui, HI 96793

Prepared by:

Wilson Okamoto Corporation
1907 S. Beretania Street, Suite 400
Honolulu, Hawaii 96826
WOC Ref #8256-01

December 2012

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The purpose of this study is to assess traffic operations along South Kihei Road with the proposed replacement of the Kulanihakoi Bridge in Kihei on the island of Maui. A temporary detour road and bridge will be provided during construction to accommodated traffic along that roadway.

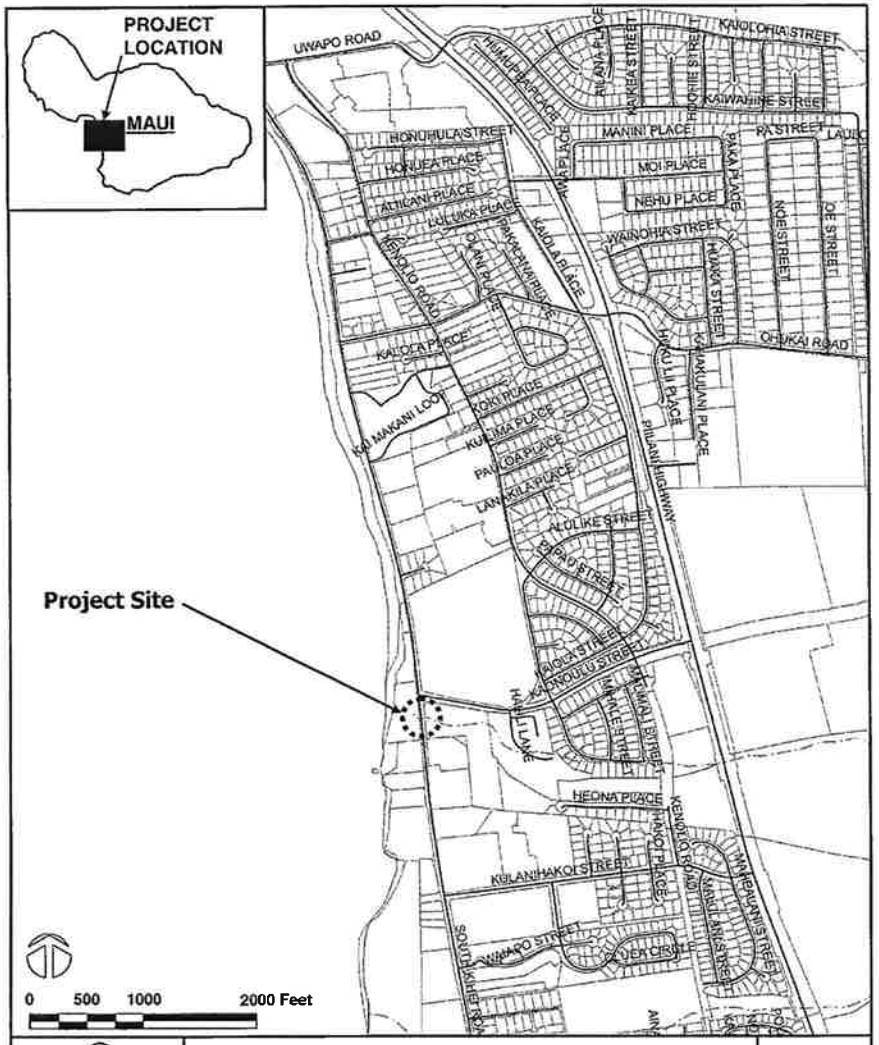
B. Scope of Study

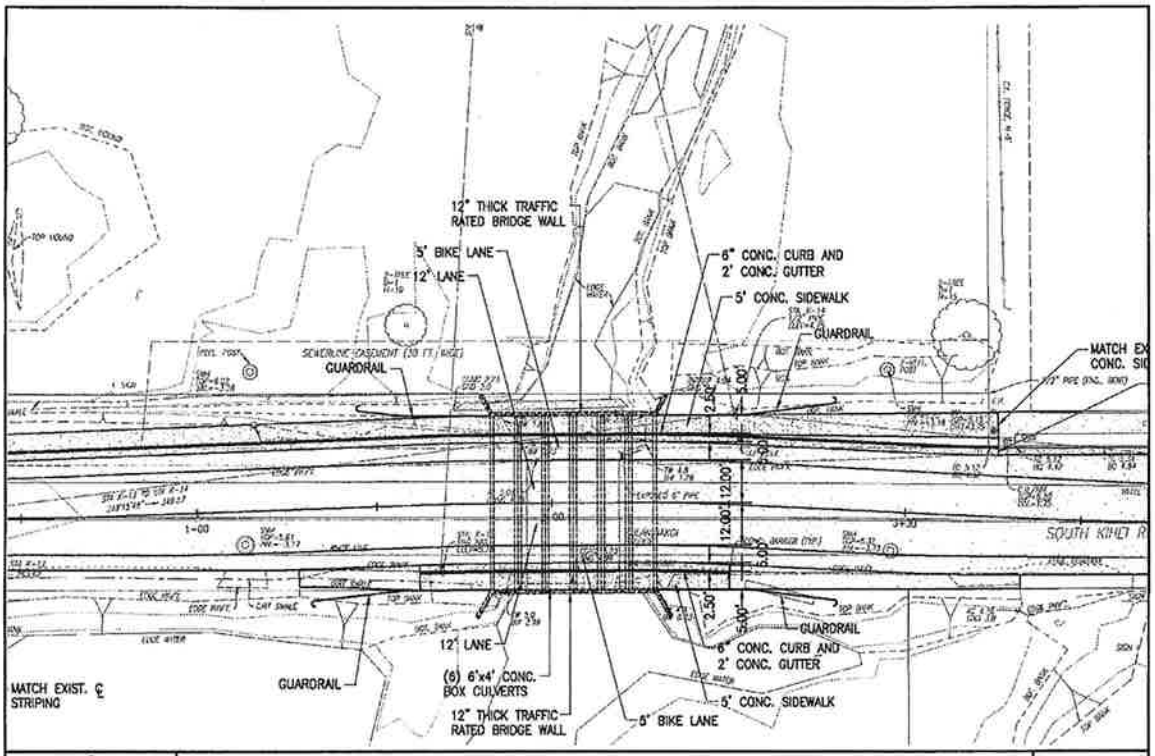
This report presents the findings and conclusions of the traffic study, the scope of which includes:

1. Description of the proposed project.
2. Evaluation of existing roadway and traffic operations in the vicinity.
3. The identification and analysis of traffic operations with the proposed project.
4. Recommendations of improvements, if appropriate, that would mitigate traffic conditions resulting from the proposed project.

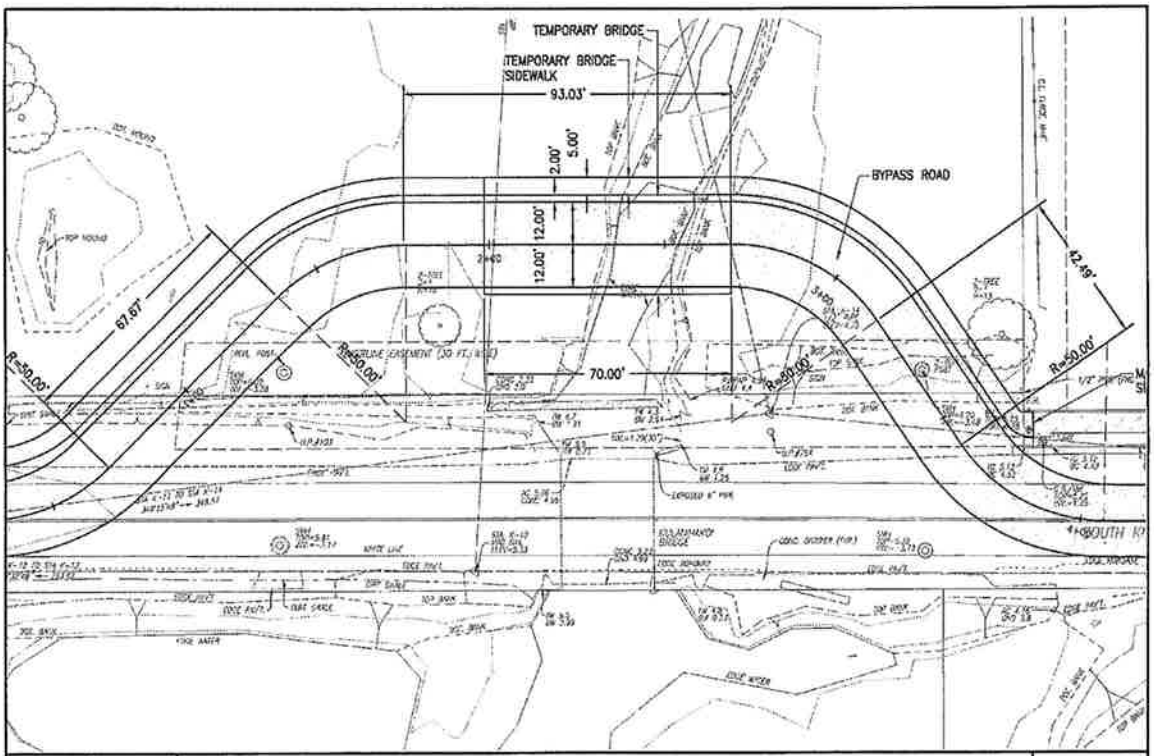
II. PROJECT DESCRIPTION

The existing Kulanihakoi Bridge is located along South Kihei Road between Kaonoulu Street and Kulanihakoi Street in Kihei on the island of Maui (see Figure 1). The proposed project entails the replacement of the existing 4-cell culvert system at the bridge with a six-cell culvert system with inlet and outlet head walls. Currently, the bridge accommodates two ~10' lanes of traffic along South Kihei Road (one lane in each direction) with ~4' shoulders. Prior to the removal of the existing bridge, a two-lane, two-way temporary detour road and steel panel bridge will be constructed east of the existing bridge that will accommodate two 12' lanes (one lane in each direction) without shoulders. After construction, the temporary road and bridge will be removed. The new Kulanihakoi Bridge is expected to be completed by the Year 2015 and will provide two 12' lanes (one lane in each direction) with 5' shoulders that should provide enhanced safety for pedestrians and bicyclists. Figures 2 and 3 show the plan views for the temporary or interim and replacement bridges.





WILSON OKAMOTO CORPORATION ENGINEERS - PLANNERS	KULANIHAKOI BRIDGE REPLACEMENT REPLACEMENT BRIDGE – PLAN VIEW	FIGURE 3



WILSON OKAMOTO CORPORATION ENGINEERS - PLANNERS	KULANIHAKOI BRIDGE REPLACEMENT TEMPORARY BRIDGE – PLAN VIEW	FIGURE 2

III. EXISTING TRAFFIC CONDITIONS

A. General

In the vicinity of the project site, South Kihei Road is a predominantly two-lane, two-way roadway generally oriented in the north-south direction that provides access through Kihei. Field investigations were conducted in October 2012 to survey the existing traffic volumes currently utilizing South Kihei Road between Kaonoulu Street and Kulanihakoi Street. The investigations consisted of 24-hour mechanical count surveys near the existing Kulanihakoi Bridge. Appendix A includes the existing traffic count data.

B. Capacity Analysis Methodology

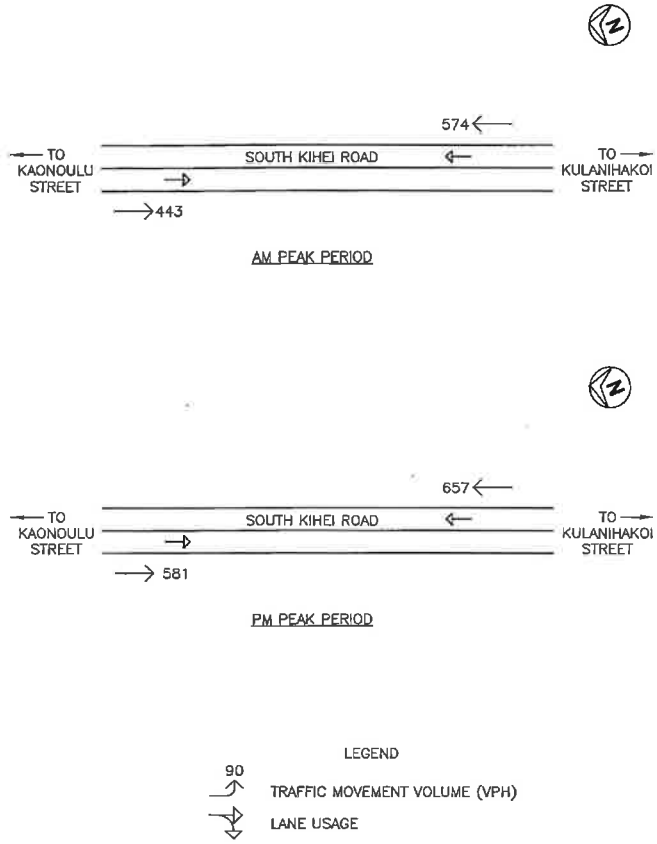
The highway capacity analysis performed in this study is based upon procedures presented in the "Highway Capacity Manual", Transportation Research Board, 2010, and the "HCS" software, developed by the Federal Highway Administration (FHWA). The analysis is based on the concept of Level of Service (LOS).

LOS is a quantitative and qualitative assessment of traffic operations. Levels of Service are defined by LOS "A" through "F"; LOS "A" representing ideal or free-flow traffic operating conditions and LOS "F" unacceptable or potentially congested traffic operating conditions.

"Volume-to-Capacity" (v/c) ratio is another measure indicating the relative traffic demand to the road carrying capacity. A v/c ratio of one (1.00) indicates that the roadway is operating at or near capacity. A v/c ratio of greater than 1.00 indicates that the traffic demand exceeds the road's carrying capacity. The LOS definitions are included in Appendix B.

C. Existing Peak Hour Traffic

Figure 4 shows the existing AM and PM peak hour traffic volumes along South Kihei Road near the existing bridge. The AM peak hour of traffic generally occurs between the hours of 7:15 AM and 8:15 AM while the PM peak hour of traffic generally occurs between the hours of 4:30 PM and 5:30 PM. The analysis is based on these peak hour time periods. LOS calculations are included in Appendix C.



WILSON OKAMOTO CORPORATION
ENGINEERS · PLANNERS

KULANIHAKOI BRIDGE REPLACEMENT

EXISTING PEAK HOURS OF TRAFFIC

FIGURE 4

Near the existing Kulanihakoi Bridge, South Kihei Road carries 574 vehicles northbound and 443 vehicles southbound during the AM peak period. During the PM peak period, traffic volumes are higher with 657 vehicles traveling northbound and 581 vehicles traveling southbound. The northbound direction of traffic operates at LOS "D" during both peak periods with a v/c ratio of 0.37 and 0.40 during the AM and PM peak periods, respectively. The southbound direction of traffic operates at LOS "C" with a v/c ratio of 0.29 during the AM peak period and at LOS "D" with a v/c ratio of 0.35 during the PM peak period.

IV. PROJECTED TRAFFIC CONDITIONS

A. Through Traffic Forecasting Methodology

The travel forecast is based upon historical traffic count data obtained from the State Department of Transportation (SDOT), Highway Division survey stations in the vicinity of the project site. The historical data were analyzed by linear regression techniques to obtain an annual traffic growth rate of approximately 2.5%. Using 2012 as the base year, a growth rate factor of 1.075 was applied to the existing traffic demands South Kihei Road to achieve the projected Year 2015 traffic demands.

B. Interim Total Traffic Volumes

Prior to the removal of the existing bridge, a two-lane, two-way temporary detour road and bridge will be constructed east of the existing bridge to accommodate traffic along South Kihei Road during construction. The temporary bridge is anticipated to have two 12' travel lanes (one lane in each direction) without shoulders. The peak hour traffic conditions during this interim construction period are summarized in Table 1. The existing levels of service are provided for comparison purposes. LOS calculations are included in Appendix D.

Table 1: Existing and Interim LOS Traffic Operating Conditions

Direction of Travel		AM		PM	
		Exist	Interim	Exist	Interim
Northbound	LOS	D	D	D	D
	v/c ratio	0.37	0.37	0.40	0.40

Table 1: Existing and Interim LOS Traffic Operating Conditions (Cont'd)

Direction of Travel		AM		PM	
		Exist	Interim	Exist	Interim
Southbound	LOS	C	D	D	D
	v/c ratio	0.29	0.29	0.35	0.35

Under interim conditions, traffic operations along South Kihei Road are generally expected to remain similar to existing conditions due to the maintenance of the existing number of travel lanes. The northbound direction of traffic is expected to continue operating at LOS "D" during both peak periods with v/c ratios similar to existing conditions. The southbound direction of traffic is expected to operate at a slightly lower LOS "D" during the AM peak period, but the v/c ratios for that direction are expected to remain similar to existing conditions during both peak periods.

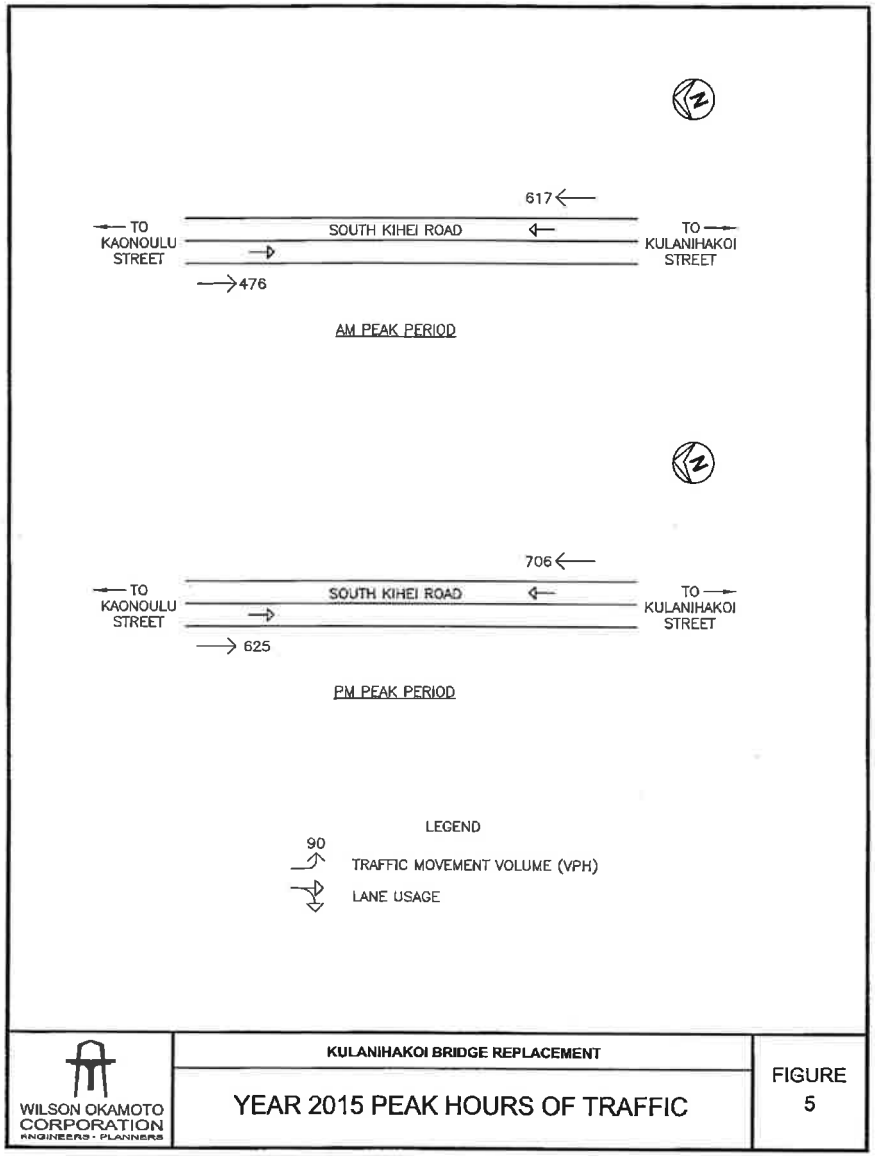
C. Year 2015 Total Traffic Volumes

The replacement of the Kulanihakoi Bridge is expected to be completed by the Year 2015 and is anticipated to have two 12' travel lanes (one lane in each direction) with 5' shoulders. The Year 2015 peak hour traffic conditions with the new bridge are shown in Figure 5 and summarized in Table 2. The existing levels of service are provided for comparison purposes. LOS calculations are included in Appendix E.

Table 2: Existing and Year 2015 LOS Traffic Operating Conditions

Direction of Travel		AM		PM	
		Exist	Year 2015	Exist	Year 2015
Northbound	LOS	D	D	D	D
	v/c ratio	0.37	0.40	0.40	0.43
Southbound	LOS	C	D	D	D
	v/c ratio	0.29	0.31	0.35	0.38

Under Year 2015 conditions, traffic operations along South Kihei Road are generally expected to remain similar to existing conditions despite the anticipated ambient growth in traffic due to the provision of wider travel lanes and shoulder areas



along this segment of South Kihei Road. The northbound direction of traffic is expected to continue operating at LOS "D" during both peak periods with v/c ratios of 0.40 and 0.43 during the AM and PM peak periods, respectively. The southbound direction of traffic is also expected to operate at LOS "D" during both peak periods with v/c ratios of 0.31 and 0.38 during the AM and PM peak periods, respectively.

V. RECOMMENDATIONS

Based on the analysis of the traffic data, the following are the recommendations of this study to be implemented in conjunction with the proposed project:

1. Provide sufficient sight distances for motorists to safely navigate the proposed temporary detour road and bridge.

2. Provide sufficient turning radii along the temporary detour road and bridge to accommodate all anticipated vehicle types. If the provision of these radii is not technically feasible, consider restriction of larger vehicles along this segment of South Kihei Road and the provision of a detour utilizing Piilani Highway.

3. Prepare a Construction Traffic Management Plan to minimize the impact of construction activities on the surrounding roadways.

VI. CONCLUSION

The existing Kulanihakoi Bridge is located along South Kihei Road between Kaonoulu Street and Kulanihakoi Street in Kihei on the island of Maui. The proposed project entails the replacement of the culvert system under the existing bridge with a newer higher-capacity system. During construction, a two-lane, two-way temporary detour road and steel panel bridge will be constructed east of the existing bridge to accommodate the existing traffic utilizing South Kihei Road in the project vicinity. Traffic operations during the interim construction period and once the project is complete in Year 2015 are anticipated to remain similar to existing conditions. However, recommendations have been provided to ensure that the temporary detour road and bridge can safely accommodate existing traffic during construction and minimize the impact of construction activities on the surrounding roadways.

APPENDIX A

EXISTING TRAFFIC COUNT DATA

Wilson Okamoto Corporation
1907 S. Beretania Street, Suite 400
Honolulu, Hawaii

Site Code:
Station ID:
S. Kihei Road

NB

Latitude: 0' 0.000 Undefined

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>5 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
10/29/12	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
00:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
00:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
00:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:45	3	72	24	0	2	0	1	0	0	0	0	0	0	11	113
	3	72	24	0	2	0	1	0	0	0	0	0	0	11	113
09:00	5	81	23	0	4	0	0	1	0	0	0	0	0	6	120
09:15	2	70	23	0	1	1	0	0	0	0	0	0	0	9	106
09:30	5	79	26	1	5	0	0	1	0	0	0	0	0	3	120
09:45	6	76	30	0	5	0	0	0	0	0	0	0	0	10	127
	18	306	102	1	15	1	0	2	0	0	0	0	0	28	473
10:00	4	89	28	0	2	0	0	1	0	0	0	0	0	5	129
10:15	3	93	20	0	3	1	0	0	0	0	0	0	0	11	131
10:30	2	90	38	0	1	0	0	0	0	0	0	0	0	10	141
10:45	12	97	24	1	2	0	0	0	0	0	0	0	0	9	145
	21	369	110	1	8	1	0	1	0	0	0	0	0	35	546
11:00	0	85	36	0	5	1	0	0	1	0	0	0	0	10	140
11:15	3	96	29	0	4	1	0	0	0	0	0	0	0	7	140
11:30	8	86	28	0	6	0	0	1	0	0	0	0	0	9	137
11:45	5	91	33	0	3	2	0	2	0	0	0	0	0	8	144
	16	357	126	0	18	4	0	3	1	0	0	0	0	34	561
Total	58	1104	364	2	43	6	1	6	1	0	0	0	0	108	1693
Percent	3.4%	65.2%	21.5%	0.1%	2.5%	0.4%	0.1%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	6.4%	

Wilson Okamoto Corporation

1907 S. Beretania Street, Suite 400
Honolulu, Hawaii

Site Code:
Station ID:
S. Kihei Road

NB

Latitude: 0° 0.000 Undefined

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>5 Axl Double	<6 Axl Multi	6 Axle Multi	>5 Axl Multi	Not Classed	Total
12 PM	0	102	26	0	4	0	0	1	0	0	0	0	0	14	147
12:15	4	87	22	1	1	1	0	0	0	0	0	0	0	10	126
12:30	5	86	25	1	8	1	0	0	0	0	0	0	0	3	129
12:45	3	97	29	2	1	0	0	0	1	0	0	0	0	3	136
	12	372	102	4	14	2	0	1	1	0	0	0	0	30	538
13:00	5	96	19	0	4	0	0	0	0	0	0	0	0	8	133
13:15	4	74	32	2	4	0	0	0	0	0	0	0	0	10	126
13:30	4	96	31	1	2	2	0	0	0	0	0	0	0	3	139
13:45	9	90	28	1	2	0	0	0	0	0	0	0	0	10	140
	23	356	110	4	12	2	0	0	0	0	0	0	0	31	538
14:00	4	114	22	0	3	0	0	0	0	0	0	0	0	10	153
14:15	3	102	26	2	0	0	0	0	0	0	0	0	0	11	144
14:30	2	100	29	1	5	1	0	1	0	0	0	0	0	8	147
14:45	5	104	29	1	6	0	0	1	0	0	0	0	0	5	151
	14	420	106	4	14	1	0	2	0	0	0	0	0	34	595
15:00	4	105	25	0	0	2	0	0	0	0	0	0	0	9	145
15:15	5	82	33	1	2	1	0	0	0	0	0	0	0	5	129
15:30	3	85	32	0	4	1	0	0	0	0	0	0	0	7	132
15:45	6	120	31	0	2	3	0	0	0	0	0	0	0	10	172
	18	392	121	1	8	7	0	0	0	0	0	0	0	31	578
16:00	4	97	40	0	5	0	0	0	0	0	0	0	0	13	159
16:15	5	101	35	0	1	1	0	0	0	0	0	0	0	12	155
16:30	8	110	30	0	5	0	0	0	0	0	0	0	0	11	164
16:45	4	100	30	1	2	1	0	2	0	0	0	0	0	18	158
	21	408	135	1	13	2	0	2	0	0	0	0	0	54	636
17:00	5	103	33	0	1	1	0	0	0	0	0	0	0	14	157
17:15	5	96	24	0	2	1	0	0	0	0	0	0	0	10	138
17:30	5	91	35	0	3	1	0	0	0	0	0	0	0	7	142
17:45	6	114	27	0	2	2	0	0	0	0	0	0	0	13	164
	21	404	119	0	8	5	0	0	0	0	0	0	0	44	601
18:00	5	95	19	0	2	1	0	0	0	0	0	1	0	12	135
18:15	5	113	26	0	0	0	0	0	0	0	0	0	0	11	155
18:30	5	83	25	1	2	0	0	0	0	0	0	0	0	5	122
18:45	6	83	17	1	1	0	0	0	0	0	0	0	0	5	113
	21	374	88	2	5	1	0	0	0	0	0	1	0	33	525
19:00	5	79	13	0	1	1	0	2	0	0	0	0	0	5	106
19:15	2	78	17	0	0	0	0	2	0	0	0	0	0	4	103
19:30	2	73	17	0	4	0	0	0	0	0	0	0	0	8	104
19:45	7	67	8	0	2	0	0	0	0	0	0	0	0	3	87
	16	297	55	0	7	1	0	4	0	0	0	0	0	20	400
20:00	4	71	19	0	0	0	0	0	0	0	0	0	0	5	99
20:15	2	47	14	0	1	0	0	2	0	0	0	0	0	2	88
20:30	3	54	11	0	1	1	0	0	0	0	0	0	0	1	71
20:45	2	46	18	1	0	0	0	0	0	0	0	0	0	0	67
	11	218	62	1	2	1	0	2	0	0	0	0	0	8	325
21:00	3	48	8	0	0	0	0	1	0	0	0	0	0	2	62
21:15	5	46	13	0	0	1	0	0	0	0	0	0	0	1	66
21:30	1	29	13	0	0	0	0	0	0	0	0	0	0	1	44
21:45	3	38	7	0	0	0	0	0	0	0	0	0	0	0	46
	12	161	41	0	0	1	0	1	0	0	0	0	0	4	220
22:00	1	24	7	0	1	0	0	0	0	0	0	0	0	2	35
22:15	5	30	8	0	0	0	0	0	0	0	0	0	0	1	44
22:30	1	27	6	0	0	0	0	0	0	0	0	0	0	0	34
22:45	1	18	5	0	1	1	0	0	0	0	0	0	0	1	27
	8	99	26	0	2	1	0	0	0	0	0	0	0	4	140
23:00	1	27	9	0	0	0	0	0	0	0	0	0	0	0	37
23:15	0	22	5	0	0	0	0	0	0	0	0	0	0	0	27
23:30	1	11	3	0	0	0	0	0	0	0	0	0	0	1	16
23:45	3	12	1	0	0	0	0	0	0	0	0	0	0	0	16
	5	72	18	0	0	0	0	0	0	0	0	0	0	1	96
Total	182	3573	983	17	85	24	0	12	1	0	0	1	0	294	5172
Percent	3.5%	69.1%	19.0%	0.3%	1.6%	0.5%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	5.7%	

Wilson Okamoto Corporation
1907 S. Beretania Street, Suite 400
Honolulu, Hawaii

Site Code:
Station ID:
S. Kihei Road

NB

Latitude: 0° 0.000 Undefined

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>5 Axl Double	<6 Axl Multi	6 Axle Multi	>5 Axl Multi	Not Classed	Total
10/30/12	0	11	4	0	0	0	0	0	0	0	0	0	0	0	15
00:15	1	4	2	0	0	0	0	0	0	0	0	0	0	0	7
00:30	2	9	2	0	0	0	0	1	0	0	0	0	0	1	15
00:45	1	7	0	0	1	0	0	0	0	0	0	0	0	0	9
	4	31	8	0	1	0	0	1	0	0	0	0	0	1	46
01:00	0	7	0	0	0	0	0	0	0	0	0	0	0	0	7
01:15	2	3	0	0	0	0	0	0	0	0	0	0	0	0	5
01:30	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
01:45	1	7	3	0	0	0	0	0	0	0	0	0	0	0	11
	3	21	3	0	0	0	0	0	0	0	0	0	0	0	27
02:00	2	9	1	0	0	0	0	0	0	0	0	0	0	1	13
02:15	0	4	3	0	0	0	0	0	0	0	0	0	0	0	7
02:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:45	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
	2	13	6	0	0	0	0	0	0	0	0	0	0	1	22
03:00	0	5	2	0	0	0	0	0	0	0	0	0	0	0	7
03:15	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3
03:30	1	4	3	0	0	0	0	0	0	0	0	0	0	0	8
03:45	0	4	2	0	0	0	0	0	0	0	0	0	0	0	6
	1	15	8	0	0	0	0	0	0	0	0	0	0	0	24
04:00	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
04:15	1	4	4	0	0	0	0	0	0	0	0	0	0	0	9
04:30	1	5	3	0	0	0	0	0	0	0	0	0	0	0	9
04:45	1	5	3	0	0	0	0	0	1	0	0	0	0	1	11
	3	15	11	0	0	0	0	0	1	0	0	0	0	1	31
05:00	0	7	4	0	1	0	0	0	0	0	0	0	0	0	12
05:15	1	11	9	0	0	0	0	0	0	0	0	0	0	0	21
05:30	0	11	6	0	3	0	0	0	0	0	0	0	0	0	20
05:45	2	21	8	0	0	1	0	0	0	0	0	0	0	2	34
	3	50	27	0	4	1	0	0	0	0	0	0	0	2	87
06:00	2	29	12	0	4	0	0	0	0	0	0	0	0	0	47
06:15	0	44	22	0	3	0	0	0	0	0	0	0	0	5	74
06:30	5	58	13	1	2	0	0	0	0	0	0	0	0	2	81
06:45	2	70	12	2	2	0	0	0	0	0	0	0	0	5	93
	9	201	59	3	11	0	0	0	0	0	0	0	0	12	295
07:00	3	59	17	0	2	0	0	0	0	0	0	0	0	7	88
07:15	3	64	36	1	3	2	0	0	0	0	0	0	0	3	132
07:30	5	87	33	0	6	2	0	0	0	0	0	0	0	4	137
07:45	4	113	12	1	2	1	0	0	0	0	0	0	0	5	168
	15	343	126	2	13	5	0	0	0	0	0	0	0	19	525
08:00	3	91	30	0	1	0	0	0	0	0	0	0	0	12	137
08:15	6	72	33	0	3	1	0	0	0	0	0	0	0	3	118
08:30	2	79	27	0	1	2	0	1	0	0	0	0	0	13	125
08:45	4	68	26	1	3	0	0	1	0	0	0	0	0	10	113
	15	310	116	1	8	3	0	2	0	0	0	0	0	38	493
09:00	2	83	29	0	1	0	0	0	1	0	0	0	0	7	123
09:15	7	81	18	0	3	0	0	0	0	0	0	0	0	7	116
09:30	5	91	28	0	3	0	0	0	0	0	0	0	0	8	135
09:45	0	87	18	0	3	3	0	0	0	0	0	0	0	11	128
	20	342	93	0	10	3	0	0	1	0	0	0	0	33	502
10:00	3	106	24	0	4	2	0	1	0	0	0	0	0	3	143
10:15	3	107	24	0	6	1	0	0	0	0	0	0	0	3	146
10:30	5	80	29	0	4	2	0	0	0	0	0	0	0	4	124
10:45	6	97	23	1	4	1	0	0	0	0	0	0	0	5	137
	17	390	100	1	20	6	0	1	0	0	0	0	0	15	550
11:00	7	91	19	0	1	1	0	1	0	0	0	0	0	5	125
11:15	5	86	21	0	3	0	0	2	0	0	0	0	0	3	120
11:30	6	77	31	0	5	1	0	1	0	0	0	0	0	5	126
11:45	4	84	34	1	4	2	0	0	0	0	0	0	0	9	138
	22	338	105	1	13	4	0	4	0	0	0	0	0	22	509
Total	114	2069	664	8	80	22	0	8	2	0	0	0	0	144	3111
Percent	3.7%	66.5%	21.3%	0.3%	2.6%	0.7%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	4.6%	

Wilson Okamoto Corporation

1907 S. Beretania Street, Suite 400
Honolulu, Hawaii

Site Code:
Station ID:
S. Kihei Road

NB

Latitude: 0' 0.000 Undefined

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>5 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
12 PM	5	92	24	0	3	0	0	0	0	0	0	0	0	3	127
12:15	9	94	22	1	2	2	0	1	0	0	0	0	0	15	146
12:30	4	128	31	0	6	1	0	0	0	0	0	0	0	9	179
12:45	4	85	30	1	5	1	0	1	0	0	0	0	0	6	133
	22	399	107	2	16	4	0	2	0	0	0	0	0	33	585
13:00	5	84	30	0	3	1	0	1	0	0	0	0	0	9	133
13:15	3	98	33	0	5	2	0	0	1	0	0	0	0	5	147
13:30	5	90	25	0	6	0	0	1	0	0	0	0	0	7	134
13:45	5	106	25	1	1	1	0	0	1	0	0	0	0	4	144
	18	378	113	1	15	4	0	1	1	0	0	0	0	25	558
14:00	9	103	19	0	3	0	0	1	0	0	0	0	0	8	143
14:15	7	74	24	3	2	2	0	0	0	0	0	0	0	10	122
14:30	8	90	27	2	4	0	0	0	0	0	0	0	0	16	147
14:45	4	107	33	0	2	1	0	0	0	0	0	0	0	7	154
	28	374	103	5	11	3	0	1	0	0	0	0	0	41	566
15:00	6	102	27	1	5	1	0	1	0	0	0	0	0	10	153
15:15	3	115	27	0	3	1	0	0	0	0	0	0	0	14	163
15:30	4	107	35	0	2	0	0	0	0	0	0	0	0	8	156
15:45	6	112	35	1	3	3	0	1	0	0	0	0	0	10	171
	19	436	124	2	13	5	0	2	0	0	0	0	0	42	643
16:00	2	100	41	0	3	2	0	0	0	0	0	0	0	12	160
16:15	5	91	33	0	5	1	0	0	0	0	0	0	0	17	152
16:30	4	115	34	1	3	1	0	1	0	0	0	0	0	9	168
16:45	7	99	30	0	4	2	0	0	0	0	0	0	0	12	154
	18	405	138	1	15	6	0	1	0	0	0	0	0	50	634
17:00	3	112	30	1	1	0	0	0	0	0	0	0	0	19	166
17:15	6	114	31	0	2	1	0	2	0	0	0	0	0	11	169
17:30	8	99	26	0	6	0	0	1	0	0	0	0	0	20	160
17:45	3	107	34	0	1	2	0	0	0	0	0	0	0	12	159
	22	432	121	1	10	3	0	3	0	0	0	0	0	62	654
18:00	4	117	32	0	2	0	0	0	0	0	0	0	0	10	165
18:15	6	94	20	0	2	1	0	0	0	0	0	0	0	4	127
18:30	5	95	19	0	3	1	0	0	0	0	0	0	0	14	137
18:45	2	94	15	0	0	0	0	1	0	0	0	0	0	12	124
	17	400	86	0	7	2	0	1	0	0	0	0	0	40	553
19:00	6	83	20	0	4	0	0	0	0	0	0	0	0	5	118
19:15	3	74	15	0	0	0	0	0	0	0	0	0	0	3	95
19:30	2	69	22	0	3	0	0	0	0	0	0	0	0	2	98
19:45	1	63	18	1	0	0	0	0	0	0	0	0	0	3	86
	12	289	75	1	7	0	0	0	0	0	0	0	0	13	397
20:00	0	72	13	0	0	0	0	0	0	0	0	0	0	1	86
20:15	2	60	14	0	3	0	0	0	0	0	0	0	0	1	80
20:30	2	64	13	0	1	0	0	0	0	0	0	0	0	1	81
20:45	2	43	7	1	0	0	0	0	0	0	0	0	0	1	54
	6	239	47	1	4	0	0	0	0	0	0	0	0	4	301
21:00	3	58	18	0	2	0	0	0	0	0	0	0	0	1	82
21:15	1	41	10	0	1	0	0	0	0	0	0	0	0	0	53
21:30	1	35	11	0	0	0	0	0	0	0	0	0	0	1	48
21:45	4	43	9	0	1	0	0	0	0	0	0	0	0	1	58
	9	177	48	0	4	0	0	0	0	0	0	0	0	3	241
22:00	4	45	4	0	0	0	0	0	0	0	0	0	0	0	53
22:15	5	34	10	0	1	0	0	0	0	0	0	0	0	0	50
22:30	1	20	5	0	0	0	0	0	0	0	0	0	0	0	26
22:45	2	27	10	0	0	1	0	0	0	0	0	0	0	1	41
	12	126	29	0	1	1	0	0	0	0	0	0	0	1	170
23:00	2	22	4	0	0	0	0	0	0	0	0	0	0	0	28
23:15	0	28	3	0	0	0	0	0	0	0	0	0	0	0	31
23:30	2	15	3	0	0	0	0	0	0	0	0	0	0	2	22
23:45	3	7	7	0	0	0	0	0	0	0	0	0	0	0	17
	7	72	17	0	0	0	0	0	0	0	0	0	0	2	98
Total	190	3727	1008	14	103	28	0	11	3	0	0	0	0	316	5400
Percent	3.5%	69.0%	18.7%	0.3%	1.9%	0.5%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	5.9%	

Wilson Okamoto Corporation
1907 S. Beretania Street, Suite 400
Honolulu, Hawaii

Site Code:
Station ID:
S. Kihei Road

NB

Latitude: 0' 0.000 Undefined

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>5 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
10/31/12	5	17	4	0	0	0	0	0	0	0	0	0	0	1	27
00:15	1	10	3	0	0	0	0	0	0	0	0	0	0	0	14
00:30	0	11	1	0	0	0	0	0	0	0	0	0	0	0	12
00:45	1	13	0	0	1	0	0	0	0	0	0	0	0	1	16
	7	51	8	0	1	0	0	0	0	0	0	0	0	2	69
01:00	0	7	1	0	0	0	0	0	0	0	0	0	0	0	8
01:15	1	6	3	0	0	0	0	0	0	0	0	0	0	0	10
01:30	1	8	2	0	0	0	0	0	0	0	0	0	0	0	11
01:45	2	12	0	0	0	0	0	0	0	0	0	0	0	0	14
	4	33	6	0	0	0	0	0	0	0	0	0	0	0	43
02:00	1	7	2	0	0	0	0	0	0	0	0	0	0	0	10
02:15	0	4	1	0	0	0	0	0	0	0	0	0	0	0	5
02:30	0	2	3	0	0	0	0	0	0	0	0	0	0	0	5
02:45	0	2	2	0	0	0	0	0	0	0	0	0	0	0	4
	1	15	8	0	0	0	0	0	0	0	0	0	0	0	24
03:00	0	7	0	0	0	0	0	0	0	0	0	0	0	0	7
03:15	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
03:30	1	4	2	0	0	0	0	0	0	0	0	0	0	0	7
03:45	0	6	4	0	0	0	0	0	0	0	0	0	0	0	10
	1	20	6	0	0	0	0	0	0	0	0	0	0	0	27
04:00	0	2	3	0	0	0	0	0	0	0	0	0	0	0	5
04:15	0	8	3	0	0	0	0	0	0	0	0	0	0	0	11
04:30	0	6	0	0	1	0	0	0	0	0	0	0	0	0	7
04:45	0	9	2	0	1	0	0	0	0	0	0	0	0	0	12
	0	25	8	0	2	0	0	0	0	0	0	0	0	0	35
05:00	0	7	3	0	0	0	0	0	1	0	0	0	0	0	11
05:15	1	7	11	0	1	0	0	0	0	0	0	0	0	2	22
05:30	1	19	6	0	1	0	0	0	0	0	0	0	0	0	27
05:45	0	22	8	0	0	0	0	0	0	0	0	0	0	0	30
	2	55	28	0	2	0	0	0	1	0	0	0	0	2	90
06:00	1	33	5	0	3	0	0	0	0	0	0	0	0	0	42
06:15	0	36	19	0	2	0	0	0	0	0	0	0	0	1	58
06:30	3	59	20	1	5	0	0	0	0	0	0	0	0	4	92
06:45	2	58	22	1	2	0	0	0	0	0	0	0	0	5	90
	6	186	66	2	12	0	0	0	0	0	0	0	0	10	282
07:00	4	72	24	1	3	1	0	0	0	0	0	0	0	5	110
07:15	0	69	32	0	3	0	0	0	0	0	0	0	0	13	117
07:30	5	78	28	0	2	0	0	0	0	0	0	0	0	10	123
07:45	6	100	30	0	3	0	0	0	0	0	0	0	0	10	149
	15	319	114	1	11	1	0	0	0	0	0	0	0	38	499
08:00	7	93	24	0	2	0	0	1	0	0	0	0	0	7	134
08:15	0	91	25	0	1	3	0	0	0	0	0	0	0	2	122
08:30	12	80	31	0	5	1	0	0	0	0	0	0	0	9	118
08:45	4	92	20	1	5	0	1	0	0	0	0	0	0	5	128
	23	336	100	1	13	4	1	1	0	0	0	0	0	23	502
09:00	5	76	23	0	2	3	0	0	0	0	0	0	0	7	116
09:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	64	1116	367	4	43	8	1	1	1	0	0	0	0	82	1687
Percent	3.8%	66.2%	21.8%	0.2%	2.5%	0.5%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	4.9%	
Grand Total	608	11589	3386	45	354	88	2	38	8	0	0	1	0	944	17063
Percent	3.6%	67.9%	19.8%	0.3%	2.1%	0.5%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	5.5%	

Wilson Okamoto Corporation

1907 S. Beretania Street, Suite 400
Honolulu, Hawaii

Site Code:
Station ID:
S. Kihei Road

SB

Latitude: 0' 0.000 Undefined

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
10/29/12	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
00:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
00:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
00:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
01:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
02:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
03:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
04:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
05:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
06:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
07:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
08:45	5	67	26	0	2	0	0	3	0	0	0	0	0	3	106
	5	67	26	0	2	0	0	3	0	0	0	0	0	3	106
09:00	2	59	24	1	1	1	0	1	0	0	0	0	0	7	96
09:15	2	49	8	0	6	0	0	0	0	0	0	0	0	4	69
09:30	2	65	21	0	1	0	0	0	0	0	0	0	0	0	89
09:45	5	65	27	1	3	0	0	0	1	0	0	0	0	8	110
	11	238	80	2	11	1	0	1	1	0	0	0	0	19	364
10:00	0	60	21	1	3	0	0	0	0	0	0	0	0	4	89
10:15	7	55	20	1	4	2	0	0	0	0	0	0	0	8	97
10:30	8	69	14	0	1	0	0	0	0	0	0	0	0	7	99
10:45	1	68	23	0	2	0	0	0	0	0	0	0	0	11	125
	16	272	78	2	10	2	0	0	0	0	0	0	0	30	410
11:00	5	64	19	0	2	0	0	0	0	0	0	0	0	8	98
11:15	1	53	27	1	5	0	0	0	0	0	0	0	0	8	105
11:30	3	62	31	0	1	2	0	0	0	0	0	0	0	11	110
11:45	6	80	25	1	2	0	0	0	0	0	0	0	0	6	120
	15	259	102	2	10	2	0	0	0	0	0	0	0	33	433
Total	47	846	286	6	33	5	0	4	1	0	0	0	0	85	1313
Percent	3.6%	64.4%	21.8%	0.5%	2.5%	0.4%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	6.5%	

Wilson Okamoto Corporation
1907 S. Beretania Street, Suite 400
Honolulu, Hawaii

Site Code:
Station ID:
S. Kihei Road

SB

Latitude: 0' 0.000 Undefined

Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
12 PM	4	64	22	0	0	0	0	1	0	0	0	0	0	11	102
12:15	1	81	22	0	4	1	0	0	0	0	0	0	0	9	118
12:30	2	65	30	0	1	2	0	0	0	0	0	0	0	8	108
12:45	4	83	20	1	1	0	0	1	0	0	0	0	0	10	120
	11	293	94	1	6	3	0	2	0	0	0	0	0	38	448
13:00	1	93	23	0	3	1	0	0	1	0	0	0	0	9	131
13:15	2	81	20	1	3	1	0	0	0	0	0	0	0	11	119
13:30	3	76	19	0	3	0	0	0	0	0	0	0	0	8	109
13:45	3	78	24	1	1	1	0	0	0	0	0	0	0	10	118
	9	328	86	2	10	3	0	0	1	0	0	0	0	38	477
14:00	6	91	19	0	3	1	0	1	0	0	0	0	0	13	134
14:15	7	90	23	0	4	1	0	0	0	0	0	0	0	6	131
14:30	5	96	23	1	4	0	0	0	0	0	0	0	0	5	134
14:45	3	83	15	0	1	1	0	0	0	0	0	0	0	6	109
	21	360	80	1	12	3	0	1	0	0	0	0	0	30	508
15:00	6	83	23	0	2	0	0	2	0	0	0	0	0	15	131
15:15	5	89	33	0	1	0	0	1	0	0	0	0	0	4	133
15:30	2	96	18	0	2	0	0	1	0	0	0	0	0	14	133
15:45	9	95	26	0	4	2	0	0	0	0	0	0	0	14	150
	22	363	100	0	9	2	0	4	0	0	0	0	0	47	547
16:00	7	91	25	1	4	1	0	1	0	0	0	0	0	7	137
16:15	4	88	34	0	5	2	0	0	0	0	0	0	0	15	148
16:30	3	81	24	0	2	0	0	0	0	0	0	0	0	15	135
16:45	7	86	29	0	0	0	0	0	0	0	0	0	0	19	141
	21	356	112	1	11	3	0	1	0	0	0	0	0	56	561
17:00	4	93	21	0	3	1	0	1	0	0	0	0	0	17	140
17:15	1	97	23	0	2	0	0	0	0	0	0	0	0	7	130
17:30	6	89	15	0	0	2	0	1	0	0	0	0	0	9	122
17:45	3	70	23	0	4	0	0	0	0	0	0	0	0	14	114
	14	349	82	0	9	3	0	2	0	0	0	0	0	47	506
18:00	7	95	23	1	1	0	0	1	0	0	0	0	0	11	139
18:15	4	75	28	1	0	1	0	0	0	0	0	0	0	7	116
18:30	5	50	13	0	0	1	0	0	0	0	0	0	0	11	80
18:45	6	90	17	0	1	0	0	0	0	0	0	0	0	4	118
	22	310	81	2	2	2	0	1	0	0	0	0	0	33	453
19:00	2	56	15	0	2	1	0	0	0	0	0	0	0	4	80
19:15	3	48	6	0	1	0	0	0	0	0	0	0	0	1	59
19:30	2	43	10	0	1	1	0	0	0	0	0	0	0	6	83
19:45	6	39	5	0	0	0	0	0	0	0	0	0	0	0	50
	13	186	36	0	4	2	0	0	0	0	0	0	0	11	252
20:00	5	44	6	1	0	0	0	0	0	0	0	0	0	2	58
20:15	2	33	8	0	1	0	0	0	0	0	0	0	0	4	48
20:30	0	29	11	0	0	0	0	0	0	0	0	0	0	7	47
20:45	1	57	15	0	0	0	0	0	0	0	0	0	0	1	74
	8	163	40	1	1	0	0	0	0	0	0	0	0	14	228
21:00	1	49	11	1	0	0	0	0	0	0	0	0	0	0	62
21:15	4	32	11	0	1	0	0	0	0	0	0	0	0	3	51
21:30	5	24	7	0	1	0	0	0	0	0	0	0	0	2	39
21:45	0	19	3	0	0	0	0	0	0	0	0	0	0	1	23
	10	124	32	1	2	0	0	0	0	0	0	0	0	6	175
22:00	1	27	3	0	0	0	0	0	0	0	0	0	0	1	32
22:15	0	21	4	0	0	0	0	0	0	0	0	0	0	0	25
22:30	2	19	5	0	0	0	0	0	0	0	0	0	0	0	26
22:45	1	17	7	0	0	0	0	0	0	0	0	0	0	0	25
	4	84	19	0	0	0	0	0	0	0	0	0	0	1	108
23:00	1	14	5	0	0	0	0	0	0	0	0	0	0	0	20
23:15	2	10	3	0	0	0	0	0	0	0	0	0	0	0	15
23:30	0	6	1	0	0	0	0	0	0	0	0	0	0	1	8
23:45	0	12	1	0	0	0	0	0	0	0	0	0	0	2	15
	3	42	10	0	0	0	0	0	0	0	0	0	0	3	58
Total	159	2958	772	9	66	21	0	11	1	0	0	0	0	324	4321
Percent	3.7%	68.5%	17.9%	0.2%	1.5%	0.5%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	7.5%	

Wilson Okamoto Corporation

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SB

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Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
10/30/12	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
00:15	0	6	0	0	0	0	0	0	0	0	0	0	0	0	6
00:30	2	4	0	0	0	0	0	0	0	0	0	0	0	0	6
00:45	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
	2	14	1	0	0	0	0	0	0	0	0	0	0	0	17
01:00	0	3	1	0	0	0	0	0	0	0	0	0	0	0	4
01:15	0	1	1	0	1	0	0	0	0	0	0	0	0	0	3
01:30	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
01:45	0	3	0	0	1	0	0	0	0	0	0	0	0	0	4
	0	8	2	0	2	0	0	0	0	0	0	0	0	0	12
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02:15	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
02:30	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:45	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
	0	1	3	0	0	0	0	0	0	0	0	0	0	0	4
03:00	0	2	2	0	0	0	0	0	0	0	0	0	0	0	4
03:15	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
03:30	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2
03:45	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3
	0	8	4	0	0	0	0	0	0	0	0	0	0	0	12
04:00	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
04:15	0	2	2	0	0	0	0	0	0	0	0	0	0	0	4
04:30	2	6	2	0	0	0	0	0	0	0	0	0	0	0	10
04:45	0	8	6	0	0	0	0	0	0	0	0	0	0	0	14
	2	20	10	0	0	0	0	0	0	0	0	0	0	0	32
05:00	0	2	4	0	0	0	0	0	0	0	0	0	0	0	6
05:15	0	9	10	0	1	0	0	0	0	0	0	0	0	0	20
05:30	1	15	8	1	1	0	0	0	1	0	0	0	0	0	27
05:45	2	12	6	1	0	0	0	0	0	0	0	0	0	1	22
	3	38	28	2	2	0	0	0	1	0	0	0	0	1	75
06:00	2	15	3	1	0	0	0	0	0	0	0	0	0	0	21
06:15	3	30	10	0	4	0	0	0	0	0	0	0	0	3	50
06:30	4	18	12	0	2	0	0	0	0	0	0	0	0	4	40
06:45	2	43	24	0	1	0	0	0	0	0	0	0	0	6	76
	11	106	49	1	7	0	0	0	0	0	0	0	0	13	187
07:00	1	53	24	0	1	1	0	0	0	0	0	0	0	7	87
07:15	3	54	25	0	4	0	0	1	0	0	0	0	0	6	93
07:30	5	86	30	0	4	0	0	2	0	0	0	0	0	13	140
07:45	3	56	23	1	2	0	0	0	0	0	0	0	0	6	91
	12	249	102	1	11	1	0	3	0	0	0	0	0	32	411
08:00	6	65	29	0	3	0	0	2	1	0	0	0	0	13	119
08:15	2	64	24	0	4	0	0	1	0	0	0	0	0	6	101
08:30	3	56	23	0	0	2	0	0	0	0	0	0	0	10	94
08:45	4	70	32	1	1	2	0	0	0	0	0	0	0	5	115
	15	255	108	1	8	4	0	3	1	0	0	0	0	34	429
09:00	6	58	29	0	2	0	0	0	0	0	0	0	0	5	100
09:15	4	62	26	0	2	0	0	0	0	0	0	0	0	7	101
09:30	3	72	13	0	5	3	0	0	0	0	0	0	0	3	99
09:45	2	60	18	2	4	2	0	0	0	0	0	0	0	10	98
	15	252	86	2	13	5	0	0	0	0	0	0	0	25	398
10:00	4	54	16	0	5	1	0	0	0	0	0	0	0	8	88
10:15	1	80	20	0	2	0	0	0	0	0	0	0	0	9	112
10:30	5	66	30	0	0	1	0	1	0	0	0	0	0	8	111
10:45	5	82	23	1	3	0	0	1	0	0	0	0	0	2	117
	15	282	89	1	10	2	0	2	0	0	0	0	0	27	428
11:00	4	82	22	0	0	1	0	0	0	0	0	0	0	5	114
11:15	3	72	26	0	4	1	0	0	0	0	0	0	0	5	113
11:30	5	78	33	0	1	0	0	0	0	0	0	0	0	5	122
11:45	5	74	22	1	3	1	0	0	0	0	0	0	0	10	116
	17	306	105	1	8	3	0	0	0	0	0	0	0	25	465
Total	92	1539	587	9	61	15	0	8	2	0	0	0	0	157	2470
Percent	3.7%	62.3%	23.8%	0.4%	2.5%	0.6%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	6.4%	

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Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>6 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
12 PM	2	81	24	0	3	0	0	1	0	0	0	0	0	2	113
12:15	6	71	23	0	4	1	0	1	0	0	0	0	0	9	115
12:30	0	76	22	0	4	0	0	1	1	0	0	0	0	11	115
12:45	4	74	18	1	2	0	0	0	0	0	0	0	0	6	105
	12	302	87	1	13	1	0	3	1	0	0	0	0	28	448
13:00	5	67	9	0	2	0	0	1	0	1	0	0	0	7	92
13:15	6	76	21	0	2	1	0	2	0	0	0	0	0	2	110
13:30	1	75	30	1	3	0	0	0	0	0	0	0	0	3	113
13:45	2	68	27	1	3	0	0	2	1	0	0	0	0	5	129
	14	306	87	2	10	1	0	5	1	1	0	0	0	17	444
14:00	6	71	16	0	1	0	0	0	0	0	0	0	0	8	102
14:15	5	67	25	0	1	1	0	1	0	0	0	0	0	14	144
14:30	3	60	25	0	1	1	0	0	0	0	0	0	0	17	107
14:45	5	87	20	2	3	1	0	1	0	0	0	0	0	13	132
	21	315	86	2	6	3	0	2	0	0	0	0	0	50	485
15:00	6	103	25	0	3	0	0	0	0	0	0	0	0	16	153
15:15	6	93	25	0	2	0	0	0	0	0	0	0	0	10	136
15:30	3	103	19	0	3	2	0	1	0	0	0	0	0	5	136
15:45	3	85	25	0	4	0	0	0	0	0	0	0	0	12	129
	18	384	94	0	12	2	0	1	0	0	0	0	0	43	554
16:00	6	80	32	0	3	0	0	0	0	0	0	0	0	10	131
16:15	3	100	27	0	3	0	0	2	0	0	0	0	0	16	151
16:30	5	90	27	1	0	0	0	0	0	0	0	0	0	16	139
16:45	5	95	31	0	1	1	0	0	0	0	0	0	0	14	147
	19	365	117	1	7	1	0	2	0	0	0	0	0	56	568
17:00	8	102	19	1	1	1	0	0	0	1	0	0	0	12	145
17:15	6	107	25	0	3	0	0	1	0	0	0	0	0	8	150
17:30	7	93	28	0	1	2	0	0	1	0	0	0	0	13	145
17:45	3	92	23	0	2	2	0	0	0	0	0	0	0	12	134
	24	394	95	1	7	5	0	1	1	1	0	0	0	45	574
18:00	2	78	20	1	5	1	0	0	0	0	0	0	0	7	114
18:15	7	104	20	0	1	0	0	2	0	0	0	0	0	8	142
18:30	4	89	30	0	0	0	0	1	0	0	0	0	0	11	135
18:45	4	61	12	0	2	1	0	0	0	0	0	0	0	12	92
	17	332	82	1	8	2	0	3	0	0	0	0	0	38	483
19:00	3	63	11	1	0	0	0	0	0	0	0	0	0	5	83
19:15	0	46	14	0	1	0	0	0	0	0	0	0	0	4	67
19:30	1	50	13	0	0	0	0	0	0	0	0	0	0	3	67
19:45	1	38	12	0	0	0	0	0	0	0	0	0	0	2	53
	5	199	50	1	1	0	0	0	0	0	0	0	0	14	270
20:00	0	35	5	1	0	0	0	0	0	0	0	0	0	4	45
20:15	3	42	9	0	1	0	0	0	0	0	0	0	0	2	57
20:30	1	34	9	0	0	0	0	0	0	0	0	0	0	1	45
20:45	1	48	11	0	0	0	0	0	0	0	0	0	0	4	64
	5	159	34	1	1	0	0	0	0	0	0	0	0	11	211
21:00	2	30	12	0	0	0	0	0	0	0	0	0	0	2	46
21:15	1	26	8	0	1	0	0	0	0	0	0	0	0	1	39
21:30	3	26	7	0	1	0	0	0	0	0	0	0	0	0	37
21:45	2	32	6	0	0	0	0	0	0	0	0	0	0	1	41
	8	116	33	0	2	0	0	0	0	0	0	0	0	4	163
22:00	3	29	4	0	0	0	0	0	0	0	0	0	0	0	36
22:15	2	23	6	0	0	0	0	0	0	0	0	0	0	0	31
22:30	0	18	4	0	0	0	0	0	0	0	0	0	0	0	22
22:45	2	17	2	0	0	0	0	0	0	0	0	0	0	2	23
	7	87	16	0	0	0	0	0	0	0	0	0	0	2	112
23:00	0	15	7	0	0	0	0	0	0	0	0	0	0	0	22
23:15	0	9	0	0	0	0	0	0	0	0	0	0	0	2	11
23:30	0	4	2	0	0	0	0	0	0	0	0	0	0	0	6
23:45	1	8	2	0	1	0	0	0	0	0	0	0	0	0	12
	1	36	11	0	1	0	0	0	0	0	0	0	0	2	51
Total	151	2995	792	10	68	15	0	17	3	2	0	0	0	310	4363
Percent	3.5%	68.6%	18.2%	0.2%	1.6%	0.3%	0.0%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%	7.1%	

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Start Time	Bikes	Cars & Trailers	2 Axle Long	Buses	2 Axle 6 Tire	3 Axle Single	4 Axle Single	<5 Axl Double	5 Axle Double	>5 Axl Double	<6 Axl Multi	6 Axle Multi	>6 Axl Multi	Not Classed	Total
10/31/12	2	9	1	0	0	0	0	0	0	0	0	0	0	2	14
00:15	0	4	0	0	0	0	0	0	0	0	0	0	0	0	4
00:30	0	6	1	0	0	0	0	0	0	0	0	0	0	0	7
00:45	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3
	2	22	2	0	0	0	0	0	0	0	0	0	0	2	28
01:00	0	4	3	0	0	0	0	0	0	0	0	0	0	0	7
01:15	1	3	1	0	0	0	0	0	0	0	0	0	0	0	5
01:30	0	4	0	0	0	0	0	0	0	0	0	0	0	1	5
01:45	2	3	1	0	0	0	0	0	0	0	0	0	0	0	6
	3	14	6	0	0	0	0	0	0	0	0	0	0	1	23
02:00	0	2	0	0	1	0	0	0	0	0	0	0	0	0	3
02:15	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
02:30	0	2	1	0	0	0	0	0	0	0	0	0	0	0	3
02:45	0	5	0	0	0	0	0	0	0	0	0	0	0	0	5
	0	10	1	0	1	0	0	0	0	0	0	0	0	0	12
03:00	0	1	1	0	0	0	0	0	0	0	0	0	0	1	3
03:15	0	5	0	0	0	0	0	0	0	0	0	0	0	0	5
03:30	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
03:45	0	4	1	0	0	0	0	0	0	0	0	0	0	0	5
	0	10	3	0	0	0	0	0	0	0	0	0	0	1	14
04:00	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
04:15	0	3	2	0	0	0	0	0	0	0	0	0	0	0	5
04:30	1	7	2	0	0	0	0	0	0	0	0	0	0	0	10
04:45	0	9	4	0	1	0	0	0	0	0	0	0	0	0	14
	1	19	10	0	1	0	0	0	0	0	0	0	0	0	31
05:00	0	5	5	0	1	0	0	0	0	0	0	0	0	0	11
05:15	0	7	6	0	0	0	0	0	0	0	0	0	0	1	14
05:30	1	13	0	0	2	0	0	0	0	0	0	0	0	0	16
05:45	0	12	10	1	0	0	0	0	1	0	0	0	0	0	24
	1	37	21	1	3	0	0	0	1	0	0	0	0	1	65
06:00	0	18	9	0	1	0	0	0	0	0	0	0	0	2	30
06:15	1	27	9	1	3	1	0	0	0	0	0	0	0	0	42
06:30	3	33	17	0	3	0	0	0	0	0	0	0	0	3	59
06:45	2	47	19	0	1	0	0	1	0	0	0	0	0	4	74
	6	125	54	1	8	1	0	1	0	0	0	0	0	9	205
07:00	1	55	23	0	2	0	0	0	0	0	0	0	0	3	84
07:15	3	63	25	0	3	1	0	1	0	0	0	0	0	4	100
07:30	5	66	28	0	1	1	0	0	0	0	0	0	0	8	109
07:45	7	65	14	0	2	1	0	0	0	0	0	0	0	6	95
	16	249	90	0	8	3	0	1	0	0	0	0	0	21	388
08:00	9	72	24	0	0	0	0	0	0	0	0	0	0	7	112
08:15	1	48	24	0	3	0	0	0	0	0	0	0	0	7	83
08:30	4	73	22	0	1	1	0	0	0	0	0	0	0	15	116
08:45	2	81	19	0	1	1	0	1	0	0	0	0	0	7	112
	16	274	89	0	5	2	0	1	0	0	0	0	0	36	423
09:00	4	44	15	1	2	1	0	0	0	0	0	0	0	8	75
09:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
09:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
10:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:15	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:30	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
11:45	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	49	804	290	3	28	7	0	3	1	0	0	0	0	79	1264
Percent	3.9%	63.6%	22.9%	0.2%	2.2%	0.6%	0.0%	0.2%	0.1%	0.0%	0.0%	0.0%	0.0%	6.3%	
Grand Total	498	9142	2727	37	256	63	0	43	8	2	0	0	0	955	13731
Percent	3.6%	66.6%	19.9%	0.3%	1.9%	0.5%	0.0%	0.3%	0.1%	0.0%	0.0%	0.0%	0.0%	7.0%	

APPENDIX B

LEVEL OF SERVICE DEFINITIONS

LEVEL OF SERVICE DEFINITIONS

LEVEL-OF-SERVICE CRITERIA FOR A TWO-LANE HIGHWAY

The primary measures of service quality for two-lane highways are average travel speed (ATS), percent time-spent-following (PTSF) and percent of free-flow speed (PFFS). For Class I two-lane highways, LOS is defined in terms of ATS and PTSF while service quality for Class II two-lane highways is based only on PTSF. For Class II two-lane highways, LOS is defined in terms of PFFFS. LOS criteria are shown and described below.

Level of Service	Class I		Class II	Class III
	ATS (mi/h)	PTSF (%)	PTSF (%)	PFFS (%)
A	>55	≤35	≤40	>91.7
B	<50-55	>35-50	>40-55	<83.3-91.7
C	>45-50	>50-65	>55-70	>75.0-83.3
D	>40-45	>65-80	>70-85	>66.7-75.0
E	≤40	>80	>85	≤66.7

At **Level of Service A**, motorists experience high operating speeds on Class I highways and little difficulty in passing. Platoons of three or more vehicles are rare. On Class II highways, speed would be controlled primarily by roadway conditions. A small amount of platooning would be expected. On Class III highways, drivers should be able to maintain operating speeds close or equal to the free-flow speed (FFS) of the facility.

At **Level of Service B**, passing demand and passing capacity are balanced. On both Class I and Class II highways, the degree of platooning becomes noticeable. Some speed reductions are present on Class I highways. On Class III highways, it becomes difficult to maintain FFS operation, but the speed reduction is still relatively small.

At **Level of Service C**, most vehicles are traveling in platoons. Speeds are noticeably curtailed on all three classes of highway.

At **Level of Service D**, platooning increases significantly. Passing demand is high on both Class I and II facilities, but passing capacity approaches zero. A high percentage vehicles are now traveling in platoons, and PTSF is quite noticeable. On Class III highways, the fall-off from FFS is now significant.

At **Level of Service E**, demand is approaching capacity. Passing on Class I and II highways is virtually impossible, and PTSF is more than 80%. Speeds are seriously curtailed. On Class III highways, speed is less than two-thirds the FFS.

Level of Service F exists whenever demand flow in one or both directions exceeds the capacity of the segment. Operating conditions are unstable, and heavy congestion exists on all classes of two-lane highway.

"Highway Capacity Manual," Transportation Research Board, 2010.

APPENDIX C

CAPACITY ANALYSIS CALCULATIONS
EXISTING PEAK HOUR TRAFFIC ANALYSIS

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	AM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (NB)
Jurisdiction	
Analysis Year	Existing
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.92	
Shoulder width	4.0	ft	% Trucks and buses	3	%
Lane width	10.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd 574 veh/h
Opposing direction volume, Vo 443 veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.2	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.994	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	626	pc/h	484	pc/h

Free-Flow Speed from Field Measurement:

Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h

Estimated Free-Flow Speed:

Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	2.4	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	36.3	mi/h
Adjustment for no-passing zones, fnp	0.7	mi/h
Average travel speed, ATSd	27.0	mi/h
Percent Free Flow Speed, PFFS	74.4	%

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	624	pc/h	482	pc/h
Base percent time-spent-following, (note-4) BPTSFd	59.0	%		
Adjustment for no-passing zones, fnp	13.2			
Percent time-spent-following, PTSFd	66.4	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.37	
Peak 15-min vehicle-miles of travel, VMT15	47	veh-mi
Peak-hour vehicle-miles of travel, VMT60	172	veh-mi
Peak 15-min total travel time, TT15	1.7	veh-h
Capacity from ATS, CdATS	1690	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1690	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	27.0	mi/h
Percent time-spent-following, PTSFd (from above)	66.4	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following		

including passing lane, PTSFpl - %

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	623.9
Effective width of outside lane, We	14.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	4.77
Bicycle LOS	E

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	AM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (SB)
Jurisdiction	
Analysis Year	Existing
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.92	
Shoulder width	4.0	ft	% Trucks and buses	3	%
Lane width	10.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd	443	veh/h
Opposing direction volume, Vo	574	veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.2		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.994		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	484	pc/h	626	pc/h

Free-Flow Speed from Field Measurement:		
Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h
Estimated Free-Flow Speed:		
Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	2.4	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	36.3	mi/h
Adjustment for no-passing zones, fnp	0.4	mi/h
Average travel speed, ATSd	27.3	mi/h

Percent Free Flow Speed, PFFS 75.2 %

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	482	pc/h	624	pc/h
Base percent time-spent-following, (note-4) BPTSFd	51.1	%		
Adjustment for no-passing zones, fnp	13.2			
Percent time-spent-following, PTSFd	56.9	%		

Level of Service and Other Performance Measures

Level of service, LOS	C	
Volume to capacity ratio, v/c	0.29	
Peak 15-min vehicle-miles of travel, VMT15	42	veh-mi
Peak-hour vehicle-miles of travel, VMT60	155	veh-mi
Peak 15-min total travel time, TT15	1.5	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	27.3	mi/h
Percent time-spent-following, PTSFd (from above)	56.9	
Level of service, LOSd (from above)	C	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	481.5
Effective width of outside lane, We	14.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	4.64
Bicycle LOS	E

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific dewngrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

HCS 2010: Two-Lane Highways Release 6.3

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	PM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (NB)
Jurisdiction	
Analysis Year	Existing
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.97	
Shoulder width	4.0	ft	% Trucks and buses	3	%
Lane width	10.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd 657 veh/h
Opposing direction volume, Vo 581 veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	679	pc/h	601	pc/h

Free-Flow Speed from Field Measurement:

Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h

Estimated Free-Flow Speed:

Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	2.4	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	36.3	mi/h
Adjustment for no-passing zones, fnp	0.4	mi/h
Average travel speed, ATSd	26.0	mi/h

Percent Free Flow Speed, PFFS 71.6 %

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	677	pc/h	599	pc/h
Base percent time-spent-following, (note-4) BPTSFd	61.6	%		
Adjustment for no-passing zones, fnp	13.0			
Percent time-spent-following, PTSFd	68.5	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.40	
Peak 15-min vehicle-miles of travel, VMT15	59	veh-mi
Peak-hour vehicle-miles of travel, VMT60	230	veh-mi
Peak 15-min total travel time, TT15	2.3	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	26.0	mi/h
Percent time-spent-following, PTSFd (from above)	68.5	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following		

including passing lane, PTSFpl - %

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	677.3
Effective width of outside lane, We	14.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	4.81
Bicycle LOS	E

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	PM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (SB)
Jurisdiction	
Analysis Year	Existing
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHP	0.97	
Shoulder width	4.0	ft	% Trucks and buses	3	%
Lane width	10.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd	581	veh/h
Opposing direction volume, Vo	657	veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	601	pc/h	679	pc/h

Free-Flow Speed from Field Measurement:		
Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h
Estimated Free-Flow Speed:		
Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	2.4	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FPSd	36.3	mi/h
Adjustment for no-passing zones, fnp	0.4	mi/h
Average travel speed, ATSd	26.1	mi/h

Percent Free Flow Speed, PFFS 71.7 %

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	599	pc/h	677	pc/h
Base percent time-spent-following, (note-4) BPTSFd	59.6	%		
Adjustment for no-passing zones, fnp	13.0			
Percent time-spent-following, PTSFd	65.7	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.35	
Peak 15-min vehicle-miles of travel, VMT15	52	veh-mi
Peak-hour vehicle-miles of travel, VMT60	203	veh-mi
Peak 15-min total travel time, TT15	2.0	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	26.1	mi/h
Percent time-spent-following, PTSFd (from above)	65.7	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	599.0
Effective width of outside lane, We	14.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	4.75
Bicycle LOS	E

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific dewngrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

APPENDIX D

CAPACITY ANALYSIS CALCULATIONS
INTERIM PEAK HOUR TRAFFIC ANALYSIS

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	AM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (NB)
Jurisdiction	
Analysis Year	Interim
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.92	
Shoulder width	0.0	ft	% Trucks and buses	3	%
Lane width	12.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd 574 veh/h
Opposing direction volume, Vo 443 veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.2	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.994	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	626	pc/h	484	pc/h

Free-Flow Speed from Field Measurement:		
Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h
Estimated Free-Flow Speed:		
Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	4.2	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	34.5	mi/h
Adjustment for no-passing zones, fnp	0.7	mi/h
Average travel speed, ATSd	25.2	mi/h

Percent Free Flow Speed, PFFS 73.1 %

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	624	pc/h	482	pc/h
Base percent time-spent-following, (note-4) BPTSFd	59.0	%		
Adjustment for no-passing zones, fnp	13.2			
Percent time-spent-following, PTSFd	66.4	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.37	
Peak 15-min vehicle-miles of travel, VMT15	47	veh-mi
Peak-hour vehicle-miles of travel, VMT60	172	veh-mi
Peak 15-min total travel time, TT15	1.9	veh-h
Capacity from ATS, CdATS	1690	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1690	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	25.2	mi/h
Percent time-spent-following, PTSFd (from above)	66.4	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	623.9
Effective width of outside lane, We	12.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	5.03
Bicycle LOS	E

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific dewngrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	AM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (SB)
Jurisdiction	
Analysis Year	Interim
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.92	
Shoulder width	0.0	ft	% Trucks and buses	3	%
Lane width	12.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd 443 veh/h
Opposing direction volume, Vo 574 veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.2		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.994		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	484	pc/h	626	pc/h

Free-Flow Speed from Field Measurement:

Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h

Estimated Free-Flow Speed:

Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	4.2	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, PFSd	34.5	mi/h
Adjustment for no-passing zones, fnp	0.4	mi/h
Average travel speed, ATSd	25.5	mi/h
Percent Free Flow Speed, PFFS	73.9	%

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	482	pc/h	624	pc/h
Base percent time-spent-following, (note-4) BPTSFd	51.1	%		
Adjustment for no-passing zones, fnp	13.2			
Percent time-spent-following, PTSFd	56.9	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.29	
Peak 15-min vehicle-miles of travel, VMT15	36	veh-mi
Peak-hour vehicle-miles of travel, VMT60	133	veh-mi
Peak 15-min total travel time, TT15	1.4	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	25.5	mi/h
Percent time-spent-following, PTSFd (from above)	56.9	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following		

including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	481.5
Effective width of outside lane, We	12.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	4.90
Bicycle LOS	E

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	PM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (NB)
Jurisdiction	
Analysis Year	Interim
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.97	
Shoulder width	0.0	ft	% Trucks and buses	3	%
Lane width	12.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd	657	veh/h
Opposing direction volume, Vo	581	veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	679	pc/h	601	pc/h

Free-Flow Speed from Field Measurement:		
Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h
Estimated Free-Flow Speed:		
Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	4.2	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	34.5	mi/h
Adjustment for no-passing zones, fnp	0.4	mi/h
Average travel speed, ATSd	24.2	mi/h

Percent Free Flow Speed, PFFS 70.1 %

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	677	pc/h	599	pc/h
Base percent time-spent-following, (note-4) BPTSFd	61.6	%		
Adjustment for no-passing zones, fnp	13.0			
Percent time-spent-following, PTSFd	68.5	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.40	
Peak 15-min vehicle-miles of travel, VMT15	51	veh-mi
Peak-hour vehicle-miles of travel, VMT60	197	veh-mi
Peak 15-min total travel time, TT15	2.1	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	24.2	mi/h
Percent time-spent-following, PTSFd (from above)	68.5	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	677.3
Effective width of outside lane, We	12.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	5.07
Bicycle LOS	E

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific dewngrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

HCS 2010: Two-Lane Highways Release 6.3

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	PM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (SB)
Jurisdiction	
Analysis Year	Interim
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.97	
Shoulder width	0.0	ft	% Trucks and buses	3	%
Lane width	12.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd 581 veh/h
Opposing direction volume, Vo 657 veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	601	pc/h	679	pc/h

Free-Flow Speed from Field Measurement:

Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h

Estimated Free-Flow Speed:

Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	4.2	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	34.5	mi/h
Adjustment for no-passing zones, fnp	0.4	mi/h
Average travel speed, ATSd	24.3	mi/h

Percent Free Flow Speed, PFFS 70.2 %

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	599	pc/h	677	pc/h
Base percent time-spent-following, (note-4) BPTSFd	59.6	%		
Adjustment for no-passing zones, fnp	13.0			
Percent time-spent-following, PTSFd	65.7	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.35	
Peak 15-min vehicle-miles of travel, VMT15	45	veh-mi
Peak-hour vehicle-miles of travel, VMT60	174	veh-mi
Peak 15-min total travel time, TT15	1.9	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	24.3	mi/h
Percent time-spent-following, PTSFd (from above)	65.7	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following		

including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	599.0
Effective width of outside lane, We	12.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	5.01
Bicycle LOS	E

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific dewngrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

APPENDIX E

CAPACITY ANALYSIS CALCULATIONS
PROJECTED YEAR 2015 PEAK HOUR TRAFFIC ANALYSIS

HCS 2010: Two-Lane Highways Release 6.3

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	AM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (NB)
Jurisdiction	
Analysis Year	Projected
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.92	
Shoulder width	5.0	ft	% Trucks and buses	3	%
Lane width	12.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd 617 veh/h
Opposing direction volume, Vo 476 veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.2	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.994	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	673	pc/h	521	pc/h

Free-Flow Speed from Field Measurement:

Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h

Estimated Free-Flow Speed:

Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	1.3	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	37.5	mi/h
Adjustment for no-passing zones, fnp	0.6	mi/h
Average travel speed, ATSd	27.6	mi/h
Percent Free Flow Speed, PFFS	73.7	%

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	671	pc/h	517	pc/h
Base percent time-spent-following, (note-4) BPTSFd	60.6	%		
Adjustment for no-passing zones, fnp	12.9			
Percent time-spent-following, PTSFd	67.9	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.40	
Peak 15-min vehicle-miles of travel, VMT15	50	veh-mi
Peak-hour vehicle-miles of travel, VMT60	185	veh-mi
Peak 15-min total travel time, TT15	1.8	veh-h
Capacity from ATS, CdATS	1690	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1690	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	27.6	mi/h
Percent time-spent-following, PTSFd (from above)	67.9	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following		

including passing lane, PTSFpl - %

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	670.7
Effective width of outside lane, We	22.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	3.37
Bicycle LOS	C

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific dewngrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	AM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (SB)
Jurisdiction	
Analysis Year	Projected
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.92	
Shoulder width	5.0	ft	% Trucks and buses	3	%
Lane width	12.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd	476	veh/h
Opposing direction volume, Vo	617	veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.2		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.994		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	521	pc/h	673	pc/h

Free-Flow Speed from Field Measurement:		
Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h
Estimated Free-Flow Speed:		
Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	1.3	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	37.5	mi/h
Adjustment for no-passing zones, fnp	0.4	mi/h
Average travel speed, ATSd	27.8	mi/h

Percent Free Flow Speed, PFFS	74.3	%

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	517	pc/h	671	pc/h
Base percent time-spent-following, (note-4) BPTSFd	54.3	%		
Adjustment for no-passing zones, fnp	12.9			
Percent time-spent-following, PTSFd	59.9	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.31	
Peak 15-min vehicle-miles of travel, VMT15	39	veh-mi
Peak-hour vehicle-miles of travel, VMT60	143	veh-mi
Peak 15-min total travel time, TT15	1.4	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	27.8	mi/h
Percent time-spent-following, PTSFd (from above)	59.9	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	517.4
Effective width of outside lane, We	22.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	3.24
Bicycle LOS	C

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	PM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (NB)
Jurisdiction	
Analysis Year	Projected
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.97	
Shoulder width	5.0	ft	% Trucks and buses	3	%
Lane width	12.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd	706	veh/h
Opposing direction volume, Vo	625	veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	730	pc/h	646	pc/h

Free-Flow Speed from Field Measurement:		
Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h
Estimated Free-Flow Speed:		
Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	1.3	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, PFSd	37.5	mi/h
Adjustment for no-passing zones, fnp	0.4	mi/h
Average travel speed, ATSd	26.4	mi/h

Percent Free Flow Speed, PFFS	70.5	%

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	728	pc/h	644	pc/h
Base percent time-spent-following, (note-4) BPTSFd	65.2	%		
Adjustment for no-passing zones, fnp	12.6			
Percent time-spent-following, PTSFd	71.9	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.43	
Peak 15-min vehicle-miles of travel, VMT15	55	veh-mi
Peak-hour vehicle-miles of travel, VMT60	212	veh-mi
Peak 15-min total travel time, TT15	2.1	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	26.4	mi/h
Percent time-spent-following, PTSFd (from above)	71.9	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following		

including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	727.8
Effective width of outside lane, We	22.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	3.41
Bicycle LOS	C

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific downgrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

Phone: Fax:
E-Mail:

Directional Two-Lane Highway Segment Analysis

Analyst	CL
Agency/Co.	
Date Performed	12/5/2012
Analysis Time Period	PM Peak
Highway	South Kihei Road
From/To	North of Kulanihakoi (SB)
Jurisdiction	
Analysis Year	Projected
Description	

Input Data

Highway class	Class 3		Peak hour factor, PHF	0.97	
Shoulder width	5.0	ft	% Trucks and buses	3	%
Lane width	12.0	ft	% Trucks crawling	0.0	%
Segment length	0.3	mi	Truck crawl speed	0.0	mi/hr
Terrain type	Level		% Recreational vehicles	0	%
Grade: Length	-	mi	% No-passing zones	0	%
Up/down	-	%	Access point density	25	/mi

Analysis direction volume, Vd	625	veh/h
Opposing direction volume, Vo	706	veh/h

Average Travel Speed

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.1		1.1	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adj. factor, (note-5) fHV	0.997		0.997	
Grade adj. factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	646	pc/h	730	pc/h

Free-Flow Speed from Field Measurement:		
Field measured speed, (note-3) S FM	-	mi/h
Observed total demand, (note-3) V	-	veh/h
Estimated Free-Flow Speed:		
Base free-flow speed, (note-3) BFFS	45.0	mi/h
Adj. for lane and shoulder width, (note-3) fLS	1.3	mi/h
Adj. for access point density, (note-3) fA	6.3	mi/h
Free-flow speed, FFSd	37.5	mi/h
Adjustment for no-passing zones, fnp	0.3	mi/h
Average travel speed, ATSd	26.4	mi/h

Percent Free Flow Speed, PFFS 70.6 %

Percent Time-Spent-Following

Direction	Analysis (d)		Opposing (o)	
PCE for trucks, ET	1.0		1.0	
PCE for RVs, ER	1.0		1.0	
Heavy-vehicle adjustment factor, fHV	1.000		1.000	
Grade adjustment factor, (note-1) fg	1.00		1.00	
Directional flow rate, (note-2) vi	644	pc/h	728	pc/h
Base percent time-spent-following, (note-4) BPTSFd	62.3	%		
Adjustment for no-passing zones, fnp	12.6			
Percent time-spent-following, PTSFd	68.2	%		

Level of Service and Other Performance Measures

Level of service, LOS	D	
Volume to capacity ratio, v/c	0.38	
Peak 15-min vehicle-miles of travel, VMT15	48	veh-mi
Peak-hour vehicle-miles of travel, VMT60	188	veh-mi
Peak 15-min total travel time, TT15	1.8	veh-h
Capacity from ATS, CdATS	1695	veh/h
Capacity from PTSF, CdPTSF	1700	veh/h
Directional Capacity	1695	veh/h

Passing Lane Analysis

Total length of analysis segment, Lt	0.3	mi
Length of two-lane highway upstream of the passing lane, Lu	-	mi
Length of passing lane including tapers, Lpl	-	mi
Average travel speed, ATSd (from above)	26.4	mi/h
Percent time-spent-following, PTSFd (from above)	68.2	
Level of service, LOSd (from above)	D	

Average Travel Speed with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for average travel speed, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for average travel speed, Ld	-	mi
Adj. factor for the effect of passing lane on average speed, fpl	-	
Average travel speed including passing lane, ATSpl	-	
Percent free flow speed including passing lane, PFFSpl	0.0	%

Percent Time-Spent-Following with Passing Lane

Downstream length of two-lane highway within effective length of passing lane for percent time-spent-following, Lde	-	mi
Length of two-lane highway downstream of effective length of the passing lane for percent time-spent-following, Ld	-	mi
Adj. factor for the effect of passing lane on percent time-spent-following, fpl	-	
Percent time-spent-following including passing lane, PTSFpl	-	%

Level of Service and Other Performance Measures with Passing Lane

Level of service including passing lane, LOSpl	E	
Peak 15-min total travel time, TT15	-	veh-h

Bicycle Level of Service

Posted speed limit, Sp	55
Percent of segment with occupied on-highway parking	0
Pavement rating, P	3
Flow rate in outside lane, vOL	644.3
Effective width of outside lane, We	22.00
Effective speed factor, St	4.79
Bicycle LOS Score, BLOS	3.35
Bicycle LOS	C

Notes:
1. Note that the adjustment factor for level terrain is 1.00, as level terrain is one of the base conditions. For the purpose of grade adjustment, specific dewngrade segments are treated as level terrain.
2. If vi (vd or vo) >= 1,700 pc/h, terminate analysis-the LOS is F.
3. For the analysis direction only and for v>200 veh/h.
4. For the analysis direction only.
5. Use alternative Exhibit 15-14 if some trucks operate at crawl speeds on a specific downgrade.

APPENDIX E

Drainage Report for Kūlanihāko‘i Bridge Replacement

Wilson Okamoto Corporation

March 2013

DRAINAGE REPORT

For

KULANIHAKOI BRIDGE REPLACEMENT

South Kihei Road
Kihei, Maui, Hawaii

Lic. Exp. 04-30-14

This work was prepared by me or under my supervision and construction of this project will be under my observation. (Observation of construction as defined in Chapter 16-115 Subchapter 1 Definitions of the Hawaii Administrative Rules "Professional Engineers, Architects, Surveyors, and Landscape Architects.")

Prepared for:

County of Maui Department of Public Works
200 South High St.
Kalana O Maui Bldg. 4th Flr
Wailuku, Hawaii 96793

Prepared by:

Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, HI 96826

March 2013

WILSON OKAMOTO
CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

Civil Engineering Department
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

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I. INTRODUCTION

A. General

The County of Maui Department of Public Works proposes to replace and upgrade the Kulanihakoi Bridge crossing at South Kihei Road. The existing bridge consists of four 6' x 4' high reinforced concrete box culverts with temporary concrete barriers located on either side of the roadway. The bridge is in deteriorated condition with exposed reinforcement and crumbling concrete and is not capable of handling heavy storm events, causing storm water runoff to overtop South Kihei Road. The purpose of this report is to analyze the impact of the proposed development on the existing drainage conditions of the area, and to recommend any drainage improvements as required.

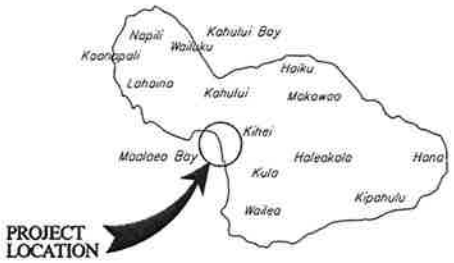
B. Site Location & Project Description

The project site is located on South Kihei Road approximately 200 feet south of Kaonoulu Street intersection in the Kihei area on the island of Maui, Hawaii (see Exhibit 1). The proposed project will involve demolishing the four 6' x 4' high existing reinforced concrete box culverts and replacing them with new six 6' x 4' high reinforced concrete box culverts. Proposed improvements also include road widening, installation of concrete curb and gutter, concrete sidewalk, bike lanes, headwalls and guardrails. Other improvements include a new 24" drainline and relocating the outlet of an existing 30" drainline. A temporary bypass road and detour bridge will be located on the adjacent property (TMK (2) 3-9-01: 162) east of South Kihei Road prior to the construction of the new culverts and road improvements. See Exhibit 2 for site layout of bridge replacement and temporary by-pass road.

II. EXISTING CONDITIONS

A. Topography

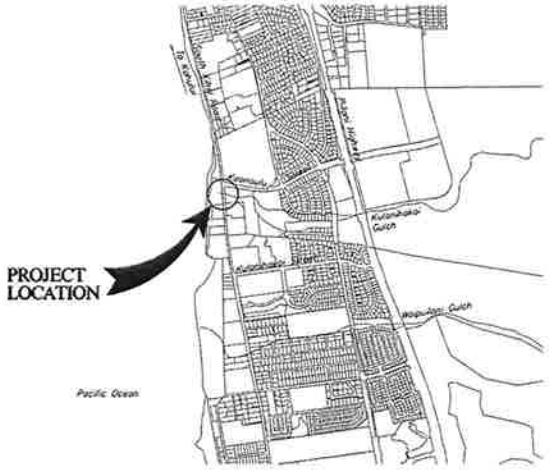
The existing topography of the project site consists of a two-way asphalt concrete. paved roadway. Existing pavement grades around the stream crossing range approximately between 5.2 feet and 5.7 feet mean sea level (msl). The area around the location of the bypass road and detour bridge consists of sparsely to moderately covered grass and some trees. The existing stream channel is approximately 30 feet wide near the location of the detour bridge. The area is also flat with ground elevations ranging from approximately 4.5 feet to 6.5 feet mean sea level (msl).



NORTH
WEST EAST
SOUTH

ISLAND OF MAUI

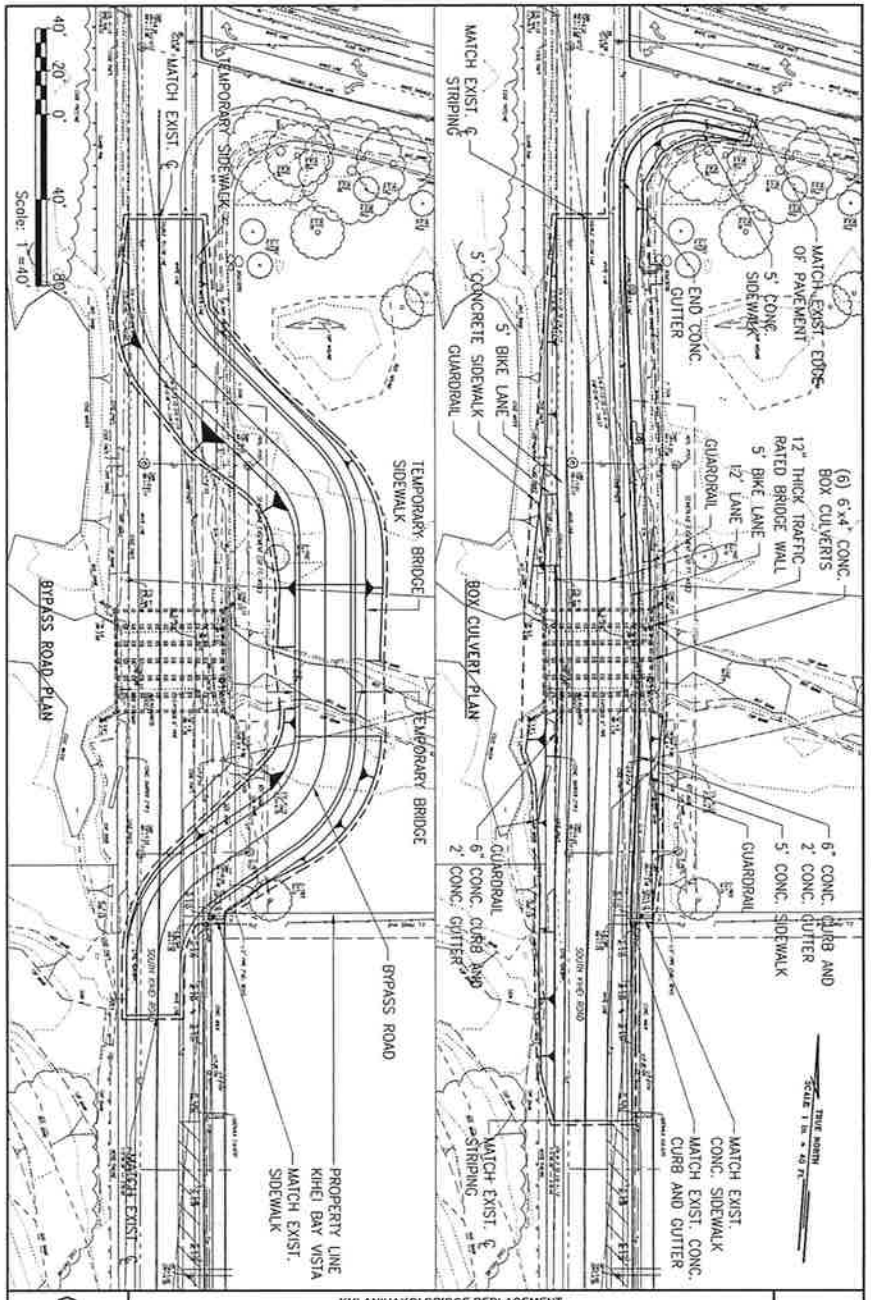
VICINITY MAP
NOT TO SCALE



NORTH
WEST EAST
SOUTH

LOCATION MAP
NOT TO SCALE

ENGINEERS + PLANNERS WILSON OKAMOTO CORPORATION	KULANIHAKOI BRIDGE REPLACEMENT KIHEI, MAUI, HAWAII VICINITY AND LOCATION MAPS	EXHIBIT 1



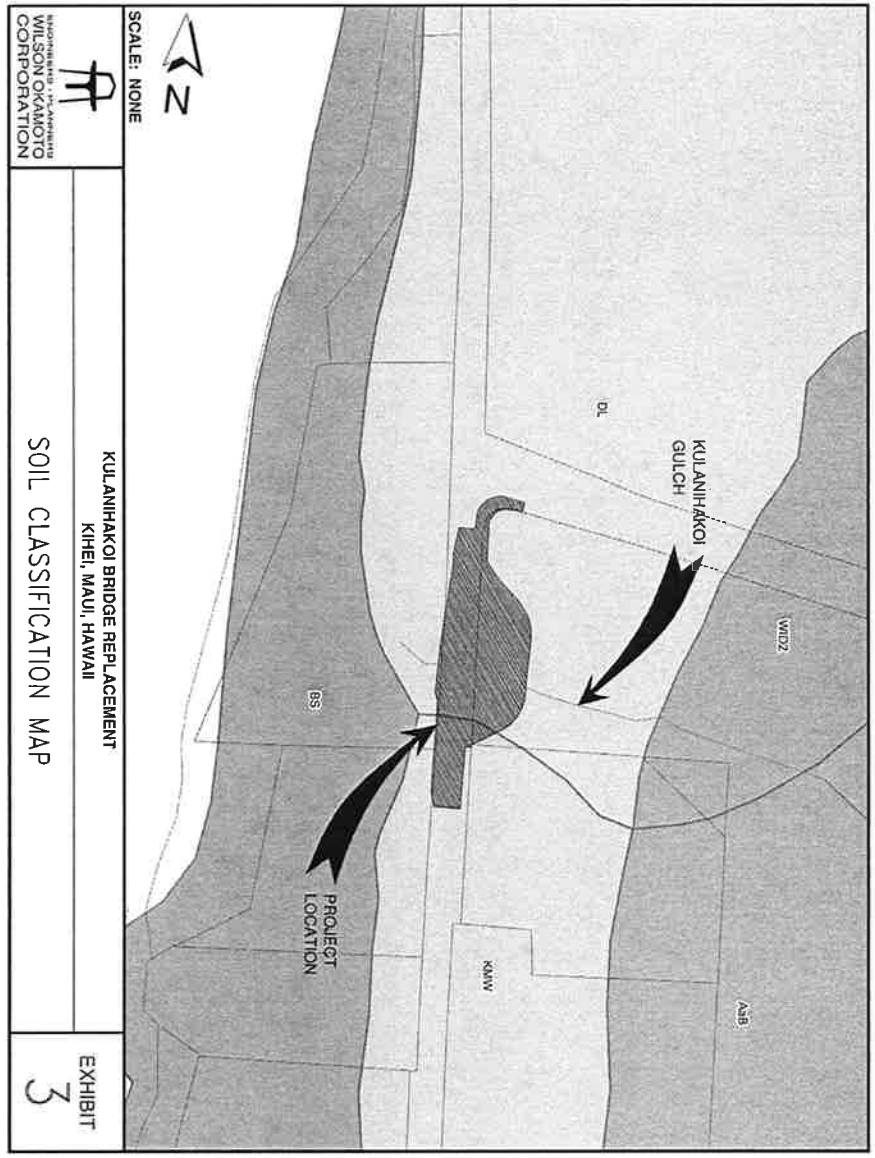
WILSON OKAMOTO CORPORATION	KULANIHAKOI BRIDGE REPLACEMENT KIHEI, MAUI, HAWAII SITE LAYOUT PLAN	EXHIBIT 2

B. Soil Conditions

From Geolabs, Inc. draft report, "Geotechnical Engineering Exploration: Kulanihakoi Bridge Replacement, South Kihei Road, Kihei, Maui, Hawaii," October 26, 2012, the soil around the box culverts consists of very hard clayey silts and dense silty gravel over basaltic boulders extending to a depth of approximately 5 to 6 feet below the existing pavement surface. Medium dense sands were encountered approximately 28 feet below the existing surface, which is underlain by moderately weathered, medium hard to hard basalt rock formation extending to a depth of approximately 40 feet below the existing pavement surface. The area east of South Kihei Road consists of medium dense sands and stiff sandy silts approximately 10 to 12 feet below ground surface. Approximately 25 feet below the existing ground surface, medium dense to dense silty sands were encountered, which is underlain by moderately weathered, hard basalt rock formation extending to the maximum depth explored of approximately 50 feet below the existing ground surface. Groundwater was encountered about 4.1 to 4.8 feet below ground surface (0.7 to 1.9 feet mean sea level).

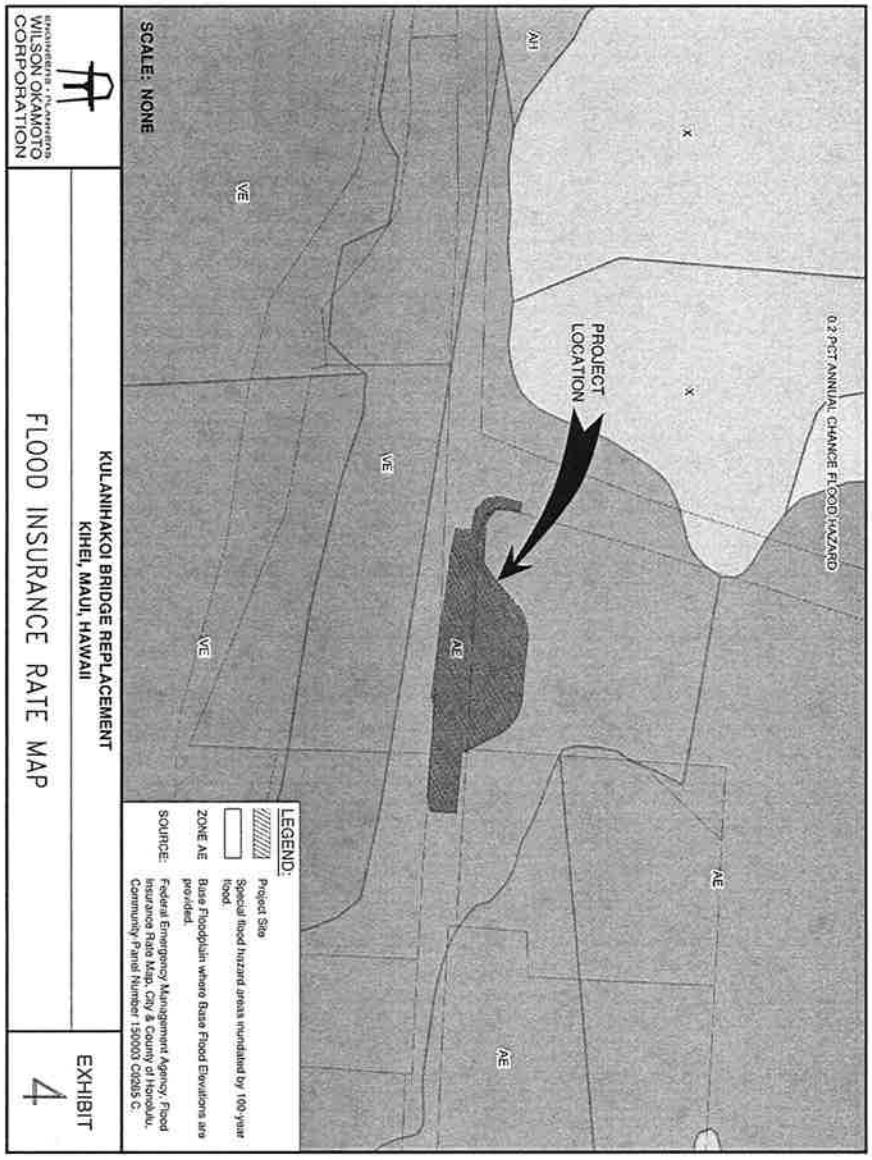
From the U.S. Department of Agriculture Soil Conservation Service's "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," August 1972, majority of the soil within and around the project site are classified as Dune Land soil (DL). Dune Land soil consists of hills and ridges of sand size particles drifted and piled by winds. Hills and ridges are actively shifting or are so recently fixed or stabilized that no soil horizons have developed. The sand is dominantly coral and seashells with elevations ranging from sea level to 150 feet and an annual rainfall of 15 to 90 inches. The soil west of South Kihei Road is classified as Beach soil (BS) which consists of sandy, gravelly, or cobbly areas. Soils are washed and rewashed by ocean waves and are mainly light-colored sands derived from coral and seashells. The soil south of the bridge is classified as Kealia Silt Loam (KMW) which consists of poorly drained soil and has a high content of salt. Ponding occurs in low areas after heavy rain and when the soil dries, salt crystals form on the surface. Slope of the soil varies between 0 to 1 percent. Permeability is moderately rapid. Hazard of water erosion is slight, but can be severe when dry and windy.

See Exhibit 3 for Soil Classification Map.



C. Flood Hazard

According to Panel Number 15003 C0265 C of the revised (September 6, 1989) U.S. Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map, the entire project site is situated in Flood Zone *AE*. *AE* zones represent the base floodplain where base flood elevations are provided (See Exhibit 4).



D. Existing Drainage Conditions

According to the County of Maui's Draft Report, "Kihei Drainage Master Plan Waiakoa Gulch to Kilohana Drive Existing Conditions," dated April 2009, there are eight different flood districts in the Kihei Region. The Kulanihakoi Bridge at South Kihei Road is located in the Kulanihakoi district, which is the largest district in the region that ranges near the summit of Haleakala down to the ocean. Runoffs from a 100-yr storm event are contributed by six drainage areas; Piilani Basins 5, 6, 7, 8 and Makai Basins Kula2_1 and Kula2_2 (see Exhibit 5). The Kihei Drainage Master Plan follows Maui County Drainage Standards which states that for drainage areas greater than 100 acres and for all streams, the Natural Resources Conservative Service (NRCS) method is required with recurrence interval equal to 100 year based on the 24-hour storm. The Hydrologic Engineering Center-Hydrologic Modeling System (HEC-MIS) was used to determine the flow rates and runoff volumes which incorporate the NRCS method. Some of the areas in the Kulanihakoi District are not greater than 100 acres, but for consistency, the HEC-MIS model and NRCS method was used for all drainage areas. Culvert analyses were used to determine the existing culvert capacities with the use of CulvertMaster program and nomographs.

Piilani Basins 5 and 6

Basin 5 is located east of Piilani Highway that consists of 13 acres of residential properties that generate 59 cfs of storm runoff that discharges through a roadside ditch and underground pipes into basin 6. Basin 6 is also east of Piilani Highway and produces approximately 208 cfs of runoff from 62 acres of residential and agricultural lands. The combined flows from both basins cross Piilani Highway through a 54" culvert that connects to Kaonoulu Estates Phase I drainage system and eventually is routed to Kulanihakoi Gulch at the makai side of Kaonoulu Estates Phase III.

Piilani Basin 7

Basin 7 is located east of Piilani Highway that produces 1,038 cfs from 526 acres of agricultural land. The runoff flows through two 102" culverts under the highway into a shallow earth channel and enters a 16'x6'-6" box culvert. The outlet from the culvert flows to a crossing at Kulanihakoi Gulch where it combines with runoffs from basin 8 and Kula2_1.

Piilani Basin 8

Basin 8 is located east of Piilani Highway and is mostly agricultural land. This is the largest drainage area of 9,576 acres which creates 13,373 cfs of runoff. The

flow crosses under Piilani Highway through Kulanihakoi Gulch. It continues down through a natural earth channel and enters a trapezoidal channel with boulder-lined side slopes and geotextile bottom. Basin 8 flow combines with basin 7 and Kula2_1 near Kaonoulu Estates Phase IV area at the Kulanihakoi Gulch.

Kula2_1

This drainage basin consists mostly of agricultural land in its 18 acres and produces 61 cfs of runoff that combines with basins 7 and 8 at the Kulanihakoi Gulch near Kaonoulu Estates Phase IV with a total flow of 14,022 cfs.

Kula2_2

This drainage basin is approximately 129 acres of mostly residential and some agricultural areas and contributes 356 cfs of runoff into Kaonoulu Estates Subdivision Phase III drainage system and discharges into Kulanihakoi Gulch. The combined flows from all the areas at this point are approximately 14,016 cfs.

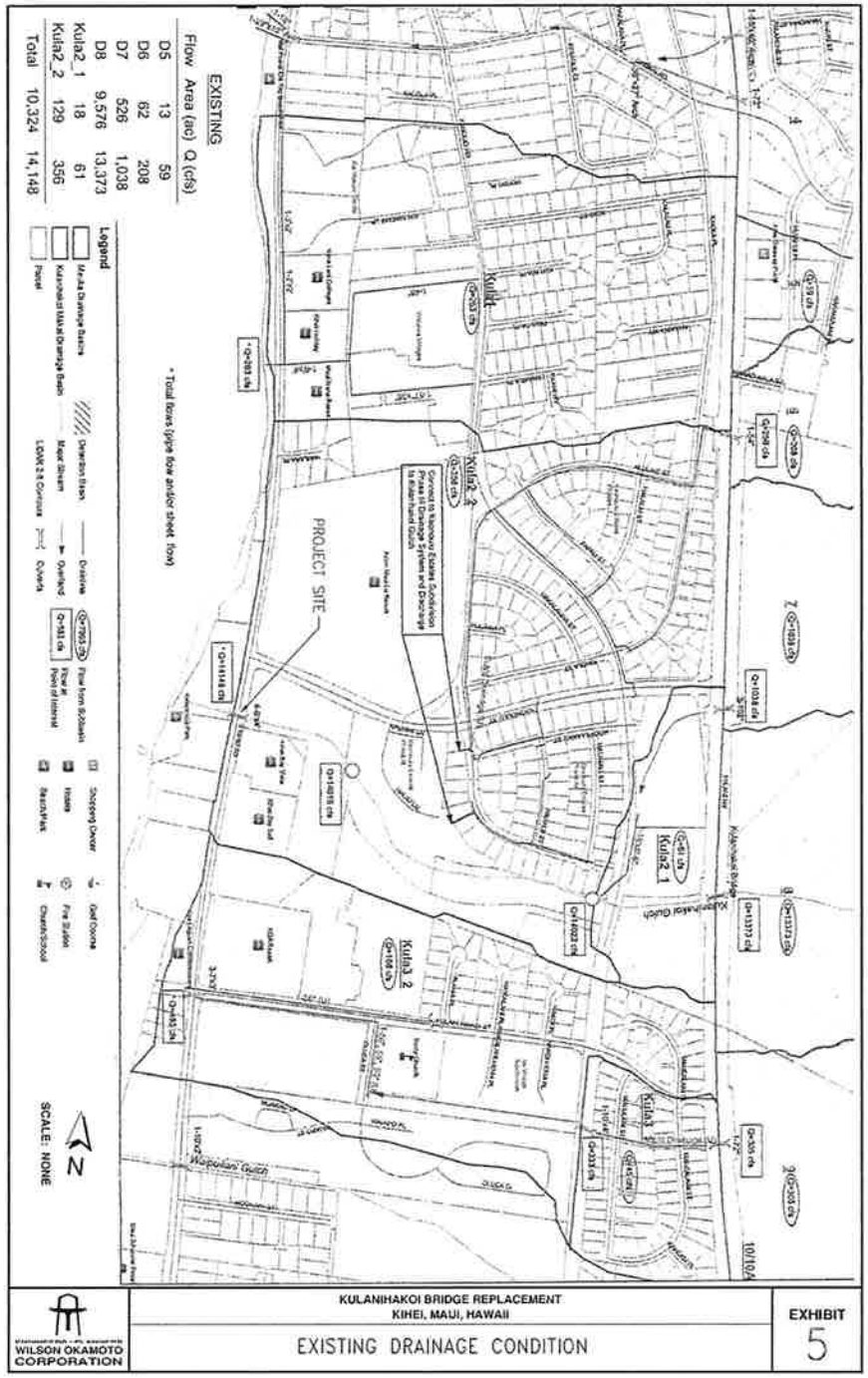
The runoff continues flowing through the gulch which flattens out as it approaches South Kihei Road. It then flows to the existing four 6' x 4' concrete box culverts underneath South Kihei Road with a total approximate flow of 14,148 cfs for a 100-yr storm event. Sand dunes accumulate at the downstream end of Kulanihakoi Gulch, west of South Kihei Road, which causes flooding problems and backwater effects during heavy storm events. Water surface elevations at the existing culverts along South Kihei Road were analyzed using the Hydrologic Engineering Centers River Analysis System (HEC-RAS) under existing conditions (see Appendix B). HEC-RAS models the water flow through the natural open channels and computes water surface profiles. It also analyzes bridge and culvert designs which will help compute the different proposed culverts and bridges in this report. Roadway overtopping calculations were also conducted to determine how much runoff will flow over South Kihei Road during large storm events (see Appendix A).

1. 100-year Storm Event

Calculations show that the downstream elevations of the culvert were slightly higher than the upstream elevations, which may be caused by the accumulating sand dunes which prevent runoff from flowing out to the ocean and causing backwater effects that flood neighboring properties. Results also show that the existing culverts are not capable of handling large amounts of runoff which leads to runoff overtopping the roadway.

2. Existing Flood Occurrence

We also determined the water surface elevations at the existing culvert from past flood events in the area from the Western Regional Climate Center website. Data from their site provides information on the amount of precipitation recorded daily from 1949 to 2012. Using the highest precipitation value recorded, we determined the actual flow that occurred around our project site using the NRCS Peak Flow Method (see Appendix A), and used HEC-RAS to analyze the water surface elevations at the existing culverts (see Appendix B). The calculations show that the past rainfall event produced much less flow to that of the 100-year storm event, however, this estimated peak flow was merely a conservative estimate since determining an actual values take extensive research and data of the existing drainage areas of the Kulanihakoi District that is beyond our scope of work. Although the existing flood event produced less flow from the upstream drainage areas, the existing culverts are still not able to handle that amount of flow, which results in flooding over South Kihei Road. This flooding is also caused by the blocked off outlet preventing the storm runoff from flowing out into the ocean.



III. TEMPORARY DRAINAGE CONDITIONS

A. General

Before construction of the proposed roadway and culvert, a temporary bypass road and bridge will need to be constructed. The temporary bypass route will be constructed and remain for approximately one year. It will be located east of South Kihei Road on the adjacent property (TMK (2) 3-9-01: 162). The runoff from the temporary road and bridge is intended to flow into the existing stream.

B. Temporary Drainage Conditions

The finished grade of the temporary bridge is approximately three feet above the top bank of the existing stream. The capacity of flow between the bridge and existing stream was calculated so we could determine the largest storm event the bridge is capable of handling (see Appendix A). HEC-RAS was used to determine how the existing stream conditions during a 100-year storm event will affect the temporary bypass bridge (see Appendix B).

1. Temporary Bridge

Results show that the clearance between the bridge and stream allows approximately 705 cfs of flow. Using this runoff value, we determined that the largest storm event the temporary bridge can handle is a 1-year, 24-hour storm event. The location and elevation of the temporary bridge is constrained due to the physical location of the project area, making it difficult to raise the bridge over the stream and providing more flow to pass beneath.

2. 100-year Storm Event

For a 100-year storm event, HEC-RAS shows that the bridge will likely be flooded due to large amounts of runoff flowing from upstream. To compensate for this occurrence, the temporary bridge will need to be raised, but due to physical constraints of the project site, raising the bridge will increase the bypass road slope and may become too steep for vehicles to travel on.

IV. PROPOSED DRAINAGE CONDITION

A. General

Upon completion of this project, the runoff from Kulanihakoi Gulch will flow through six 6' x 4' reinforced box culverts. The runoff from the re-graded road is intended to flow into the existing 30" drain line, or into the proposed 24" drainline, and eventually into the stream.

B. Proposed Drainage Conditions

A total flow of 14,148 cfs during a 100-year storm event from the existing drainage areas upstream will flow to the proposed six 6' x 4' reinforced concrete box culverts. The size of the box culverts and water surface elevations were analyzed through HEC-RAS (see Appendix B) to determine if they can handle the large amounts of runoff flowing through the existing drainage areas during heavy storm events as well as how much runoff will overtop South Kihei Road (see Appendix A).

1. Proposed Six 6' x 4' Reinforced Concrete Box Culverts during 100-year Storm Event

The proposed six box culverts were analyzed assuming the downstream end of the stream was blocked off from the existing accumulated sand dunes. The results from HEC-RAS show that the six 6' x 4' box culverts have more capacity and can handle more flow than the existing four culverts. Additional calculations also show that the depth of flow over South Kihei Road is slightly reduced compared to the existing box culverts. Although there is an increase in drainage capacity and depth of flow over the roadway is slightly decreased, the proposed bridge replacement ultimately does not resolve the existing flooding that occurs near and around the project site during heavy storm events. This is due to the accumulating sand dunes blocking off the downstream path causing runoff to back up and flood the roadway.

The six box culverts were also analyzed assuming that the outlet is not blocked. The results from the model and calculations show that the depth overtopping the roadway is reduced significantly by about three feet.

2. Proposed Eight 6' x 4' Reinforced Concrete Box Culverts during 100-year Storm Event

The proposed eight box culverts were analyzed assuming the downstream end of the stream is not blocked off. Results from the calculations show that adding more box culverts can handle more flow, but does not significantly reduce the amount of runoff overtopping South Kihei Road. This is mostly due to the sand dunes blocking the natural flow path at the outlet of the stream causing the runoff to back up and flood the roadway. Adding more culverts will not reduce the existing flooding in the area.

3. Proposed Bridge over South Kihei Road during 100-year Storm Event

An option to relieve some of the flooding over South Kihei Road is to provide a bridge of the existing culvert/stream. The bridge will sit approximately 3 feet above the existing road to help reduce and/or eliminate the amount of runoff overtopping the roadway during heavy storm events. We modeled this proposed option in HEC-RAS (see Appendix B), assuming the outlet is not blocked off and determined that the storm runoff from the 100-year storm event will still overtop the bridge, but not as severe as the proposed six box culverts. To compensate for this occurrence, the bridge would be raised higher. However, due to the physical constraints of the project site, which includes the Kaonoulu Street intersection north of the stream and the Kihei Bay Vista property south of the stream, constructing a bridge will require extensive improvements which may require reconstruction of Kaonoulu intersection and the existing drainage system along South Kihei Road to prevent flooding of the Kihei Bay Vista complex from the proposed bridge.

V. SUMMARY & CONCLUSION

After extensive calculations and research, the proposed six 6' x 4' reinforced box culverts will replace the existing deteriorated four 6' x 4' reinforced box culverts. However, the proposed culverts are not intended to alleviate the existing flooding conditions over South Kihei Road. Adding more than six culverts is not very cost effective because they do not significantly decrease the flooding over the roadway. Also, the option to place a bridge over the existing stream may be ideal, but it will require more site and roadway improvements and will eventually cost more.

From past rainfall data and the Kihei Master Drainage Plan, South Kihei Road and the adjacent properties are prone to flooding during large storm events. This is partially due to the enormous drainage areas upstream that contribute large amounts of runoff to Kulanihakoi Gulch. It is also due to the accumulating sand dunes at the end of the gulch that obstruct the natural flow path at the outlet of the stream and causes runoff to back up and flood onto South Kihei Road and the neighboring properties. Overall, a more in-depth approach to handling the significant amount of runoff during large rainfall events is needed in order to reduce flooding over South Kihei Road, which is beyond the scope of work for this project.

REFERENCES

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3. "Flood Insurance Rate Map, City and County of Honolulu, Hawaii, Community-Panel Number 150003 C0265 C," Federal Emergency Management Agency, Federal Insurance Administration, September 6, 1989.

4. "Kihei 311, Hawaii: Period of Record Daily Climate Summary." Western Regional Climate Center, http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?hi4489.

5. "Rules for the Design of Storm Drainage Facilities in the County of Maui." Department of Public Works and Waste Management, County of Maui, July 1995.

6. "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," U.S. Department of Agriculture, Soil Conservation Service, August 1972.

Kulanihakoi Bridge Replacement *Drainage Report*

APPENDIX A

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Appendix A – Roadway Overtopping Sample Calculations

The purpose of this calculation is to determine the height of runoff flowing over South Kihei Road and at what velocity. The following calculation solves for the height and velocity of runoff for the proposed six 6' x 4' reinforce concrete box culvert. The attached tabulated results show heights and velocities for the existing four box culverts, the proposed six culverts, and a proposed eight culverts.

100-yr storm event: Q_{tot} = 14,148 cfs where Q_{tot} is the total flow in cubic feet per second

Assuming inlet and outlet of 6'x4' culvert is submerged (outlet control), the following equation was used:

$$Q_p = C_d A_p \sqrt{2g\left(\frac{h_1 - h_4}{1 + \frac{29C_d^2 n^2 L}{R^{4/3}}}\right)}$$

Q_p =	flow in culvert [cfs]	
C_d =	coefficient of discharge =	0.62 (for squared-edge opening)
A_p =	area of culvert [ft^2] =	24
g =	acceleration due to gravity [ft/s^2] =	32.2
n =	Manning's roughness coefficient =	0.012 (for concrete)
L_p =	length of culvert [ft] =	49
h_1* =	height of water at inlet [ft] =	9.0
h_4* =	height of water at outlet [ft] =	8.8
P =	wetted perimeter [ft] =	(6) + 2(4) = 14
R =	hydraulic radius [ft] =	A_p / P = 24/14 = 1.714

*Values were determined through HEC-RAS. If the height of water at the outlet (h_4) of the culvert is higher than the height of water at the inlet (h_1) of the culvert, than the above equation does not apply. This is caused by the blocked off outlet of the stream which allows runoff to back up and flood the roadway.

$$Q_p = (0.62)(24)\sqrt{2(32.2)\left(\frac{(9.0)-(8.8)}{1 + \frac{29(0.62)^2(0.012)^2(49)}{(1.714)^{4/3}}}\right)} = 51$$

We are proposing to install six 6'x4' culverts in place of the existing four 6'x4' culverts, total flow through the entire culvert:

$$N^*Q_p = (6)^*(51) = \mathbf{306\ cfs}$$

Appendix A
Roadway Overtopping Tabulated Results
Kulanihakoi Bridge Replacement
#8256-01
11/9/2012

100-yr storm event
Q_{tot} = 14,148 cfs

Culvert Size
base = 6 ft
height = 4 ft

	CULVERT											ROADWAY				
	N	C_d	A_p ft^2	g ft/s^2	n	L_p ft	h_1 ft	h_4 ft	P ft	R ft	Q_p cfs	N^*Q_p cfs	Q_r cfs	C	L_r ft	H ft	A_r ft^2	V_r ft/s
(4) 6' x 4'	4	0.62	24	32.2	0.012	37	12.75	12.99	14	1.714	N/A	N/A	N/A	2.63	300	N/A	N/A	N/A
(6) 6' x 4'	6	0.62	24	32.2	0.012	49	12.73	12.99	14	1.714	N/A	N/A	N/A	2.63	300	N/A	N/A	N/A
(6) 6' x 4' *	6	0.62	24	32.2	0.012	49	9.00	8.81	14	1.714	51	306	N/A	2.63	300	N/A	N/A	N/A
(8) 6' x 4' *	8	0.62	24	32.2	0.012	49	9.00	8.81	14	1.714	51	409	13,739	2.63	300	6.72	2015	6.82
(4) 6' x 4'													N/A	2.63	300	N/A	N/A	N/A
(6) 6' x 4'													N/A	2.63	300	N/A	N/A	N/A
(6) 6' x 4' *													13,842	2.63	300	6.75	2025	6.83
(8) 6' x 4' *													13,739	2.63	300	6.72	2015	6.82

*Note: Assumed outlet is not blocked. See HEC-RAS profile.

The remaining total flow that does not flow through the culvert is assumed to flow over the road. The total flow over the road was determined as follows:

$$Q_r = Q_{tot} - Q_p \text{ where } Q_r \text{ is the total flow over the roadway}$$

$$Q_r = (14{,}148) - (306) = \mathbf{13{,}842\ cfs}$$

To determine how high the water will flow above the roadway, the following equation was used:

$$Q_r = CLH^{3/2}$$

Q_r =	flow over the road [cfs] =	13,842
C =	coefficient =	2.63
L_r =	length of road span [ft] =	300
H =	height of water from roadway to top of water surface [ft]	

$$(13{,}842) = (2.63)*(300)*H^{3/2}$$

$$\mathbf{H = 6.75\ ft**}$$

**If h_4 is greater than h_1, than the equation above does not apply. If this occurs, the amount of runoff overtopping the roadway can be determined from the HEC-RAS result.

The velocity of the water over the roadway was determined as follows:

$$V_r = Q_r / A_r$$

V_r =	velocity over the road [ft/s]	
Q_r =	flow over the road [cfs] =	13,842
A_r =	Area of road span [ft^2] =	$L_r*H = (300)*(6.75) = 2025$

$$V_r = (13{,}842) / (2025)$$

$$\mathbf{V_r = 6.84\ ft/s}$$

The flow velocity over the roadway is approximately 7 ft/s. The finished roadway should be paved with a material that is capable of handling this flow velocity. The County of Maui's "Rules for the Design of Storm Drainage Facilities" shows different lining material and the maximum flow velocity for each lining. Concrete is an ideal pavement choice with no limits on a maximum velocity. Concrete would be a great material for long term use and increases strength protection over the culverts, however can be very costly. City and County of Honolulu's "Rules Relating to Storm Drainage Standards" also shows concrete to have no limitation for maximum velocity, but also show that A.C.

pavement is capable of 20 ft/s of flow over it. This is more than enough to handle the flow velocity we determined and is cheaper than concrete.

Appendix A – Peak Flow from Actual Storm Event Sample Calculations

The purpose of this calculation is to determine the total peak flow that occurred from past flood events around our project site. We used the SCS (NRCS) Peak Flow Method to find the peak flow since the total drainage area is approximately 10,324 acres which is greater than 100 acres. For the State of Hawaii, it is assumed that the SCS rainfall distribution is a 24-hour, Type I Rainfall Distribution. Tabulated results are attached.

From the Western Regional Climate Center website, we determined the largest daily rainfall amount that occurred around the project area between 1949 and 2012. The largest rainfall amount that occurred was six inches (January 10, 1980).

First, we need to determine the composite Curve Number from all the existing drainage areas (see tabulated results). The equation we use is:

$$CN = \frac{\sum CN_X A_X}{A_X}$$

CN =	curve number
CN_X =	curve number for each drainage basin
A_X =	area of each drainage basin [ac]

From the tabulated results, we calculated a composite curve number of 74.

Next, we calculate the retention value, S_R [in] which we use the equation:

$$S_R = 1.0\left(\frac{1000}{CN} - 10\right) = 1.0\left(\frac{1000}{(74)} - 10\right) = 3.5in$$

The following equation was used to calculate the depth of direct runoff:

$$Q_D = \frac{(P - 0.2S_R)^2}{P + 0.8S_R}$$

Q_D =	depth of direct runoff [in]	
P =	depth of 24-hr precipitation [in]	6
S_R =	retention [in]	3.5

Inserting the values from the table into the equation results in a depth of Q_D = 3.2 in.

Next, we solve for the initial abstraction, I_a using:

$$I_a = 0.2S_R = 0.2(3.5) = 0.70 \text{ in.}$$

From there, we can solve for I_a/P:

$$I_a/P = (0.70) / (6) = 0.12$$

We now solve for the unit peak flow by using the equation below:

$$q_u = (K_u)\left(10^{C_0 + C_1 \log t_c + C_2 (\log t_c)^2}\right)$$

q_u =	unit peak flow [$ft^3/s/mi^2/in$]	
K_u =	coefficient =	1.0 (English Units)
C_0 =	coefficient =	2.294512
C_1 =	coefficient =	-0.512657
C_2 =	coefficient =	-0.11308
t_c =	time of concentration [hr] =	4.87*

*Note: The time of concentration value should be between 0.1 and 10. Since determining this value requires a more in depth calculation of all the existing drainage areas and is beyond our scope of work, we conservatively estimated this value.

The C_0, C_1, and C_2 coefficients were determined from the Coefficients of SCS Peak Discharge Method table based on the type of rainfall distribution and I_a/P value. Inputting the values from the table above resulted in a unit peak flow of approximately 77 $ft^3/s/mi^2/in$.

Finally, we can calculate the peak or total flow using the equation below:

$$q_P = (q_u)\ (A_k)\ (Q_D)$$

q_p =	peak flow [ft^3/s]	
q_u =	unit peak flow [$ft^3/s/mi^2/in$] =	77
A_k =	basin area [mi^2] =	16.13
Q_D =	depth of direct runoff [in] =	3.2

The total peak flow we calculated is approximately:

$$q_P = (77)\ (16.13)\ (3.2)$$

q_P = 4,004 cfs

The total peak flow from an actual storm flood event around our project area is approximately 4,004 cfs, which is significantly less than the 100-yr storm event of 14,148 cfs. We can use the total peak flow value we calculated and use HEC-RAS to determine the water surface elevations at the existing culverts at Kulanihakoi Bridge under South Kihei Road (see Appendix B).

Appendix A
Existing Flood Occurrence Tabulated Results
SCS (NRCS) Peak Flow Method
Kulanihakoi Bridge Replacement
#8256-01
1/14/2013

Largest Rainfall Event
P= 6 in
A_{tot}= 16.13 mi^2
Type I Rainfall
t_c= 4.87 hr

Drainage Basin	Area (ac)	Area (mi^2)	Curve Number (CN)
Piilani Basin 5	13	0.02	83
Piilani Basin 6	62	0.10	78
Piilani Basin 7	526	0.82	74
Piilani Basin 8	9576	14.96	74
Kula 2_1	18	0.03	76
Kula 2_2	129	0.20	90
Total	10324	16.13	74

S_R = 3.5 in
Q_D = 3.2 in
I_a = 0.69 in
I_a/P = 0.12

C_0 = 2.294512
C_1 = -0.512657
C_2 = -0.11308

q_u = 77 $cfs/mi^2/in$
q_P = 4,004 cfs

Appendix A
Temporary Bypass Road and Bridge Tabulated Results
SCS (NRCS) Peak Flow Method
Kulanihakoi Bridge Replacement
#8256-01
1/14/2013

q_p= 705 cfs
S_R = 3.5 in
A_{tot}= 16.13 mi^2
Type I Rainfall
t_c= 4.87 hr

Drainage Basin	Area (ac)	Area (mi^2)	Curve Number (CN)
Piilani Basin 5	13	0.02	83
Piilani Basin 6	62	0.10	78
Piilani Basin 7	526	0.82	74
Piilani Basin 8	9576	14.96	74
Kula 2_1	18	0.03	76
Kula 2_2	129	0.20	90
Total	10324	16.13	74

P= 2.581 in
I_a= 0.69 in
I_a/P = 0.27
C_0 = 2.18219
C_1 = (0.48488)
C_2 = (0.06589)

q_u= 66 $cfs/mi^2/in$
A_k= 16.1 mi^2
Q_D= 0.66 in
q_p= 705 cfs

Appendix A – Temporary Bypass Road and Bridge Calculations

The purpose of this calculation is to determine how much flow can travel through in the area under the temporary bridge as well as the largest storm event the temporary bridge can handle. Tabulated results are attached.

To determine flow under the temporary bridge, we used Manning's equation:

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

Q =	flow under temp. bridge [cfs]	
n =	Manning's roughness coefficient =	0.043
A =	area under temp. bridge [ft^2] =	100.6
P =	wetted perimeter [ft] =	58.9
R =	hydraulic radius [ft] =	A / P = 100.6/58.9 = 1.71
S =	slope of stream [ft/ft] =	.02

$$Q = \frac{1.49}{(0.043)}(100.6)(1.71)^{2/3}(.02)^{1/2} = 705$$

To determine the rainfall intensity, I, from the flow above, the SCS (NRCS) Peak Flow Method was used. By rearranging the steps of this method, we are able to calculate the depth of 24-hr precipitation, P [in] and assume the intensity is the same as the depth, I [in/hr]. The following values were given:

q_p =	total peak flow [cfs] =	705
CN =	composite curve number =	74
S_R =	retention [in] =	1.0(1000/CN-10) = 3.5
A_k =	area [mi^2] =	16.13
t_c =	time of concentration [hr] =	4.87*
I_a =	initial abstraction [in] =	$0.2S_R$ = 0.70
K_u =	coefficient =	1.0 (English Units)

*Note: The time of concentration value should be between 0.1 and 10. Since determining this value requires a more in depth calculation of all the existing drainage areas and is beyond our scope of work, we conservatively estimated this value.

The following equations are needed to solve for the total peak flow:

$$Q_D = \frac{(P - 0.2S_R)^2}{P + 0.8S_R}$$

I_a / P

$$q_u = (K_u)\left(10^{C_0 + C_1 \log t_c + C_2 (\log t_c)^2}\right)$$

$$q_P = (q_u)\,(A_k)\,(Q_D)$$

Q_D =	depth of direct runoff [in]
P =	depth of 24-hr precipitation [in]
q_u =	unit peak flow [$ft^3/s/mi^2/in$]
C_0 =	coefficient
C_1 =	coefficient
C_2 =	coefficient

The C_0, C_1, and C_2 coefficients were determined from the Coefficients of SCS Peak Discharge Method table based on the type of rainfall distribution and I_a/P value. Since these four equations depend on depth P, and we are trying to solve for depth P, an iterative process was conducted with the help of Excel. After several calculations, we determined the depth P is approximately 2.6 inches, therefore we used a rainfall intensity of 2.6 in/hr.

With this rainfall intensity at the temporary bridge, we can determine the largest storm event that can occur. From the U.S. Department of Commerce Weather Bureau, "Rainfall-Frequency Atlas of the Hawaiian Islands," a 1-year, 24-hour storm is the largest storm event that can occur to that will allow flow to pass beneath the temporary bridge.

Existing Drainage Conditions during 100-year Storm Event

HEC-RAS Plan: Plan 30 River: Konoulu Stream Reach: Site 1 Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Site 1	635.35	100-YR	14148.00	2.93	13.19	13.19	17.14	0.006922	23.68	1360.64	164.05	1.32
Site 1	610.35	100-YR	14148.00	2.51	13.04	13.04	16.52	0.005814	20.91	1453.66	193.96	1.19
Site 1	585.35	100-YR	14148.00	2.99	12.73	12.73	16.18	0.006018	21.14	1474.49	205.06	1.22
Site 1	560.35	100-YR	14148.00	2.73	12.81	12.81	15.66	0.005483	20.16	1692.90	257.68	1.15
Site 1	535.37	100-YR	14148.00	2.34	12.13	11.90	14.70	0.005062	18.64	1739.36	266.49	1.10
Site 1	510.35	100-YR	14148.00	2.31	12.33	11.67	14.44	0.004271	17.33	1906.41	284.30	1.01
Site 1	485.35	100-YR	14148.00	2.10	12.37	11.55	14.28	0.003795	16.62	2034.93	302.68	0.95
Site 1	460.35	100-YR	14148.00	1.72	12.24	11.50	14.17	0.003918	16.69	2020.66	305.25	0.96
Site 1	435.35	100-YR	14148.00	0.27	12.87		13.80	0.002116	12.61	2786.90	387.74	0.69
Site 1	410.36	100-YR	14148.00	1.51	12.70		13.74	0.002226	13.52	2755.02	394.45	0.74
Site 1	385.37	100-YR	14148.00	1.63	12.47		13.66	0.002784	14.78	2609.85	401.91	0.81
Site 1	360.35	100-YR	14148.00	1.25	12.42		13.58	0.002912	14.55	2583.96	403.85	0.81
Site 1	323.16	100-YR	14148.00	1.12	12.50		13.43	0.001864	11.97	2942.45	437.61	0.67
Site 1	313.03	100-YR	14148.00	0.68	12.75	9.18	13.30	0.000865	8.94	3718.09	444.99	0.47
Site 1	288.5		Culvert									
Site 1	264.01	100-YR	14148.00	-0.13	12.99		13.16	0.000369	5.14	6184.58	805.82	0.29
Site 1	255.13	100-YR	14148.00	0.18	12.84		13.14	0.000422	5.99	4800.30	568.82	0.33
Site 1	228.53	100-YR	14148.00	1.28	12.88		13.11	0.000283	5.12	5603.36	658.70	0.27
Site 1	201.86	100-YR	14148.00	0.88	12.70		13.08	0.000408	6.04	3996.63	453.84	0.33
Site 1	134.82	100-YR	14148.00	3.22	10.86	9.87	12.87	0.002682	11.64	1439.32	270.40	0.78
Site 1	109.84	100-YR	14148.00	3.46	10.09	10.09	12.72	0.004330	13.22	1214.03	274.58	0.96
Site 1	84.95	100-YR	14148.00	3.72	9.24	9.24	11.43	0.005075	12.82	1483.76	350.89	1.01
Site 1	59.95	100-YR	14148.00	3.99	8.74	8.74	10.94	0.006106	13.06	1435.33	331.40	1.09
Site 1	34.95	100-YR	14148.00	3.93	8.31	8.31	10.47	0.007536	13.22	1417.12	340.68	1.19
Site 1	5.58	100-YR	14148.00	1.04	6.30	6.30	8.65	0.005811	12.88	1286.31	281.29	1.07

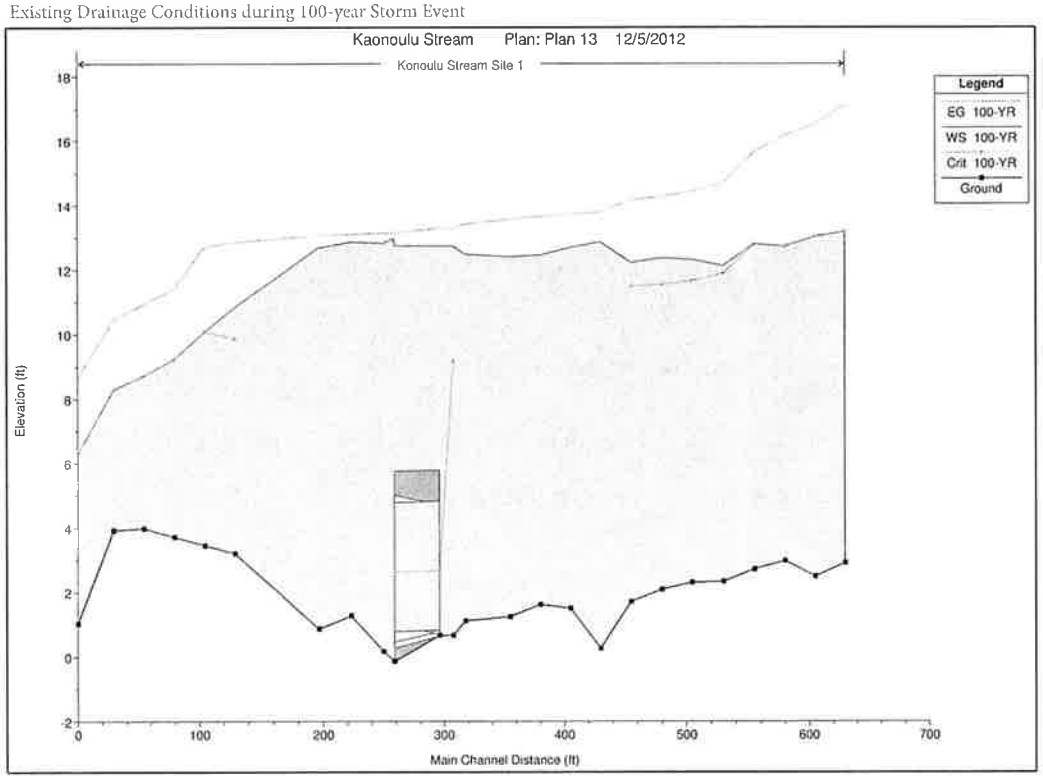
APPENDIX B

Existing Flood Occurrence

HEC-RAS Plan: 88 River: Konoulu Stream Reach: Site 1 Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Site 1	635.35	100-YR	4004.00	2.93	9.53		10.64	0.003302	12.06	759.93	164.05	0.85
Site 1	610.35	100-YR	4004.00	2.51	9.50		10.54	0.002873	10.85	782.44	184.20	0.77
Site 1	585.35	100-YR	4004.00	2.99	9.49		10.45	0.002646	10.56	827.04	195.03	0.75
Site 1	560.35	100-YR	4004.00	2.73	8.81	8.78	10.31	0.004799	13.10	702.05	213.52	0.98
Site 1	535.37	100-YR	4004.00	2.34	9.22		10.02	0.002298	9.85	963.48	266.49	0.69
Site 1	510.35	100-YR	4004.00	2.31	9.22		9.94	0.002140	9.31	1024.26	284.30	0.67
Site 1	485.35	100-YR	4004.00	2.10	9.19		9.88	0.001977	9.13	1073.04	302.68	0.64
Site 1	460.35	100-YR	4004.00	1.72	9.14		9.83	0.001974	9.09	1074.50	305.25	0.64
Site 1	435.35	100-YR	4004.00	0.27	9.31		9.70	0.001313	7.48	1403.68	387.74	0.51
Site 1	410.36	100-YR	4004.00	1.51	9.19		9.66	0.001393	8.14	1369.52	394.45	0.54
Site 1	385.37	100-YR	4004.00	1.63	8.42	8.42	9.55	0.003435	11.80	984.57	391.20	0.83
Site 1	360.35	100-YR	4004.00	1.25	8.34	8.34	9.43	0.003761	11.67	960.48	383.20	0.84
Site 1	323.16	100-YR	4004.00	1.12	7.98	7.98	9.04	0.003194	10.46	968.46	433.21	0.79
Site 1	313.03	100-YR	4004.00	0.68	8.03	6.47	8.34	0.000796	6.01	1617.47	444.99	0.41
Site 1	288.5		Culvert									
Site 1	264.01	100-YR	4004.00	-0.13	8.14		8.27	0.000615	4.16	2276.49	805.82	0.34
Site 1	255.13	100-YR	4004.00	0.18	8.13		8.27	0.000387	3.83	2120.97	568.82	0.28
Site 1	228.53	100-YR	4004.00	1.28	8.16		8.25	0.000205	2.99	2604.41	580.47	0.21
Site 1	201.86	100-YR	4004.00	0.88	8.13		8.24	0.000226	3.09	2037.03	392.62	0.22
Site 1	134.82	100-YR	4004.00	3.22	7.49		8.15	0.002106	6.60	653.44	202.04	0.62
Site 1	109.84	100-YR	4004.00	3.46	6.75	6.75	8.00	0.006209	9.00	452.59	191.46	1.00
Site 1	84.95	100-YR	4004.00	3.72	6.58	6.58	7.59	0.006175	8.45	586.46	301.41	0.98
Site 1	59.95	100-YR	4004.00	3.99	6.26	6.26	7.21	0.007701	8.51	615.17	331.40	1.07
Site 1	34.95	100-YR	4004.00	3.93	5.84	5.84	6.78	0.013410	8.94	576.68	340.68	1.34
Site 1	5.58	100-YR	4004.00	1.04	3.69	3.69	4.69	0.008082	8.50	549.73	281.29	1.09

Existing Drainage Conditions during 100-year Storm Event

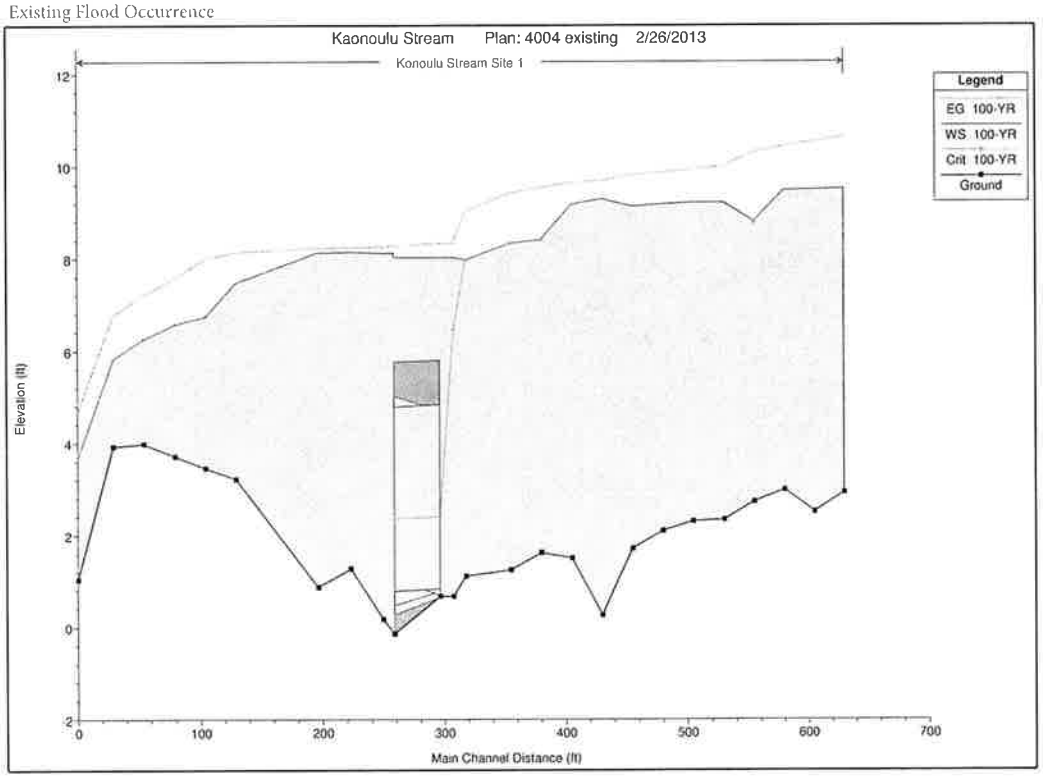


Temporary Drainage Condition during 100-year Storm Event

HEC-RAS Plan: Temp Bridge River: Kaonoulu Stream Reach: Alignment - Cent Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Alignment - Cent	635.35	PF 1	14148.00	2.93	13.19	13.19	17.14	0.006922	23.68	1360.64	164.05	1.32
Alignment - Cent	610.35	PF 1	14148.00	2.51	13.04	13.04	16.52	0.005814	20.91	1453.66	193.96	1.19
Alignment - Cent	585.35	PF 1	14148.00	2.99	12.73	12.73	16.18	0.006018	21.14	1474.49	205.06	1.22
Alignment - Cent	560.35	PF 1	14148.00	2.73	12.81	12.81	15.66	0.005483	20.16	1692.90	257.68	1.15
Alignment - Cent	535.37	PF 1	14148.00	2.34	12.70	11.90	14.83	0.003926	17.11	1890.80	268.49	0.98
Alignment - Cent	510.35	PF 1	14148.00	2.31	12.84		14.63	0.003399	16.04	2054.12	284.30	0.91
Alignment - Cent	485.35	PF 1	14148.00	2.10	12.89		14.50	0.003024	15.37	2192.51	302.68	0.86
Alignment - Cent	460.35	PF 1	14148.00	1.72	12.83		14.42	0.003028	15.27	2199.52	305.25	0.85
Alignment - Cent	435.35	PF 1	14148.00	0.27	13.32		14.12	0.001758	11.82	2958.97	387.74	0.64
Alignment - Cent	410.36	PF 1	14148.00	1.51	13.19		14.07	0.001808	12.55	2949.01	394.45	0.67
Alignment - Cent	385.37	PF 1	14148.00	1.63	13.05	11.21	14.02	0.002140	13.45	2844.42	401.91	0.72
Alignment - Cent	383.08		Bridge									
Alignment - Cent	360.35	PF 1	14148.00	1.25	12.73	11.15	13.76	0.002522	13.81	2708.28	403.85	0.75
Alignment - Cent	357.33		Bridge									
Alignment - Cent	323.16	PF 1	14148.00	1.12	12.50		13.43	0.001863	11.97	2943.08	437.61	0.67
Alignment - Cent	313.03	PF 1	14148.00	0.68	12.76		13.30	0.000865	8.94	3718.66	444.99	0.47
Alignment - Cent	264.01	PF 1	14148.00	-0.13	12.99		13.16	0.000369	5.14	6184.61	805.82	0.29
Alignment - Cent	255.13	PF 1	14148.00	0.18	12.84		13.14	0.000422	5.99	4800.32	568.82	0.33
Alignment - Cent	228.53	PF 1	14148.00	1.28	12.88		13.11	0.000283	5.12	5604.45	658.80	0.27
Alignment - Cent	201.86	PF 1	14148.00	0.88	12.70		13.08	0.000408	6.04	3996.63	453.84	0.33
Alignment - Cent	134.82	PF 1	14148.00	3.22	10.86	9.87	12.87	0.002682	11.64	1439.32	270.40	0.78
Alignment - Cent	109.84	PF 1	14148.00	3.46	10.09	10.09	12.72	0.004330	13.22	1214.03	274.58	0.96
Alignment - Cent	84.95	PF 1	14148.00	3.72	9.24	9.24	11.43	0.005075	12.82	1483.76	350.89	1.01
Alignment - Cent	59.95	PF 1	14148.00	3.99	8.74	8.74	10.94	0.006104	13.06	1435.52	331.40	1.09
Alignment - Cent	34.95	PF 1	14148.00	3.93	8.29	8.29	10.47	0.007635	13.27	1411.73	349.68	1.19
Alignment - Cent	5.58	PF 1	14148.00	1.04	5.26	5.26	7.17	0.008217	12.84	1553.03	418.95	1.22

Existing Flood Occurrence

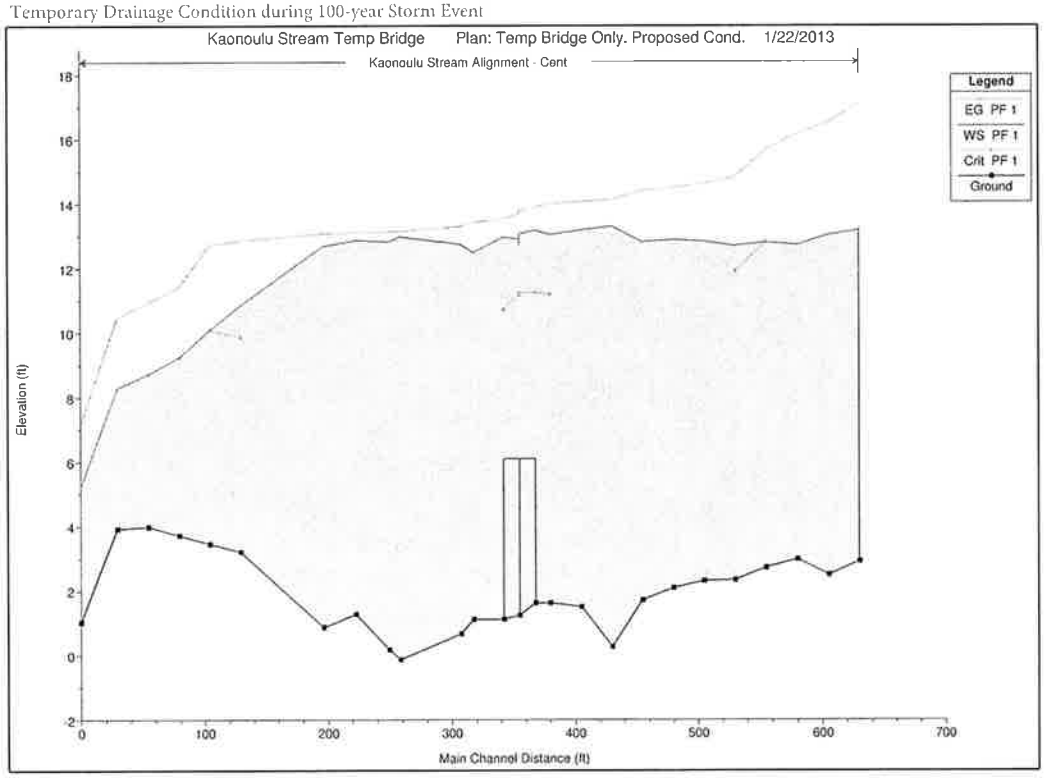


Proposed Six 6' x 4' Box Culverts during 100-year Storm Event with Blocked Outlet

HEC-RAS Plan: 99 River: Konoulu Stream Reach: Site 1 Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Site 1	635.35	100-YR	14148.00	2.93	13.19	13.19	17.14	0.006922	23.68	1360.64	164.05	1.32
Site 1	610.35	100-YR	14148.00	2.51	13.04	13.04	16.52	0.005814	20.91	1453.86	193.96	1.19
Site 1	585.35	100-YR	14148.00	2.99	12.73	12.73	16.18	0.006018	21.14	1474.49	205.06	1.22
Site 1	560.35	100-YR	14148.00	2.73	12.81	12.81	15.66	0.005483	20.16	1692.90	257.68	1.15
Site 1	535.37	100-YR	14148.00	2.34	12.11	11.90	14.70	0.005112	18.71	1733.71	266.49	1.11
Site 1	510.35	100-YR	14148.00	2.31	12.31	11.67	14.44	0.004307	17.38	1901.10	284.30	1.01
Site 1	485.35	100-YR	14148.00	2.10	12.35	11.55	14.27	0.003828	16.66	2029.23	302.68	0.96
Site 1	460.35	100-YR	14148.00	1.72	12.22	11.50	14.16	0.003962	16.75	2013.27	305.25	0.96
Site 1	435.35	100-YR	14148.00	0.27	12.86		13.79	0.002131	12.64	2780.30	387.74	0.69
Site 1	410.36	100-YR	14148.00	1.51	12.68		13.73	0.002245	13.56	2747.35	394.45	0.74
Site 1	385.37	100-YR	14148.00	1.63	12.44		13.65	0.002817	14.85	2599.79	401.91	0.81
Site 1	360.35	100-YR	14148.00	1.25	12.39		13.57	0.002949	14.81	2573.37	403.85	0.81
Site 1	323.16	100-YR	14148.00	1.12	12.47		13.41	0.001885	12.02	2931.65	437.61	0.67
Site 1	313.03	100-YR	14148.00	0.68	12.73	9.18	13.28	0.000872	8.97	3708.57	444.99	0.47
Site 1	288.5		Culvert									
Site 1	264.01	100-YR	14148.00	-0.13	12.99		13.16	0.000369	5.14	6184.58	805.82	0.29
Site 1	255.13	100-YR	14148.00	0.18	12.84		13.14	0.000422	5.99	4800.30	568.82	0.33
Site 1	228.53	100-YR	14148.00	1.28	12.88		13.11	0.000283	5.12	5603.36	658.70	0.27
Site 1	201.86	100-YR	14148.00	0.88	12.70		13.08	0.000408	6.04	3996.63	453.84	0.33
Site 1	134.82	100-YR	14148.00	3.22	10.88	9.87	12.87	0.002682	11.64	1439.32	270.40	0.78
Site 1	109.84	100-YR	14148.00	3.46	10.09	10.09	12.72	0.004330	13.22	1214.03	274.58	0.96
Site 1	84.95	100-YR	14148.00	3.72	9.24	9.24	11.43	0.005075	12.82	1483.76	350.89	1.01
Site 1	59.95	100-YR	14148.00	3.99	8.74	8.74	10.94	0.006106	13.06	1435.33	331.40	1.09
Site 1	34.95	100-YR	14148.00	3.93	8.31	8.31	10.47	0.007536	13.22	1417.12	340.68	1.19
Site 1	5.58	100-YR	14148.00	1.04	6.30	6.30	8.65	0.005811	12.88	1286.31	281.29	1.07

Temporary Drainage Condition during 100-year Storm Event

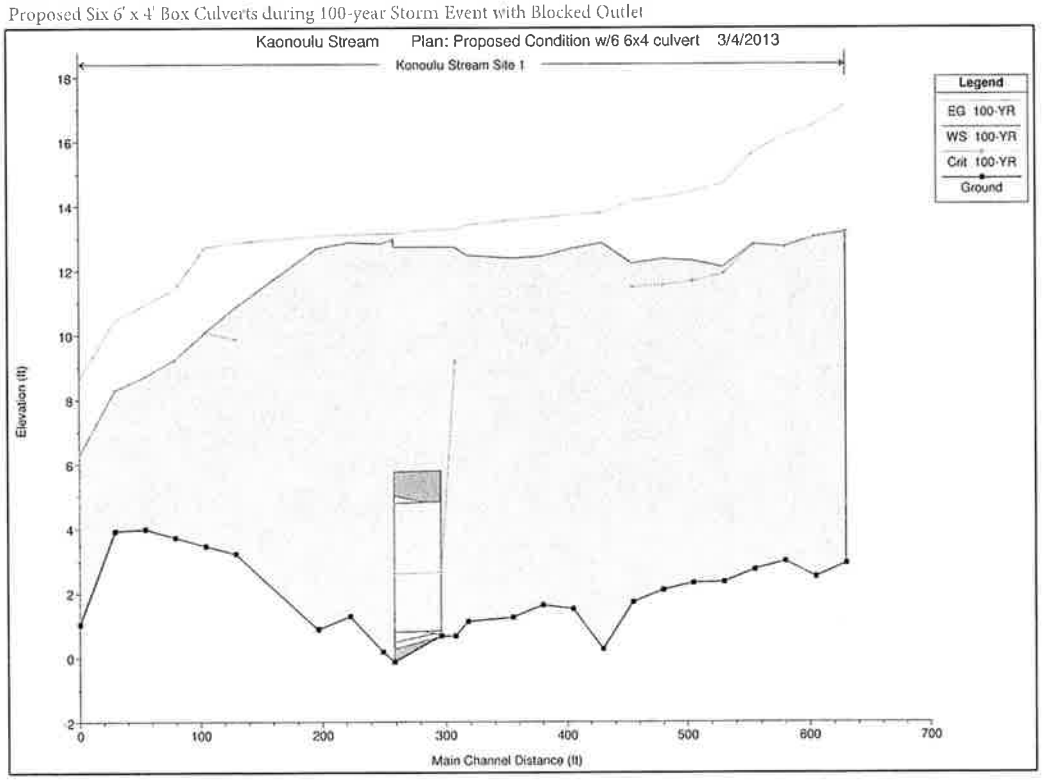


Proposed Six 6' x 4' Box Culverts during 100-year Storm Event without Blocked Outlet

HEC-RAS Plan: Plan 30 River: Konoulu Stream Reach: Site 1 Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Site 1	635.35	100-YR	14148.00	2.93	13.19	13.19	17.14	0.006922	23.68	1360.64	164.05	1.32
Site 1	610.35	100-YR	14148.00	2.51	13.04	13.04	16.52	0.005814	20.91	1453.66	193.96	1.19
Site 1	585.35	100-YR	14148.00	2.99	12.73	12.73	16.18	0.006018	21.14	1474.49	205.06	1.22
Site 1	560.35	100-YR	14148.00	2.73	12.81	12.81	15.66	0.005483	20.16	1692.90	257.68	1.15
Site 1	535.37	100-YR	14148.00	2.34	11.90	11.90	14.69	0.005643	19.34	1678.12	266.49	1.16
Site 1	510.35	100-YR	14148.00	2.31	12.07	11.67	14.38	0.004815	18.05	1832.74	284.30	1.07
Site 1	485.35	100-YR	14148.00	2.10	12.11	11.55	14.20	0.004281	17.32	1955.67	302.68	1.01
Site 1	460.35	100-YR	14148.00	1.72	11.57	11.50	14.04	0.005428	18.69	1813.35	305.25	1.11
Site 1	435.35	100-YR	14148.00	0.27	12.46		13.53	0.002541	13.44	2626.31	387.74	0.75
Site 1	410.36	100-YR	14148.00	1.51	12.20		13.44	0.002788	14.65	2559.07	394.45	0.82
Site 1	385.37	100-YR	14148.00	1.63	11.65	11.21	13.32	0.004196	17.17	2278.90	401.91	0.98
Site 1	360.35	100-YR	14148.00	1.25	11.15	11.15	13.17	0.005685	18.56	2070.71	403.85	1.11
Site 1	323.16	100-YR	14148.00	1.12	10.66	10.66	12.66	0.004820	16.80	2139.72	437.61	1.04
Site 1	313.03	100-YR	14148.00	0.00	9.00	9.00	11.12	0.003472	15.78	2213.73	444.99	0.93
Site 1	288.5		Culvert									
Site 1	264.01	100-YR	14148.00	0.00	8.81		9.99	0.002500	11.41	2990.77	805.82	0.75
Site 1	255.13	100-YR	14148.00	-0.04	8.80		9.96	0.001673	10.36	2730.96	568.82	0.63
Site 1	228.53	100-YR	14148.00	-0.18	9.16		9.76	0.000766	7.59	3676.78	626.21	0.44
Site 1	201.86	100-YR	14148.00	-0.31	9.27		9.69	0.000531	6.43	3760.79	436.01	0.37
Site 1	134.82	100-YR	14148.00	-0.65	8.20		9.55	0.001306	9.41	1622.26	207.85	0.56
Site 1	109.84	100-YR	14148.00	-0.77	6.39	6.39	9.33	0.004665	13.76	1033.62	183.42	1.00
Site 1	84.95	100-YR	14148.00	-0.90	4.87		6.05	0.002447	9.84	2021.57	350.89	0.72
Site 1	59.95	100-YR	14148.00	-1.02	4.71		5.98	0.002520	9.95	1899.62	331.40	0.73
Site 1	34.95	100-YR	14148.00	-1.15	4.76		5.88	0.002117	9.31	2011.22	340.68	0.67
Site 1	5.58	100-YR	14148.00	-1.25	3.33	3.33	5.66	0.005613	12.79	1288.25	281.29	1.05

Proposed Six 6' x 4' Box Culverts during 100-year Storm Event with Blocked Outlet

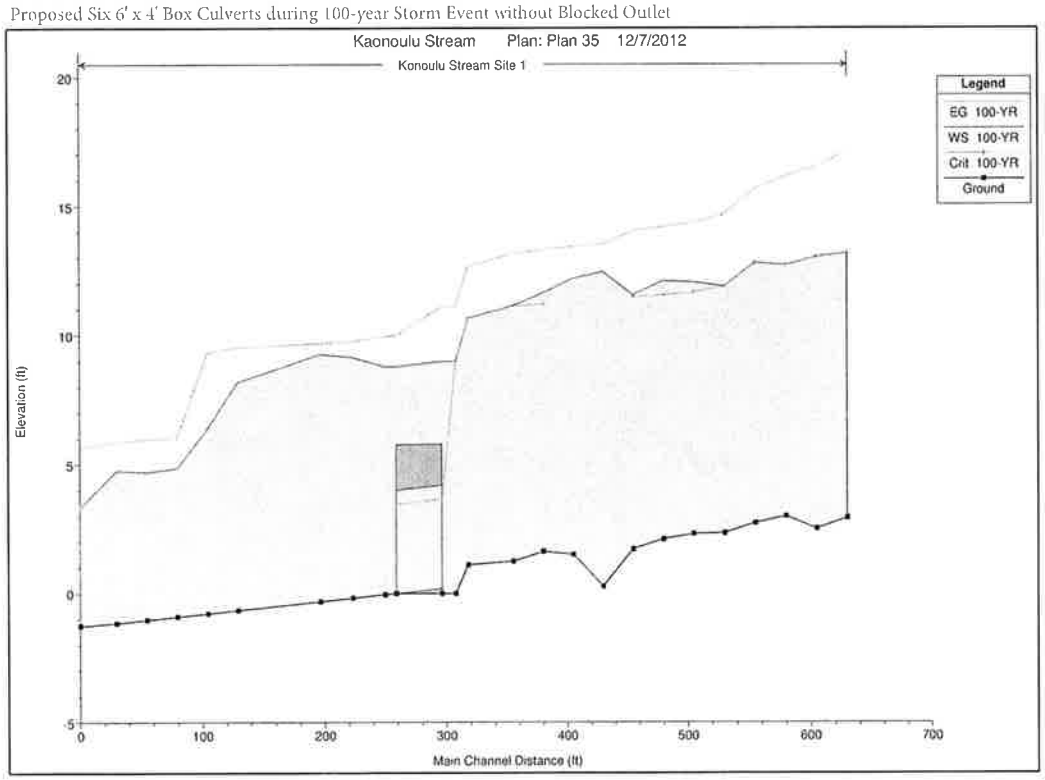


Proposed Eight 6' x 4' Box Culverts during 100-year Storm Event without Blocked Outlet

HEC-RAS Plan: Plan 30 River: Konoulu Stream Reach: Site 1 Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Site 1	635.35	100-YR	14148.00	2.93	13.19	13.19	17.14	0.006922	23.68	1360.64	164.05	1.32
Site 1	610.35	100-YR	14148.00	2.51	13.04	13.04	16.52	0.005814	20.91	1453.56	193.96	1.19
Site 1	585.35	100-YR	14148.00	2.99	12.73	12.73	16.18	0.006018	21.14	1474.49	205.06	1.22
Site 1	560.35	100-YR	14148.00	2.73	12.81	12.81	15.66	0.005483	20.16	1692.90	257.68	1.15
Site 1	535.37	100-YR	14148.00	2.34	11.90	11.90	14.69	0.005643	19.34	1678.12	266.49	1.16
Site 1	510.35	100-YR	14148.00	2.31	12.07	11.67	14.38	0.004815	18.05	1832.74	284.30	1.07
Site 1	485.35	100-YR	14148.00	2.10	12.11	11.55	14.20	0.004281	17.32	1955.67	302.68	1.01
Site 1	460.35	100-YR	14148.00	1.72	11.57	11.50	14.04	0.005428	18.69	1813.35	305.25	1.11
Site 1	435.35	100-YR	14148.00	0.27	12.46		13.53	0.002541	13.44	2626.31	387.74	0.75
Site 1	410.36	100-YR	14148.00	1.51	12.20		13.44	0.002788	14.65	2559.07	394.45	0.82
Site 1	385.37	100-YR	14148.00	1.63	11.65	11.21	13.32	0.004196	17.17	2278.90	401.91	0.98
Site 1	360.35	100-YR	14148.00	1.25	11.15	11.15	13.17	0.005685	18.56	2070.71	403.85	1.11
Site 1	323.16	100-YR	14148.00	1.12	10.66	10.66	12.66	0.004820	16.80	2139.72	437.61	1.04
Site 1	313.03	100-YR	14148.00	0.00	9.00	9.00	11.12	0.003472	15.78	2213.73	444.99	0.93
Site 1	288.5		Culvert									
Site 1	264.01	100-YR	14148.00	0.00	8.81		9.99	0.002500	11.41	2990.77	865.82	0.75
Site 1	255.13	100-YR	14148.00	-0.04	8.80		9.96	0.001673	10.36	2730.96	568.82	0.63
Site 1	228.53	100-YR	14148.00	-0.18	9.16		9.76	0.000766	7.59	3676.78	626.21	0.44
Site 1	201.86	100-YR	14148.00	-0.31	9.27		9.69	0.000531	6.43	3760.79	436.01	0.37
Site 1	134.82	100-YR	14148.00	-0.65	8.20		9.55	0.001306	9.41	1622.26	207.85	0.56
Site 1	109.84	100-YR	14148.00	-0.77	6.39	6.39	9.33	0.004665	13.76	1033.62	183.42	1.00
Site 1	84.95	100-YR	14148.00	-0.90	4.87		6.05	0.002447	9.84	2021.59	350.89	0.72
Site 1	59.95	100-YR	14148.00	-1.02	4.71		5.98	0.002519	9.95	1899.65	331.40	0.73
Site 1	34.95	100-YR	14148.00	-1.15	4.76		5.88	0.002117	9.30	2011.40	340.68	0.67
Site 1	5.58	100-YR	14148.00	-1.25	3.33	3.33	5.66	0.005613	12.79	1288.25	281.29	1.05

Proposed Six 6' x 4' Box Culverts during 100-year Storm Event without Blocked Outlet

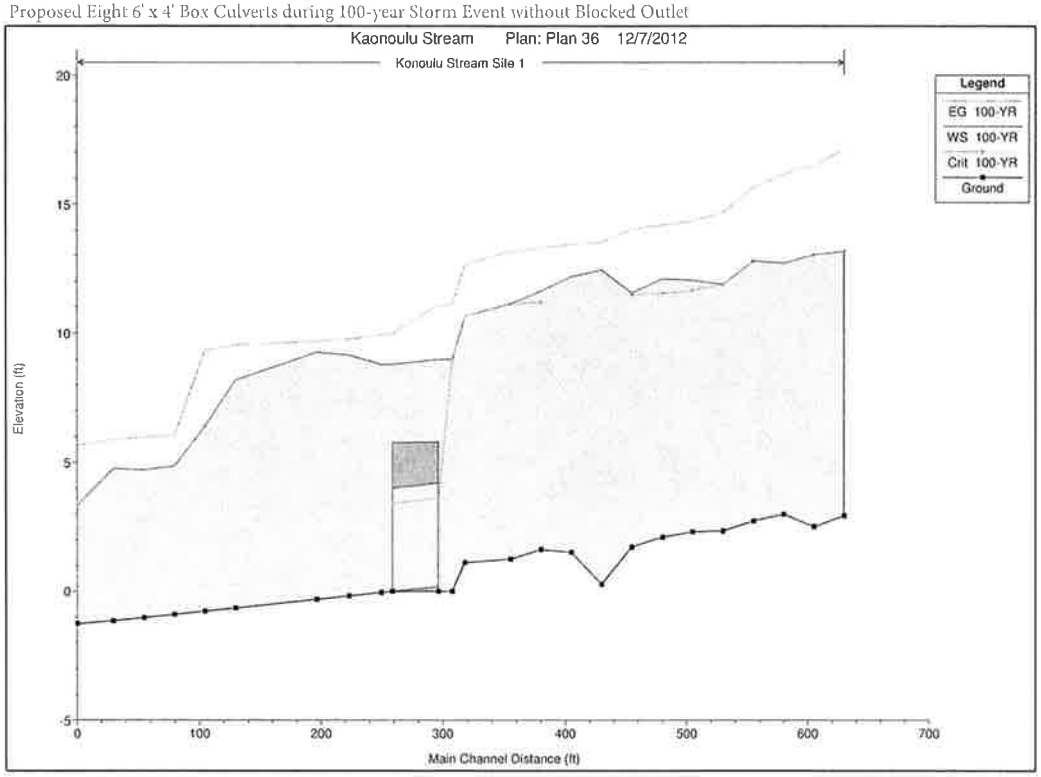


Proposed Bridge during 100-year Storm Event without Blocked Outlet

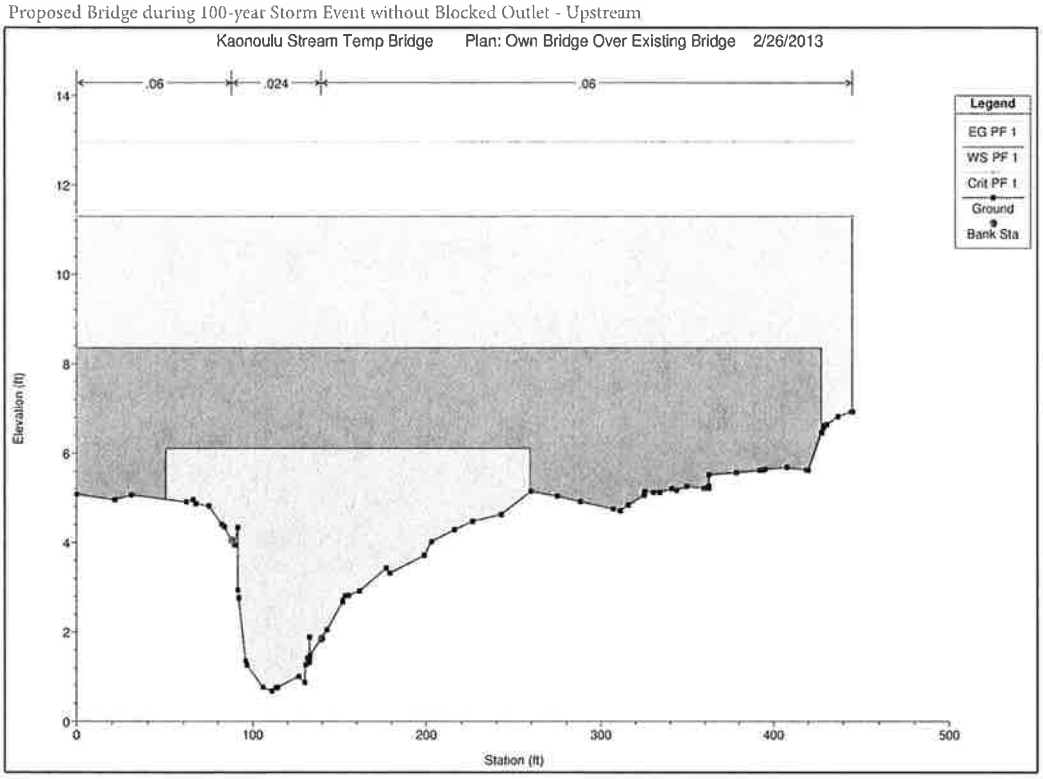
HEC-RAS Plan: 99 River: Kaonoulu Stream Reach: Alignment - Cont Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Alignment - Cont	635.35	PF 1	14148.00	2.93	13.19	13.19	17.14	0.006922	23.68	1360.64	164.05	1.32
Alignment - Cont	610.35	PF 1	14148.00	2.51	13.04	13.04	16.52	0.005814	20.91	1453.68	193.96	1.19
Alignment - Cont	585.35	PF 1	14148.00	2.99	12.73	12.73	16.18	0.006018	21.14	1474.49	205.06	1.22
Alignment - Cont	560.35	PF 1	14148.00	2.73	12.81	12.81	15.66	0.005483	20.16	1692.90	257.68	1.15
Alignment - Cont	535.37	PF 1	14148.00	2.34	11.92	11.90	14.69	0.005608	19.30	1681.50	266.49	1.15
Alignment - Cont	510.35	PF 1	14148.00	2.31	12.15	11.67	14.40	0.004623	17.80	1857.45	284.30	1.05
Alignment - Cont	485.35	PF 1	14148.00	2.10	12.20	11.55	14.22	0.004109	17.08	1982.33	302.68	0.99
Alignment - Cont	460.35	PF 1	14148.00	1.72	12.00	11.50	14.10	0.004398	17.37	1944.94	305.25	1.01
Alignment - Cont	435.35	PF 1	14148.00	0.27	12.71		13.69	0.002278	12.93	2721.95	387.74	0.72
Alignment - Cont	410.36	PF 1	14148.00	1.51	12.50		13.62	0.002427	13.94	2678.40	394.45	0.77
Alignment - Cont	385.37	PF 1	14148.00	1.63	12.20		13.53	0.003159	15.48	2503.71	401.91	0.86
Alignment - Cont	360.35	PF 1	14148.00	1.25	12.14		13.44	0.003337	15.28	2471.04	403.85	0.86
Alignment - Cont	323.16	PF 1	14148.00	1.12	12.24		13.26	0.002101	12.49	2828.46	437.61	0.71
Alignment - Cont	313.03	PF 1	14148.00	0.68	12.54	9.18	13.11	0.000939	9.19	3620.47	444.99	0.48
Alignment - Cont	288.5		Bridge									
Alignment - Cont	264.01	PF 1	14148.00	0.00	8.80		9.99	0.002506	11.42	2988.05	805.82	0.75
Alignment - Cont	255.13	PF 1	14148.00	-0.04	8.80		9.96	0.001672	10.36	2731.05	568.82	0.63
Alignment - Cont	228.53	PF 1	14148.00	-0.18	9.16		9.76	0.000766	7.59	3677.29	626.35	0.44
Alignment - Cont	201.86	PF 1	14148.00	-0.31	9.27		9.69	0.000531	6.43	3760.81	436.01	0.37
Alignment - Cont	134.82	PF 1	14148.00	-0.65	8.20		9.55	0.001306	9.41	1622.27	207.85	0.56
Alignment - Cont	109.84	PF 1	14148.00	-0.77	6.39	6.39	9.33	0.004665	13.76	1033.54	183.41	1.00
Alignment - Cont	84.95	PF 1	14148.00	-0.90	4.19	3.35	5.70	0.003895	11.13	1785.18	350.89	0.87
Alignment - Cont	59.95	PF 1	14148.00	-1.02	3.31	3.31	5.52	0.006389	13.15	1434.80	331.40	1.11
Alignment - Cont	34.95	PF 1	14148.00	-1.15	3.09	3.09	5.25	0.006348	12.92	1444.29	340.68	1.11
Alignment - Cont	5.58	PF 1	14148.00	-1.25	2.53	2.53	4.45	0.007068	12.62	1581.92	418.95	1.14

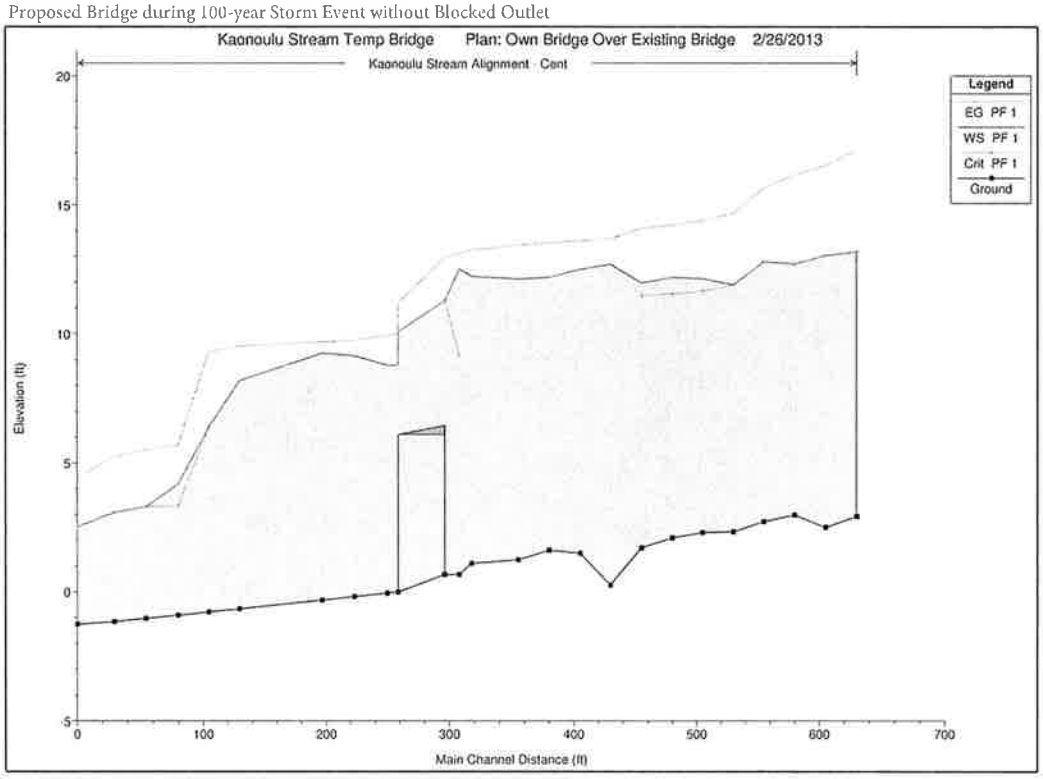
Proposed Eight 6' x 4' Box Culverts during 100-year Storm Event without Blocked Outlet



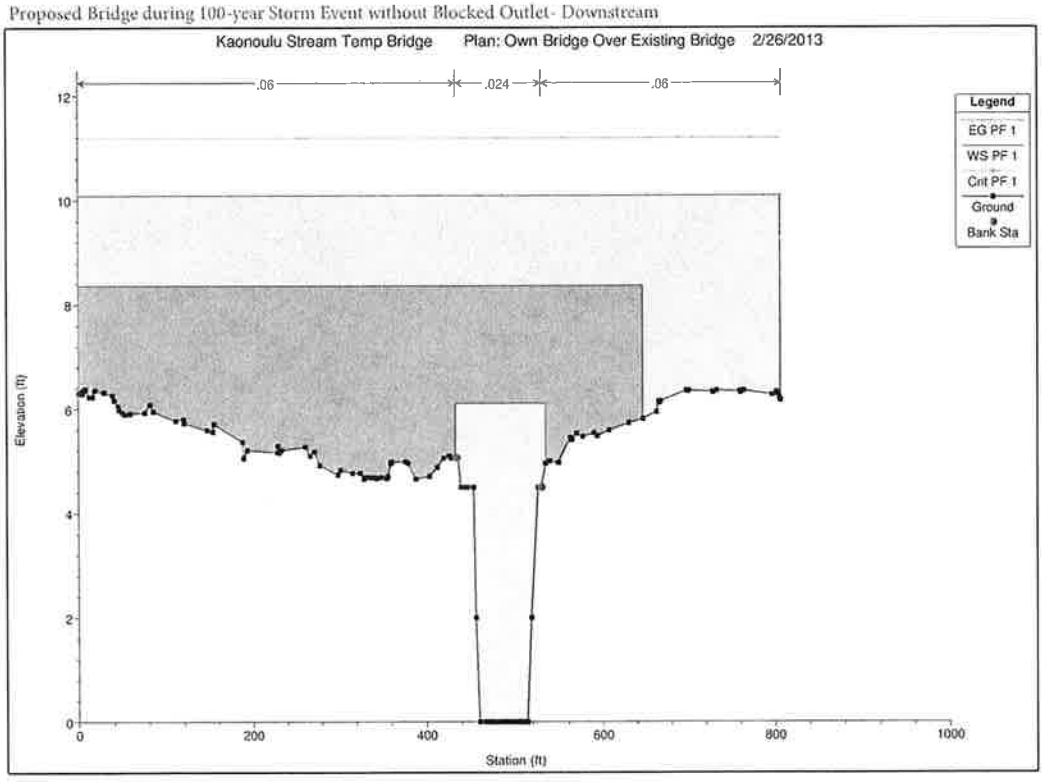
Proposed Bridge during 100-year Storm Event without Blocked Outlet - Upstream



Proposed Bridge during 100-year Storm Event without Blocked Outlet



Proposed Bridge during 100-year Storm Event without Blocked Outlet- Downstream



APPENDIX F

Pre-Assessment Consultation Comment and Response Letters

EW

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, HONOLULU DISTRICT
FORT SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF:

January 10, 2013

Regulatory Branch

POH-2013-00014

Wilson Okamoto Corporation
Attn: Earl Matsukawa, AICP
1907 S. Beretania St
Artesian Plaza, Suite 400
Honolulu, HI 96826

PERMIT REQUIRED

Dear Mr. Matsukawa:

This is in response to your November 30, 2012 letter requesting the Department of the Army review and provide comments for the preparation of a Draft Environmental Assessment for proposed Bridge Replacement in Kulanihako'i Gulch located at the Kulanihako'i Stream Bridge Crossing at S. Kihei Road, near Kihei, County of Maui, Island of Maui, Hawai'i. We have determined the potential project site contains waters under the regulatory jurisdiction of the Corps of Engineers.

Your proposed project was reviewed pursuant to Section 10 of the Rivers and Harbors Act of 1899 (Section 10) and Section 404 of the Clean Water Act (Section 404). Section 10 requires that a DA permit be obtained for certain structures or work in or affecting navigable waters of the United States (U.S.), prior to conducting the work (33 U.S.C. 403). Navigable waters of the U.S. are those waters subject to the ebb and flow of the tide shoreward to the mean high water mark, and/or other waters identified as navigable by the Honolulu District. In addition, a Section 10 permit is required for structures or work outside this limit if they affect the course, capacity, or condition of the waterbody. Some typical examples of structures or work requiring Section 10 permits within this jurisdictional area include beach nourishment, boat ramps, breakwaters, bulkheads, dredging, filling or discharging material such as sand, gravel or stones, and placement of riprap for wave protection or streambank stabilization.

Section 404 requires that a DA permit be obtained for the placement or discharge of dredged and/or fill material into waters of the U.S., including wetlands, prior to conducting the work (33 U.S.C. 1344). For regulatory purposes, the U.S. Army Corps of Engineers (Corps) defines wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The area of Corps jurisdiction under Section 404 extends to the Mean Higher High Tide Line (MHHTL) or to the Ordinary

High Water Mark (OHWM) for navigable waters other than the Pacific Ocean, and to the upland boundary of any adjacent wetlands. Fill material is any material that replaces a jurisdictional aquatic area with dry land or changes the bottom elevation of a waterbody. Fill may be temporary or permanent and often includes, but is not limited to, rock, sand, concrete, sandbags, etc. Projects involving discharges typically include placement of fill material for homes and landscaping, impoundments , road fills, dams and dikes, culverts, riprap, groins, and beach nourishment. Section 404 also regulates discharges of dredged material incidental to certain activities such as grading, mechanized landclearing, ditching or other excavation activity, and the installation of certain pile-supported structures.

The **Kulanihako'i Gulch** is considered a navigable water of the U.S. and therefore a Section 10 and Section 404 **permit is required** for certain structures or work in, over, or under navigable waters of the U.S., as well as any activities that would involve either **the temporary or permanent placement of fill and/ or dredged material** into waters of the U.S. Documents submitted to this office indicated temporary concrete barriers on either side of the current bridge, a temporary detour road and steel panel bridge, and replacement of existing culverts with six new culverts with inlet and outlet head walls. Our assertion of jurisdiction is based on our documentation that the proposed work would occur waterward of the line on the shore reached by the MHW of the Pacific Ocean and that discharges would occur waterward of the MHHW mark, requiring both a Section 10 and Section 404 authorization from the Corps. Also note that a Section 401 water quality certification from the State of Hawaii Department of Health will also be required. Please contact DOH directly to discuss their permit application requirements.

Thank you for giving us the opportunity to review this proposal and for your cooperation with our regulatory program. Please be advised you can provide comments on your experience with the Honolulu District Regulatory Branch by accessing our web-based customer survey form at http://per2.nwp.usace.army.mil/survey.html.

Should you have any questions, please contact Kaitlyn Seberger of this office at the above address or telephone 808-835-4303 (FAX: 808-835-4301) or by E-Mail at Kaitlyn.R.Seberger@usace.army.mil. Please refer to File Number **POH-13-00014** in all future communications with this office regarding this or other projects at this location.

Sincerely,

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

WILSON OKAMOTO
CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. George P. Young, P.E.
Chief, Regulatory Branch
Department of the Army
U.S. Army Corps of Engineers
Honolulu District
Fort Shafter, Hawai'i 96858-5440

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Young:

Thank you for your letter dated January 10, 2013 (POH-2013-00014) regarding the subject project. We offer the following responses to your letter.

We appreciate the information provided on the applicability of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. We intend to work cooperatively with your office in providing the requisite permit application submittals. We also acknowledge that coordination with the State of Hawai'i Department of Health regarding the Section 401 water quality certification will also be required.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

NEIL ABERCROMBIE
GOVERNOR

Dean H. Seki
Comptroller

Maria E. Zielinski
Deputy Comptroller

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810-0119

DEC 10 2012

(P)1285.2

EM

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

RECEIVED
DEC 11 2012
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa:

Subject: Kulanihakoi Bridge Replacement
Environmental Assessment
Kihei, Maui, Hawaii

Thank you for the opportunity to provide comments for the subject project. This project does not impact any of the Department of Accounting and General Services' projects or existing facilities in the general area, and we have no comments to offer at this time.

If you have any questions, please call me at 586-0400 or have your staff call Mr. Alva Nakamura of the Public Works Division at 586-0488.

Sincerely,

DEAN H. SEKI
Comptroller

c: Mr. David Victor, DAGS-Maui District Office

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

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www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. Dean Seki, Comptroller
State of Hawai'i
Department of Accounting and General Services
P.O. Box 119
Honolulu, Hawai'i 96810-0119

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Seki:

Thank you for your letter dated December 10, 2012 regarding the subject project. We offer the following responses to your letter.

We appreciate the information that the proposed project does not impact any of the Department of Accounting and General Services projects or existing facilities in the general area.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

Re: 8251-01 EM

NEIL ABERCROMBIE
GOVERNOR
RICHARD C. LIM
DIRECTOR
MARY ALICE EVANS
DEPUTY DIRECTOR
JESSE K. SOUKI
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-13813

December 18, 2012

RECEIVED
DEC 20 2012
WILSON OKAMOTO CORPORATION

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 S. Beretania Street, Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

Subject: Pre-Assessment Consultation
Kulanihakoi Bridge Replacement
Kihei, Maui, Hawai'i

Thank you for the opportunity to review and comment on the above referenced early consultation in preparation of an Environmental Assessment (EA). The Office of Planning (OP) has reviewed the initial project information and has the following comments:

1. The entire State is defined to be within the Coastal Zone Management Area (Hawaii Revised Statutes (HRS) §205A-1 – definition of "coastal zone management area"). The Draft EA should include a discussion of the proposed project's consistency with the objectives and policies set forth in HRS §205A-2.

2. We invite the applicant to review the *Hawaii Watershed Guidance*, specifically the sections on management measures for Urban Areas – Bridges; Operation and Maintenance, Roads and Highways; and Runoff Systems for Roads, Highways and Bridges, beginning on p. 130 of the Guidance. The Guidance provides a summary and links to management measures that may be implemented to minimize coastal non-point pollution impact. The *Hawaii Watershed Guidance* document can be found on-line at: http://hawaii.gov/dbedt/czm/initiative/nonpoint.

3. Coastal Zone Management Act (CZMA) federal consistency review will be required for the application for federal funding from the Federal Highway Administration and for the Department of the Army Permit from the U.S. Army Corps of Engineers, if applicable. Pre-application consultation for the Coastal Zone Management (CZM) review is encouraged. Contact John Nakagawa of our CZM Program at 587-2878, for further information.

If you have any questions, please contact Leo Asuncion of our CZM Program at 587-2875.

Sincerely,

Jesse K. Souki
Director

WILSON OKAMOTO
CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. Jesse K. Souki, Director
State of Hawai'i
Department of Business, Economic Development & Tourism
Office of Planning
235 South Beretania Street, 6th Floor
Honolulu, Hawai'i 96804

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Souki:

Thank you for your letter dated December 18, 2012 (Ref. No. P-13813) regarding the subject project. We offer the following responses to your letter.

We acknowledge that the entire State is defined to be within the Coastal Zone Management Area. The Draft EA will include a discussion of the proposed project's consistency with the objectives and policies set forth in Section 205A-2, HRS.

We appreciate your suggestion to review *Hawai'i Watershed Guidance*, specifically sections on management measures for Urban Area – Bridges; Operation and Maintenance, Roads and Highways; and Runoff Systems for Roads, Highways and Bridges.

Since use of Federal funding for the project is anticipated, we acknowledge that Coastal Zone Management Act federal consistency review will be required. We will coordinate with applicable staff on this matter.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

EM

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
EMD/CWB

03017PST.13

March 6, 2013

Mr. Earl Matsukawa, AICP
Project Manager
Wilson Okamoto Corporation
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii 96826

RECEIVED
MAR 08 2013
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa:

SUBJECT: Comments on the Draft Environmental Assessment for the Kulanihakoi Bridge Replacement Project Kihei, Island of Maui, Hawaii

The Department of Health (DOH), Clean Water Branch (CWB), acknowledges receipt of your letter, dated November 30, 2012, requesting comments on your project. The DOH-CWB has reviewed the subject document and offers these comments. Please note that our review is based solely on the information provided in the subject document and its compliance with the Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at: http://www.hawaii.gov/health/environmental/env-planning/landuse/CWB-standardcomment.pdf.

1. Any project and its potential impacts to State waters must meet the following criteria:

   a. Antidegradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.

   b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.

   c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

2. You may be required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55). An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. To request NPDES permit coverage, you must submit the CWB

Individual NPDES Form through the e-Permitting Portal and the hard copy certification statement with $1,000 filing fee. Please open the e-Permitting Portal website at: https://eha-cloud.doh.hawaii.gov/epermit/View/home.aspx. You will be asked to do a one-time registration to obtain your login and password. After you register, click on the Application Finder tool and locate the "CWB Individual NPDES Form." Follow the instructions to complete and submit this form.

3. If your project involves work in, over, or under waters of the United States, it is highly recommend that you contact the Army Corp of Engineers, Regulatory Branch (Tel: 438-9258) regarding their permitting requirements.

   Pursuant to Federal Water Pollution Control Act [commonly known as the "Clean Water Act" (CWA)], Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40 of the Code of Federal Regulations, Section 122.2; and Hawaii Administrative Rules (HAR), Chapter 11-54.

4. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 WQC are required, must comply with the State's Water Quality Standards. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

If you have any questions, please visit our website at: http://www.hawaii.gov/health/environmental/water/cleanwater/index.html, or contact the Engineering Section, CWB, at (808) 586-4309.

Sincerely,

ALEC WONG, P.E., CHIEF
Clean Water Branch

ST:jst

c: DOH-EPO [via email only]

WILSON OKAMOTO
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ENGINEERS | PLANNERS | CONSULTANTS

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FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. Alec Wong, P.E.
Chief, Clean Water Branch
Department of Health
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Wong:

Thank you for your letter dated March 6, 2013 (03017PST.13) regarding the subject project. We offer the following responses to your letter.

We appreciate the information provided on the applicability of Chapter 11-54 and 11-55, Hawai'i Administrative Rules, National Pollutant Discharge Elimination System, and Section 401 water quality certification provisions. We intend to work cooperatively with your office in providing the requisite permit application submittals. We also acknowledge that coordination with the U.S Army Corps of Engineers regarding work in, over, or under waters of the United States will also be required.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

LORETTA J. FUDDY, A.C.S.W., M.P.H.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:
12-224
Kulanihakoi Bridge

December 12 2012

RECEIVED
DEC 17 2012
WILSON OKAMOTO CORPORATION

EM

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Dear Mr. Matsukawa:

SUBJECT: Environmental Assessment for Kulanihako`i Bridge Replacement Kihei, Maui, Hawaii

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your letter, dated November 30, 2012. Thank you for allowing us to review and comment on the subject document. The document was routed to the various branches of the Environmental Health Administration. We have no comments at this time, but reserve the right to future comments. We strongly recommend that you review all of the Standard Comments on our website: www.hawaii.gov/health/environmental/env-planning/landuse/landuse.html. Any comments specifically applicable to this application should be adhered to.

The United States Environmental Protection Agency (EPA) provides a wealth of information on their website including strategies to help protect our natural environment and build sustainable communities at: http://water.epa.gov/infrastructure/sustain/ . The DOH encourages State and county planning departments, developers, planners, engineers and other interested parties to apply these strategies and environment principles whenever they plan or review new developments or redevelopments projects. We also ask you to share this information with others to increase community awareness on healthy, sustainable community design. If there are any questions about these comments please contact me.

Sincerely,

Laura Leialoha Phillips McIntyre, AICP
Environmental Planning Office Manager
Environmental Health Administration
Department of Heath
919 Ala Moana Blvd., Ste. 312
Honolulu, Hawaii 96814
Phone: 586-4337
laura.mcintyre@doh.hawaii.gov

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8256-01
June 6, 2013

Ms. Laura Leialoha Phillips McIntyre, AICP
Environmental Planning Office Manager
Environmental Health Administration
Department of Health
919 Ala Moana Boulevard, Suite 312
Honolulu, Hawai'i 96814

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Ms. McIntyre:

Thank you for your letter dated December 12, 2012 regarding the subject project. The following responds to your letter.

We appreciate your sharing information on Standard Comments from the Department of Health website as well as information from the U.S. Environmental Protection Agency website. This information will be taken into consideration as we move forward on the planning and design of the project.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

EM/ma

cc: Wendy Kobashigawa

EM

NEIL ABERCROMBIE
GOVERNOR

GARY L. GILL
ACTING DIRECTOR

STATE OF HAWAI'I
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
Department of Health
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96813
Telephone (808) 586-4185
Facsimile (808) 586-4186
Email: oeqc@doh.hawaii.gov

In reply, please refer to:
File:

December 7, 2012

RECEIVED
DEC 10 2012
WILSON OKAMOTO CORPORATION

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawai'i 96826

Subject: Kūlanihāko'i Bridge Replacement
Environmental Assessment
Kihei, Maui, Hawai'i

Dear Mr. Matsukawa,

This is in response to your November 30, 2012, pre-assessment consultation about the subject proposed environmental assessment (EA). The Office of Environmental Quality Control offers these comments:

1. We recommend inclusion of an analysis of the temporary detour bridge site; please identify impacts, mitigation, and disposition of the temporary bridge upon project completion.

2. We recommend a discussion of the construction staging area(s), a discussion on traffic management and level of service during the construction period, and impacts and mitigation.

3. Please check with the Clean Water Branch, Department of Health, for requirements regarding water quality issues.

Thank you for the opportunity to provide comments to the proposed project. Feel free to contact Herman Tuiolosega at (808) 586-4185, if you have any questions.

Sincerely,

GARY GILL,
Acting Director

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. Gary Gill, Acting Director
State of Hawai'i
Office of Environmental Quality Control
Department of Health
235 South Beretania Street, Suite 702
Honolulu, Hawai'i 96813

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Gill:

Thank you for your letter dated December 7, 2012 regarding the subject project. We offer the following responses to your letter.

Impacts and mitigation relating to the temporary bridge located mauka of South Kīhei Road will be discussed in the Draft EA. After completion of the replacement culverts, the temporary bridge is intended to be removed. If it is still in good operating condition, the temporary bridge can be stored and reused.

Discussion of traffic management and level of service during the construction period, and impacts and mitigation will be discussed in the Draft EA. Construction staging will be provided at an off-site location.

We acknowledge that close coordination with the Clean Water Branch, Department of Health, will need to be undertaken regarding water quality issues.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

December 27, 2012

Wilson Okamoto Corporation
Attention: Mr. Earl Matsukawa, AICP
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

RECEIVED
DEC 28 2012
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa:

SUBJECT: Kulanihako'i Bridge Replacement

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 comments.

At this time, enclosed are comments from the (a) Office of Conservation and Coastal Lands and (b) Engineering Division on the subject matter. Should you have any questions, please feel free to call Lydia Morikawa at 587-0410. Thank you.

Sincerely,

Russell Y. Tsuji
Land Administrator

Enclosure(s)
cc:

MA-13-57

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

RECEIVED
2012 DEC 13 A 11:28
DEP LAND & NATURAL RESOURCES
STATE OF HAWAII

RECEIVED
2012 DEC 10 A 7:01
LAND DIVISION
STATE OF HAWAII

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

December 6, 2012

MEMORANDUM

TO: **DLNR Agencies:**
__Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
X Office of Conservation & Coastal Lands
X Land Division – Maui District
X Historic Preservation

FROM: Russell Y. Tsuji, Land Administrator
SUBJECT: Kulanihako'I Bridge Replacement
LOCATION: Kihei, Island of Maui; in the vicinity of TMK: (2) 3-9-001:015, 147 & 162
APPLICANT: Wilson Okamoto Corporation for the County of Maui Department of Public Works

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by December 27, 2012.

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 Lydia Morikawa at 587-0410. Thank you.

Attachments

SEE MEMO

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

Signed:
Print Name: ALEX ROY
Date: 12-13-2012

cc: Central Files

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

WILLIAM J. AILA, JR.
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ESTHER KIA'AINA
FIRST DEPUTY

WILLIAM M. TAM
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

OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

REF: OCCL: AJR

COR: MA-13-57

DEC 1 3 2012

MEMORANDUM

TO: Russell Y. Tsuji, Administrator
Land Division

FROM: Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

SUBJECT: **Request for Comments on the Proposed Kulanihako'i Bridge Replacement Project**
TMK(s): (2) 3-9-001:015, 147 & 162
Wailuku District, Kihei, County of Maui

The Department of Land and Natural Resources, Office of Conservation and Coastal Lands (OCCL) is in receipt of your memo regarding the proposed Kulanihako'i Bridge Replacement project which crosses the Kulanihako'i Gulch in Kihei, Maui. For your information all lands located *makai* of the shoreline are considered to be within the State Land Use Conservation District Resource Subzone.

The County of Maui, Department of Public Works (DPW) is proposing to replace the existing 4-cell concrete box culvert system under South Kihei Road with a new 6-cell concrete box culvert system. The project will also include the construction of new intake and outlet headwalls to assist in channeling water flowing from the Kulanihako'i Gulch. The OCCL is requesting additional information regarding the construction of the intake and outlet headwalls and the type and location of shoreline or sand-moving activities in order to determine potential permitting or approval requirements.

Additionally there are a number of existing coastal management projects located near the proposed project site that may need to be integrated into the design and/or function of the new bridge repair and outlet. North of the Kulanihako'i Bridge, the Maui Lu Resort is currently working to mitigate the construction of revetments with multiple beach nourishment activities. Similarly, Maui County has an on-going Dune Management project south of the project site in Kalepolepo Park. The OCCL is requesting that the various agencies and consultants integrate the proposed project design principles with the existing projects to promote a coordinated approach to Coastal Zone Management.

This office looks forward to reviewing the full proposal and completing a review of the Environmental Assessment (EA) report. Pease make sure to address the effect of the other projects in the vicinity of your proposal.

Should you have any questions, please feel free to contact Alex J. Roy of the Office of Conservation and Coastal Lands at 808-587-0316 or via email at alex.j.roy@hawaii.gov

NEIL ABERCROMBIE
GOVERNOR OF HAWAII

'12 DEC 11 PM 3:06 ENGINEERING D
ISION

2012 DEC 19 A 6:07

DEPT. OF LAND & NATURAL RESOURCES STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

December 6, 2012

MEMORANDUM

TO: Fr:

DLNR Agencies:
___Div. of Aquatic Resources
___Div. of Boating & Ocean Recreation
_X_ Engineering Division
___Div. of Forestry & Wildlife
___Div. of State Parks
_X_ Commission on Water Resource Management
_X_ Office of Conservation & Coastal Lands
_X_ Land Division – Maui District
_X_ Historic Preservation

FROM: To: Russell Y. Tsuji, Land Administrator
SUBJECT: Kulanihako'I Bridge Replacement
LOCATION: Kihei, Island of Maui; in the vicinity of TMK: (2) 3-9-001:015, 147 & 162
APPLICANT: Wilson Okamoto Corporation for the County of Maui Department of Public Works

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by December 27, 2012.

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 Lydia Morikawa at 587-0410. Thank you.

Attachments

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

Signed:
Print Name: Carty S. Chang, Chief Engineer
Date: 12/19/12

cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/LydiaMorikawa
Ref.:KulanihakoBridgeReplacement
Maui.590

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 project site, according to the Flood Insurance Rate Map (FIRM), is located in Zones AE and VE. The National Flood Insurance Program regulates developments within Zones AE and VE as indicated in bold letters below.

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

(X) 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. Mario Siu Li at (808) 768-8098 or Ms. Ardis Shaw-Kim of the City and County of Honolulu, Department of Planning and Permitting.

( ) Mr. Frank DeMarco at (808) 961-8042 of the County of Hawaii, Department of Public Works.

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

( ) Ms. Wynne Ushigome at (808) 241-4890 of the County of Kauai, Department of Public Works.

( ) The applicant should include water demands and infrastructure required to meet project needs. Please note that projects within State lands requiring water service from the Honolulu Board of Water Supply system will be required to pay a resource development charge, in addition to Water Facilities Charges for transmission and daily storage.

( ) 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. Suzie S. Agraan of the Planning Branch at 587-0258.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: 12/18/12

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. Russell Tsuji, Land Administrator
State of Hawai'i
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, Hawai'i 96809

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Tsuji:

Thank you for your letter dated December 27, 2012 regarding the subject project. The following responds to your letter.

Regarding comments from the Office of Conservation and Coastal Lands, additional construction details such as the construction of new intake and outlet headwalls and potential activities relating to shoreline or sand-moving activities will be provided in the Draft EA. Other shoreline related projects in the vicinity will also be discussed in the Draft EA.

Regarding comments from the Engineering Division, we acknowledge that the project site is located within Flood Zones AE and VE, and that compliance with applicable National Flood Insurance Program rules and regulations are required.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa

NEIL ABERCROMBIE
GOVERNOR

GLENN M. OKIMOTO
DIRECTOR

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

IN REPLY REFER TO:
STP 8.1073

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

December 28, 2012

EM

Mr. Earl Matsukawa, AICP
Wilson Okamoto Corporation
1907 South Beretania, Suite 400
Honolulu, Hawaii 96826

RECEIVED
JAN 09 2013
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa:

Subject: Kulanihakoi Bridge
Pre-Assessment Consultation
Draft Environmental Assessment
TMK: (2) 3-9-001:999

Thank you for requesting the State Department of Transportation's (DOT) review of the subject project. DOT understands the Maui County, Department of Public Works proposes to replace the existing deteriorated bridge with a new bridge.

Given the location and the nature of the project, DOT does not anticipate any significant adverse impacts to the State transportation facilities.

DOT appreciates the opportunity to provide comments. If there are any other questions, please contact Mr. Garrett Smith of the DOT Statewide Transportation Planning Office at telephone number (808) 831-7976.

Very truly yours,

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

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Glenn M. Okimoto, Ph.D., Director
State of Hawaii
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813-5097

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Dr. Okimoto:

Thank you for your letter dated December 28, 2012 (STP 8.1073) regarding the subject project. We offer the following response to your letter.

We appreciate the information that DOT does not anticipate any significant adverse impacts to State transportation facilities.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

ALAN M. ARAKAWA
Mayor

KYLE K. GINOZA, P.E.
Director

MICHAEL M. MIYAMOTO
Deputy Director

TRACY TAKAMINE, P.E.
Solid Waste Division

ERIC NAKAGAWA, P.E.
Wastewater Reclamation Division

EM

COUNTY OF MAUI
DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
2200 MAIN STREET, SUITE 100
WAILUKU, MAUI, HAWAII 96793

December 28, 2012

Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, HI 96826
Attention Earl Matsukawa, AICP

RECEIVED
JAN 09 2013
WILSON OKAMOTO CORPORATION

Dear Mr. Matsukawa,

SUBJECT: KULANIHAKOI BRIDGE REPLACEMENT
ENVIRONMENTAL ASSESSMENT
KIHEI, MAUI, HAWAII

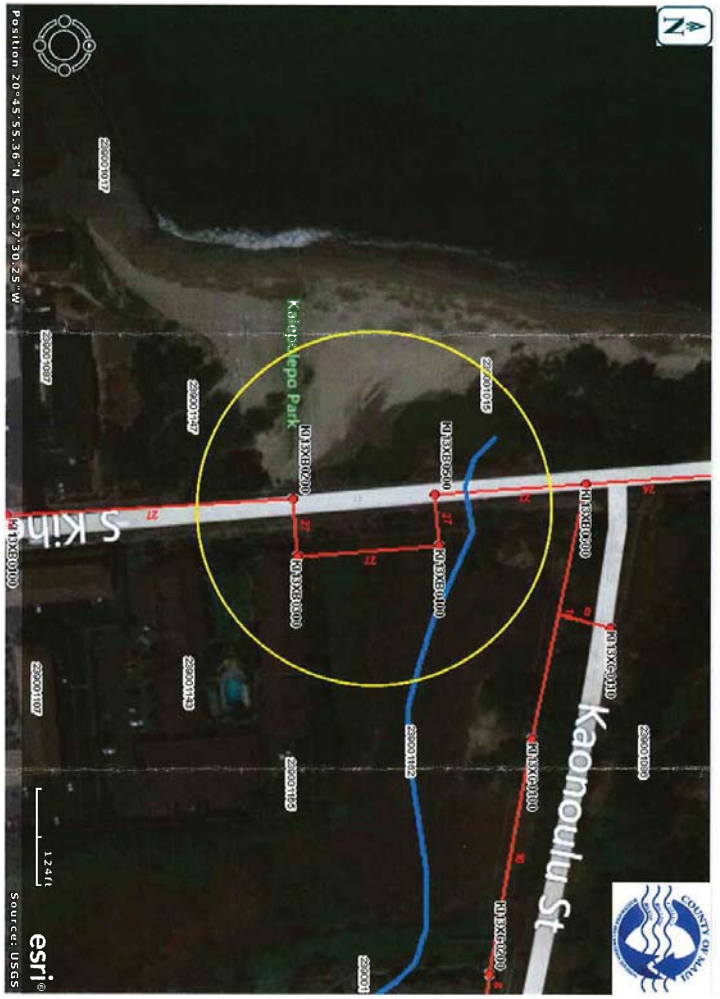
The Wastewater Reclamation Division has reviewed your project as requested in your November 30, 2012 letter. Be advised that there is a major sewer line in the vicinity of your proposed working area. You will be required to work with our division in order to eliminate any possibility of breaking or harming the line during construction of the bridge or other temporary traffic structures. Any wastewater spills must be avoided. The County is still under a Consent Decree that requires substantial fees for any spills, especially those that reach waterways and the ocean.

Attached is a schematic of the sewer location for your use. As Built plans are available upon request. Should you have any questions please contact Mr. Arnold Abe ((808) 270-7428) or our Wastewater Reclamation Division.

Sincerely,

Kyle K. Ginoza, Director
Department of Environmental Management

KG:sr(Kulanihakoi Bridge Replacement.doc)



WILSON OKAMOTO
CORPORATION
ENGINEERS / PLANNERS / CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. Kyle Ginoza, Director
County of Maui
Department of Environmental Management
2200 Main Street, Suite 100
P.O. Box 621
Wailuku, Hawai'i 96793

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Ginoza:

Thank you for your letter dated December 28, 2012 regarding the subject project. We offer the following response to your letter.

We acknowledge the existence of the County sewerline in the vicinity of the project mauka of South Kīhei Road and intend to work with your department in order to eliminate any damage to the sewer line or wastewater spills.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

ALAN M. ARAKAWA
Mayor

GLENN T. CORREA
Director

PATRICK T. MATSUI
Deputy Director

(808) 270-7230
FAX (808) 270-7934

DEPARTMENT OF PARKS & RECREATION
700 Hali'a Nakoa Street, Unit 2, Wailuku, Hawaii 96793

December 11, 2012

Wilson Okamoto Corporation
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826
Attention: Earl Matsukawa, AICP

Dear Mr. Matsukawa:

SUBJECT: KULANIHAKOI BRIDGE REPLACEMENT
ENVIRONMENTAL ASSESSMENT
KIHEI, MAUI, HAWAII

Thank you for the opportunity to review and comment on the project summary for the Kulanihakoi Bridge Replacement. As the project is adjacent to Kalepolepo Park, our Department would like to review the design as it develops.

Please feel free to contact me or Robert Halvorson, Chief of Planning and Development, at 270-7931, should you have any questions.

Sincerely,

GLENN T. CORREA
Director of Parks and Recreation

c: Robert Halvorson, Chief of Planning and Development
Project File

GTC:RH:kp

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. Glenn T. Correa, Director
County of Maui
Department of Parks and Recreation
700 Hali'a Nakoa Street, Unit 2
Honolulu, Hawai'i 96793

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Correa:

Thank you for your letter dated December 11, 2012 regarding the subject project. The following responds to your letter.

We acknowledge that the nearby Kalepolepo Park is under the jurisdiction of the Department of Parks and Recreation. Additional design details of the project will be available in the Draft EA. We intend to coordinate with your department on this matter.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

ALAN M. ARAKAWA
Mayor

DAVID C. GOODE
Director

ROWENA M. DAGDAG-ANDAYA
Deputy Director

RALPH M. NAGAMINE, L.S., P.E.
Development Services Administration

CARY YAMASHITA, P.E.
Engineering Division

BRIAN HASHIRO, P.E.
Highways Division

COUNTY OF MAUI
DEPARTMENT OF PUBLIC WORKS
DEVELOPMENT SERVICES ADMINISTRATION
250 SOUTH HIGH STREET
WAILUKU, MAUI, HAWAII 96793

EM

December 26, 2012

Earl Matsukawa, AICP
WILSON OKAMOTO CORPORATION
1907 South Beretania Street, Suite 400
Honolulu, Hawaii 96826

Subject: KULANIHAKO'I BRIDGE REPLACEMENT
ENVIRONMENTAL ASSESSMENT

Dear Mr. Matsukawa:

We reviewed the subject application and have no comments at this time.

Please call Rowena M. Dagdag-Andaya at 270-7845 if you have any questions regarding this letter.

Sincerely,

David C. Goode
Director of Public Works

ls S:\LUCA\CZM\kulanihakoi_bridge_replacement_ls.wpd
xc: Highways Division
Engineering Division

WILSON OKAMOTO CORPORATION
ENGINEERS | PLANNERS | CONSULTANTS

1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. David Goode, Director
County of Maui
Department of Public Works
Development Services Administration
250 South High Street
Wailuku, Hawai'i 96793

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Goode:

Thank you for your letter from the Development Services Administration dated December 26, 2012 regarding the subject project.

We acknowledge that there are no comments at this time.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

ALAN M. ARAKAWA
MAYOR

JEFFREY A. MURRAY
CHIEF

ROBERT M. SHIMADA
DEPUTY CHIEF

COUNTY OF MAUI
DEPARTMENT OF FIRE AND PUBLIC SAFETY
FIRE PREVENTION BUREAU

313 MANEA PLACE • WAILUKU, HAWAII 96793
(808) 244-9161 • FAX (808) 244-1363

December 29, 2012

To : Wilson Okamoto Corporation
Attn: Earl Matsukawa, AICP
1997 South Beretania Street, Suite 400
Honolulu, HI 96826

Re : **Kulanihako'i Bridge Replacement**
Kihei, Maui, HI

RECEIVED
JAN 02 2013
WILSON OKAMOTO CORPORATION

Dear Earl:

Thank for the allowing the Department of Fire and Public Safety the opportunity to comment on the proposed project. At this time, our office provides the following comments:

- Our office requests that the minimum clear width of the bridge after repair be at least 20 feet (the minimum width for fire apparatus access) to allow for fire apparatus access.
- The project must be able to support the weight of the heaviest fire apparatus in district; which would be the ladder truck at the Wailea Station with a GVW of 70,000 #.

These specifics should apply to the temporary detour road in place while the project is being completed.

If there are any questions or comments, please feel free to contact me at 244-9161 ext. 23.

Sincerely,

Paul Haake
Captain, Fire Prevention Bureau
Department of Fire and Public Safety, Maui County

WILSON OKAMOTO CORPORATION
ENGINEERS + PLANNERS + CONSULTANTS
1907 South Beretania Street
Artesian Plaza, Suite 400
Honolulu, Hawaii, 96826 USA
Phone: 808-946-2277
FAX: 808-946-2253
www.wilsonokamoto.com

8256-01
June 6, 2013

Mr. Paul Haake, Captain
County of Maui
Department of Fire and Public Safety
Fire Prevention Bureau
313 Manea Place
Wailuku, Hawai'i 96793

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Captain Haake:

Thank you for your letter dated December 29, 2012 regarding the subject project. We offer the following responses to your letter.

The Department of Fire and Public Safety's request for a minimum clear width of at least 20 feet of the bridge and the ability to support the heaviest fire apparatus at the Wailea Station which has a gross vehicle weight of 70,000 pounds will be considered as we proceed through the design phase. It is noted that these comments will be taken into consideration for the permanent improvements as well as the temporary detour road.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

KCA
Kihei Community Association

EM

Wilson Okamoto Corporation
1907 S. Beretania Street. Suite 400
Honolulu HI 96286
Attn: Earl Matsukawa, AICP
January 4, 2013

RECEIVED
JAN 07 2013
WILSON OKAMOTO CORPORATION

RE: Kulanihako'i Bridge Replacement

Dear Mr. Matsukawa;

Thank you for your request for our comments regarding the proposed Kulanihako'i Bridge replacement. The Kihei Community Association provides broad based dissemination information to the community and provides feedback to decision makers. We are pleased to provide comments for the generation of the Environmental Assessment (EA) on the Kulanihako'i Bridge Replacement project that is being undertaken by the County of Maui Department of Public Works.

The EA needs to pay special attention to the very sensitive environment in this area as it contains a major floodway into the ocean with a highly active dune system. The roadway in itself posses a continual problem by its location immediately adjacent to the shoreline. Careful attention needs to be paid to the impact on the environment due to the permanently placed structures. The new flood elevation as a result of this project will have to be mitigated and should be done so within the immediate flood area. The Kulanihako'i stream at this location has been the depository point of massive amounts of silt and mud contaminating the ocean more that one half of a mile from shore and multiple miles along the coast.

The project plans to replace the existing damaged bridge with a new bridge with six culverts 6 feet wide by 4 feet deep. This will increase the storm flow under the bridge by 50%. Unfortunately, the 100 yr flood event at this location is 14,144 cfs (Draft Drainage Study South Kihei 2009 by R. M Towill Corporation for Maui Department of Public Works) and it appears that the new bridge still has insufficient capacity to handle this flow. We expect that the EA will quantify the effect of the project on the 100 yr flood flow, including new flood maps. Special attention needs to be made to identify design approaches that mitigate the impact to the structure from over topping in a severe flood. Headwalls and end walls should be designed so that when the storm flows stop, that the structure will remain serviceable.

The design should also minimize the flood flow onto South Kihei Road and onto properties upstream of the bridge. Floods in this area have damaged the nearby Kalepolepo Park, NOAA Hawaiian Island Humpback Whale facility and the Historic Fishpond. Alternative designs or other upstream improvements that could further mitigate the impact of the 100 yr flood should be identified. Such alternatives should include an elevated bridge above the base flood elevation, which would allow a freer flow of storm water, the natural migration of sand dune process, and help prevent potential debris build up caught within the proposed culverts or pilings. Retention and /or drainage basins in the near mauka area could be constructed to help prevent debris build up and storm silt and mud from entering the ocean. Any new design should be intended to be a long-term benefit 50-100 years from now and not a shorter-term fix. Consideration should be made to the overall esthetic nature of the bridge in how it relates to and accentuates the natural environment it is located in and help bring a sense of quality suitable to its park and natural drainage area.

KCA
Kihei Community Association

The traffic on S. Kihei Rd at Ka'ono'ulu Street will be impacted by the future connection of Ka'ono'ulu to the Upcountry connector road. The EA needs to evaluate the future traffic flow at that intersection and ensure that the bridge has sufficient capacity to handle that volume as this is a very sensitive issue to the Kihei community, which aspires for a pedestrian friendly, walkable community de-emphasizing the automobile and providing easy pedestrian access to our beaches and shorelines. The width of the new bridge will need to be consistent with the potential future improvements on S. Kihei Rd. The bridge structure should utilize the minimum amount of pavement to accommodate 2 travel lanes 2 sidewalks, and 2 bike lanes. Additionally, consideration should be made for the structure to potentially accommodate a turning lane if necessary at its North end in conjunction with the design of any future intersection at Ka'ono'ulu Street.

We are concerned about the impact on local traffic during the construction period. In order to reduce construction time disruption, consideration should be given to precast box culverts in 12, 24, or 48 foot lengths. Casting of the culverts adjacent to the work site could be accomplished prior to construction of the bridge detour thus saving casting and cure time of the boxes while the detour was in effect. Construction should be started after the rainy season to prevent silt damage to reefs. Storm water silt fences should be installed to prevent silt damage during construction. Work should be restricted to 8:00 AM to 4:00 PM Monday to Fridays due to peak traffic times and distance to residential units. The use of driven piles should be avoided if possible due to construction noise. Dust during construction should be minimized by use of dust fences and water where practical.

Traffic flow and Flood control are two major issues in Kihei. This project has the potential to help solve both of them if done with adequate foresight. The KCA would be pleased to assist in this effort by reviewing any work scopes or preliminary documents, and can support meetings on Maui. The Association is also able to provide public review and feedback. Please contact us at any time to participate in this important improvement.

Sincerely,

Mike Moran President
Kihei Community Association (KCA)

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8256-01
June 6, 2013

Mr. Mike Moran, President
Kīhei Community Association
P.O. Box 662
Kīhei, Hawai'i 96753

Subject: Pre-Assessment Consultation
Draft Environmental Assessment (EA)
Kūlanihāko'i Bridge Replacement
Kīhei, Island of Maui, Hawai'i

Dear Mr. Moran:

Thank you for your letter which we received on January 7, 2013 regarding the subject project. We offer the following responses to your letter.

We understand the regional concerns regarding drainage. Flooding has been a major issue in a number of South Maui watersheds which extend through the Kīhei region. Traffic on South Kīhei Road and consideration for pedestrian friendly, walkable communities are noted as concerns of the Association. Your concerns will be taken into consideration as design of the project proceeds.

Your letter, along with this response, will be included in the forthcoming Draft EA. We appreciate your participation in the pre-assessment consultation review process.

Sincerely,

Milton Arakawa, AICP
Project Manager

MA/ly

cc: Wendy Kobashigawa, DPW

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